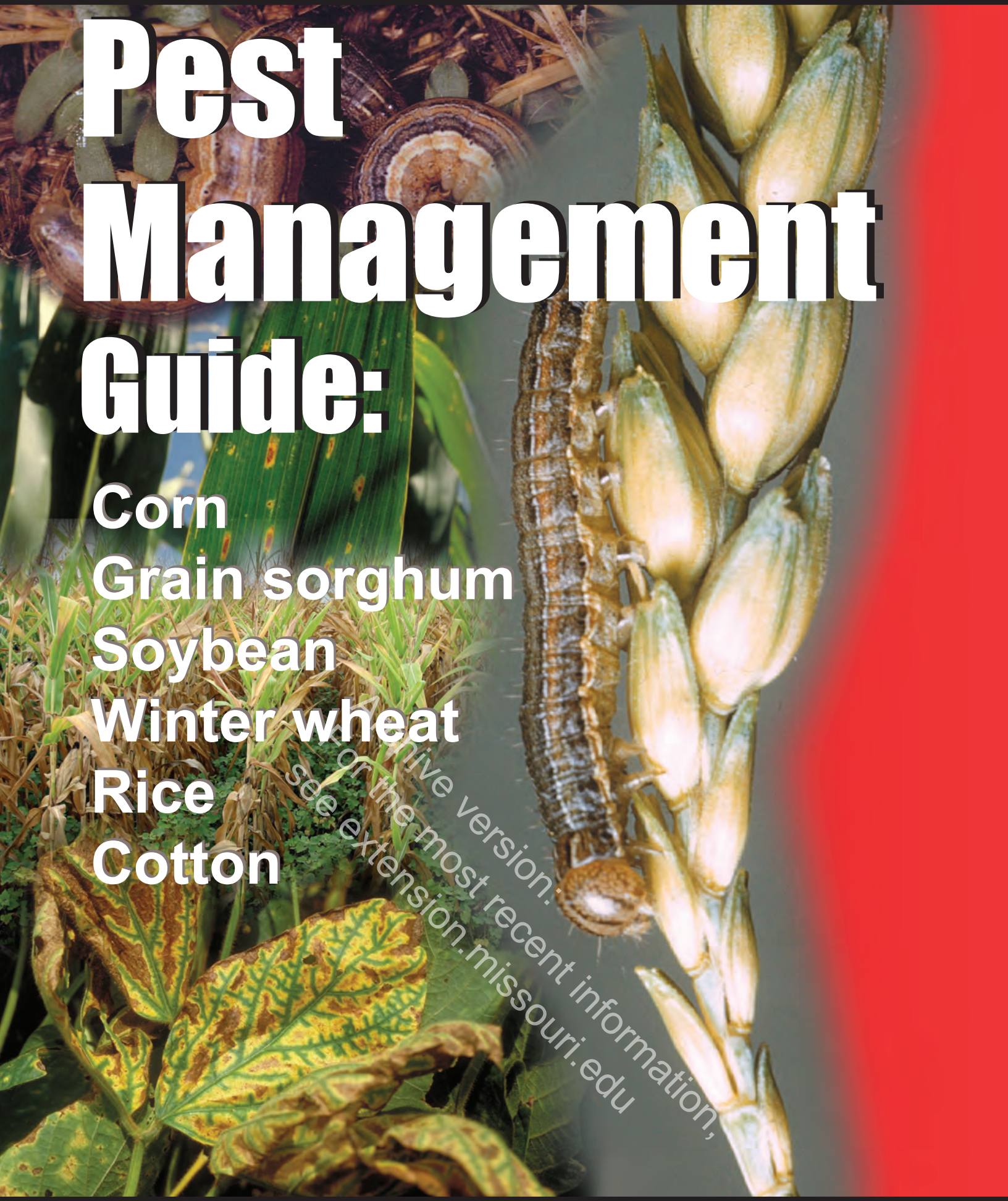
Pest Management Guide:

Corn
Grain sorghum
Soybean
Winter wheat
Rice
Cotton



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Missouri Pest Management Guide

Preface

This guide is intended to provide current recommendations for control of the most problematic weeds, insects and diseases encountered in Missouri corn, soybean and winter wheat cropping systems. This information can also be accessed on the World Wide Web at *http://extension.missouri.edu/m171*.

The information and recommendations in this publication are based on research conducted at the University of Missouri and elsewhere. This guide is a cooperative publication written by the following faculty members at the University of Missouri-Columbia:

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The trade names within this guide are given with the understanding that no discrimination is intended and no endorsement by the University of Missouri is implied. The pesticides named in this publication are registered by the U.S. Environmental Protection Agency (EPA) and the Missouri Department of Agriculture. These pesticides are designed to be used according to specific label directions pertaining to rates of application, number of applications, intervals between application and harvest, etc. Failure to follow these directions may result in hazards to humans and/or the environment, unsafe pesticide residues, and fines to the applicator. Any use of a pesticide that is inconsistent with its label is a violation of federal law.

This publication will be revised annually to reflect label updates, name changes and the entry of new herbicide, insecticide, or fungicide active ingredients in the marketplace. The authors welcome reader suggestions to help improve future editions of this publication.

Contents

Introduction

The information in this guide is based on research conducted at the University of Missouri Agricultural Experiment Station and elsewhere. It addresses crop, soil and weed problems of the state of Missouri. All herbicide information conforms to federal and state regulations at the time of writing. Consult the label attached to the herbicide container for current use precautions and restrictions.

Use this publication as a guide in selecting and comparing herbicides. It is not a substitute for reading product labels. The University of Missouri does not warrant commercial products and regrets any errors or omissions in this guide. Cost of herbicides was not considered in making these recommendations because prices vary with location and time. Herbicides may perform better or worse depending upon weeds infesting the field, rainfall, soil type, temperature and many other environmental factors. Therefore, we have made no effort to list herbicides in order of preference.

Apply herbicides only to labeled crops. Do not exceed the maximum recommended rate for a herbicide. Excessive herbicide application rates are expensive and can result in injury to the crop or make the crop unsafe as food or feed. Apply herbicides only at times specified on the label. Observe label restrictions for required intervals between time of treatment and time of planting, pasturing or harvesting a crop. Guard against injury to nearby, susceptible crops or plants that herbicide drift or volatility could cause.

This publication discusses using herbicides to control weeds. However, good agricultural practices also enhance weed control. You can reduce reliance on herbicides by planting high-quality, weed-free seed. Other practices include proper seedbed preparation, proper planting depths, proper seeding rates, timely cultivation, narrower row widths, maintaining optimum fertility and pH, and crop or tillage rotations.

Endangered species

The Environmental Protection Agency is planning to restrict the use of certain pesticides that may harm endangered species in some areas of the country. You should check with your local University Outreach and Extension Center, State Game and Fish Office, or your pesticide dealer to determine if the area you are planning to spray with any pesticide is protected for endangered species.

You should request the *Pesticide Use Bulletin for Protection of Endangered Species* for your county. The bulletin indicates which areas are protected for endangered species and lists the pesticides that may and may not be used in that area. In addition, pesticide labels will list counties where endangered species protection zones exist.

How to use this guide

Farmers frequently ask us, "What herbicides should I use for soybeans (or corn, wheat)?" Unfortunately, there is no simple answer to this question. The herbicide or, more likely, the combination of herbicides you use for producing a crop depends on the weeds you need to control. Herbicide selection that is not matched to a field's weed problems will probably result in poor weed control and lost profits from lower crop yields. Thus, the first step toward obtaining good weed control is proper identification of the weeds in your field.

Each crop chapter in this book starts with a chart entitled "Guide to Weed Response to Herbicides." You should use this chart to select the herbicide or combination of herbicides that will give good control of the weeds present in your field. In some cases several herbicide choices may do an effective job of controlling the weeds. Other considerations, such as herbicide price, method of application (pre, post), availability of proper equipment, soil type, and tillage practices, should help you narrow your choices. A soil-applied herbicide rate table is also included in most chapters as a guideline to select rates for your field. Be warned that soil-applied herbicide rates are usually dependent on soil texture, percent organic matter, crop and weed species.

All of this information could not be summarized in one table. The herbicide label should always be your final guide to herbicide use.

The largest section of each crop chapter includes specific use rates, timing, application methods and precautions for all of the herbicides and combinations recommended for Missouri. This section is most easily used after you have narrowed your choices by using the herbicide response table. If a herbicide you have heard about is not included in this guide, it could be for the following reasons:

1. The herbicide or herbicide use was not yet registered by the Environmental Protection Agency at this writing (August and September of the year preceding the date of publication).
2. There was insufficient University-generated data to evaluate the herbicides performance and applicability for Missouri crop production (a minimum of three years' data is usually required).
3. The herbicide or herbicide use did not perform well or was not appropriate in Missouri crop production conditions.

At the back of the guide are reference tables giving crop replant and rotational intervals, forage and grazing restrictions, herbicide compatibility with fertilizers, rainfast intervals and preharvest intervals. These tables are designed to answer questions that are encountered during the growing season.

Herbicide treatment methods and timing

Herbicides are generally applied at the following times:

1. *Early preplant (EPP)* onto the soil and early emerging weeds up to a month before crop planting. Some herbicides are even registered for application in the fall prior to planting the next spring.
2. **Preplant (PPS)** onto the soil or any early emerging weeds before the crop is planted.
3. **Preplant-Incorporated (PPI)** into the soil before crop planting.
4. **Preemergence (PRE)** onto the soil before or after crop

planting, but before weed or crop emergence.
5. **Postemergence-overtop (POST)** onto weeds after the crop and weeds have emerged.
6. **Post-directed (DIR)** onto small weeds in rows of taller crops.

Good coverage of the entire weed is usually necessary to obtain maximum control with postemergence herbicides. Most soil-applied herbicides can be applied in 10 to 20 gallons per acre (gpa) of water. Postemergence herbicides often require a 10 to 20 gpa spray volume using flat fan or hollow cone spray tips. Consult the herbicide label for recommended spray volumes, pressures and application equipment.

Incorporation

Incorporation of some preplant herbicides is necessary to prevent loss from the soil surface and to place the herbicide in the proper position for weed control. Incorporation may also improve weed control when rainfall is untimely or too low to activate the herbicide.

Allowable waiting periods between herbicide application and incorporation vary. The label gives the maximum acceptable waiting period for the herbicide. However, incorporating as quickly as possible after application will reduce the chances of obtaining poor weed control.

Incorporate herbicides into the top 1.5 to 3 inches of soil. Most weeds germinate within the upper 2 inches of soil. Incorporating a herbicide deeper than recommended on the label "dilutes" the herbicide and gives poor weed control. Incorporating a herbicide too shallow can result in vapor loss from the soil or failure to control weeds germinating below the herbicide zone.

Tandem disks, field cultivators, power-driven cultivation equipment and combination bed conditioners, such as a Do-All or Triple K, all give acceptable herbicide incorporation following seedbed preparation. Set tandem disks to cut to a depth of 4 to 6 inches. Operate them at 4 to 6 mph to obtain adequate incorporation to a depth of 2 to 3 inches. Set field cultivators and bed conditioners to cut 2 to 4 inches deep and operate them at a speed of at least 5 mph. Use field cultivators with three to four rows of sweeps spaced at 7 inches or less. Chisel points are unacceptable for incorporation with a field cultivator.

You need to make two passes for tandem disks, field cultivators and combination bed conditioners. Make the second pass at an angle to the first. You can use power-driven cultivators in a single pass, but don't exceed speeds of 4 mph. The spike-toothed harrow or the rotary hoe alone usually won't give satisfactory herbicide incorporation. Follow the equipment owner's manual and the herbicide label for settings for proper soil incorporation.

Cultivation

You might want to cultivate shallowly for weed control when rows are spaced far enough apart to allow the use of cultivation equipment. Cultivation can be used to control weeds that escape after herbicide treatment or to control weeds in row middles when applying herbicides in a band. You can save money by banding herbicides over the row and cultivating the middles. Don't use banding for rows narrower than 20 inches or when spraying perennials such as rhizome johnsongrass where cultivation is ineffective. Set cultivators shallow to prevent crop root pruning and new weeds' seeds from being brought to the soil surface.

A timely rotary hoeing can eliminate the need for postemergence herbicide or at least delay the need for a postemergence herbicide. Rotary hoes are especially useful in narrow-row or broadcast soybeans where you can't use conventional cultivators. You'll get best results with a rotary hoe when the crop has just emerged (just past the crook stage in soybeans, spike to two-leaf stage for corn and grain sorghum). Weeds should be just emerging (within two days). Soil surface should be dry in the top 2 inches for the best hoeing action. Using the hoe properly, you'll destroy less than 5 to 10 percent of a well-established crop stand. Do not use a rotary hoe if stands are already thin.

When following a preplant-incorporated herbicide, cultivate at less than half the depth of incorporation to prevent bringing untreated soil to the surface. Some preemergence herbicides require rainfall for activation to move the chemical into the soil. If it doesn't rain within seven days of application, you might be able to improve weed control with a shallow incorporation with a rotary hoe, harrow or field cultivator.

Multiple applications

It is usually necessary to make more than one herbicide application to obtain broad spectrum weed control. You might need a preplant incorporated herbicide for grass control, followed by a preemergence treatment for broadleaf weed control. You might need tank mixtures of two or more herbicides in one application to obtain broad spectrum control. We included only registered **package mixes** (mixtures formulated into one package by a manufacturer) and **tank mixes** (herbicides combined in the spray tank by the grower) in this guide.

Types of herbicide formulations

This guide lists several herbicide formulations. The abbreviations used are: emulsifiable concentrates (EC), liquids (L), solutions (S), flowables (F), dry flowables (DF), wettable powders (WP) and water dispersible granules (WDG). Most spray mixtures require constant agitation to prevent the herbicide from settling to the bottom of the spray tank. Granular formulations (G) are dry formulations that cannot be mixed with water. Don't mix granular herbicides with other granular pesticides or fertilizers.

Herbicide additives

Additives are substances added to the spray mixture to enhance effectiveness. Common additives used for weed control are as follows:

Emulsifiers: Substances that promote the suspension of one liquid in another (for example, oil into water).

Surfactants: Materials that modify wetting, spreading, dispersing, or emulsifying of liquids. Most herbicides that

require surfactants specify *nonionic surfactants.* Most surfactants sold for agricultural use are nonionic. Many surfactants sold for home or industrial use are not nonionic, so don't use them.

Fertilizers: Liquid fertilizers such as UAN (urea ammonium nitrate) and 10-34-0 and dry fertilizers such as ammonium sulfate are popular additives for several postemergence herbicides.

Oil concentrates: (Also crop oil concentrates). These are normally a mixture of non-phytotoxic oil and 10 to 20 percent surfactant. For herbicides that suggest an "oil concentrate," you can sometimes substitute soybean or vegetable oil concentrates for crop oil concentrates. However, some herbicide labels do not recommend the use of soybean oil. Consult the herbicide label before using a soybean oil.

Methylated oils: These can be manufactured from seed oils (such as sunflower) or petroleum oils. Be sure to consult the herbicide label for compatibility with these oils.

Utility modifiers: Two types are commonly used with herbicides.

1. Compatibility agents are frequently used to mix herbicides with liquid fertilizers.
2. Anti-foaming agents can be added to the tank or sprayed onto the solution surface to prevent foam or suds from forming when filling the spray tank.

Spray modifiers: The most common spray mix modifier used with herbicides is the *thickening agent or drift control agent.* These materials thicken the spray solution to reduce drift problems. These are usually used by aerial applicators.

Be sure you are using the proper additive for the herbicide you are using. Most herbicide labels specify the type and amount of additive to use. Failure to follow the recommendation can result in poor weed control or excessive crop injury. The proper additive is included in this guide when required or suggested by the label. It is also recommended that additives be purchased from reputable sources. Additives are not subject to quality-control regulations. Some herbicides have a list of specifically recommended products.

Herbicide application

Proper herbicide application is necessary to obtain the best weed control. Check spray equipment frequently for even and proper spray output. Generally you should apply herbicides at pressures ranging from 20 to 40 psi *at the boom*, although some postemergence-contact herbicides require 40 psi or greater for adequate coverage. Most herbicide labels recommend a flat fan or hollow cone spray nozzle. Use stainless steel or nylon tips and 50-mesh screens with wettable powder, flowable or dry flowable formulations. Some herbicide labels state that excess speed with ground equipment (>10 mph) may result in erratic weed control due to poor coverage. Provide adequate agitation to keep herbicides suspended in the tank mix. Wettable powders and flowables are especially susceptible to settling in the tank. Use flat fan, even tips for band applications. All herbicide labels include recommendations for proper spray volume, pressure and nozzle types.

Spray equipment

Accurate sprayer calibration is essential for proper herbicide application and weed control. Sprayer calibration is not difficult, but most people usually don't calibrate often enough. Screens may become blocked with trash and nozzles wear down, changing delivery patterns and spray rates. Thoroughly inspect and calibrate spray rigs at least once a year.

Sprayer calibration

It is absolutely essential to know how much spray liquid the sprayer is delivering per acre at the speed and pressure the tractor is operating. Here is a simple method for calibrating a sprayer for broadcast or banding applications.

Ounce calibration method

Step 1. Measure the specified distance in the field as determined in the following table. Select the distance that matches the nozzle spacing for broadcast or the row spacing for band applications. This table assumes that nozzle spacing equates to the effective band width per nozzle.

Row or nozzle spacing (inches)	Distance to time for calibration (feet)
40	102
38	107
36	113
34	120
32	127
30	136
28	146
26	157
24	170
22	185
20	204
18	227
16	255
14	291

Step 2. Drive the measured distance at the desired speed and record in seconds the amount of time it takes. Note: Perform the test in the field in which you will be spraying. Attach and operate any equipment you will be using during spraying (disk, planter).

Step 3. Using a measuring cup or baby bottle marked in fluid ounces, catch the discharge from a nozzle for as long as it took to travel your measured distance. If you use more than one nozzle to spray the same band or row (directed banding rigs) catch the spray from each nozzle.

Step 4. The total discharge per nozzle or row measured in step 3 in ounces equals the gallons per acre applied. If you used row spacing in step 1, you must measure all nozzles directed on the row to determine gallons per acre.

Step 5. Repeat the test for each nozzle to ensure even spray

distribution. Nozzles should vary no more than 5 percent across the boom.

Step 6. Divide tank capacity by gallons per acre determined in step 4 to calculate the number of acres one tankful of spray will cover.

Tank capacity (gals.) = # of acres covered

GPA

Step 7. Multiply the recommended herbicide rate by the number of acres covered per tank. (Measure rate and amount in ounces, pints, quarts, etc.)

Rate x acres covered = Amount to add to tank

Step 8. Band Application. All rates given in this guide are broadcast rates. You must adjust the rate for band applications using the following formula.

Band width x Broadcast rate = Band rate

Row width

Use the above formula to adjust rates if you have calibrated your sprayer on a row-width basis for band spraying.

Calibration examples

Example A. Broadcast.

A grower will apply trifluralin with a broadcast boom having nozzles spaced 18 inches apart while pulling a P.T.O.-driven ROTERRA for incorporation.

Step 1. The distance to travel for an 18-inch nozzle spacing is 227 feet. Measure the distance in the field to be sprayed.

Step 2. Measure the time to drive the distance with the incorporation implement. In this example, it took 39 seconds to cover 227 feet (4 mph).

Step 3. Set the pressure to be used and catch the output of one nozzle for 39 seconds.

Step 4. The output in ounces equals the amount of spray applied in gallons per acre. If the nozzle output was 20 ounces in 39 seconds, then the sprayer is applying 20 gpa.

Step 5. Repeat step 4 for each nozzle.

Step 6. Assume you have two 200-gallon saddle tanks and wish to apply 1.5 pints of trifluralin per acre.

400 gal per fill = 20 acres covered per fill

20 gpa

Step 7. Since the recommended rate is 1.5 pints per acre, you would use 30 pints of trifluralin per refill (15 pints per 200 gallon tank).

1.5 pt/A x 20 acres = 30 pints

30 pints = 15 pints per tank

2 tanks

Example B. Band application.

Two nozzles spraying the same band.

A grower will apply Poast plus crop oil concentrate on a 15-inch band with a 30-inch row.

Step 1. The distance to travel for a 30-inch row is 136 feet.

Step 2. Measure the time required to travel 136 feet in the field. Let's say it took 23 seconds (4 mph).

Step 3. Set pressure and catch the output of each of the two nozzles spraying the band for 23 seconds.

Step 4. The output in ounces of the two nozzles combined is equal to the amount in gallons per acre. If the output of the two nozzles combined was 25 ounces, the sprayer is applying 25 gpa.

Step 5. Repeat step 4 for each set of tips.

Step 6. Assume the grower used a 200-gallon tank and a broadcast rate of 1.5 pints per acre of Poast and 1 quart per acre of crop oil concentrate.

200 gal tank = 8 acres covered per tank

25 gpa

Step 7. Reduce the rates for a 15-inch band.

15 in. band x 1.5 pt/A broadcast = 0.75 pt/A Poast

30 inch row

15 in. band x 1 qt/A broadcast = 0.5 qt/A crop oil

30 inch row (1 pt/A)

Step 8.

8 acres x 0.75 pt/A = 6 pints of Poast per refill.

8 acres x 1 pt /A = 8 pints of crop oil per refill.

Mixing chemicals in the tank

1. Fill tank 1/4 full with water, liquid nitrogen, or other desired carrier.
2. Start agitation.
3. Add wettable powders or water dispersible granules (WDG) first, than flowables or dry flowables.
4. Add liquids or emulsifiable concentrates next.
5. Add surfactants last when tank is nearly full, to minimize foaming.

Tank-mix compatibility

Some liquid or dry fertilizers, adjuvants or herbicide combinations may be incompatible. Determine the compatibility of the herbicide with the specific fertilizer to be used. A compatibility agent may be necessary for certain liquid fertilizer/herbicide mixes. Use a jar test if you are uncertain about the compatibility of the mix.

1. Mix an approved compatibility agent and the fertilizer or water to be used in two 1-quart jars.
2. Add the herbicides and adjuvants in both of the jars in the same proportion as that used in the spray tank. Add dry herbicides first, flowables next and emulsifiable concentrates last. The amount and proportion vary with the herbicide. Check the label for each herbicide used. Add compatibility agent to one of the jars.
3. Invert or shake each jar at least 10 times to mix. Let the mixtures stand for 15 minutes.

4. If no separation, large flakes, precipitation, gels or heavy oil films form, you can use the mixture. If the mixture can be remixed after separation, the tank-mix can be used if good agitation is provided.
5. If the mixture is incompatible, try slurrying dry herbicides in water before mixing. Also try adding half the compatibility agent to the fertilizer and half the compatibility agent to emulsifiable concentrate or flowable herbicides before mixing. If the mixture still separates the mix cannot be used. Always consult the label for compatibility tests and agents to use for the herbicides involved.

Cleaning spray equipment

After using a sprayer, you should flush tanks, lines, booms and nozzles with water for a minimum of 5 minutes. After using any herbicide and flushing the sprayer with water, add any of the following plus detergent, surfactant, or spray tank cleaner to the filled tank, then flush the cleaning solution through the boom, hoses and nozzles. Add more water and then clean again by running the pump and agitation for at least 15 minutes. Remove nozzle and screens and clean separately in a bucket of the cleaning agent and water. Add the following in 50 gallons of water to make the cleaning solution:

1. 0.5 gallon of household ammonia (let stand in sprayer overnight for growth regulator type herbicides such as 2, 4-D, Banvel, or Tordon).
2. 4 pounds trisodium phosphate cleaner.
3. 2.5 pounds sal soda.

Some herbicides have specified cleanout procedures. Check label for specific instructions. Consult guidesheet G4852, *Cleaning Field Sprayers to Avoid Crop Injury* for additional information.

Algae and moss control in tanks

Moss and algae will appear in plastic tanks during warm weather. There are three ways to prevent or eliminate algae and moss:

1. Keep tanks dry when not in use.
2. Paint tanks black to block sunlight. Algae will not grow without sunlight.
3. Use copper sulfate. Measure copper sulfate by dissolving 1 ounce in a pint of water. Then add 7.5 tablespoons of the copper sulfate solution to each 100 gallons of water and mix.

Pesticide container disposal

Triple rinse all pesticide containers and puncture them before disposing of them in an approved burial site or sanitary landfill. Missouri has a pesticide container recycling program. Contact your dealer or local University of Missouri Extension center for information. Follow local regulations.

Ground and surface water protection

Contamination of ground and surface water with pesticides has become a growing public concern. Well-water monitoring of pesticides in Missouri indicates very little pesticide contamination in the state. The levels that have been detected are generally in the parts per billion (ppb) range and are below current health advisory levels considered safe for drinking water. Point-source contamination is usually suspected where levels over a few ppb are detected in water supplies.

Point-source problems are related to a confined area, event or site such as mixing, storage or transport sites. Point-source contamination is probably responsible for a majority of the pesticide detections in wells. These sources of contamination are relatively easy to correct.

The potential for point-source contamination can be reduced by following these suggestions:

1. Mix chemicals in the field away from wells and water sources.
2. If chemicals must be mixed or stored at the well site, use hoses to maintain at least a 150-foot buffer from the well to the spray tank.
3. Keep filling hoses out of the spray tank, maintain an air gap, use check valves and do not leave tanks unattended while filling to avoid back siphoning or overflow.
4. Never dump rinsate or concentrated product in a localized area. Spilling 4 oz. of a chemical in a 100-square-foot area is the equivalent of applying 100 lb per acre! Dispose of rinsate by applying to a labeled crop site.
5. Triple rinse herbicide containers into the spray tank before disposal or return.
6. Properly construct, grout and case new well construction. Properly cap and seal abandoned wells.

Spills or back siphoning of any consequence have the potential to contaminate ground or surface water unless handled properly and promptly. Report spills to the Missouri Department of Natural Resources and local authorities.

Missouri Department of Natural Resources:
Environmental Emergency Response
(573) 634-2436

Nonpoint water pollution occurs over a broad, generally ill-defined area and the direct cause of contamination may not be readily apparent. Leaching from general field applications within labeled guidelines is often mentioned as a possible cause of nonpoint-source pollution. Field application of herbicides is actually a rare form of water pollution. However, the following steps will further minimize the potential for water contamination.

1. Select herbicides with shorter residual half-lives and strong soil adsorption characteristics, especially for late-season herbicide applications.
2. Leave buffer strips around sinkholes, streams and bodies of water.
3. When possible, banding herbicides, using herbicides with higher unit activity (applied at low lb/A rates), and the use of the reduced-rate herbicide recommendations in this guide can all reduce the overall pesticide load on the environment.
4. Properly calibrate and maintain sprayer equipment to avoid over application.
5. Use practices such as crop rotation, herbicide rota-

tion and cultivation in addition to herbicides for weed control.
6. Use conservation or no-tillage practices on erodible land to reduce off-site herbicide movement that occurs with surface water runoff.
7. See special information for atrazine and cyanazine products.

Good land stewardship dictates that herbicide characteristics be assessed in relation to their ground or surface water pollution potential. Reducing the potential for groundwater pollution (especially point-source contamination) will help ensure the continued availability of agricultural chemicals as an important tool in crop production while protecting our water resources.

Warning: The chance of having herbicide crop injury is increased when several herbicides are applied to the same crop. Adherence to labeled rates is especially important when making multiple herbicide applications.

Weed resistance to herbicides

Weed resistance to many herbicides has been confirmed around the world. The ALS/AHAS inhibiting herbicides (including Accent, Beacon, Classic, Exceed, FirstRate, Harmony Extra, Permit, Pinnacle, Pursuit, Scepter and others) have had numerous cases of herbicide-resistant weeds developing. It is a good general practice to rotate herbicides and herbicide families in a field. Other practices such as cultivation and sequential applications of herbicides from different families can help to reduce the probability of herbicide-resistant weed populations appearing. Herbicide modes of action are given in the table of herbicide name, active ingredients, modes of action and manufacturers found on page 10. Additional information on herbicide family groups, and suggestions for preventing weed resistance problems can be obtained from your county Extension office, your dealer and herbicide manufacturers.

Special information for atrazine

Atrazine-containing products may not be mixed, loaded or used within 50 feet of any well, including abandoned drainage wells and sinkholes.

In conventional tillage, atrazine may not be surface applied within 66 feet of points where field surface water runoff enters perennial or intermittent streams and rivers or within 200 feet of natural or impounded lakes and reservoirs. On highly erodible land as defined by the USDA Natural Resources Conservation Service (NRCS), the 66-foot buffer for runoff points from fields MUST be planted to crop or seeded with grass.

Note: This restriction is voided if (1) the herbicide is applied to fields with heavy plant residues (no-till) or (2) the herbicide is incorporated in conventional tillage crop production.

The maximum annual rate for preemergence application on land designated as having "highly erodible soils" as defined by the NRCS will be 2.0 lb/A active ingredient (a.i.) of atrazine on fields with greater than 30% surface residue and 1.6 lb a.i./A on fields with less than 30% surface residue. The maximum rate on soils not designated as highly erodible is 2.0 lb a.i./A of atrazine. The maximum annual rate for postemergence applications of atrazine are 2.0 lb a.i./A in fields with no soil-applied atrazine in the same year. The maximum annual amount must not exceed 2.5 lb a.i./A where a soil-applied plus a postemergence application of atrazine is made to a field in the same year.

Conservation tillage

Weed control programs

Obtaining good weed control in reduced tillage or no-tillage cropping systems is an important component of successful conservation tillage crop production. Eliminating heavy tillage operations reduces horsepower requirements for farm tractors and reduces the number of trips across the field. Surface mulches from crop residues protect the topsoil from erosion and maintain a higher supply of soil moisture. However, you might need to rely more heavily on herbicides for weed control because you can't till or cultivate.

Reduced tillage. There are several reduced tillage systems used for crop production in Missouri. With some systems, primary tillage is completed during dry periods in the fall and winter weeds provide soil protection. A burndown herbicide is then applied before planting. This is sometimes termed *stale seedbed.* In other systems, the soil is worked just enough before planting that winter and annual weeds are controlled; however, residue from the previous year's crop remains to provide ground cover. This system is sometimes termed *stubble* or *mulch tillage.* Perennial weeds are likely to be greatest in this system because tillage is not severe enough to control the deep root systems, and shallow tillage actually spreads these roots.

Ridge-till is also practiced in some areas of Missouri. This system provides more winter cover than chisel-disk systems and still allows in-crop cultivation for weed control. This allows herbicide use to be reduced as in conventional tillage systems by banding in the row and cultivating between rows. However, ridge-till is most suited to gently sloping land (less than 2%) and still allows considerable surface water runoff. This can be an advantage on relatively flat, poorly drained fields.

Ridge-till requires frequent trips through the field for cultivation and to maintain the ridges. The ridges are also difficult to maintain during winter small-grain production. Burndown herbicides may also be required as in no-till to control winter weeds before planting. Perennial weeds will also be spread by the shallow tillage as with chisel and disk systems.

No-till is rapidly becoming the most important and widely used method of crop production on highly erodible land in Missouri. This system can control erosion and increase water infiltration. Compaction is often lessened in no-till.

You will need herbicide treatments to control winter and early spring weeds, and cover crops that emerge before planting in no tillage (and some ridge-till) fields and to control weeds that emerge later in the season. Winter and early spring weeds, winter cover crops, and sods growing in a no-tillage field can actually deplete soil moisture levels before

planting. This can eliminate the soil-moisture-conserving advantages of the no-tillage mulch. We recommend applying burndown herbicides two weeks before planting for cover crop control. This prevents the cover crop from using available soil moisture in dry years and aids in soil drying and crop seedling establishment in wet years. However, herbicides will be required to kill most cover crops and sods and to reduce the spread of perennial weeds.

Planting crops in narrower rows can enhance weed control in any tillage system by causing the crop canopy to close earlier. Shading the weeds and soil as early as possible makes the crop less susceptible to weed competition and can reduce late-season weed germination or emergence.

Herbicide recommendations made in the no-tillage sections of this guide are designed to control weeds that emerge before planting and also provide residual weed control. If you apply herbicides preemergence either before or after crop planting, do so at higher spray volumes with contact herbicides such as Gramoxone and atrazine (20 to 40 gpa). This improves herbicide penetration through the mulch cover. The only exception is Roundup and mixtures containing Roundup, which are more effective applied in 10 gpa of water.

Some of the herbicide applied preplant or preemergence will be intercepted by the mulch cover; to compensate for this, you need to use the higher recommended rates for your soil type. Consult the herbicide label for specific directions for no-tillage applications. Postemergence herbicides perform similarly in conventional or reduced tillage systems.

Herbicide trade and common name, formulation, mode of action, and manufacturer

Trade name	Common name	Formulation	Mode of action/group number[a]	Manufacturer
AAtrex 4L	atrazine	4 lb/gal	PSII/5	Syngenta
AAtrex Nine-0	atrazine	90%	PSII/5	Syngenta
Accent Q	nicosulfuron	54.4%	ALS/2	DuPont
Achieve	tralkoxydim	50%	ACCase/1	Syngenta
Aim 2EC and 2EW	carfentrazone-ethyl	40%	PPO/14	FMC
Amplify 84DG	cloransulam	84%	ALS/2	Monsanto
Armezon	topramezone	2.8 lb/gal	HPPD/27	BASF
Assure II 0.88 EC	quizalofop	0.88 lb/gal	ACCase/1	DuPont
Authority Assist	sulfentrazone + imazethapyr	3.33 lb + 0.67 lb/gal	PPO/14 + ALS/2	FMC
Authority First	sulfentrazone + cloransulam	62.1% + 7.9%	PPO/14 + ALS/2	FMC
Authority MTZ	sulfentrazone + metribuzin	18% + 27%	PPO/14 + PSII/5	FMC
Authority XL	sulfentrazone + chlorimuron	0.62 lb + 0.08 lb/gal	PPO/14 + ALS/2	FMC
Autumn 10WDG	iodosulfuron	10%	ALS/2	Bayer
Axial XL	pinoxaden	0.42 lb/gal	ACCase/1	Syngenta
Axiom 68 DF	flufenacet + metribuzin	54.4% + 13.6%	LCFA/15 + PSII/5	Bayer
Axiom AT	atrazine + flufenacet + metribuzin	50.5% + 19% + 4.9%	PSII/5 + LCFA/15 + PSII/5	Bayer
Banvel 4E	dicamba	4 lb/gal	GR/4	MicroFlo
Basagran 4S	bentazon	4 lb/gal	PSII/6	MicroFlo
Beacon 75DF	primisulfuron	75%	ALS/2	Syngenta
Balance Flexx	isoxaflutole + safener	2 lb/gal	HPPD/27	Bayer
Balance Pro 4L	isoxaflutole	4 lb/gal	HPPD/27	Bayer
Basis Blend	rimsulfuron + thifensulfuron	20% + 20%	ALS/2 + ALS/2	DuPont
Bicep II Magnum 5.5L	atrazine + *S*-metolachlor	3.1 + 2.4 lb/gal	PSII/5 + LCFA/15	Syngenta
Bicep Lite II Magnum 6L	*S*-metolachlor + atrazine	3.33 + 2.67 lb/gal	LCFA/15 + PSII/5	Syngenta
Blazer 2L	acifluorfen	2 lb/gal	PPO/14	BASF
Boundary 6.5 EC	*S*-metolachlor + metribuzin	5.25 + 1.25 lb/gal	LCFA/15 + PSI	Syngenta
Breakfree	acetochlor + antidote	6.4 lb/gal	LCFA/15	DuPont
Breakfree ATZ	acetochlor + atrazine	3 + 2.5 lb/gal	LCFA/15 + PSII/5	DuPont
Broclean 4L	bromoxynil	2 lb/gal	PSII/6	Platte Chemical
Bronate 4AS	bromoxynil + MCPA	2 + 2 lb/gal	PSII/6 + GR/4	Bayer
Buctril 2EC	bromoxynil	2 lb/gal	PSII/6	Bayer
Buctril 4EC	bromoxynil	4 lb/gal	PSII/6	Bayer
Buctril + Atrazine 3L	bromoxynil + atrazine	1 + 2 lb/gal	PSII/6 + PSII/5	Bayer
Bullet 4F	alachlor + atrazine	2.5 + 1.5 lb/gal	LCFA/15 + PSII/5	Monsanto
Butyrac 200	2,4-DB	2 lb/gal	GR/4	Bayer
Cadet	fluthiacet-methyl	0.91 lb/gal	PPO/14	FMC
Callisto	mesotrione	4 lb/gal	HPPD/27	Syngenta
Callisto Xtra	mesotrione + atrazine	0.5 lb + 3.2 lb/gal	HPPD/27 + PSII/5	Syngenta
Canopy 75 DF	metribuzin + chlorimuron	64.3% + 10.7%	PSII/5 + ALS/2	DuPont
Canopy EX	chlorimuron + tribenuron	22.7% + 6.8%	ALS/2 + ALS/2	DuPont
Cinch 7.64EC	*S*-metolachlor	7.64 lb/gal	LCFA/15	DuPont
Cinch ATZ 5.5L	atrazine + *S*-metolachlor	3.1 + 2.4 lb/gal	PSII/5 + LCFA/15	DuPont
Cinch Lite ATZ 6L	*S*-metolachlor + atrazine	3.33 + 2.67 lb/gal	LCFA/15 + PSII/5	DuPont
Clarity 4L	dicamba	4 lb/gal	GR/4	BASF
Classic 25DF	chlorimuron	25%	ALS/2	DuPont
Cobra 2EC	lactofen	2 lb/gal	PPO/14	Valent
Command 3 ME	clomazone	2 lb/gal	DS/13	FMC
Corvus	thiencarbazone + isoxaflutole + safener	2.6 lb/gal	ALS/2 + HPPD/27	Bayer
Credit	glyphosate	3 lb/gal	EPSP/9	Nu-farm
Cornerstone	glyphosate	3 lb/gal	EPSP/9	Winfield

Herbicide trade and common name, formulation, mode of action, and manufacturer - *continued*

Trade name	Common name	Formulation	Mode of action/group number[a]	Manufacturer
Define	flufenacet	4 lb/gal	LCFA/15	Bayer
Degree 3.8L	acetochlor + safener	3.8 lb/gal	LCFA/15	Monsanto
Degree Xtra 4.04L	acetochlor + atrazine	2.7 + 1.34 lb/gal	LCFA/15 + PSII/5	Monsanto
Domain 60DF	metribuzin + flufenacet	24% + 36%	PSII/5 + LCFA/15	Bayer
Distinct 70WG	dicamba + diflufenzopyr	55% + 15%	GR/4	BASF
Dual II Magnum 7.64EC	*S*-metolachlor	7.64 lb/gal	LCFA/15	DuPont
Duramax	glyphosate (dimethylamine salt)	4 lb acid eq./gal	EPSP/9	Dow
Durango DMA	glyphosate (dimethylamine salt)	4 lb acid eq./gal	EPSP/9	Dow
Enlite	flumioxazin + chlorimuron + thifensulfuron	36.2% + 2.9% + 8.8%	PPO/14 + ALS/2 + ALS/2	DuPont
Envive	flumioxazin + chlorimuron + thifensulfuron	29.2% + 9.2% + 2.9%	PPO/14 + ALS/2 + ALS/2	DuPont
Epic 58DG	flufenacet + isoxaflutole	58% + 10%	LCFA/15 + HPPD/27	Bayer
Equip 32DG	foramsulfuron + iodosulfuron	30% + 2%	ALS/2 + ALS/2	Bayer
Expert 4.9L	atrazine + *S*-metolachlor + glyphosate	2.14 + 1.74 + 1 lb/gal	PSII/5 + LCFA/15 + EPSP/9	Syngenta
Express TotalSol	tribenuron-methyl	50%	ALS/2	DuPont
Extreme 1.67L[b]	glyphosate + imazethapyr	1.5 + 0.17 lb/gal	EPSP/9 + ALS/2	BASF
Fieldmaster 4.25L	acetochlor + atrazine + glyphosate	2 + 1.5 + 0.56 lb/gal	LCFA/15 + PSII/5 + EPSP/9	Monsanto
Fierce 76WDG	flumioxazin + pyroxasulfone	33.5% + 42.5%	PPO/14 + LCFA/15	Valent
Finesse	chlorsulfuron + metsulfuron	62.5 + 12.5 WG	ALS/2	DuPont
Finess Grass + Broadleaf	chlorsulfuron + flucarbazone	25% + 46.7%	ALS/2 + ALS/2	DuPont
FirstRate 84DG	cloransulam	84%	ALS/2	Dow
Flexstar 1.88ME	fomesafen + adjuvants	1.88 lb ae/gal	PPO/14	Syngenta
Flexstar GT 3.5	fomesafen + glyphosate	0.56 lb + 2.26 lb/gal	PPO/14 + EPSP/9	Syngenta
Frontrow 80 + 84DG	cloransulam + flumetsulam	80% + 84%	ALS/2 + ALS/2	Dow
Fultime 4CS	acetochlor + atrazine	2.4 + 1.6 lb/gal	LCFA/15 + PSII/5	Dow
Fusilade DX	fluazifop	2 lb/gal	ACCase/1	Syngenta
Fusion 2.66EC	fluazifop + fenoxaprop	2 + 0.66 lb/gal	ACCase/1 + ACCase/1	Syngenta
Gangster (co-pack)	flumioxazin + cloransulam	51% + 84%	PPO/14 + ALS/2	Valent
Glyfos/Glyfos Xtra	glyphosate	3 lb/gal	EPSP/9	Cheminova
Glyphosate Original	glyphosate (dimethylamine salt)	3 lb/gal	EPSP/9	Griffin
Gramoxone Max 2SL	paraquat	2 lb/gal	PSI/22	Syngenta
Guardsman Max	atrazine + dimethenamid-P	3.3 + 1.7 lb/gal	PSII/5 + LCFA/15	BASF
G-Max Lite	atrazine + dimethenamid-P	2.75 + 2.25 lb/gal	PSII/5 + LCFA/15	BASF
Halex GT	S-metolachlor +glyphosate + mesotrione	2.09 + 2.09 + 0.209 lb/gal	LCFA/15 + EPSP/9 + HPPD/27	Syngenta
Harmony Extra TotalSol	thifensulfuron + tribenuron	33.3% + 16.7%	ALS/2 + ALS/2	DuPont
Harmony SG TotalSol	thifensulfuron	50%	ALS/2	DuPont
Harness 7EC	acetochlor + antidote	7 lb/gal	LCFA/15	Monsanto
Harness Xtra 5.6L	acetochlor + atrazine	3.1 + 2.5 lb/gal	LCFA/15 + PSII/5	Monsanto
Harness Xtra 6L	acetochlor + atrazine	4.3 + 1.7 lb/gal	LCFA/15 + PSII/5	Monsanto
Hoelon 3EC	diclofop	3 lb/gal	ACCase/1	Bayer
Hornet 78.5 WDG	clopyralid + flumetsulam	60% + 18.5%	GR/4 + ALS/2	Dow
Ignite 280 SL	glufosinate	2.34 lb/gal	GS/10	Bayer
Impact 2.8SC	topramezone	2.8 lb/gal	HPPD/27	Amvac
Instigate	rimsulfuron + mesotrione	4.17% + 41.67%	ALS/2 + HPPD/27	DuPont
Intrro 4EC	alachlor	4 lb/gal	LCFA/15	Monsanto
Keystone 5.25L	acetochlor + atrazine	3 + 2.5 lb/gal	LCFA/15 + PSII/5	Dow
Landmaster II 1.7 E	glyphosate + 2,4-D amine	0.9 + 0.8 lb/gal	EPSP/9 + GR/4	Monsanto
Lasso 4EC	alachlor	4 lb/gal	LCFA/15	Monsanto
Lariat 4F	alachlor + atrazine	2.5 + 1.5 lb/gal	LCFA/15 + PSII/5	Monsanto

Herbicide trade and common name, formulation, mode of action, and manufacturer - *continued*

Trade name	Common name	Formulation	Mode of action/group number[a]	Manufacturer
Laudis	tembotrione + safener	3.5 lb/gal	HPPD/27	Bayer
Lexar EZ	*S*-metolachlor + atrazine + mesotrione	1.74 + 1.74 + 0.224 lb/gal	LCFA/15 + PSII/5 + HPPD/27	Syngenta
Liberty 280 SL	glufosinate	2.34 lb/gal	GS/10	Bayer
Liberty ATZ 4.3L	atrazine + glufosinate	3.3 + 1 lb/gal	PSII/5 + GS/10	Bayer
Lorox	linuron	4 lb/gal	PSII/7	Novasource
Lumax EZ	*S*-metolachlor + atrazine + mesotrione	2.49 +0.94 + 0.25	LCFA/15 + PSII/5 + HPPD/27	Syngenta
MCP amine 4L	MCPA	4 lb/gal	GR/4	Dow, others
Micro-Tech 4L	alachlor	4 lb/gal	LCFA/15	Monsanto
Mirage	glyphosate	3 lb/gal	EPSP/9	UAP
NorthStar 47.4DG	dicamba + primisulfuron	39.9% + 7.5%	GR/4 + ALS/2	Syngenta
Olympus 70WDG	propoxycarbazone	70%	ALS/2	Bayer
Olympus Flex	propoxycarbazone + mesosulfuran	6.75 + 4.5	ALS/2 + ALS/2	Bayer
Option 35DG	foramsulfuron	35%	ALS/2	Bayer
OpTill	saflufenacil + imazethapyr	17.8% + 50.2 %	PPO/14 + ALS/2	BASF
OpTill PRO	saflufenacil + imazethapyr + dimethenamid	0.178 + 0.5 + 6.0 lb/gal	PPO/14 + ALS/2 + LCFA/15	BASF
Osprey 4.5WDG	mesosulfuron	4.5%	ALS/2	Bayer
Outlook	dimethenamid-P	6 lb/gal	LCFA/15	BASF
Paramount	quinclorac	75%	GR/4	BASF
Partner 65DG	alachlor	65%	LCFA/15	Monsanto
Peak 57DG	prosulfuron	57%	ALS/2	Syngenta
Permit 75DG	halosulfuron	75%	ALS/2	Gowan
Phoenix 2EC	lactofen	2 lb/gal	PPO/14	Valent
Poast 1.5L	sethoxydim	1.5 lb/gal	ACCase/1	MicroFlo
Poast Plus 1E	sethoxydim	1 lb/gal	ACCase/1	MicroFlo
Prefix	S-metolachlor + fomesafen	4.34 lb/gal + 0.95 lb/gal	LCFA/15 + PPO/14	Syngenta
Prequel	rimsulfuron + isoxaflutole	15% + 30%	ALS/2 + HPPD/27	DuPont
Princep 4L	simazine	4 lb/gal	PSII/5	Syngenta
Princep Caliber 90	simazine	90%	PSII/5	Syngenta
Propel	dimethenamid-P	6.0 lb/gal	LCFA/15	Rosen's
Propel ATZ	dimethenamid-P + atrazine	1.7 + 3.3 lb/gal	LCFA/15 + PSII/5	Rosen's
Prowl H_2O 3.8ACS	pendimethalin	3.8 lb/gal	MI/3	BASF
Pursuit 2AS	imazethapyr	2 lb/gal	ALS/2	BASF
Python 80WDG	flumetsulam	80%	ALS/2	Dow
Raptor 1AS	imazamox	1 lb/gal	ALS/2	BASF
Ready Master ATZ	glyphosate + atrazine	2 + 2 lb/gal	EPSP/9 + PSII/5	Monsanto
Realm Q	rimsulfuron + mesotrione	7.5% + 31.25%	ALS/2 + HPPD/27	DuPont
Reflex 2LC	fomesafen	2 lb/gal	PPO/14	Syngenta
Resolve	rimsulfuron	25%	ALS/2	DuPont
Resolve Q	rimsulfuron + thifensulfuron	18.4% + 4%	ALS/2 + ALS/2	DuPont
Resource 0.86EC	flumiclorac-pentyl	0.86 lb/gal	PPO/14	Valent
Roundup Ultra 3L	glyphosate	3 lb acid eq./gal	EPSP/9	Monsanto
Roundup PowerMax	Glyphosate (potassium salt)	4.5 lb acid eq./gal	EPSP/9	Monsanto
Roundup WeatherMax 4.5L	Glyphosate (potassium salt)	4.5 lb acid eq./gal	EPSP/9	Monsanto
Scepter 70DG	imazaquin	70%	ALS/2	BASF
Select 2EC	clethodim	2 lb/gal	ACCase/1	Valent
Select Max	clethodim	0.97 lb/gal	ACCase/1	Valent
Sencor 4L	metribuzin	4 lb/gal	PSII/5	Bayer
Sencor 75DF	metribuzin	75%	PSII/5	Bayer

Herbicide trade and common name, formulation, mode of action, and manufacturer - *continued*

Trade name	Common name	Formulation	Mode of action/group number[a]	Manufacturer
Sequence 5.25L	glyphosate + *S*-metolachlor	2.25 + 3 lb/gal	EPSP/9 + LCFA/15	Syngenta
Sharpen	saflufenacil	2.85 lb/gal	PPO/14	BASF
Shotgun 3.25L	atrazine + 2,4-D	2.25 + 1 lb/gal	PSII/5 + GR/4	United Ag Products
Sierra	flucarbazone-sodium	3.5 lb/gal	ALS/2	Syngenta
Sonalan 3EC	ethalfluralin	3 lb/gal	MI/3	Dow
Sonic	sulfentrazone + cloransulam methyl	62.1% + 7.9%	PPO/14 + ALS/2	Dow
Spartan 4F	sulfentrazone	75%	PPO/14	FMC
Spirit 57DG	primisulfuron + prosulfuron	42.8% + 14.2%	ALS/2 + ALS/2	Syngenta
Starane 1.5L	fluroxypyr	1.5 lb/gal	GR/4	Dow
Status	dicamba + diflufenzopyr + isoxadifen (safener)	16% + 40%	GR/4	BASF
Steadfast Q	nicosulfuron + rimsulfuron	25.2% + 12.5%	ALS/2 + ALS/2	DuPont
SureStart 4.25L	acetochlor + flumetsulam + clopyralid	3.75 + 0.12 + 0.38 lb/gal	LCFA/15 + ALS/2 + GR/4	Dow
Surpass 6.4EC	acetochlor + antidote	6.4 lb/gal	LCFA/15	Dow
Synchrony STS XP	chlorimuron + thifensulfuron	21.5% + 6.9%	ALS/2 + ALS/2	DuPont
TopNotch 3.2 CS	acetochlor	3.2 lb/gal	LCFA/15	Dow
Touchdown HiTech 5L	glyphosate (potassium salt)	5 lb acid eq./gal	EPSP/9	Syngenta
Touchdown Total	glyphosate (potassium salt)	4.17 lb acid eq./gal	EPSP/9	Syngenta
Traxion	glyphosate	4.17 lb acid eq./gal	EPSP/9	Syngenta
Treflan 4HFP	trifluralin	4 lb/gal	MI/3	Many
Treflan 10G	trifluralin	10%	MI/3	Many
Trific 60DF	trifluralin	60%	MI/3	Riverside/Terra
Trilin 4E	trifluralin	4 lb/gal	MI/3	Griffin
Trilin 10G	trifluralin	10%	MI/3	Tri Corporation
TripleFlex	acetochlor + flumetsulam + clopyralid	3.75 + 0.12 + 0.38 lb/gal	LCFA/15 + ALS/2 + GR/4	Monsanto
Ultra Blazer	acifluorfen	2 lb/gal	PPO/14	UPI
Unity 75WDG	thifensulfuron	75%	ALS/2	Gowan
Valor 51 SX	flumioxazin	51%	PPO/14	Valent
Valor XLT	flumioxazin + chlorimuron	30% + 10.3%	PPO/14 + ALS/2	Valent
Verdict	saflufenacil + dimethenamid-P	0.57 + 5.0 lb/gal	PPO/14 + LCFA/15	BASF
Warrant	acetochlor	3 lb/gal	LCFA/15	Monsanto
Yukon 67.5 DF	dicamba + halosulfuron	55% + 12.5%	ALS/2	Monsanto
Zemax	*S*-metolachlor + mesotrione	3.34 + 0.33 lb/gal	LCFA/15 + HPPD/27	Syngenta
Zidua	pyroxasulfone	85%	LCFA/15	BASF
2,4-D amine or ester	2,4-D	several	GR/4	Many

[a]**Mode of action abbreviations:** ACCase(1): acetyl coenzyme A carboxylase, the target enzyme for lipid synthesis by selective grass herbicides; ALS(2): acetolactate synthase, the target enzyme for branch-chain amino acid synthesis; EPSP(9): 5-enolpyruvylshikimate-3-phosphate synthase, the target enzyme for aromatic amino acid synthesis; LCFA(15): inhibition of long-chain fatty acids; GR(4): growth-regulating, hormone imitating herbicides; GS(10): glutamine synthetase inhibitor, which results in the build-up of free ammonia; MI(3): mitotic inhibitor of root growth; PPO(14): inhibitor of protoporphryn IX, which ultimately results in membrane disruption; HPPD(27): inhibition of the enzyme p-hydroxyphenyl pyruvate dioxygenase, pigment inhibiting herbicides; PSII(5): photosynthetic electron transport inhibitor, which ultimately results in membrane disruption; DS(13): inhibition of diterpene synthesis, pigment inhibitors.

No-tillage burndown
Guide to weed response to herbicides

Herbicide	Corn	Cotton	Grain sorghum	Rice	Small grain	Soybeans	Annual bluegrass	Little barley	Cheat/downy brome	Annual ryegrass	Bittercress	Buttercup	Chickweed	Curly dock (established)	Cutleaf eveningprimrose	Dandelion	Field pennycress	Geranium species	Henbit	Horseweed (marestail)	Prostrate knotweed	Purslane speedwell	Rough (daisy) fleabane	Shepherdspurse	Vetch	Virginia pepperweed	Prickly lettuce
	Preplant Interval (days)[a]						Winter Weeds																				
2,4-D	b	b	b	b	NL	b	0	0	0	0	9	9	5	4	9	8	8	-	4	8	-	9	6	9	9	9	8
Aim	0	0	0	0	0	0	1	1	1	1	-	-	2	1	5	-	-	2	5	3	-	-	-	2	2	2	-
Atrazine	0	NL	0	NL	NL	NL	10	10	7	6	9	10	10	4	7	4	8	8	8	9	7	10	7	10	9	8	9
Authority XL	NL	NL	NL	NL	NL	0	-	2	1	1	5	5	6	4	-	8	7	5	8	7	-	6	-	7	-	-	-
Balance Flexx	0	NL	NL	NL	NL	NL	-	-	-	-	-	-	-	-	-	-	8	-	8	-	-	-	-	-	-	-	-
Banvel/Clarity	7	NL	15	NL	NL	c	0	0	0	0	7	7	5	7	5	7	8	-	8	9	-	5	8	7	9	7	9
Basis Blend	0	NL	NL	NL	NL	NL	9	-	6	2	7	9	9	3	6	7	9	7	9	6	-	7	8	9	5	7	7
Canopy EX	NL	NL	NL	NL	NL	7	0	0	0	0	10	9	10	5	6	7	9	7	9	6	-	10	8	9	-	9	9
Distinct/Status	d	NL	NL	NL	NL	30	1	1	1	1	8	7	6	7	5	7	8	8	8	8	-	-	8	8	9	9	-
Glyphosate	0	0	0	0	0	0	10	9	9	9	8	9	10	4	6	5	9	8	9	9	7	9	5	10	6	10	8
Gramoxone 2SL	0	0	0	0	0	0	9	9	8	9	9	9	10	1	8	4	8	9	9	6	6	5	5	10	8	8	7
Ignite/Liberty	0	0	180	0	70	0	8	-	-	-	9	-	9	5	-	5	9	9	8	6	8	-	8	9	-	-	-
OpTill	0[f]	NL	NL	NL	NL	0	5	4	3	-	9	8	9	5	8	6	8	-	8	8	-	7	8	9	-	8	9
Prequel	0	NL	NL	NL	NL	NL	9	-	-	7	-	-	9	-	-	7	9	-	9	-	-	-	-	9	-	-	-
Sencor	NL	NL	NL	NL	NL	0	-	10	8	5	10	9	10	-	6	-	-	7	8	6	6	-	-	6	6	6	8
Scepter	NL	NL	NL	NL	NL	0	-	4	3	5	5	9	9	-	5	-	9	5	7	4	5	-	2	9	-	9	5
Sharpen	0	1.5[e]	0	NL	0	0[d]	0	0	0	0	9	8	7	5	8	6	9	-	7	9	-	7	8	7	-	7	9
Valor	7	30	30	30	NL	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Valor XLT	NL	NL	NL	NL	4	0	-	1	1	1	5	5	6	4	-	8	6	5	8	6	-	6	-	7	-	-	5
Verdict	0	NL	NL	NL	NL	0	0	0	0	0	9	8	9	6	8	7	9	-	9	9	-	8	9	9	-	9	9

[a] NL = Not labeled

[b] For 2,4-D, see label for details regarding rates and fomulations. Be sure to use a 2,4-D formulation that is labeled for the target crop.

[c] 14 days and 1 inch rainfall are required for 8 fl oz or less and 28 days for 16 fl oz per acre.

[d] Corn can be planted 14 days after a Distinct application of 6 oz or less, 21 days if more than 6 oz is used.

[e] Rotational crop interval for Sharpen is dependent on rate.

[f] Labeled for use in Clearfield corn only.

No-tillage burndown
Guide to weed response to herbicides

Herbicide	Barnyardgrass	Broadleaf signalgrass	Crabgrass	Giant foxtail	Goosegrass	Rhizome johnsongrass	Red rice	Common cocklebur	Common lambsquarters	Entire/ivyleaf morningglory	Redroot/smooth pigweed	Pitted morningglory	Prickly sida/teaweed	Ragweed, common	Ragweed, giant	Annual smartweed species	Annual rye	Winter wheat	Alfalfa	Crimson clover	Red clover	Hairy vetch	Fescue	Orchardgrass	Timothy	Alfalfa
	Summer weeds																Cover crops						Established sods			
2,4-D	0	0	0	0	0	0	0	9	9	9	9	9	7	9	8	7	0	0	7	8	8	9	0	0	0	6
Aatrex	-	-	7	7	0	0	-	9	10	9	9	9	-	9	9	10	6	6	4	3	5	7	2	4	4	3
Authority XL	5	-	5	5	3	1	-	7	8	9	-	9	9	8	6	8	-	6	4	4	4	-	1	2	2	-
Balance Flexx	-	-	-	9	-	-	-	-	-	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Banvel/Clarity	0	0	0	0	-	0	0	8	8	8	9	8	8	9	9	7	0	0	9	8	9	9	0	0	0	8
Basis Blend	8	-	7	5	-	2	-	5	9	4	7	4	-	7	5	8	-	5	5	5	5	5	-	-	-	3
Canopy EX	0	-	1	1	-	0	-	5	6	4	7	4	-	8	7	8	-	1	4	5	5	-	-	-	-	4
Distinct/Status	2	2	1	2	0	0	0	8	9	9	9	8	8	9	9	8	1	1	8	8	8	8	0	1	1	8
Glyphosate	8	9	9	9	9	9	7	9	9	7	8	8	7	9	9	8	9	9	4	3	6	6	6	6	6	2
Gramoxone 2SL	9	9	8	8	8	3	8	6	8	5	9	5	6	8	8	7	7	6	4	9	4	8	5	3	3	3
Ignite/Liberty	9	8	9	9	8	4	9	9	9	9	9	9	8	9	9	9	-	8	-	-	-	-	-	-	-	-
OpTill	6	5	6	7	-	0	-	9	9	9	9	9	9	9	9	9	1	1	7	7	7	-	1	1	1	4
Prequelw	9	6	6	9	-	-	-	6	7	6	9	6	-	7	4	6	-	9	8	-	-	-	-	-	-	7
Sencor	-	-	8	-	5	7	8	8	8	7	8	7	8	7	7	7	9	9	4	3	5	5	5	5	5	2
Scepter	7	2	3	3	7	5	-	10	4	5	10	6	3	6	6	7	4	4	3	2	5	3	-	-	-	3
Sharpen	0	0	0	0	0	0	0	9	9	9	9	9	9	9	9	9	0	0	7	7	7	-	0	0	0	4
Spartan	3	3	7	7	2	0	-	7	8	10	10	10	9	-	-	7	-	-	-	-	-	-	-	-	-	-
Valor	2	-	1	1	-	0	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-
Valor XLT	5	-	5	5	3	1	-	7	8	9		9	9	8	6	8	-	6	4	4	4	-	1	2	2	-
Verdict	0	0	0	0	0	0	0	9	9	9	9	9	9	9	9	9	0	0	7	7	7	-	0	0	0	4

Weed control: 8 to 10 = good 6 to 7 = Fair* Less than 6 = poor - = No data available
*A weed control rating of 6 to 7 indicates partial control or suppression.

Use this table as a guide for comparing the relative effectiveness of herbicides on individual weeds. Herbicides may perform better or worse than indicated due to extreme weather conditions and other variables if you are obtaining satisfactory results under your growing conditions, changing products as a result of information in this table is not necessarily recommended.

Due to the overwhelming number of package mixes and tank mixes, it has become impractical to list and distinguish these combinations. In the interest of fairness, we are therefore listing no package mixes in this table. A reasonably accurate estimate may be obtained by combining the control ratings from the individual package or tank-mix components

Corn

Guide to grass and sedge weed response to herbicides

Herbicide	Barnyardgrass	Broadleaf signalgrass	Crabgrass	Fall panicum	Giant foxtail	Goosegrass	Johnsongrass, seedling	Johnsongrass, rhizome	Red rice	Shattercane	Woolly cupgrass	Yellow nutsedge	Crop response**
Preplant or preemergence													
Atrazine	8	6	5	3	7	6	2	0	8	0	4	0	0
Balance Flexx	8	7	8	9	7	-	7	0	5	6	9	4	1
Bicep II Magnum/Cinch ATZ/ Others	9	7	9	8	9	-	5	1	-	5	6	8	1
Callisto	4	6	5	-	2	6	0	0	5	1	-	-	0
Corvus	9	8	9	7	9	8	9	6	-	6	6	4	1
Degree Xtra	9	-	9	8	9	-	5	1	-	4	5	8	1
Dual II Magnum/Cinch	8	7	9	9	9	9	8	0	8	5	7	8	1
Guardsman Max	9	-	8	8	8	-	5	1	-	4	7	8	1
Harness/Breakfree/Degree	8	7	9	9	9	9	6	0	7	6	8	8	1
Harness Xtra/Fultime/Keystone	9	-	9	8	9	-	5	1	-	4	6	8	1
Hornet	0	0	0	0	0	0	0	0	0	0	0	0	2
Instigate	9	7	6	7	9	-	8	0	4	6	-	4	1
Lasso/Micro-Tech	8	7	9	9	9	9	6	0	7	5	7	7	1
Lumax EZ/Lexar EZ	8	8	9	8	9	9	6	1	9	5	7	8	1
Outlook	8	7	9	8	9	9	5	0	8	4	7	7	1
Prequel	9	8	9	8	9	8	8	2	-	9	-	4	1
Princep	7	6	7	6	7	7	2	0	-	1	2	0	0
Python	6	6	6	7	6	-	7	-	4	6	-	-	2
Resolve Q	8	7	6	6	8	-	8	4	0	7	6	3	1
Sharpen	0	0	0	0	0	0	0	0	0	0	0	-	1
Surestart/TripleFLEX	8	-	8	7	8	-	4	0	-	2	4	6	1
Verdict	8	-	8	7	8	-	-	2	-	4	6	7	1
Zemax	9	-	9	8	9	-	3	1	-	4	6	8	1
Zidua	8	8	9	9	9	9	8	0	-	6	7	5	1
Preemergence													
Prowl H_2O	9	-	8	8	9	9	7	0	-	7	7	0	1
Postemergence													
Accent Q	9	8	6	8	8	-	9	9	-	9	7	2	1
Atrazine + oil	8	7	7	5	7	6	3	0	10	2	6	6	1
Banvel/Clarity	0	0	0	0	0	0	0	0	0	0	0	0	1
Basagran	0	0	0	0	0	0	0	0	0	0	0	9	0
Beacon	0	-	0	7	3	-	9	8	-	10	2	2	1
Buctril	0	0	0	0	0	0	0	0	0	0	0	0	1
Cadet	1	1	1	1	1	1	1	1	1	1	1	1	2
Callisto	3	1	8	4	6	3	1	1	2	0	0	3	1
Distinct/Status	0	0	0	0	0	0	0	0	0	0	0	0	1
Glyphosate (Roundup Ready corn)	9	10	10	10	10	10	10	10	9	10	9	6	1
Impact/Armezon	8	3	8	6	8	4	3	1	-	6	4	3	1
Laudis	8	-	8	0	8	-	-	1	-	2	-	4	1
Liberty/Ignite (Liberty Link corn)	8	7	7	7	8	7	8	5	7	8	9	6	0
Option	8	6	7	8	9	8	10	9	-	9	-	2	2
Permit	0	0	0	0	0	0	0	0	0	0	0	9	0
Realm Q	8	5	7	8	8	-	5	1	-	8	7	5	1
Resource	-	-	-	-	-	-	-	-	0	-	-	-	1
Sencor	-	-	-	-	-	-	-	-	0	0	-	-	1
Spirit	-	-	0	6	6	-	5	4	-	5	0	0	2
Starane	0	0	0	0	0	0	0	0	0	0	0	0	1
Steadfast Q	9	8	8	8	9	8	10	8	-	9	8	4	1
2,4-D	0	0	0	0	0	0	0	0	0	-	-	-	1

Weed control: 8 to 10 = Good 6 to 7 = Fair* Less than 6 = Poor - = No data available

*A weed control rating of 6 to 7 indicates partial control or suppression.
**Crop response: A rating of 3 or less will not result in loss of crop yield under normal growing conditions.

Use this table as a guide for comparing the relative effectiveness of herbicides on individual weeds. Herbicides may perform better or worse than indicated due to extreme weather conditions and other variables. If you are obtaining satisfactory results under your growing conditions, changing products as a result of information in this table is not necessarily recommended.

Corn

Guide to broadleaf weed response to herbicides

Herbicide	Black nightshade	Cocklebur	Jimsonweed	Lambsquarters	Morningglory, annual	Pigweed, smooth/ redroot	Prickly sida	Ragweed, common	Ragweed, giant	Smartweed, annual	Sunflower	Velvetleaf	Waterhemp**
Preplant or preemergence													
Atrazine	9	9	9	9	9	9	9	9	8	9	7	7	9
Balance Flexx	8	6	6	9	4	8	8	-	-	7	7	8	9
Bicep II Magnum/Cinch ATZ/Others	9	9	8	9	7	9	-	9	8	9	7	8	9
Callisto	8	6	9	9	8	9	9	7	8	9	-	9	-
Corvus	8	8	5	9	6	9	-	8	6	8	6	8	9
Degree Xtra	9	9	7	9	7	9	-	9	8	9	7	8	9
Dual II Magnum/Cinch	9	0	4	6	0	9	3	5	3	5	0	2	9
Guardsman Max	9	9	7	9	7	9	-	9	8	9	6	8	9
Harness/Breakfree/Degree	-	4	-	9	4	9	-	8	5	6	0	4	9
Harness Xtra/Fultime/Keystone	9	9	8	9	7	9	-	9	8	9	7	8	9
Hornet	8	8	8	9	6	9	-	8	8	8	8	9	9
Instigate	9	8	9	9	7	8	8	8	7	9	8	9	7
Lasso/Micro-Tech	9	0	4	6	0	9	4	5	3	5	0	2	9
Lumax EZ/Lexar EZ	9	9	8	9	8	9	8	9	8	9	8	9	9
Outlook	8	2	4	7	2	9	0	5	2	4	0	2	9
Princep	8	8	8	8	8	9	8	8	6	8	6	7	-
Python	7	7	9	9	6	9	9	8	-	9	8	9	7
Prequel	9	7	8	9	7	9	-	8	7	8	9	9	9
Resolve Q	5	6	5	8	6	8	7	6	4	6	5	4	5
Sharpen	8	9	8	9	8	7	-	8	8	8	7	8	7
Surestart/TripleFLEX	8	8	8	9	6	9	-	7	6	8	7	8	8
Verdict	9	8	8	9	8	8	-	8	8	9	8	8	8
Zemax	9	8	8	9	6	9	-	8	7	8	8	9	9
Zidua	9	0	5	6	1	9	7	6	3	6	3	4	9
Preemergence													
Prowl H_2O	0	0	0	7	0	9	-	0	0	3	0	2	7
Postemergence													
Accent Q	0	2	7	5	5	8	2	2	2	8	5	3	5
Atrazine + oil	9	9	10	10	9	10	9	9	8	9	9	8	9
Banvel/Clarity	9	9	9	9	9	9	8	10	9	9	9	8	8
Basagran	2	9	9	6	5	4	8	8	8	9	8	8	3
Beacon	7	6	8	5	-	8	6	8	8	8	8	6	5
Buctril	9	9	10	9	8	7	4	9	9	9	8	8	6
Cadet	2	2	8	7	7	5	5	4	2	5	3	9	5
Callisto	8	8	9	9	7	9	8	7	8	9	8	9	9
Distinct/Status	9	9	9	9	9	9	8	10	9	9	9	8	8
Glyphosate (Roundup Ready corn)	8	9	9	8	6	9	5	9	8	5	8	8	9
Impact/Armezon	8	9	9	9	6	9	8	8	8	7	8	8	9
Laudis	8	8	9	9	6	9	8	8	8	7	8	8	9
Liberty/Ignite (Liberty Link corn)	8	9	9	8	9	7	7	8	8	9	8	7	7
Option	8	7	8	7	4	8	6	-	4	6	8	8	6
Permit	6	9	8	6	6	9	6	8	8	8	9	8	5
Realm Q	9	8	9	9	7	9	9	8	8	9	8	8	9
Resource	5	7	7	6	5	7	0	7	7	5	0	9	7
Sencor	3	7	7	4	5	6	5	5	2	6	6	7	6
Spirit	8	9	9	8	8	7	5	9	8	8	9	7	1
Starane	6	9	6	6	7	-	-	8	4	4	8	8	6
Steadfast Q	0	5	9	5	8	9	3	3	3	9	8	4	5
2,4-D	7	9	8	9	9	9	8	9	8	7	9	8	7

Weed control: 8 to 10 = Good 6 to 7 = Fair* Less than 6 = Poor - = No data available

*A weed control rating of 6 to 7 indicates partial control or suppression.
**Waterhemp has been observed to routinely escape ALS-herbicide treatments in many areas. Resistance has been formally confirmed in some fields. Control may vary from indicated values on ALS-inhibiting herbicides.

Use this table as a guide for comparing the relative effectiveness of herbicides on individual weeds. Herbicides may perform better or worse than indicated due to extreme weather conditions and other variables.

Corn

Soil-applied herbicide rates for corn

Herbicide	Soil texture*		
	Coarse (light, sandy)	Medium (loamy)	Fine (heavy, clay)
	(Rate per Acre)		
Atrazine 4L	3 pt	4 pt	4 pt
Aatrex Nine-0	1.6 lb	2.2 lb	2.2 lb
Axiom 68.8DF	8 to 15 oz	10 to 20 oz	20 to 23 oz
Balance 75WDG	1 to 2 oz	1.5 to 2.5 oz	1.5 to 3 oz
Balance Flexx	3 to 4 fl oz	5 to 6 fl oz	6 fl oz
Bicep II Magnum 5.5L	1.3 to 1.6 qt	1.6 to 2.1 qt	2.1 to 2.6 qt
Bicep Lite II Magnum 6L	0.9 to 1.5 qt	1.1 to 1.5 qt	1.5 to 2.2 qt
Bullet 4F	2.5 to 3 qt	3 to 5 qt	3.75 to 5 qt
Camix 3.7L	2 to 2.4 qt	2 to 2.4 qt	2 to 2.4 qt
Cinch 7.64L	0.8 to 1 pt	1 to 1.33 pt	1.33 to 1.67 pt
Cinch ATZ 5.5L	1.3 to 1.6 qt	1.6 to 2.1 qt	2.1 to 2.6 qt
Cinch Lite ATZ 6L	0.9 to 1.5 qt	1.1 to 1.5 qt	1.5 to 2.2 qt
Callisto	5 to 7.7 fl oz	5 to 7.7 fl oz	5 to 7.7 fl oz
Degree 3.8 L	2.25 to 3.25 pt	3.25 to 4.25 pt	3.25 to 5 pt
Degree Xtra 4.04L	2.9 qt	2.9 to 3.7 qt	3.2 to 3.7 qt
Dual II Magnum 7.64L	0.8 to 1 pt	1 to 1.33 pt	1.33 to 1.67 pt
Epic 58DG	6 to 10 oz	7 to 15 oz	10 to 15 oz
Fieldmaster 4.25L	3.5 to 5 qt	4 to 5 qt	4 to 5 qt
Fultime 4CS	2.5 to 3 qt	2.7 to 3.3 qt	3 to 5 qt
Guardsman 5L	3 to 4.5 pt	3.5 to 5 pt	4.5 to 5 pt
Guardsman Max 5L	2.4 to 3 pt	3 to 4 pt	4 to 4.6 pt
Harness 7E	1.25 to 1.75 pt	1.75 to 2.25 pt	1.75 to 2.75 pt
Harness Xtra 5.6L	1.4 to 1.7 qt	1.7 to 2.6 qt	2.3 to 3 qt
Harness Xtra 6L	1.5 to 1.8 qt	1.8 to 2.3 qt	1.8 to 2.3 qt
Hornet 78.5 WDG	4 to 5 oz	4 to 6 oz	4 to 6 oz
Keystone 5.25L/Breakfree ATZ	2.2 to 2.6 qt	2.4 to 2.8 qt	2.6 to 3.4 qt
Lasso 4EC	2 to 2.5 qt	2 to 4 qt	2 to 4 qt
Lariat 4F	2.5 to 3 qt	3 to 5 qt	3.75 to 5 qt
Lexar EZ	3 to 3.5 qt	3 to 3.5 qt	3 to 3.5 qt
Linex 4L	0.67 to 1.5 pt	1 to 1.5 pt	1.33 to 1.5 pt
Lumax EZ	2.7 to 3.25 qt	2.7 to 3.25 qt	2.7 to 3.25 qt
Micro-Tech 4EC	2 to 2.5 qt	2 to 4 qt	2 to 4 qt
Outlook 6L	12 to 14 fl oz	14 to 18 fl oz	18 to 21 fl oz
Partner 65G	3 to 3.8 lb	3 to 4.5 lb	3 to 4.5 lb
Prequel		1.66 to 2.5 oz	1.66 to 2.5 oz
Princep 90DF		1.1 lb	1.1 lb
Prowl H_2O 3.8 ACS	2 to 3 pt	3 to 4 pt	3 to 4 pt
Python WDG	0.8 to 1 oz	0.89 to 1.33 oz	0.89 to 1.33 oz
Ramrod 4F	4 to 4.5 qt	4.5 to 5.5 qt	5.25 to 6 qt
Resolve	0.5 to 2 oz	0.5 to 2 oz	0.5 to 2 oz
Sharpen	2 fl oz	2.5 fl oz	3.0 fl oz
Surestart/TripleFLEX	1.5 pt	1.5 to 1.75 pt	2.0 pt
Surpass 6.4EC/Breakfree	1.5 to 2.5 pt	1.5 to 2.5 pt	1.5 to 3 pt
Surpass 100 5SC	2 to 2.4 qt	2.2 to 2.6 qt	2.6 to 4 qt
TopNotch 3.2CS	2 qt	2 to 2.5 qt	2.5 to 3.75 qt
Verdict	10 to 12 fl oz	13 to 15 fl oz	16 to 18 fl oz
Zidua	1.5 to 2.75 oz	1.5 to 3 oz	2 to 4 oz

*Refer to herbicide labels for proper rates for your soil texture and organic matter content and for tank mixes.

Corn, Burndown

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Labeled tank-mix partners	Application method and precautions
The following preemergence corn herbicides may be used for burndown. Application information is listed in the preemergence herbicide section. In most cases, a broad-spectrum, foliar burndown herbicide such as Roundup or Gramoxone should be tank mixed with the preemergence herbicide; however, if grass pressure is light and broadleaf weeds are small, the addition of crop oil to an atrazine-containing product may be sufficient.				
2,4-D LV ester or amine (4 lb/gal formulation)	1 to 3 pt/A	2,4-D 0.5 to 1.5 lb/A	atrazine, Banvel, Bicep, Bronco, Bullet, Callisto, Dual, Glyphosate, Gramoxone, Guardsman, Harness Plus, Lariat, Lasso, Lumax, Outlook, Princep, Python, Surpass	May be applied early preplant (EPP) through planting. Use lower rate for small, susceptible weeds, and higher rates for large or difficult to control weeds.
Aim 2E + Nonionic surfactant	0.25 to 2 fl oz/A + 2 pt/100 gal	carfentrazone 0.004 to 0.031 lb/A	No restrictions listed.	Should be applied with a broad-spectrum burndown herbicide.
Banvel 4E	0.3 to 1 pt/A	dicamba 0.15 to 0.5 lb/A	atrazine, Bicep, Bronco, Bullet, Dual, Gramoxone, Guardsman, Harness Plus, Lariat, Lasso, Lumax, Outlook, Princep, Glyphosate, Surpass, 2,4-D	May be applied early preplant (EPP) until 7 days before planting (EPP7). See label for specific rates and weed stages for application.
Basis Blend + Nonionic surfactant or Crop oil concentrate + Urea ammonium nitrate or Ammonium sulfate	0.825 to 2.5 oz/A + 2 pt/100 gal or 1 gal/100 gal + 2 qt/A or 2 lb/A	rimsulfuron + thifensulfuron 0.01 + 0.005 lb to 0.02 + 0.008 lb	Express, Glyphosate, Princep, 2,4-D	May be applied early preplant (EPP) through planting up to the two-collar stage of corn.
Distinct 70WG + Nonionic surfactant	2 to 8 oz/A + 2 pt/100 gal	dicamba + diflufenzopyr 0.06 + 0.025 to 0.25 + 0.1 lb/A	Glyphosate, 2,4-D	Corn can be planted 14 days after application of 6 oz or less, or 21 days if more than 6 oz is used.
Expert 4.9L	2.5 to 3.75 qt/A	glyphosate + S-metotachlor + atrazine 0.6 + 1 + 1.33 to 0.9 + 1.63 + 2 lb/A	atrazine, Dual, Princep, Glyphosate, Python, Hornet, Prowl, Banvel, Clarity, 2,4-D	May be applied up to 30 days before planting and before emergence of conventional corn hybrids.
Fierce + Nonionic surfactant or Crop oil concentrate	3 oz/A + 2 pt/100 gal or 1 gal/100 gal	flumioxanin + pyroxasulfone 0.064 + 0.080	Basis, Dicamba, Express, Glyphosate, Gramoxone, 2,4-D	Do not apply within 7 days of planting.
Gramoxone SL2 + Nonionic surfactant or Crop oil concentrate	2 to 3.4 pt/A + 1 to 2 pt/100 gal or 1 gal/100 gal	paraquat 0.7 to 1.4 lb/A	atrazine, Banvel, Bicep, Dual, Bronco, Bullet, Callisto, Dual, Guardsman, Harness Plus, Lariat, Lasso, Lumax, Outlook, Princep, Python, Roundup, Surpass, 2,4-D	May be applied early preplant (EPP) through planting, but before crop emergence. See label for specific rates and weed stages for application. Rate should normally be at least 1.67 pt/A.
Harmony Extra XP	0.3 to 0.6 oz/A	thifensulfuron + tribenuron 0.009 + 0.005 lb/A to 0.018 + 0.01 lb/A	Glyphosate, Gramoxone, 2,4-D	Use for control of smartweed and dock. Tank mix with Gramoxone or Roundup. DO NOT APPLY WITHIN 14 DAYS OF PLANTING.
Liberty/Ignite 280SL + Ammonium sulfate	29 to 36 fl oz/A + 3 lb/A	glufosinate 0.53 to 0.66 lb/A	atrazine, Banvel, 2,4-D	For larger weeds, use higher rate of 36 fl oz at burndown but no additional applications of Ignite 280SL may be made during the growing season.
Prequel + Nonionic surfactant or Crop oil concentrate + Ammoniated sulfate or Urea ammonium nitrate	1.66 to 2.5 oz/A + 2 pt/100 gal or 1 gal/100 gal	rimsulfuron + isozaflutole 0.016 + 0.03 lbA to 0.023 + 0.047 lb/A	Dicamba, Glyphosate, Gramozone, 2,4-D	May be applied preplant through planting but before crop emergence. The addition of a bkurndown herbicide will enhance control of many large or tough-to-control species.
Roundup brands/ Touchdown brands/other glyphosates glyphosate 3L or Roundup WeatherMax 4.5L or Roundup PowerMax 4.5L + Recommended additives	 1 to 3 pt/A or 11 to 32 fl oz/A or 11 to 32 fl oz/A + See label	glyphosate 0.38 to 1.12 lb/A	atrazine, Banvel, Bicep, Bullet, Callisto, Dual, Guardsman, Harness Plus, Lariat, Lasso, Lumax, Outlook, Princep, Python, Surpass, 2,4-D	May be applied early preplant (EPP) through planting. Use lower rate for small, susceptible weeds and higher rates for large or difficult to control weeds.

Corn, Burndown - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Labeled tank-mix partners	Application method and precautions
Sharpen + Methylated seed oil + Ammonium sulfate or Urea ammonium nitrate	2 to 3 oz/A + 1 gal/100 gal + 8.5 to 17 lb/100 gal or 1.25–2.5 gal/100 gal	saflufenacil 0.04 to 0.06 lb/A	atrazine, Glyphosate, Ignite	Do not apply after corn has emerged. If spray volume is 12 GPA or less, use methylated seed oil at 1 pt/A.
Valor 51 WDG + Nonionic surfactant (80%) or Crop oil concentrate	2 oz/A + 2 pt/100 gal or 1 gal/100 gal	flumioxazin 0.064 lb/A	Basis, Dicamba, Express, Glyphosate, Gramoxone	Do not apply within 7 days of planting.
Verdict + Methylated seed oil + Ammonium sulfate or Urea ammonium nitrate	10 to 18 fl oz/A + 1 gal/100 gal + 8.5 to 17 lb/100 gal or 1.25–2.5 gal/100 gal	saflufenacil + dimethenamid-P 0.015 + 0.4 to 0.08 + 0.72 lb/A	atrazine, Glyphosate, Ignite	Do not apply after corn has emerged. If spray volume is 12 GPA or less, use methylated seed oil at 1 pt/A.

Fall and early preplant applications of preemergence herbicides for reduced tillage

Many preemergence herbicides may be used two or more weeks before planting in an early preplant (EPP) application. Advantages include: Early preplant applications will prevent weed emergence and aid or eliminate a formal burndown application. They may limit weed growth if weather delays planting. Some preemergence herbicides have significant postemergence, burndown activity (adjuvants are sometimes required). Some preemergence herbicides increase the activity or spectrum of burndown herbicides. Finally, combining a preemergence herbicide with a burndown herbicide may simply save time and costs by eliminating a second trip for the traditional preemergence, after-planting application.

Several herbicides are registered for fall application. A fall herbicide application may be beneficial if it eliminates the need for a burndown application in the spring and soil erosion is not a problem. Fall applications could also benefit drying of the soil in the spring and could reduce the need for tillage before planting.

There are many choices and an option that works well in one field may work poorly in another. For most situations we recommend that growers target early preplant applications 15 or less days before planting. The sooner a herbicide is applied, the sooner it will break down and loose effectiveness. If rain delays planting too long, most advantages of extra-early preplant applications may be lost. Also, after 30 days, there is a much higher probability that a burndown application will be needed and most labels specify that additional preemergence herbicide be applied at planting. Finally, exceptionally long (>30 day) preplant intervals remove winter vegetation and leave the soil vulnerable to erosion and may increase the probability of herbicide contamination of ground and surface water.

Early preplant (EPP) labels for corn herbicides

		Label allows preplant application		
Herbicide	Burndown activity	45 days	30 days	15 days
Atrazine	Yes	Yes*	Yes*	Yes
Autumn	Yes	Yes	Yes	No
Axiom	No	Yes*	Yes*	Yes
Balance Pro	Yes	No	Yes	Yes
Basis	Yes	Yes	Yes	Yes
Bicep II Magnum	Yes	Yes*	Yes*	Yes
Bicep Lite II Magnum	Yes	Yes*	Yes*	Yes
Bronco	Yes	Yes	Yes	Yes
Bullet	Yes	Yes*	Yes*	Yes
Callisto	Yes	No	No	No
Cinch	No	Yes*	Yes*	Yes
Cinch ATZ	Yes	Yes*	Yes*	Yes
Cinch Lite ATZ	Yes	Yes*	Yes*	Yes
Degree	Yes	Yes	Yes	Yes
Degree Extra	Yes	Yes	Yes	Yes
Dual II Magnum	No	Yes*	Yes*	Yes
Epic	Yes	No	Yes	Yes
Fieldmaster	Yes	No	Yes	Yes
Fultime	Yes	No***	Yes	Yes
Guardsman Max	Yes	Yes*	Yes*	Yes
Harness	No	Yes*	Yes*	Yes

Early preplant (EPP) labels for corn herbicides - *continued*

Herbicide	Burndown activity	Label allows preplant application		
		45 days	30 days	15 days
Harness Xtra	Yes	Yes*	Yes*	Yes
Hornet	Yes	No	Yes	Yes
Keystone/Breakfree ATZ	Yes	No	Yes	Yes
Lariat	Yes	Yes*	Yes*	Yes
Lasso	No	Yes*	Yes*	Yes
Lexar EZ	Yes	No	No	Yes
Lumax EZ	Yes	No	No	Yes
Microtech	No	Yes*	Yes*	Yes
Outlook	No	Yes*	Yes	Yes
Partner	No	Yes*	Yes*	Yes
Prequel	Yes	No	Yes	Yes
Princep	Yes	Yes	Yes	Yes
Python	Yes	No	Yes	Yes
Sharpen	Yes	No	Yes	Yes
Shotgun	Yes	No	No	Yes
Surestart/TripleFLEX	Yes	No	Yes	Yes
Surpass/Breakfree	No	No	Yes	Yes
Topnotch	No	No***	Yes	Yes
Verdict	Yes	No	Yes	Yes
Zemax	Yes	No	No	Yes

*Label requires reapplication at the time of planting. (Typically 2/3 applied EPP and 1/3 preemergence at planting.)

**EPP intervals greater than 15 days are not recommended on coarse-textured (light, sandy) soils.

***EPP treatments are not recommended on coarse-textured (light, sandy) soils where average annual rainfall exceeds 40 inches.

Corn, Preplant or preemergence

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Preplant incorporated or preemergence tank-mix partners	Application method and precautions
Aatrex 4L or Aatrex 90DF	3 to 4 pt/A or 1.6 to 2.2 lb/A	atrazine 1.5 to 2 lb/A	Dual, Guardsman, Harness Plus, Lasso, Micro-Tech, Outlook, Princep, Surpass, Surpass 100	Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils.
Balance Flexx	3 to 6 fl oz/A	isoxaflutole 0.05 to 0.09 lb/A	Aatrex, Axiom, Bicep, Dual, Fultime, Guardsman, Leadoff, Harness, Harness Xtra, Lasso, Outlook, Simazine, Surpass, Surpass 100, Topnotch	Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils. **See label for crop safety restrictions.** Plant corn at least 1.5 inches deep and ensure that the seed-furrow is closed. May also be applied early postemergence up to V2 corn. **Not registered for use in Butler, Cape Girardeau, Dunklin, Mississippi, New Madrid, Pemiscot, Scott and Stoddard counties.**
Callisto 4L	5 to 7.7 fl oz/A	mesotrione 0.16 to 0.24 lb/A	atrazine, Axiom, Bicep, Degree, Degree Xtra, Doubleplay, Dual, Fultime, Glyphosate, Gramoxone Max, Guardsman/Leadoff, Harness, Harness Xtra, Outlook, Surpass, Prowl, Topnotch, 2,4-D	Callisto primarily controls broadleaf weeds, tank mix with a grass herbicide for broad-spectrum weed control. Tank mixtures with atrazine-containing products are recommended for optimal morningglory control. Use lower rates when tank-mixed with atrazine and higher rates without atrazine. See label for organophosphate and carbamate insecticide restrictions.
Dual II Magnum 7.64E/Cinch 7.64E	0.8 to 1.67 pt/A	*S*-metolachlor 0.76 to 1.6 lb/A	atrazine, Princep	Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils.
Harness 7E or Degree 3.8L	1 to 3 pt/A or 2.25 to 5 pt/A	acetochlor + antidote 0.875 to 2.33 lb/A or 1.07 to 2.38 lb/A	Aatrex, Accent, Banvel, Clarity, Glyphosate, Gramoxone Max, Marksman, Permit, Princep, Prowl, Permit, Pursuit,	Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils. Degree is a microencapsulated, slow-release formulation of acetochlor.
Instigate	5.25 to 7.0 oz/A	rimsulfuron + mesotrione 0.013 + 0.14 lb/A to 0.018 + 0.18 lb/A	atrazine, Cinch, Dicamba, Princep, 2,4-D	May be appied up to 2 leaf collar stage. Do not apply to corn treated with Counter or tank-mix with foliar applied OP insecticides. Do not apply with Basagran.

Corn, Preplant or preemergence - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Preplant incorporated or preemergence tank-mix partners	Application method and precautions
Lasso 4EC or Micro-Tech 4L or Partner 65G	2 to 4 qt/A or 2 to 4 qt/A or 3 to 4.5 lb/A	alachlor 2 to 4 lb/A	atrazine, Princep	Preplant treatment may be shallow incorporated.
Lexar EZ	2.5 to 3.5 qt/A	*S*-metolachor + atrazine + mesotrione 1.3 + 1.3 + 0.17 to 1.5 + 1.5 + 0.2 lb/A	atrazine, Glyphosate, Gramoxone, Princep, Touchdown brands	Use low rate when organic matter is less than 3% and high rate when organic matter is more than 3%. **See label for insecticide interaction restrictions.**
Lumax EZ	2.7 to 3.25 qt/A	*S*-metolachlor + atrazine + mesotrione 1.68 + 0.63 + 0.17 to 2 + .75 + 0.2 lb/A	atrazine, Glyphosate, Gramoxone, Princep, 2,4-D	Use low rate when organic matter is less than 3% and high rate when organic matter is above 3%. **See label for insecticide interaction restrictions.**
Outlook 6E	10 to 21 oz/A	dimethenamid-P 0.47 to 0.98 lb/A	atrazine, Princep	Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils.
Prequel	1.66 to 2.5 oz/A	rimsulfuron + isoxaflutole 0.016 + 0.03 lb/A to 0.023 to 0.047 lb/A	atrazine, Cinch, Dicamba, Glyphosate, 2,4-D,	Use higher rates on fine soils. Do not apply to coarse soils with less than 1% organic matter.
Python 80WDG	0.8 to 1.33 oz/A (5 to 3 A/pkt)	flumetsulam 0.04 to 0.07 lb/A	2,4-D, Dual II Magnum, Glyphosate, Gramoxone, Harness, Outlook, Surpass, Touchdown	Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils. See label for crop injury precautions regarding varieties, soil pH, soybean herbicide carryover, at-planting insecticides and cool weather.
Surpass 6.4EC/ Breakfree	1.5 to 3 pt/A	acetochlor + antidote 0.8 to 2.4 lb/A	atrazine, Balance Pro, Banvel, Clarity, Glyphosate, Gramoxone, Hornet WDG, Marksman, Pendemax/Prowl, Princep, Python, 2,4-D	Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils.
TopNotch 3.2L	2-3.75 qt/A	acetochlor + antidote 1.6 to 3 lb/A	atrazine, Balance Pro, Banvel, Glyphosate, Gramoxone, Hornet, Lorox, Prowl, Pursuit (IMI corn only), Python, Sencor, Touchdown, 2,4-D	Use lower rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils. Topnotch is a microencapsulated, slow-release formulation of acetochlor.
Zidua	1.5 to 4 oz/A	pyroxasulfone 0.094 to 0.25 lb/A	atrazine, Glyphoxate, Guardsman Max, Prowl H_2O, Sharpen, others	Use low rates on coarse soils.
Package mixes - Preplant or preemergence				
Axiom 68DF	8 to 23 oz/A	flufenacet + metribuzin 0.27 + 0.07 to 0.78 + 0.19 lb/A	atrazine, Balance, Banvel, Clarity, Glyphosate, Gramoxone, Hornet, Marksman, Pentagon, Prowl, Python, Sencor, 2,4-D	Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils. Rates are futher defined depending upon soil organic matter. Plant corn at least 1.5 inches deep.
Bicep II Magnum 5.5L or Cinch ATZ 5.5L	1.3 to 2.6 qt/A	atrazine + *S*-metolachlor 1 + 0.78 to 2 + 1.56 lb/A	atrazine, Dual	Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils. Atrazine and/or Dual may be added to Bicep to improve weed control in heavy infestations or for hard-to-control weeds.
Bicep II Lite Magnum 6L or Cinch ATZ 6L	0.9 to 2.2 qt/A	*S*-metolachlor + atrazine 0.75 + 0.6 to 1.83 + 1.47 lb/A	atrazine, Dual	Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils. Atrazine and/or Dual may be added to Bicep to improve weed control in heavy infestations or for hard-to-control weeds.
Bullet 4F	2.5 to 4.5 qt/A	alachlor + atrazine 1.56 + 0.94 to 2.8 + 1.7 lb/A	atrazine, Micro-Tech	Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils. Atrazine and/or Lasso may be added to Bullet or Lariat to improve weed control in heavy infestations or for hard-to-control weeds.

Corn, Preplant or preemergence - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Preplant incorporated or preemergence tank-mix partners	Application method and precautions
Epic 58DF	8 to 15 oz/A	flufenacet+ isoxaflutole 0.24 + 0.05 to 0.45 + 0.094 lb/A	atrazine, Axiom, Axiom AT, Banvel, Clarity, Define, Glyphosate, Gramoxone, Hornet, Liberty, Marksman, 2,4-D	Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils. Plant corn at least 1.5 inches deep**. See label for crop safety and soil restrictions. Not registered for use in Butler, Cape Girardeau, Dunklin, New Madrid, Mississippi, Pemiscot, Scott and Stoddard counties.**
Fieldmaster 4.25L + Ammonium sulfate (optional)	3.5 to 5 qt/A	acetochlor + atrazine + glyphosate 1.75 + 1.31 + 0.49 to 2.5 + 1.88 + 0.7 lb/A + 17 lb/100 gal	atrazine, Glyphosate, Harness, Princep	No-tillage burndown product. Apply approximately 14 days before planting. Use lower rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils.
Guardsman Max 5L	2.4 to 3.6 pt/A	atrazine + dimethenamid-P 0.99 + 0.51 to 1.9 + 0.98 lb/A	atrazine, Balance, Outlook, Princep	Use lower rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils. Outlook and/or atrazine may be added to Guardsman to improve weed control in heavy infestations or for hard-to-control weeds.
Harness Xtra 5.6L or Harness Xtra 6L or Degree Xtra 4.04 L	1.4 to 3 qt/A or 1.5 to 2.3 qt/A or 2.9 to 3.7 qt/A	acetochlor + atrazine 1.09 + 0.88 to 2.3 + 1.88 lb/A or 1.6 + 0.6 to 2.5 + 1 lb/A or 1.96 + 0.97 to 2.5 + 1.25 lb/A	Aatrex, Accent, Banvel, Clarity, Glyphosate, Gramoxone, Harness, Hornet, Marksman, Permit, Princep, Prowl, Pursuit, Python,	Use lower rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils. Degree Xtra contains microencapsulated, slow-release acetochlor.
Hornet 78.5 WDG	4 to 5 oz/A	clopyralid + flumetsulam 0.125 + 0.46 to 0.188 + 0.06 lb/A	Banvel, Bicep, Buctril, Clarity, Fultime,Glyphosate, Gramoxone, Guardsman, Harness Xtra, Keystone, Leadoff, Marksman, Touchdown, 2,4-D	Use lower rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils. See label for crop injury precautions regarding varieties, soil pH, soybean herbicide carryover, at-planting insecticides and cool weather.
Lariat 4F	2.5 to 4.5 qt/A	alachlor + atrazine 1.56 + 0.94 to 2.8 + 1.7 lb/A	atrazine, Lasso	Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils. Atrazine and/or Surpass may be added to Bullet or Lariat to improve weed control in heavy infestations or for hard-to-control weeds.
Keystone 5.25L or Fultime 4CS	2.2 to 3.4 qt/A or 2.5 to 5 qt/A	acetochlor + atrazine 1.5 + 1 to 3 + 2 lb/A or 1.7 + 1.3 to 2.6 + 1.9 lb/A or 1.5 + 1 to 3 + 2 lb/A	atrazine, Balance Pro, Banvel, Clarity, Glyphosate, Gramoxone, Hornet WDG, Lasso, Marksman, Pendemax/Prowl, Princep, Python, Surpass, 2,4-D	Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils. Atrazine and/or Surpass may be added to improve control in heavy infestations or for hard-to-control weeds.

Corn, Preemergence only

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Preemergence tank-mix partners	Application method and precautions
Expert 4.9L	2.5 to 3.75 qt/A	glyphosate + S-metotachlor + atrazine 0.6 + 1 + 1.33 to 0.9 + 1.63 + 2 lb/A	atrazine, Dual, Princep, Glyphosate, Python, Hornet, Prowl, Banvel, Clarity, 2,4-D	May be applied up to 30 days before planting and before emergence of conventional corn hybrids.
Lexar EZ	2.5 to 3.5 qt/A	*S*-metolachor + atrazine + mesotrione 1.3 + 1.3 + 0.17 to 1.5 + 1.5 + 0.2 lb/A	atrazine, Glyphosate, Gramoxone, Princep, Touchdown brands	Use low rate when organic matter is less than 3% and high rate when organic matter is more than 3%. **See label for insecticide interaction restrictions.**
Lumax EZ	2.7 to 3.25 qt/A	*S*-metolachlor + atrazine + mesotrione 1.68 + 0.63 + 0.17 to 2 + .75 + 0.2 lb/A	atrazine, Glyphosate, Gramoxone, Princep, 2,4-D	Use low rate when organic matter is less than 3% and high rate when organic matter is above 3%. **See label for insecticide interaction restrictions.**

Prowl H_2O 3.8ACS	2 to 4 pt/A	pendimethalin 0.95 to 1.9 lb/A	Aatrex, Balance, Banvel, Bicep, Dual, Guardsman, Hornet, Marksman, Python	**DO NOT INCORPORATE** or serious crop injury may occur. Plant at least 1.5 inches deep.
Resolve Q	1.25 to 2.5 oz/A	rimsulfuron + thifensulfuron 0.014 + 0.003 to 0.028 + 0.006 lb/A	atrazine, Balance, Balance Pro, Bicep, Cinch, Dual, Cinch ATZ, Harness, Lumax, Lexar, Outlook	May be applied preemergence or postemergence to corn that is up to 12 inches tall. Postemergence applications require addition of spray adjuvants.
Zemax	2 to 2.4 qt/A	*S*-metolachlor + mesotrione 1.68 + 0.17 to 2 + 0.2 lb/A	atrazine, Glyphosate, Gramoxone, Touchdown, 2, 4-D	Use low rate when organic matter is less than 3% and high rate when organic matter is more than 3%. **See label for insecticide interaction restrictions.**

Corn, Preemergence, Applied postemergence to crop

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Preemergence herbicides applied postemergence tank-mix partners	Application method and precautions
AAtrex 4L or AAtrex Nine-0 + Crop oil concentrate	3 to 4 pt or 1.6 to 2.2 lb + See label	atrazine 1.5 to 2 lb/A	Banvel, Basagran, Buctril, Dual	Apply after weed emergence, but before grass weeds reach 1.5 inches and broadleaf weeds reach 4 inches in height and before corn reaches 12 inches tall. The use of crop oil concentrate may injure corn under conditions of stress. Follow mixing procedures and precautions on label to minimize possible injury.
Balance Flexx	3 to 6 fl oz/A	isoxaflutole 0.05 to 0.09 lb/A		May be applied early postemergence up to V2 corn. Use low rates on coarse (light,sandy) soils and higher rates on fine (heavy, clay) soils. See label for crop safety restrictions.
Callisto 4L + Crop oil concentrate	5 to 7.7 fl oz/A + 1 gal/100 gal	mesotrione 0.16 to 0.24 lb/A	Do not tank mix with emusifiable-concentrate (EC) formulations of grass herbicides.	Callisto primarily controls broadleaf weeds, tank mix with a grass herbicide for broad-spectrum weed control. Tank mixtures with atrazine-containing products are recommended for optimal morningglory control. Use lower rates when tank-mixed with atrazine and higher rates without atrazine. See label for organophosphate and carbamate insecticide restrictions. Do not apply with methylated seed oils.
Dual II Magnum 7.64E/Cinch 7.64E	0.8 to 1.67 pt/A	*S*-metolachlor 0.76 to 1.6 lb/A	atrazine, Banvel, Clarity, Steadfast	**Apply before weed emergence or tank mix with a POST-active herbicide.** Apply before corn is 5 inches tall.
Harness 7E or Degree 3.8L	1.25 to 2.75 pt/A or 2.25 to 5 pt/A	acetochlor + antidote 1.1 to 2.4 lb/A or 1.07 to 2.38 lb/A	atrazine, Accent, Banvel, Clarity, Marksman, Permit, Princep, Prowl, Permit, Pursuit, Roundup	**Apply before weed emergence or tank mix with a POST-active herbicide.** Apply before corn is 11 inches tall. Degree is a microencapsulated, slow-release formulation of acetochlor.
Linex 4L	1 to 1.5 pt/A	linuron 0.5 to 0.75 lb/A	atrazine, Prowl, Dual II Magnum	Apply after planting but before crop emerges. Plant seed at least 1.75 inches deep.
Outlook 6E	12 to 21 fl oz/A	dimethenamid-P 0.56 to 0.98 lb/A	atrazine, Accent, Banvel, Clarity, Marksman, Beacon	**Apply before weed emergence or tank mix with a POST-active herbicide.** Apply before corn is 8 inches tall.
Prowl H_2O 3.8ACS	2 to 4 pt/A	pendimethalin 0.95 to 1.9 lb/A	Accent, atrazine, Banvel, Basis Gold, Beacon, Hornet, Marksman	**DO NOT INCORPORATE** or serious crop injury may occur. This herbicide has no postemergence activity, but may be used to add residual control to other postemergence herbicides. Plant at least 1.5 inches deep. Use lower rates for coarse (light, sandy) soils and higher rates for fine (heavy, clay) soils.

Corn, Preemergence, Applied postemergence to crop - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Preemergence herbicides applied postemergence tank-mix partners	Application method and precautions
Surpass 6.4EC	1.5 to 3 pt/A	acetochlor 1.2 to 2.4 lb/A	Aim, Accent, Accent Gold, atrazine, Banvel, Basis, Basis Gold, Beacon, Buctril, Buctril/atrazine, Clarity, Distinct, Exceed, Hornet WDG, Liberty, Lightning, Marksman, Peak, Permit, Princep, Prowl, Pursuit, Shotgun, Spirit, Steadfast	**Apply before weed emergence or tank mix with a POST-active herbicide.** Apply until corn is 11 inches tall.
Topnotch 3.2CS	2 to 3 qt/A	acetochlor 1.6 to 2.4 lb/A	Accent, Banvel, Basis, Basis Gold, Beacon, Buctril, Buctril/atrazine, Clarity, Distinct, Liberty, Lightning, Marksman, Peak, Pendemax/Prowl, Permit, Prowl, Pursuit, Resource, Shotgun, Spirit, Steadfast, 2,4-D	**Apply before weed emergence or tank mix with a POST-active herbicide.** Apply until corn is 11 inches tall.
Package mixes - Preemergence applied postemergence				
Bicep II Magnum 5.5L/Cinch ATZ 5.5L	1.3 to 2.6 qt/A	atrazine + *S*-metolachlor 1 + 0.78 to 2 + 1.56 lb/A		Apply before weeds reach the two-leaf stage and before corn is 5 inches tall.
Bicep Lite II Magnum 6L or Cinch Lite ATZ 6L	0.9 to 2.2 qt/A	*S*-metolachlor + atrazine 0.75 + 0.6 to 1.83 + 1.47 lb/A	atrazine, Banvel, Clarity, Lorox	Apply before weeds reach the two-leaf stage and before corn is 5 inches tall.
Guardsman Max 5L	2.4 to 3.6 pt/A	atrazine + dimethenamid P 0.99 + 0.51 to 1.9 + 0.98 lb/A	atrazine, Accent, Banvel, Clarity, Marksman, Pursuit	Apply before weeds are taller than 1.5 inches and before corn is 12 inches tall.
Harness Xtra 5.6L or Harness Xtra 6L or Degree Xtra 4.04 L	1.4 to 3 qt/A or 1.5 to 2.3 qt/A or 2.9 to 3.7 qt/A	acetochlor + atrazine 1.09 + 0.88 to 2.3 + 1.88 lb/A or 1.6 + 0.6 to 2.5 + 1 lb/A or 1.96 + 0.97 to 2.5 to 1.25 lb/A	atrazine, Accent, Banvel, Clarity, Harness, Hornet, Marksman, Permit, Princep, Prowl, Pursuit, Python, Roundup	Apply before weeds reach the two-leaf stage and before corn is 11 inches tall.
Keystone 5.25L or Fultime 4CS or Breakfree ATZ	2.2 to 3.4 qt/A or 2.5 to 5 qt/A or 2.2 to 3.4 qt/A	acetochlor + atrazine 1.7 + 1.3 to 2.6 + 1.9 lb/A or 1.5 + 1 to 3 + 2 lb/A or 1.7 + 1.3 to 2.6 + 1.9 lb/A	atrazine, Accent, Banvel, Basis, Beacon, Buctril, Buctril/atrazine, Clarity, Exceed, Marksman, Peak, Permit, Princep, Prowl, Shotgun, Steadfast	Apply before weeds reach the two-leaf stage and before corn is 11 inches tall.
Lexar EZ + Nonionic surfactant	2.5 to 3.5 qt/A + 2 pt/100 gal	*S*-metolachor + atrazine + mesotrione 1.3 + 1.3 + 0.17 to 1.5 + 1.5 + 0.2 lb/A	atrazine, Accent, Basis, Steadfast, Stout, Touchdown brands (GT corn only)	Apply before corn exceeds 12 inches in height. Use low rate when organic matter is less than 3% and high rate when organic matter is more than 3%. **See label for insecticide interaction restrictions.** Do not use methylated seed oils or nitrogen additives when applying to corn.
Lumax EZ + Nonionic surfactant	2.7 to 3.25 qt/A + 2 pt/100 gal	*S*-metolachlor + atrazine + mesotrione 1.68 + 0.63 + 0.17 to 2 + .75 + 0.2 lb/A	atrazine, Accent, Basis, Steadfast, Steadfast ATZ, Stout, Touchdown brands (GT corn only)	Apply before corn exceeds 5 inches in height. Use low rate when organic matter is less than 3% and high rate when organic matter is more than 3%. **See label for insecticide interaction restrictions.** Do not use methylated seed oils or nitrogen additives when applying to corn.
Resolve Q	1.25 to 2.5 oz/A	rimsulfuron + thifensulfuron 0.014 + 0.003 to 0.028 + 0.006 lb/A	atrazine, Balance, Balance Pro, Bicep, Cinch, Dual, Cinch ATZ, Harness, Lumax, Lexar, Outlook	May be applied preemergence or postemergence to corn that is up to 12 inches tall. Postemergence applications require addition of spray adjuvants.
Zemax + Nonionic surfactant	2 to 2.4 qt/A + 2 pt/100 gal	*S*-metolachlor + mesotrione 1.68 + 0.17 to 2 + 0.2 lb/A	atrazine, Accent, Basis, Steadfast, Steadfast ATZ	Apply before corn exceeds 5 inches in height. Use low rate when organic matter is less than 3% and high rate when organic matter is more than 3%. **See label for insecticide interaction restrictions.** Do not use crop oils or methylated seed oils or nitrogen additives when applying to corn.

Corn, Postemergence

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Postemergence tank-mix partners	Application method and precautions
AAtrex 4L or AAtrex Nine-0 + crop oil concentrate containing not more than 20% emulsifier or Emulsifiable oil containing 1 to 2% emulsifier	3 to 4 pt or 1.6 to 2.2 lb + 1 qt or 1 gal/A	atrazine 1.5 to 2 lb/A	Banvel, Basagran, Buctril, Steadfast	Apply after weed emergence, but before weeds reach 1.5 inches in height. The use of oil may injure corn under conditions of stress. Follow mixing procedures and precautions on label to minimize possible injury.
Accent Q + Nonionic surfactant (80%) or crop oil concentrate and 28% or 32% UAN liquid fertilizer (Optional)	0.9 to 1.8 oz/A + 1 to 2 qt/100 gal or 1 gal/100 gal and 2 to 4 qt/100 gal	nicosulfuron 0.031 to 0.062 lb/A	atrazine, Banvel, Basis, Beacon, Buctril, Buctril + atrazine, Clarity, Exceed, Marksman, Northstar	Apply broadcast to corn up to 20 inches tall (up to 6 collars), or 20 to 36 inches tall (less than 10 collars) with drop nozzles. Do not apply to corn treated with any formulation of Counter insecticide. See label for restrictions with other organophosphate insecticides and postemergence herbicides. Split application may be needed for johnsongrass control.
Aim 2E + Nonionic surfactant (80%)	0.5 fl oz/A + 2 pt/100 gal	carfentrazone-ethyl 0.008 lb/A	2,4-D, atrazine, Accent, Banvel, Basis, Basis Gold, Beacon, Clarity, Exceed, Glyphosate, Hornet, Marksman, Permit, Spirit, Liberty	May be applied over-top until corn has 14 collars. See label regarding use of crop oil, EC formulations and crop injury.
Banvel (4 lb/gal formulation)	1 pt/A or 0.5 pt/A	dicamba 0.5 lb/A or 0.25 lb/A	Accent, atrazine, Beacon, Dual II, Lasso, Outlook, Prowl, 2,4-D	Apply from corn planting until corn is 8 inches tall. For best results, apply after weeds have emerged. Do not apply this rate after corn is taller than 8 inches. or Apply anytime after weeds have emerged until corn is 36 inches tall or 15 days before corn tassel emergence.
Basagran 4S	1.5 to 2 pt/A	bentazon 0.75 to 1 lb/A	atrazine	Apply when weeds are small. Add 1 qt/A of crop oil concentrate for yellow nutsedge. Add 2 to 4 qt/A of UAN for velvetleaf.
Beacon 75DF + Non-ionic surfactant (80%) or crop oil concentrate and 28 - 34% UAN liquid fertilizer (Optional)	0.38 to 0.76 oz/A (1 pkt/ 4 to 2 A) + 2 pt/100 gal or 1 to 4 pt/A and 1 to 2 pt/A	primisulfuron 0.018 to 0.036 lb/A	Accent, atrazine, Banvel, Buctril, Clarity, 2,4-D	Use lower rate in split applications and higher rate in single applications. Apply overtop on 4 to 20 inch tall corn. After 20 inches to tasseling use drop nozzles. Do not apply to corn treated with any formulation of Counter insecticide. See label for restriction with other organophosphate insecticides, and other postemergence herbicides. Some corn hybrids may be susceptible to injury, see your dealer for a list of restricted hybrids. Split application is recommended for johnsongrass control and may be made before tassel emergence.
Buctril 2E or Buctril 4 lb/gal	1 to 1.5 pt/A or 0.5 to 0.75 pt/A	bromoxynil 0.25 to 0.38 lb/A	Accent, atrazine, Beacon	See label for specific rates, crop stages and weed stages for application.
Cadet	0.6 to 0.9 fl oz/A	fluthracet 0.004 to 0.006 lb/A	Glyphosate, Liberty	See label for specific rates, weed sizes, and tank-mix partner recommendations.

Corn, Postemergence - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Postemergence tank-mix partners	Application method and precautions
Callisto 4L + crop oil concentrate + Urea ammonium nitrate or Ammonium sulfate	3 fl oz/A + 1 gal/100 gal + 2.5 gal/100 gal or 8.5 lb/100 gal	mesotrione 0.094 lb/A	atrazine, Basagran, Liberty, Liberty ATZ, Stout, Touchdown brands (GT corn only). Do not tank mix with emusifiable-concentrate (EC) formulations of grass herbicides.	Callisto primarily controls broadleaf weeds, tank mix with a grass herbicide for broad-spectrum weed control. Tank mixtures with atrazine-containing products are recommended for optimal morningglory control. Use lower rates when tank-mixed with atrazine and higher rates without atrazine. See label for organophosphate and carbamate insecticide restrictions.
Callisto Xtra + crop oil concentrate + Ammonium sulfate	20 to 24 oz/A + 1 gal/100 gal + 8.5 lb/100 gal	mesotrione 0.078 to 0.094 lb ai/A + atrazine 0.5 to 0.6 ai/A	AAtrex, Accent Q, Steadfast Q, Stout, Bicep II Magnum, Bicep II Lite Magnum, Buctril, Clarity, Status, Ignite in Liberty Link corn, and Glyphosate in glyphosate-tolerant corn. If tank-mixed with Ignite or Glyphosate, refer to Ignite or Glyphosate labels for adjuvant recommendation.	Callisto Xtra primarily controls broadleaf weeds; tank-mix with a grass herbicide for broad-spectrum control. Apply only up to 12-inch corn. See label for organophosphate and carbamate restriction.
Clarity 4E + 28 - 32% UAN liquid fertilizer (Optional) or Nonionic surfactant (Optional)	16 fl oz/A	diglycolamine salt of dicamba, 0.5 lb/A	Accent, atrazine, Beacon, Steadfast, 2,4-D	May be applied from corn emergence (spike) until corn is 8 inches tall. Addition of UAN is recommended only for velvetleaf control. Nonionic surfactant may be added to improve weed control in dry growing conditions.
Impact 2.8SC/ Armezon + Methylated seed oil + Urea ammonium nitrate or Ammonium sulfate	0.5 to 0.75 fl oz/A + 1 gal/100 gal + 1.25 to 2.5 gal/100 gal or 8.5 to 17 lb/100 gal	topramezone 0.01 to 0.016 lb/A	atrazine, Accent, Glyphosate, Liberty, Steadfast, Status, others. May be tank-mixed with residual herbicides in early post applications to control emerged weeds.	Impact primarily controls broadleaf weeds. Tank mix with a grass herbicide for broad-spectrum weed control. Tank mixtures with atrazine-containing products will enhance weed control significantly. Impact may be applied from anytime after corn emergence up to 45 days before harvest.
Laudis (3.5 lb/gal formulation)	3 oz/A	tembotrione 0.66 lb/A	atrazine, Liberty, Glyphosate, Accent, Stout, Steadfast, Option	Laudis primarily controls broadleaf weeds. Tank mix with a grass herbicide for broad spectrum weed control. Tank mixtures with atrazine-containing product will enhance weed control significantly.
Option 35DG + Methylated seed oil + Urea ammonium nitrate or Ammonium sulfate	1.5 to 1.75 oz/A + 1.5 pt/A + 1.5 to 2 qt/A or 1.5 to 3 lb/A	foramsulfuron 0.03 to 0.04 lb/A	atrazine, Beacon, Callisto, Degree, Degree Xtra, Banvel, Clarity, Distinct, Exceed, Fultime, guardsman Max, Harness, Harness Xtra, Hornet, Keystone, Marksman, Northstar, Outlook, Permit, Prowl, Spirit, Surpass, Topnotch, Tough, Volley, Yukon	Broadcast applications must be made when corn is in the V1 to V6 growth stage. Temporary yellowing (flashing), stunting and internode stacking can sometimes occur. See label for insecticide interaction restrictions.
Permit 75DF + Nonionic surfactant (80%) or Crop oil concentrate + Urea ammonium nitrate or Ammonium sulfate (optional)	0.67 to 1.33 oz/A + 1 to 2 qt/A or 1 gal/100gal + 4 gal/100 gal or 2 to 4 lb/A	halosulfuron 0.032 to 0.063 lb/A	Accent, atrazine, Banvel, Beacon, Buctril, Buctril + atrazine, Clarity, Marksman, 2,4-D	Do not cultivate for 7 days following application. Apply from spike to lay-by (corn that's approximately 30 inches tall).
Python 80WDG	0.8 to 1.14 oz/A	flumetsulam 0.04 to 0.057 lb/A	No restrictions	Apply before corn reaches 20 inches or 6 collars.

Corn, Postemergence - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Postemergence tank-mix partners	Application method and precautions
Resource 0.86 EC + Crop oil concentrate	2 to 4 fl oz/A + 1 to 2 pt/A	flumiclorac-pentyl, 0.013 to 0.027 lb/A	2,4-D, atrazine, Accent, Banvel, Beacon, Buctril, Clarity, Glyphosate, Hornet, Liberty, Marksman, Northstar, Permit, Spirit, Stinger	Velvetleaf control and lambsquarters suppression only. Higher herbicide and adjuvant rates are for drop-nozzle directed application only.
Sencor 75 DF	2 oz/A	metribuzin 0.094 lb/A	2,4-D, atrazine, Banvel, Basagran, Buctril, Buctril Gel, Clarity, Laddok, Marksman, Resource, Pursuit, Tough	Must be applied with a tank-mix partner for acceptable weed control. Do not use crop oil. Consult label for tank-mix partners to determine appropriate adjuvant. Do not use on coarse-textured, low organic matter soils.
Starane 1.5L	2/3 pt/A	fluroxypyr 0.125 lb/A	No restrictions	Apply as a broadcast or band treatment to field corn up to and including 5 fully exposed leaf collars (V5 growth stage). Applications to field corn beyond V5 should be made as a directed spray using drop nozzles. Brittleness of corn after application may cause stalk breakage if windstorms or cultivation follow within 8 to 10 days of treatment. Do not use between tasseling and hard dough stage.
2,4-D amine or ester (4 lb/gal formulation)	0.5 to 1 pt/A	2,4-D amine or ester 0.25 to 0.5 lb/A	Banvel, Beacon	May be applied overtop until corn is 8 inches tall. After corn is over 8 inches tall, and until tasseling, use only directed application. Crop injury may occur when using higher rates or if applied during periods of rapid growth. Brittleness of corn after application may cause stalk breakage if windstorms or cultivation follow within 8 to 10 days of treatment. Do not use between tasseling and hard dough stage.
Package mixes – Postemergence				
Basis 75DG + Crop oil concentrate or Nonionic surfactant + UAN or ammonium sulfate	1/3 oz/A + 1% v/v or 1 qt/100 gal + 2-4 qt/A or 2-4 lb/A	rimsulfuron + thifensulfuron 0.01 + 0.005 lb/A	atrazine, Callisto, Hornet	Apply broadcast to field corn in the spike through four-leaf (2 collar) stage. Do not apply to corn having 3 fully emerged collars or more than 6 inches tall. See label for restrictions regarding insecticide interactions.
Buctril + atrazine 3L	1.5 to 3 pt/A	bromoxynil + atrazine 0.19 + 0.38 to 0.38 + 0.75 lb/A	atrazine, Buctril	See label for specific rates, crop stages and weed stages for application. Buctril and/or atrazine may be added to the package-mix to improve control in heavy infestations or for hard-to-control weeds.
Distinct 70WG + Nonionic surfactant (80%) + UAN	4 to 6 oz/A + 1 qt/100 gal + 2 to 4 qt/A	dicamba + diflufenzopyr 0.138 + 0.053 to 0.206 + 0.079 lb/A	Accent, Steadfast	Apply after corn is 4 inches tall. A 6 oz rate may be used until corn is 10 inches tall and a 4 oz rate may be used until corn is 24 inches tall.
Equip 32 DG	1.5 oz/A	foramsulfuron + iodosulfuron 0.3 + 0.002 lb/A	atrazine, Degree, Degree Xtra, Banvel, Clarity, Distinct, Fultime, Guardsman Max, Harness, Harness Xtra, Keystone, Marksman, Outlook, Permit, Prowl, Topnotch, Volley, Yukon	Broadcast applications must be made when corn is in the V1 to V4 growth stage. Temporary yellowing (flashing), stunting and internode stacking can sometimes occur. See label for insecticide interaction restrictions.

Corn, Postemergence - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Postemergence tank-mix partners	Application method and precautions
Hornet 78.5 WDG + Crop oil concentrate or Methylated seed oil or Nonionic surfactant (80%) and UAN or ammonium sulfate (optional)	2 to 5 oz/A + 1 gal/100 gal or 1 gal/100 gal or 1 qt/100 gal and 2.5 gal/A or 2 lb/A	clopyralid + flumetsulam 0.063 + 0.023 to 0.16 + 0.058 lb/A	Accent, atrazine, Banvel, Basis Gold, Buctril, Callisto Clarity, Distinct, Glyphosate, Option, Steadfast	Apply to actively growing weeds from corn emergence to 20 inches tall over the top or to 20 inches to 36 inches tall with drop nozzles. Do not tank-mix with Basagran, Laddok or Lightning. See label for specific rates and restrictions.
Laddok S-12 5L + Crop oil concentrate	1.3 to 2.3 pt/A + 1 qt/A	bentazon + atrazine 0.52 + 0.52 to 0.73 + 0.73 lb/A	atrazine, Stinger, 2,4-D	See label for specific rates, crop stages and weed stages for application. Corn is tolerant at all stages of growth. However, best performance is obtained when weeds are small.
NorthStar 47.4DG + Nonionic surfactant (80%) or Crop oil concentrate + Urea ammonium nitrate or ammonium sulfate (optional)	5 oz/A + 1 qt/100 gal or 1 to 4 pt/A + 2 to 4 qt/A or 2 to 4 lb/A	dicamba + primisulfuron 0.125 + 0.023 lb/A	atrazine, Accent, Banvel, Beacon, Clarity, Marksman, Resource, Tough	Apply over the top when corn is from 4 to 20 inches tall. Applied in a directed or semi-directed spray when corn is from 20 to 36 inches tall. See label comments regarding insecticide interactions. Do not apply to sensitive varieties.
Realm Q + Nonionic surfactant or Crop oil concentrate + UAN or ammonium sulfate	4 oz/A + 1 qt/100 gal or 1 gal/100 gal + 2 qt/A or 2 lb/A	rimsulfuron + mesotrione 0.018 + 0.078 lb/A	Glyphosate, Ignite, Liberty	Apply to corn up to 20 inches in height. Do not apply to corn taller than 20 inches or exhibiting 7 or more leaf collars, whichever is more restrictive.
Resolve Q + Nonionic surfactant + UAN or ammonium sulfate	1.25 oz/A + 1 qt/100 gal + 2 qt/A or 2 lb/A	rimsulfuron + thifensulfuron 0.014 + 0.003 lb/A	Glysophate, Cinch, Cinch ATZ, Lumax, Balance PRO, Harness, Outlook, atrazine, others	May be applied to field corn that is up to 12 inches tall. Do not apply to corn taller than 12 inches or exhibiting 6 or more leaf collars, whichever is more restrictive. Do not tank-mix with Basagran, Laddok, 2,4-D-containing products or foliar applied organophosphate insecticides.
Shotgun 3.25L	1.5 to 3 pt/A	atrazine + 2,4-D 0.24 + 0.19 to 0.84 + 0.38 lb/A	atrazine, Banvel, Buctril	Do not tank mix with Accent. Apply at least 7 days before or 3 days after Accent applications. See label for rates regarding soil textures. Apply over the top when corn is from the spike to 8-inch (four-leaf) stage or in drop nozzles from 8-inch to 12-inch (five-leaf) stage.
Spirit 57DG + Nonionic surfactant (80%) or Crop oil concentrate + UAN or ammonium sulfate (optional)	1 oz/A + 1 to 2 qt/100 gal or 1 to 4 pt/A + 2 to 4 at/A or 2 to 4 lb/A	primisulfuron + prosulfuron 0.027 + 0.009 lb/A	2,4-D, atrazine, Accent, Banvel, Beacon, Bicep, Buctril, Clarity, Dual, Marksman, Tough	See label restrictions regarding insecticide interactions. Apply over the top when corn is 4 to 20 inches tall (or 6 collars). Do not apply to sensitive hybrids. This herbicide is an option for areas with higher pH where Peak and Exceed may present carryover problems.

Corn, Postemergence - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Postemergence tank-mix partners	Application method and precautions
Status 56WG + Nonionic surfactant (80%) or Crop oil concentrate or Methylated seed oil	5 oz/A + 2 pt/100 gal or 1 gal/100 gal or 1 gal/100 gal	Dicamba + diflufenzopyr 0.03 + 0.07	Accent, Steadfast	Apply over the top to corn that is 4 to 36 inches tall. Drop nozzles are not required.
Steadfast Q + Nonionic surfactant (80%) or Crop oil concentrate + UAN or ammonium sulfate	1.50 oz/A + 2 to 4 pt/100 gal or 1 gal/100gal + 2 qt/A or 2 lb/A	nicosulfuron + rimsulfuron 0.023 + 0.012 lb/A	atrazine, Callisto, Clarity, Distinct, Marksman, Hornet, Stinger, Tough	May be applied to corn that is up to 20 inches tall and exhibiting up to and including 6 leaf collars. Do not apply to corn taller than 20 inches or exhibiting more than 6 leaf collars, whichever is more restrictive. See label restrictions regarding insecticide interactions.
Stout 72.5 DF + crop oil concentrate or nonionic surfactant + UAN or ammonium sulfate	0.5 to 0.75 oz/A + 1% v/v or 1 qt/100 gal + 2 qt/A or 2 lb/A	nicosulfuron + thifensulfuron 0.02 to 0.0016 to 0.03 + 0.0002 lb/A	atrazine, Callisto, Distinct, Clarity, Banvel, Dual, Prowl, Cinch, Outlook, others	Apply to field corn that is up to 16 inches tall and is exhibiting up to and including 5 leaf collars. See label for restrictions regarding insecticide interactions.
Yukon 67.5 DF + Nonionic surfactant or Crop oil concentrate + UAN or ammonium sulfate (optional)	4 to 8 oz/A + 2 to 4 pt/100 gal or 1 gal/100 gal + 2 to 4 qt/A or 2 to 4 lb/A	Dicamba + halosulfuron 0.14 + 0.03 to 0.28 + 0.06 lb/A	Accent, atrazine, Beacon, Bullet, Degree, Degree Xtra, Glyphosate, Partner	Apply over the top to corn from spike to 36 inches.

Herbicide-resistant corn

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Labeled tank-mix partners	Application method and precautions
Liberty Link Corn				
Ignite 280SL + Ammonium sulfate	22 oz/A + 3 lb/A	glufosinate 0.4 lb/A		Use on Liberty Link corn only. Applications may be made from emergence through the 7-collar growth stage. Apply at 22 fl oz/A per application and no more than 44 fl oz/A may be applied per growing season.
Liberty 280SL + Ammonium sulfate	22 oz/A + 3 lb/A	glufosinate 0.4 lb/A	Do not tank mix with Aim, Basis, Prowl, Resource, or Sencor.	Use on Liberty Link corn only. Applications may be made from emergence through the 7-collar growth stage. Apply at 22 fl oz/A per application and no more than 44 fl oz/A may be applied per growing season.
Liberty ATZ 4.3SC + Ammonium sulfate	32 to 40 fl oz/A + 3 lb/A	atrazine + glufosinate 0.83 + 0.25 to 1.03 + 0.31 lb/A	Do not tank mix with Basis, Prowl, Resource, or Sencor.	Use on Liberty Link corn only. Use caution to avoid spraying the wrong field. Consult label to refine rates for particular weed species. Apply overtop from emergence to 12-inch tall corn See label regarding fertilizer additives. Do not apply within two hours of sunset.

Herbicide-resistant corn - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Labeled tank-mix partners	Application method and precautions
Surestart	1.5 to 2 pts/A	acetochlor + flumetsulan + clopyralid 0.7 to 0.02 + 0.07 lb/A to 0.9 + 0.03 + 0.10 lb/A	atrazine, glyphosate, Liberty, 2,4-D	Use only on Roundup Ready or Liberty Link corn. Can be applied preplant preemergence, or early postemergence, to corn up to 11 inches tall. Minimum planting depth should be 1.5 inches.
Roundup Ready Corn				
Preemergence or postemergence				
Expert 4.9L	2.5 to 3.75 qt/A	atrazine + *S*-metolachlor + glyphosate 1.3 + 1 + 0.63 to 2 + 1.6 + 0.9 lb/A	No tank mixes with other products after corn emerges. Before corn emergence, may be tank mixed with atrazine, Banvel, Clarity, Dual II Magnum, Glyphosate, Hornet, Princep, Prowl, Python, Touchdown, or 2, 4-D	Use on Roundup Ready Corn only. May be applied from 30 days preplant up to 12-inch corn.
Halex GT + Nonionic surfactant + Ammonium sulfate	3.6 to 4 pts/A + 2 pt/100 gal + 8.5 to 17 lb/100 gal	S-metolachlor + glyphosate + mesotrione 0.94 + 0.94 + 0.094 lb/A to 1.05 + 1.05 + 0.105 lb/A	atrazine	Use on Roundup ready corn only. Can be applied postemergence from spike to 30-inch or 8-leaf corn. No PRE applications.
Roundup brands/ Touchdown Total/ other glyphosates + Recommended additives	+ See label	glyphosate 0.77 to 1.1 lb ae/A	Bullet, Harness, Harness Xtra, Micro-Tech, Partner, Permit	Use on Roundup Ready corn only. Use caution to avoid spraying the wrong field. Apply overtop from emergence until corn is 30 inches tall (8 collars). Higher rates per application are allowed on Roundup Ready corn 2. Drop nozzles may also be used on Roundup Ready corn 2 for corn 30 to 48 inches in height.
Ready Master ATZ + Ammonium sulfate	1.5 to 2 qt/A + 8.5 to 17 lb/100 gal	atrazine + glyphosate 0.75 + 0.56 to 1 + 0.75 lb/A	Aatrex, Harness, Microtech, Partner	Use on Roundup Ready corn only. Use caution to avoid spraying the wrong field. Apply from emergence until corn reaches 12 inches in height.
Surestart/TripleFLEX	1.5 to 2 pts/A	acetochlor + flumetsulan + clopyralid 0.7 to 0.02 + 0.07 lb/A to 0.9 + 0.03 + 0.10 lb/A	atrazine, glyphosate, Liberty, 2,4-D	Use only on Roundup Ready or Liberty Link corn. Can be applied preplant preemergence, or early postemergence, to corn up to 11 inches tall. Minimum planting depth should be 1.5 inches.

Corn, special problems

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Weeds controlled	Application method and precautions
Note: Shattercane and johnsongrass have similar foliar responses to treatments; however, rhizomes of johnsongrass are more difficult to kill and regrowth is possible. Heavy johnsongrass infestations will require split and/or sequential herbicide applications for optimal control. Rhizome johnsongrass should typically be allowed to grow larger than seedling johnsongrass or shattercane so that more leaf area is available to absorb herbicides and translocate them to rhizomes.				
Johnsongrass, Preplant burndown				
Roundup brands/ Touchdown brands/ other glyphosates + Recommended additives	+ See label	glyphosate at least 0.77 lb ae/A	Johnsongrass (seedling and rhizome), shattercane and other annual grass and broadleaf weeds.	Treat with glyphosate before plants are 12 inches tall. Allow 7 or more days after application before tillage. Roundup may be tank-mixed with several preemergence herbicides. Control will be limited if johnsongrass is just emerging.

Corn, special problems - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Weeds controlled	Application method and precautions
Johnsongrass, Postemergence				
Accent Q + Nonionic surfactant (80%) or Crop oil concentrate and 28 or 32% UAN liquid fertilizer (Optional)	0.9 oz/A + 1 to 2 qt/100gal or 1 gal/100 gal and 2 to 4 qt/100gal	nicosulfuron 0.031 lb/A	Seedling and rhizome johnsongrass, shattercane and other annual grass weeds.	Apply to 4- to 10-inch seedling and 8 to 12 inch rhizome johnsongrass. If regrowth occurs, second application may be made when johnsongrass is 8 to 10 inches tall. May be applied up to 20-inch corn broadcast, and 20- to 36-inch corn with drop nozzles. Do not apply to corn treated with Counter insecticide. See label for restrictions with other organophosphate insecticides, and postemergence herbicides.
Beacon 75DF + Nonionic surfactant (80%) or crop oil concentrate and 28 - 32% UAN liquid fertilizer (Optional)	1 water soluble packet per 2 acres + 2 pt/100 gal or 1 to 4 pt/A and 1 to 2 pt/A	primisulfuron 0.036 lb/A	Seedling and rhizome johnsongrass, shattercane and other annual broadleaf weeds.	Apply to 4- to 12-inch tall seedling and 8- to 16-inch tall rhizome johnsongrass. Another option is a half-rate, split application where a second application is made when regrowth is 8 to 16 inches tall. May be applied over the top to 4- to 20-inch tall corn. Use drop nozzles for 20-inch corn to tasseling. Do not apply to corn treated with Counter insecticide. See label for restrictions with other organophosphate insecticides, and postemergence herbicides. Some corn hybrids may be susceptible to injury, see your dealer for a list of restricted hybrids.
Roundup brands/other glyphosates Glyphosate 3L or Roundup WeatherMax 4.5L or Roundup PowerMax 4.5L + Recommended additives	 1 to 2 pt/A or 11 to 21 fl oz/A or 11 to 21 fl oz/A + See label	glyphosate 0.375 to 0.75 lb/A	Johnsongrass (seedling and rhizome), most grass and broadleaf weeds	Roundup Ready corn only. For optimal results, apply to 15- to 20-inch tall rhizome johnsongrass and retreat if new growth reaches 6 to 12 inches tall.
Roundup brands/other glyphosates Glyphosate 3L or Roundup WeatherMax 4.5L or Roundup PowerMax 4.5L + Recommended additives	1.3 fl oz/gallon + See label	glyphosate 1% solution	Johnsongrass (seedling and rhizome), and many annual and perennial grass and broadleaf weeds.	Spot spray only, corn plants in treated area will be severely injured or killed. Cover foliage thoroughly. Apply to 12- to 18-inch tall johnsongrass.
Harvest aid				
Aim + Crop oil concentrate or Nonionic surfactant or Methylated seed oil	1 to 2 oz/A	Carfentrazone 0.015 to 0.031	—	Allow a minimum of three days between application and harvest.
Gramoxone SL2 + Nonionic surfactant or Crop oil concentrate	1.2 to 2 pt/A	paraquat 0.4 to 0.7	Most grass and broadleaf weeds	Preharvest treatment: Apply after the black layer has formed, at least 7 days before harvest.

Corn, special problems - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Weeds controlled	Application method and precautions
2,4-D amine or 2,4-D ester (4 lb/gal formulation)	1.5 to 2 pt or 1 to 2 pt/A	2,4-D 0.75 to 1 lb or 0.5 to 1 lb/A	Cocklebur, common ragweed, jimsonweed, morningglories, velvetleaf and suppression of vines such as honeyvine milkweed, field bindweed, trumpetcreeper and redvine that interfere with harvesting.	Preharvest treatment: Apply after hard dough or denting stage. Do not forage or feed corn fodder for 7 days following application.
Roundup brands/other glyphosates Glyphosate 3L or Roundup WeatherMax 4.5L or Roundup PowerMax 4.5L + Recommended additives	 2 to 6 pt/A or 21 to 64 fl oz/A or 22 fl oz/A + See label	glyphosate 0.75 to 2.25 lb/A	Most grass and broadleaf weed species	Preharvest treatment: Apply at 35% moisture or less (black layer). Allow a minimum of 7 days between application and harvest. Do not treat corn grown for seed because reductions in germination or vigor may occur.

Grain sorghum

Guide to weed response to herbicides

Herbicide	Barnyardgrass	Broadleaf signalgrass	Crabgrass	Fall panicum	Foxtail, giant	Goosegrass	Seedling johnsongrass	Rhizome johnsongrass	Red rice	Shattercane	Yellow nutsedge	Eastern black nightshade	Cocklebur	Jimsonweed	Common lambsquarters	Entire/Ivyleaf morningglroy	Pitted morningglory	Redroot and smooth pigweed	Prickly sida	Common ragweed	Giant ragweed/horseweed	Annual smartweed spp.	Sunflower	Velvetleaf	Tall waterhemp	Crop response***
Preplant incorporated or preemergence																										
Atrazine	8	6	5	3	7	6	2	0	8	0	0	9	9	10	9	9	10	10	9	9	8	9	7	8	10	1
Dual II Magnum/Cinch	8	7	9	9	9	9	6	0	9	5	8	9	0	4	6	2	2	9	3	5	3	5	0	2	9	1**
Intro/Lasso/Micro-Tech	8	7	9	9	9	9	6	0	8	5	7	9	0	4	6	2	2	9	4	5	3	5	0	2	9	1**
Outlook	8	7	9	9	9	9	6	0	9	4	8	8	2	4	7	2	2	9	0	5	2	4	0	2	9	1**
Preemergence																										
Lexar EZ	8	8	9	9	9	8	6	0	9	5	7	9	8	9	9	7	7	9	8	8	6	9	6	9	9	2
Lumax EZ	8	8	8	8	9	8	6	0	9	5	7	9	8	9	9	7	7	9	8	8	6	9	6	9	9	2
Sharpen	0	0	0	0	0	0	0	0	0	0	-	8	9	8	8	9	9	8	8	9	9	9	9	9	8	1
Postplant incorporated																										
Treflan	8	-	8	7	8	8	7	0	-	7	0	0	0	0	8	0	0	8	-	0	0	3	0	0	7	1
Paramount	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prowl/others	9	-	9	8	9	9	7	0	-	7	0	0	0	0	7	0	0	8	-	0	0	3	0	0	7	1
Postemergence																										
Aim	2	1	2	3	3	-	2	1	1	1	-	10	6	9	9	7	7	9	7	7	6	9	7	9	8	1
Atrazine + oil	8	7	7	5	7	6	3	0	10	2	6	9	9	10	10	9	9	10	9	9	8	9	9	9	10	1
Banvel/Clarity	0	0	0	0	0	0	0	0	0	0	0	9	9	9	9	9	10	9	8	10	9	9	9	9	8	1
Basagran	0	0	0	0	0	0	0	0	0	0	7	2	9	9	6	5	7	4	8	8	8	9	8	8	3	0
Buctril	0	0	0	0	0	0	0	0	0	0	0	9	9	10	9	8	8	7	4	9	9	9	8	8	6	1
Paramount	7	-	2	4	7	-	-	-	-	2	2	5	5	-	5	-	-	5	-	5	-	5	-	-	5	1
Peak	0	0	0	0	0	0	0	0	0	0	0	-	8	8	7	8	8	9	8	7	8	8	9	8	5	1
Permit	0	0	0	0	0	0	0	0	0	0	9	6	9	8	6	6	6	9	7	8	8	7	9	9	5	0
Starane	0	0	0	0	0	0	0	0	0	0	0	7	9	-	-	9	9	8	-	9	-	-	9	9	8	1
2,4-D	0	0	0	0	0	0	0	0	0	0	0	7	9	8	9	9	10	9	8	9	8	7	9	8	8	1
Post directed																										
Linex	7	-	8	8	8	-	7	0	6	-	-	-	8	-	9	8	8	9	9	8	-	8	-	9	-	1
Gramoxone SL2	9	9	9	8	8	8	8	0	9	6	3	-	4	7	9	5	4	9	4	8	-	5	-	6	-	1

Weed control: 8 to 10 = Good 6 to 7 = Fair*** Less than 6 = Poor - = No data available

*Shallow incorporation needed for this level of control.
**Treated seed.
***A weed control rating of 6 to 7 indicates partial control or suppression.

Due to the overwhelming number of package mixes and tank mixes, it has become impractical to list and distinguish these combinations. In the interest of fairness, we are therefore listing no package mixes in this table. A reasonably accurate estimate may be obtained by combining the control ratings from the individual package or tank-mix component

Grain sorghum

Soil-applied herbicide rates for grain sorghum

Herbicide	Soil texture*		
	Coarse (light, sandy)	Medium (loamy)	Fine (heavy, clay)
	----------(Rate per acre)----------		
Atrazine 4L	DO NOT USE	3.2 to 4 pt	4.0 to 4.75 pt
AAtrex Nine-0	DO NOT USE	1.7 to 2.2 lb	2.2 to 2.6 lb
Bicep II Magnum/Cinch ATZ	DO NOT USE	1.6 to 2.1 qt	1.6 to 2.1 qt
Bicep Lite II Magnum/Cinch Lite	DO NOT USE	1.1 to 1.5 qt	1.1 to 1.5 qt
Dual II Magnum/Cinch	1 to 1.33 pt	1.33 to 1.5 pt	1.33 to 1.67 pt
Guardsman Max	2.4 to 3 pt	3 to 4 pt	4 to 4.6 pt
G-Max Lite	2 to 3 pt	2.5 to 3.5 pt	2.5 to 3.5 pt
Intrro/Lasso/Microtech	1.5 to 2.5 qt	2 to 2.75 qt	2 to 3 qt
Lariat/Bullet	2.5 to 2.75 qt	2.75 to 3.75 qt	3 to 4 qt
Lexar EZ	DO NOT USE	3 qt	3 qt
Lumax EZ	DO NOT USE	2.5 qt	2.5 qt
Outlook	12 to 18 fl oz	14 to 21 fl oz	14 to 21 fl oz
Paramount 75DF	5.3 to 8 oz	5.3 to 8 oz	5.3 to 8 oz
Partner	2.3 to 3.8	3.1 to 4.2	3.1 to 4.6
Prowl 3.3E/others	DO NOT USE	1.8 pt	2.4 pt
Sharpen	1 to 2 oz	1 to 2 oz	1 to 2 oz

*Refer to herbicide labels for proper rates for your soil texture and organic matter content and for tank mixes.

Grain sorghum, Burndown

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Labeled tank-mix partners	Application method and precautions
The following preemergence grain sorghum herbicides may be used for burndown: Atrazine, Bicep, Guardsman, Marksman, Ramrod/Atrazine. Application information is listed in the preemergence herbicide section. In most cases, a broad-spectrum, foliar burndown herbicide such as Roundup or Gramoxone should be tank mixed with the preemergence herbicide; however if grass pressure is light and broadleaf weeds are small, the addition of crop oil to an atrazine-containing product may be sufficient.				
Aim 2E + Nonionic surfactant	0.25 to 2 fl oz/A + 2 pt/100 gal	carfentrazone 0.004 to 0.031 lb/A	No restrictions listed.	Should be applied with a broad-spectrum burndown herbicide.
Clarity 4L	8 oz/A	dicamba 0.25 lg/A		Do not apply within 15 days of planting.
Gramoxone SL2 + Nonionic surfactant or Crop oil concentrate	2 to 4 pt/A + 1 to 2 pt/100 gal or 1 gal/100 gal	paraquat 0.7 to 1.4 lb/A	atrazine, Bicep, Dual, Lasso, Lariat	May be applied early preplant (EPP) through planting, but before crop emergence. See label directions for specific rates, weed stages, and tank-mix instructions. Rate should normally be at least 1.67 pt/A
Roundup brands/ Touchdown brands/ other glyphosates 3L or Roundup WeatherMax 4.5L or Roundup PowerMax 4.5L + Recommended additives	1 to 3 pt/A or 11 to 32 fl oz/A or 11 to 32 fl oz./A + See label	glyphosate 0.38 to 1.12 lb/A	atrazine, Bicep, Dual, Lasso, Lariat	May be applied early preplant (EPP) through planting, but before crop emergence. See label directions for specific rates, weed stages, and tank-mix instructions.
Sharpen + Methylated seed oil + Ammonium sulfate or Urea ammonium nitrate	2 to 3 oz/A + 1 gal/100 gal + 8.5 to 17 lb/100 gal or 1.25–2.5 gal/100 gal	saflufenacil 0.04 to 0.06 lb/A	atrazine, Bicep, Glyphosate	Do not apply after grain sorghum has emerged. If spray volume is 12 GPA or less, use methylated seed oil at 1 pt/A.
Starane	0.66 pt/A	fluroxypyr 0.12 lb/A	atrazine	For burndown applications, apply after planting, but before grain sorghum emergence.
Valor 51 WDG + Nonionic surfactant (80%)	2 to 2.5 oz/A + 1 qt/100 gal	flumioxazin 0.064 to 0.08 lb/A	Roundup, Gramoxone	**Do not apply within 30 days of planting.**
2,4-D LV ester (4 lb/gal formulation)	1 to 3 pt/A	2,4-D 0.5 to 1.5 lb/A	atrazine, Lariat, Lasso	

Grain sorghum, Burndown - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Labeled tank-mix partners	Application method and precautions
Package mixes - Preplant incorporated or preemergence				
Lexar EZ + Crop oil concentrate	3 qt/A + 1 gal/100/gal	mesotrione at 0.1659 lb ai + atrazine 1.3 lb ai + *S*-metolachlor 1.3 lb ai	Touchdown/glyphosate + Gramoxone	Lexar can be applied preplant non-incorporated from 7 to 21 days before planting. Applying Lexar less than 7 days before sorghum planting will increase the risk of crop injury. Use sorghum seed treated with Concep III. Do not apply to sandy soils: (sand, sandy loam, or loamy sand). Do not apply to emerged grain sorghum. Do not use on forage sorghum, sweet sorghum, sudangrass, or any dual-purpose sorghum.
Lumax EZ + Crop oil concentrate	2.5 qt + 1 gal/100 gal	mesotrione at 0.1675 lb ai + atrazine 0.63 lb ai + *S*-metolachlor 1.68 lb ai	Touchdown/glyphosate + Gramoxone	Lumax can be applied preplant non-incorporated from 7 to 21 days before planting. Applying Lumax less than 7 days before sorghum planting will increase the risk of crop injury. Use sorghum seed treated with Concep III. Do not apply to sandy soils: (sand, sandy loam, or loamy sand). Do not apply to emerged grain sorghum. Do not use on forage sorghum, sweet sorghum, sudangrass, or any dual-purpose sorghum.
Expert 4.9L	2.5 to 3.75 qts/A	glyphosate + *S*-metolachlor + atrazine 0.6 + 1 + 1.33 to 0.9 + 1.63 +2 lb/A	Glyphosate, Touchdown	USE SAFENED SEED.
Sequence 5.25L + Ammonium sulfate	2 to 4 pt/A + 8.5 to 17 lb/A	glyphosate + *S*-metolachlor 0.5 + 0.75 to 1.1 + 1.5 lb/A	atrazine, Bicep, Dual, Banvel, Claity, Touchdown	USE SAFENED SEED.

Fall and early preplant applications of preemergence herbicides for reduced tillage

Many preemergence herbicides may be used two or more weeks before planting in an early preplant (EPP) application. Advantages include: Early preplant applications will prevent weed emergence and aid or eliminate a formal burndown application. They may limit weed growth if weather moderately delays planting. Some preemergence herbicides have significant postemergence, burndown activity (adjuvants are sometimes required). Some preemergence herbicides increase the activity or spectrum of burndown herbicides. Finally, combining a preemergence herbicide with a burndown herbicide may simply save time and costs by eliminating a second trip for the traditional preemergence, after-planting application.

Several herbicides are registered for fall application. A fall herbicide application may be beneficial if it eliminates the need for a burndown application in the spring and soil erosion is not a problem. Fall applications could also benefit drying of the soil in the spring and could reduce the need for tillage before planting.

There are many choices and an option that works well in one field may work poorly in another. For most situations we recommend that growers target early preplant applications 15 days or less before planting. The sooner a herbicide is applied, the sooner it will break down and loose effectiveness. If rain delays planting too long, most advantages of extra-early preplant applications may be lost. Also, after 30 days, there is a much higher probability that a burndown application will be needed and most labels specify that additional preemergence herbicide be applied at planting. Finally, exceptionally long (>30 day) preplant intervals remove winter vegetation and leave the soil vulnerable to erosion and may increase the probability of herbicide contamination of ground and surface water.

Early preplant (EPP) labels for grain sorghum herbicides

		Label allows preplant application		
Herbicide	**Burndown activity**	**45 days**	**30 days**	**15 days**
Atrazine	Yes	Yes*	Yes*	Yes
Bicep II/Magnum/Bicep Lite II/Magnum/Cinch	Yes	Yes*	Yes*	Yes
Dual II/ Magnum/Cinch	No	Yes*	Yes*	Yes
Guardsman Max	Yes	Yes*	Yes*	Yes
G-Max Lite	Yes	Yes*	Yes*	Yes
Lariat/Bullet	Yes	Yes*	Yes*	Yes
Lexar EZ	Yes	No	No	Yes
Lumax EZ	Yes	No	No	Yes
Intrro/Lasso/Microtech	No	Yes*	Yes*	Yes
Outlook	No	Yes*	Yes*	Yes
Sharpen	Yes	Yes	Yes	Yes

*Label recommends reapplication at the time of planting (Typically 2/3 applied EPP and 1/3 preeemergence at planting)
**EPP intervals greater than 15 days are not recommended on coarse-textured (light, sandy) soils.

Grain sorghum, Preplant, preplant incorporated or preemergence

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Labeled tank-mix partners	Application method and precautions
Preplant incorporated or preemergence				
Atrazine, 4L or Aatrex Nine-0	3.2 to 4 pt or 1.7 to 2.2 lb/A	atrazine 1.6 to 2 lb/A	Bicep, Dual, Lariat, Lasso	Do not use on coarse (light, sandy) soils. Do not use on medium (loam) or fine (heavy, clay) soils with less than 1% organic matter.
Dual II Magnum 7.64E/Cinch	1 to 1.67 pt/A	s-metolachlor 1 to 1.6 lb/A	Atrazine, Bicep	USE SAFENED SEED.
IntRRo 4L or Lasso 4EC or Microtech 4L or Partner 65DG	1.5 to 3 qt/A or 1.5 to 3 qt/A or 1.5 to 3 qt/A or 2.3 to 4.5 lb/A	alachlor 1.5 to 3 lb/A	Atrazine, Lariat	USE SAFENED SEED. Preplant treatment should be shallow incorporated. Use higher recommended rate if shallow incorporated.
Lexar EZ	3 qt/A	mesotrione at 0.1659 lb ai + atrazine 1.3 lb ai + s-metoachlor 1.3 lb ai	Touchdown/glyphosate + Gramoxone	Lexar can be applied preplant non-incorporated from 7 to 21 days before planting. Applying Lexar less than 7 days before sorghum planting will increase the risk of crop injury. Use sorchum seed treated with Concep III Do not apply to sandy soils: (sand, sandy loam, or loamy sand). Do not apply to emerged grain sorghum. Do not use on forage sorghum, sweet sorghum, sudangrass, or any dual-purpose sorghum.
Lumax EZ	2.5 qt/A	mesotrione at 0.1675 lb ai + atrazine 0.63 lb ai + s-metoachlor 1.68 lb ai.	Touchdown/glyphosate + Gramoxone	Lumax can be applied preplant non-incorporated from 7 to 21 days before planting. Applying Lumax less than 7 days before sorghum planting will increase the risk of crop injury. Use sorchum seed treated with Concep III Do not apply to sandy soils: (sand, sandy loam, or loamy sand). Do not apply to emerged grain sorghum. Do not use on forage sorghum, sweet sorghum, sudangrass, or any dual-purpose sorghum.
Paramount 75DF	5.3 to 8 oz/A	quinclorac 0.25 to 0.38 lb/A	Atrazine, Clarity, Roundup, 2,4-D	
Package mixes - Preplant incorporated or preemergence				
Bicep II Magnum 5.5L or Cinch ATZ	1.6 to 2.1 qt/A	atrazine + s-metolachlor 1.24 + 0.96 to 1.63 + 1.26 lb/A	Atrazine, Dual	USE SAFENED SEED. Do not use on coarse (light, sandy) soils. Do not use on medium (loam) soils with less than 1.5% organic matter.
Bicep Lite II Magnum 6L or Cinch Lite ATZ	1.1 to 1.5 qt/A	s-metolachlor + atrazine 0.92 + 0.73 to 1.25 + 1 lb/A	Atrazine, Dual	USE SAFENED SEED. Do not use on coarse (light, sandy) soils. Do not use on medium (loam) soils with less than 1.5% organic matter.

Grain sorghum, Preplant, preplant incorporated or preemergence - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Labeled tank-mix partners	Application method and precautions
Guardsman Max	2.4 to 4.6 pt/A	atrazine+dimethanamid-P 0.99 + 0.51 to 1.9 + 0.98 lb/A	Atrazine, Gramoxone, Glyphosate	USE SAFENED SEED.
G-Max Lite	2 to 3.5 pt/A	atrazine+dimethanamid-P 0.7 + 0.5 to 1.2 + 0.98 lb/A	Atrazine, Banvel, Basagran, Clarity, Gramoxone, Glyphosate, Marksman, Outlook, Prowl	USE SAFENED SEED.
Lariat 4F/Bullet	2.5 to 4 qt/A	alachlor + atrazine 1.6 + 0.9 to 2.5 + 1.5 lb/A	Atrazine, Lasso	USE SAFENED SEED. Use lower rates for coarse (light, sandy) soils and higher rates for heavy (fine, clay) soils. Do not use on coarse soils with less than 3% organic matter. Atrazine and/or Lasso may be added to Lariat to improve weed control in heavy infestations or for hard-to-control weeds.
Preemergence only				
Linex 4L	0.625 to 2 pt/A	linuron 0.3 to 1 lb/A		Consult label for specific rates according to soil type. Apply after planting but before crop emergence.
Early postemergence incorporated				
Prowl 3.3EC/others	1.8 to 2.4 pt/A	pendimethalin 0.74 to 1.0 lb/A		BOOTHEEL COUNTIES ONLY. Cultivation with sweeps or a rolling cultivator is required before and after application. Do not use on coarse (light, sandy) soils. Apply after grain sorghum is more than 4 inches tall until last (layby) cultivation.
Prowl H2O 3.8ACS	2 pts/A	pendimethalin 0.74 to 1.0 lb/A		BOOTHEEL COUNTIES ONLY. Cultivation with sweeps or a rolling cultivator set to provide thorough incorporation in the top 1 inch of soil. Do not use on coarse (light, sandy) soils. Apply after grain sorghum is more than 4 inches tall until last (layby) cultivation.
Treflan 4EC/ others	0.75 to 2 pt/A	trifluralin 0.38 to 1 lb/A		Cultivation with sweeps or a rolling cultivator is required before and after application. Apply after grain sorghum is more than 8 inches tall.

Grain sorghum, Postemergence and directed

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Labeled tank-mix partners	Application method and precautions
Aim 2E + Nonionic surfactant	0.5 fl oz/A + 2 pt/100 gal	carfentrazone 0.008 lb/A	Atrazine, Banvel, Clarity, Laddok, Peak, Permit	Do not use crop oil concentrate. Leaf speckling is likely. Weeds must be 4 inches or less for adequate control.
Atrazine 4L or AAtrex Nine-0 + Crop oil concentrate (optional)	2 qt/A or 2.2 lb/A	atrazine 2 lb/A	Basagran, Buctril, Laddok	See label precautions for the use of crop oil concentrate. Apply after grain sorghum reaches three-leaf stage but before the 12-inch stage. Apply before weeds exceed 1.5 inches tall. Do not use on sand or loamy sand.
Banvel/Clarity (4 lb/gal formulation)	0.5 pt	dicamba 0.25 lb/A	None	Apply before sorghum is more than 15 inches tall. From 8 to 15 inches, use only directed applications with drop pipes. Apply to weeds less than 3 inches tall for best performance.
Basagran 4S	1.5 to 2 pt/A	bentazon 0.75 to 1 lb/A	None	Apply when weeds are small. May be applied up to and including early boot stage. Add 1 qt/A oil concentrate for use on yellow nutsedge and other hard-to-control weeds listed on the label.

Grain sorghum, Postemergence and directed - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Labeled tank-mix partners	Application method and precautions
Buctril 2E or Buctril 4 lb/gal	1 to 1.5 pt/A or 0.5 to 0.75 pt/A	bromoxynil 0.25 to 0.38 lb/A	Atrazine	See label for specific rates and weed stages for application. Do not spray when grain sorghum foliage is wet. Application may be made from the three-leaf stage of sorghum up to 14 inches tall.
Paramount 75DF + Crop oil concentrate + Urea ammonium nitrate or ammonium sulfate (optional)	5.3 to 8 oz/A + 1 gal/100 gal + 0.5 to 10 gal/100 gal or 2.5 lb/A	quinclorac 0.25 to 0.38 lb/A	Atrazine, Clarity, Peak, 2,4-D	Apply to grain sorghum up to 12 inches tall. For best annual grass control apply with 0.5 to 1 lb/A atrazine when weeds are less than 2 inches tall. Do not tank mix with fungicides, insecticides or fertilizers.
Peak 57DG + Nonionic surfactant (80%) or Crop oil concentrate + Urea ammonium nitrate or ammonim sulfate (optional)	0.5 to 1 oz/A (1 pkt/ 6 to 3 A) + 1 gal/100 gal or 4 gal/100 gal + 1 gal or 2 lb/A	prosulfuron 0.018 to 0.036 lb/A	Atrazine, Banvel, Buctril, Marksman, 2,4-D	Apply to actively growing weeds when sorghum is 5 to 30 inches tall.
Permit 75 DF + Nonionic surfactant (80%) or Crop oil concentrate + Urea ammonium nitrate or ammonium sulfate (optional)	0.67 to 1.33 oz/A + 1 to 2 qt/A or 1 gal/ 100 gal + 4 gal/100 gal or 2 to 4 lb/A	halosulfuron 0.032 to 0.047 lb/A	Atrazine	Do not cultivate for 7 days following application. Do not apply to sorghum treated with an organophosphate insecticide.
Starane	0.66 pt/A	fluroxypyr 0.12 lb/A	Atrazine	May be applied from the 3-leaf growth stage through the 7-leaf stage. Use drop nozzles and directed spray from the 8-leaf stage to the boot stage.
2,4-D amine (4 lb/gal formulation)	1 pt/A	2,4-D 0.5 lb/A	None	Treat only after grain sorghum is over 6 inches tall and before it is 15 inches tall. If crop is over 8 inches tall, use drop nozzles to keep spray off leaves.
2,4-D LV ester	0.5 pt/A	2,4-D 0.25 lb/A	None	Treat only after grain sorghum is more than 5 inches tall and before it is 15 inches tall. If crop is more than 8 inches tall, use drop nozzles to keep spray off of leaves.
Package mixes: Postemergence overtop				
Buctril/ Atrazine 3F	1.5 to 3 pt/A	bromoxynil + atrazine 0.19 + 0.38 to 0.38 + 0.75 lb/A	Buctril, atrazine	See label for specific rates, crop and weed stages for application. Buctril and/or atrazine may be added to the package mix to improve control in heavy infestations or for hard-to-control weeds. Application may be made from the 2-leaf stage (0.19 lb Buctril rate), the 3-leaf stage (0.25 lb rate) or the 4-leaf stage (0.38 lb rate) of sorghum up to 10 inches tall.
Laddok S-12 5L + Crop oil concentrate or 28% urea ammonium nitrate	2 to 3.5 pt/A + 1 qt/A or 2 to 4 qt/A	bentazon + atrazine 0.52 + 0.52 0.73 + 0.73 lb/A	None	Apply when weeds are small. May be applied up to and including early boot stage. Use higher rates for yellow nutsedge and other hard-to-control weeds listed on the label.
Shotgun 3.25L	2 pt/A	atrazine + 2,4-D 0.56 + 0.25 lb/A	Atrazine, Banvel, Buctril	Apply to actively growing weeds. Apply over the top from spike- to 8-inch (4-leaf) growth stages and in a directed spray from 8-inch to 12-inch growth stages.

Grain sorghum, Postemergence and directed - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Labeled tank-mix partners	Application method and precautions
Yukon 67.5 DF + Nonionic surfactant or Crop oil concentrate + Urea ammonium nitrate or ammonium sulfate (optional)	4 to 6 oz/A + 2 to 4 pt/100 gal or 1 gal/100 gal + 2 to 4 qt/A or 2 to 4 lb/A	dicamba + halosulfuron 0.14 + 0.03 to 0.21 + 0.045 lb/A	Atrazine, Bullet, Partner	Apply over the top to grain sorghum from 2 leaf through 8 inches and with drop nozzles until 15 inches tall.
Postemergence directed				
Linex 4L or Lorox 50DF + Surfactant	1 to 2 pt/A or 1 to 2 lb/A + 2 qt/100 gal	linuron 0.5 to 1 lb/A	None	Keep spray off all but the lower 3 inches of grain sorghum plants. See label directions for application methods, equipment and proper crop and weed heights for application.
Gramoxone Inteon + Nonionic surfactant	1 to 2 pt/A + 8 oz/100 gal	paraquat 0.34 to 0.7 lb/A	None	Apply after grain sorghum is more than 12 inches tall, but before weeds are more than 3 inches tall. Keep spray off all but the lower 3 inches of grain sorghum plants.

Grain sorghum, Special problems

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Weeds controlled	Application method and precautions
Johnsongrass control				
Roundup brands/Other glyphosates 3L or Roundup WeatherMax 4.5L or Roundup PowerMax 4.5L + Recommended additives	1 to 3 pt/A or 11 to 32 fl oz/A or 11 to 32 fl oz./A + See label	glyphosate 2% solution	Johnsongrass (seedling and rhizome), shattercane and many annual and perennial grass and broadleaf weeds.	Cover foliage thoroughly. Sorghum plants in treated area will be severely injured or killed.
Roundup brands/Other glyphosates 3L or Roundup WeatherMax 4.5L or Roundup PowerMax 4.5L + Recommended additives	33% solution + See label	glyphosate 1 gal + 2 gal water	Johnsongrass (rhizome), shattercane and many annual and perennial grass and broadleaf weeds.	
Perennial vine control				
Note: Consider using a tank mixture of two or more of the listed herbicides for optimal perennial vine control.				
2,4-D amine (4 lb/gal formulation) or 2,4-D LV ester (4 lb/gal formulation)	1.5 to 2 pt or 0.75 to 1 pt/A	2,4-D 0.75 to 1 lb or 0.38 to 0.5 lb/A	Annual morningglories and suppression of vines such as honeyvine milkweed, field bindweed, trumpetcreeper, and redvine.	These rates are more likely to cause some crop injury than the lower rates in the "post-emergence" section. Treat only after grain sorghum is more than 6 inches tall and before it is 15 inches tall. If crop is more than 8 inches tall, use drop nozzles to keep spray off of grain sorghum leaves.

Grain sorghum, Special problems - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Weeds controlled	Application method and precautions
Banvel (4 lb/gal formulation)	2 to 4 pt/A	dicamba 1 to 2 lb/A	Field bindweed, trumpetcreeper, redvine and many other problem broadleaf weeds.	Between cropping application: Apply as a broadcast or spot treatment to emerged and actively growing weeds after crop harvest but before a killing frost. Majority of weeds should be 8 inches or taller. Avoid disturbing treated areas for at least 7 days. Rates depend on type and density of weeds. Corn, grain sorghum or soybeans may be planted in the spring following application. Wheat may be planted in the fall, but planting must be delayed 45 days for each pint of Banvel applied.
Roundup Brands/Other glyphosates 3L or Roundup WeatherMax 4.5L or Roundup PowerMax 4.5L + Recommended additives	2 to 4 pt/A or 21 to 42 fl oz/A or 26 to 52 fl oz./A + See label	glyphosate 0.75 to 1.5 lb/A	Field bindweed and other problem grass and broadleaf weeds.	Between cropping applications: Apply as a broadcast or spot treatment to emerged and actively growing weeds, after crop harvest but before a killing frost. Majority of weeds should be 8 inches or taller. Avoid disturbing treated areas for 14 days. See labels for rates on type and density of weeds present. Wheat may be planted in the fall, but planting must be delayed 45 days for each pint of Banvel applied. Corn, sorghum and soybeans may be planted in the spring following application.
Hooded sprayer application				
Gramoxone SL2 + Nonionic surfactant (80%) or Crop oil concentrate	1 to 2 pt/A + 1 to 2 pt/100 gal or 1 gal/100 gal	paraquat 0.34 to 0.7 lb/A		Gramoxone drift is injurious to grain sorghum. May be applied with a postemergence directed sprayer when corn is 12 inches or taller.
Roundup Brands/Other glyphosates 3L or Roundup WeatherMax 4.5L or Roundup PowerMax 4.5L + Recommended additives	1 to 2 pt/A or 11 to 21 fl oz/A or 13 to 26 fl oz./A + See label	glyphosate 0.375 to 0.75 lb/A	Grass and broadleaf weeds in row middles.	See label for hood specifications and application directions. Avoid drift. Roundup drift is extremely injurious to grain sorghum. Weeds in the drill will not be controlled.
Harvest aid				
Reglone 2L	1.5 to 2 pt/A	diquat, 0.38 to 0.5 lb/A	Desiccation of green weed foliage.	Make applications at 30% grain moisture or less. Apply 1 to 2 weeks before harvest. Do not use seed from treated plants for food, feed or oil purposes.
Roundup Brands/Other glyphosates 3L or Roundup WeatherMax 4.5L or Roundup PowerMax 4.5L + Recommended additives	2 to 4 pt/A or 21 to 42 fl oz/A or 26 to 52 fl oz./A + See label	glyphosate 0.75 to 1.5 lb/A	Most grass and broadleaf weeds	Make applications at 30% grain moisture and at least 7 days prior to harvest. Do not apply to grain sorghum grown for seed.

Soybean: Guide to grass and sedge weed response to herbicides

Herbicide	Barnyardgrass	Broadleaf signalgrass	Crabgrass	Fall panicum	Foxtail, giant	Goosegrass	Johnsongrass, seedling	Johnsongrass, rhizome	Shattercane	Volunteer corn***	Volunteer wheat	Woolly cupgrass	Yellow nutsedge	Crop response**
Preplant incorporated														
Sonalan	9	9	9	9	10	9	8	3	9	7	6	8	0	1
Treflan/others	9	9	9	9	10	9	9	3	9	7	6	9	0	0
Preplant or Preemergence														
Authority Assist	6	5	6	6	7	5	6	4	7	4	3	5	7	1
Authority First/Sonic	2	0	2	2	2	-	0	0	1	1	-	1	8	1
Authority MTZ	5	-	4	4	4	4	2	0	1	1	-	-	6	2
Boundary	8	5	9	8	8	8	5	1	4	1	-	4	6	1
Canopy DF	1	2	1	3	4	2	1	0	0	1	-	0	2	2
Canopy EX	1	-	3	2	4	2	1	0	0	0	-	0	4	2
Command	9	9	9	9	10	9	9	2	6	4	8	8	-	0
Define	9	8	9	8	9	8	5	1	4	0	3	5	6	0
Dual II Magnum/Cinch	8	7	9	9	9	9	6	0	5	0	3	7	8	0
Envive	4	2	3	3	5	2	1	0	0	1	-	0	5	2
Fierce 76WDG	9	-	9	8	9	-	3	0	3	-	-	-	2	2
FirstRate	4	-	5	-	3	-	2	0	0	-	-	-	7	0
Gangster	1	2	3	3	3	1	1	0	0	1	-	1	2	1
Intrro/Lasso/Micro-Tech	8	7	9	9	9	9	6	0	5	0	3	7	7	0
OpTill	6	5	4	5	7	5	6	2	6	4	2	3	5	2
OpTill PRO	8	6	9	8	8	8	8	2	7	4	2	5	6	2
Outlook	8	-	9	9	9	-	-	0	5	0	3	7	7	0
Prefix	8	6	8	7	8	6	5	1	2	4	-	4	6	1
Prowl H_2O	9	9	9	9	10	9	9	3	8	7	6	9	0	0
Pursuit	6	-	7	6	7	-	-	4	6	4	-	5	3	1
Python	6	6	6	7	6	-	7	-	6	0	6	-	-	1
Scepter	6	6	6	6	6	6	6	2	-	-	-	-	4	1
Sencor	6	6	6	6	6	6	5	0	1	2	-	-	2	2
Sharpen	6	5	4	5	7	5	6	2	6	1	2	3	5	2
Spartan	-	-	-	6	6	-	-	-	-	-	-	-	9	2
Synchrony XP	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Lorox/Linex	6	6	6	6	6	6	4	0	0	0	-	-	0	1
Prowl H_2O	9	-	8	8	9	9	7	0	6	6	5	8	0	2
Valor	2	-	2	-	2	-	-	-	-	-	-	-	-	2
Valor XLT	4	2	4	4	4	2	1	0	0	1	-	0	5	2
Warrant	8	-	9	8	9	9	6	0	5	0	3	-	7	1
Postemergence overtop														
Assure II	8	9	9	9	10	9	10	9	8	9	9	9	0	0
Basagran	0	0	0	0	0	0	0	0	0	0	0	0	7	0
Cadet	1	1	1	1	1	1	1	1	1	1	1	1	1	2
Classic	0	0	0	0	0	0	0	0	0	0	-	0	7	1
Cobra/Phoenix	0	0	0	0	0	0	0	0	0	2	4	-	2	2
FirstRate/Amplify	3	-	4	-	5	-	6	-	5	2	-	-	7	0
Flexstar/Reflex	0	0	0	0	0	0	0	0	3	2	3	-	3	1
Fusilade DX	8	8	8	8	9	9	10	9	10	9	9	9	0	0
Glyphosate (Roundup Ready only)	10	10	10	10	10	10	10	9	10	0	10	9	7	0
Harmony GT XP/Unity	0	0	0	0	0	0	0	0	0	0	0	-	0	2
Ignite (Libery Link only)	8	8	7	7	8	7	8	6	8	6	-	7	5	1
Poast Plus	9	10	9	9	10	9	10	8	9	8	7	9	0	0
Pursuit	7	7	7	7	8	5	6	4	9	4	3	5	4	1
Raptor	7	7	7	8	9	5	8	6	9	7	6	5	5	1
Resource	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Scepter	1	1	3	3	3	0	6	0	5	4	-	-	3	1
Select/Select Max	9	9	9	9	9	9	10	9	8	9	9	9	0	0
Ultra Blazer	0	0	0	0	0	0	0	0	0	2	3	-	2	1
Postemergence directed														
Authority XL	3	-	3	2	4	3	3	0	-	1	1	-	9	2
Gramoxone SL2	9	9	9	8	8	8	8	0	6	6	6	-	3	2
Lorox	7	7	8	7	7	7	7	0	-	-	-	-	2	2
2,4-DB	0	0	0	0	0	0	0	0	0	0	0	0	0	2

Weed control: 8 to 10 = Good 6 to 7 = Fair* Less than 6 = Poor - = No data available

*A weed control rating of 6 to 7 indicates partial control or suppression.

**Crop response: A rating of 3 or less will not result in loss of crop yield under normal growing conditions.

***Indicates volunteer Roundup Ready© corn.

Use this table and the one on the next page as a guide for comparing the relative effectiveness of herbicides on individual weeds. Herbicides may perform better or worse than indicated due to extreme weather conditions and other variables.

Soybean: Guide to broadleaf weed response to herbicides

Herbicide	Black nightshade	Carpetweed	Cocklebur	Hophornbeam copperleaf	Jimsonweed	Lambsquarters	Morningglory, annual	Pigweed, smooth/ redroot	Palmer amaranth	Prickly sida	Ragweed, common	Ragweed, giant	Smartweed, annual	Spurred anoda	Sunflower	Velvetleaf	Waterhemp
Preplant incorporated																	
Sonalan	6	10	0	-	3	9	3	10	8	0	3	0	3	-	0	4	8
Treflan/others	0	10	0	0	3	9	3	10	8	0	3	0	3	0	0	3	8
Preplant or preemergence																	
Authority Assist	8	-	8	8	8	9	7	9	8	7	8	7	8	6	8	8	8
Authority First/Sonic	8	-	8	8	8	9	6	9	8	7	9	7	8	4	7	8	8
Authority MTZ	8	9	7	8	6	9	7	9	8	7	8	7	9	8	8	7	8
Authority XL	9	9	8	9	9	9	8	9	9	8	9	7	9	-	8	8	9
Boundary	8	9	6	5	7	9	4	9	8	6	8	6	8	9	8	7	8
Canopy DF	4	9	8	-	9	9	8	8	6	-	9	7	9	8	8	8	6
Canopy EX	4	-	8	-	9	9	8	7	6	6	8	7	9	-	8	8	4
Command	5	0	6	3	9	9	0	5	3	9	8	3	7	8	3	10	4
Define	6	-	2	3	3	5	4	9	9	3	7	2	3	0	0	2	9
Dual II Magnum/Cinch	9	9	2	5	4	6	2	9	9	4	5	3	5	0	0	2	9
Envive	9	9	8	-	9	9	8	8	8	8	9	7	9	9	8	8	8
Fierce	9	9	4	9	9	9	8	9	9	8	7	5	-	9	4	9	9
FirstRate	-	-	9	-	9	7	8	7	5	6	9	9	-	-	9	7	5
Gangster	9	9	8	9	9	9	8	9	8	8	9	8	9	9	9	8	8
Intrro/Lasso/Micro-Tech	9	9	0	5	4	6	0	9	8	4	5	3	5	0	0	2	8
OpTill	6	9	7	8	-	9	7	8	8	7	7	6	9	6	7	7	8
OpTill PRO	9	9	7	8	-	9	7	9	9	7	7	7	9	8	7	7	9
Outlook	8	-	2	-	4	7	2	9	8	0	5	2	4	-	0	2	8
Prefix	8	9	6	-	-	6	4	9	8	4	8	6	8	-	6	6	8
Prowl H_2O	0	10	0	0	3	9	3	9	8	0	3	0	3	0	0	3	8
Pursuit	9	-	6	-	7	8	7	8	5	-	7	6	9	-	7	8	5
Python	-	-	8	-	9	9	7	9	7	9	7	7	8	9	7	9	7
Scepter	8*	9	9	4	8	9	5	9	5	9	9	7	9	7	9	7*	5
Sencor	5	9	7	9	7	8	2	9	8	9	9	6	9	9	7	8	8
Sharpen	8	-	8	-	8	0	7	6	6	8	9	9	9	-	8	9	6
Spartan	8	-	3	6	6	9	8	8	9	-	4	3	2	-	4	6	9
Lorox/Linex	4	9	6	-	-	9	4	8	8	8	8	5	7	-	5	6	8
Prowl/others PRE	0	-	0	0	0	7	0	9	7	-	0	0	3	0	0	2	7
Valor	9	9	2	9	9	9	8	9	8	8	8	7	7	-	2	7	9
Valor XLT	9	9	8	9	9	9	8	9	8	8	9	7	9	9	8	8	8
Warrant	8	-	2	5	-	8	2	9	9	4	5	3	5	0	0	2	9
Postemergence overtop																	
Aim	9	-	6	-	-	8	7	9	6	6	-	-	-	-	-	9	6
Assure II	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Basagran	2	0	9	0	9	6	5	4	3	8	8	7	9	8	8	8**	3
Cadet	2	-	2	4	8	7	6	5	4	5	4	3	5	8	3	9	5
Classic	5	2	2	4	8	3	7	8	5	3	8	6	8	2	9	8**	5
Cobra/Phoenix	9	10	9	9	9	5	7	10	9	6	9	8	7	7	8	7	9
FirstRate/Amplify	5	-	9	-	9	4	8	7	5	6	9	9	9	-	9	9	5
Flexstar/Reflex	8	10	9	8	9	5	8	10	9	2	8	8	7	2	6	7	9
Fusilade DX	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glyphosate (Roundup Ready only)	9	9	10	8	9	9	8	10	9	8	9	9	7	-	9	8	9
Harmony GT XP/Unity	4	-	6	-	4	8	2	9	5	4	5	4	8	2	6	9	5
Ignite (Liberty Link only)	8	9	9	3	9	8	9	7	8	8	8	8	9	-	9	7	8
Poast Plus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pursuit	9	-	8	2	8	5	7	9	5	5	8	6	8	6	8	8	5
Raptor	9	7	8	5	8	7	7	9	5	5	7	6	8	7	8	8	5
Resource	-	-	7	-	7	6	5	7	7	-	7	7	5	-	-	9	7
Scepter	6	1	9	1	4	3	2	9	5	1	6	5	7	2	8	4	5
Select/Select Max	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Synchrony XP	5	-	8	-	9	8	6	8	6	-	8	6	8	-	9	8	2
Ultra Blazer	9	10	7	9	9	5	8	10	9	2	9	5	8	2	6	7**	9
Postemergence directed																	
Gramoxone SL2	-	10	4	7	7	9	5	9	8	4	8	-	5	3	-	6	9
Lorox	7	7	7	7	7	8	8	8	-	8	8	7	7	8	-	6	7
2,4-DB	0	10	9	2	4	-	9	2	2	3	1	-	0	2	-	3	1

Weed control: 8 to 10 = Good 6 to 7 = Fair*** Less than 6 = Poor - = No data available

*Shallow incorporation needed for this level of control.
**Split application required for this level of control.
***A weed control rating of 6 to 7 indicates partial control or suppression.
****Waterhemp has been observed to routinely escape ALS-herbicide treatments in many areas. Resistance has been formally confirmed in some fields. Control may vary from indicated valued on ALS-inhibiting herbicides.

Soybean
Soil-applied herbicide rates

Herbicide	Soil texture*		
	Coarse (light, sandy)	Medium (loamy)	Fine (heavy, clay)
	(Rate per acre)		
Authority First	3.2 to 6.4 oz	3.2 to 8 oz	3.2 to 8 oz
Authority MTZ	8 to 14 oz	8 to 18 oz	10 to 20 oz
Authority XL (full use rates)	5 to 7 oz	6.5 to 8 oz	7 to 9.6 oz
Authority XL (for GMO)	3 to 4 oz	3.2 to 4.8 oz	4 to 5 oz
Axiom 68DF	8 to 15 oz	10 to 20 oz	20 to 23 oz
Boundary 6.5L	1.2 to 1.8 pt	1.8 to 2.4 pt	2.4 to 3 pt
Canopy	2.25 to 7 oz	2.25 to 7 oz	2.25 to 7 oz
Canopy EX 29.5 WDG	1.1 to 3.3 oz	1.1 to 3.3 oz	1.1 to 3.3 oz
Cinch 7.64EC	1 to 1.33 pt	1.33 to 1.67 pt	1.33 to 2 pt
Command 3ME	2 to 3.33 pt	2 to 3.33 pt	2 to 3.33
Domain 60DF	Do not use	9 to 16 oz	9 to 16 oz
Dual II Magnum 7.64 EC	1 to 1.33 pt	1.33 to 1.67 pt	1.33 to 2 pt
Enlite	2 to 4 oz	2 to 4 oz	2 to 4 oz
Envive	2.5 to 5.25 oz	2.5 to 5.25 oz	2.5 to 5.25 oz
Fierce	3 oz	3.75 oz	4.5 oz
FirstRate 84 DG	0.6 to 0.75 oz	0.6 to 0.75 oz	0.6 to 0.75 oz
Outlook	12 to 18 fl oz	14 to 21 fl oz	14 to 21 fl oz
Gangster (multi-pack)	3 to 3.6 oz	3 to 3.6 oz	3 to 3.6 oz
Intrro 4E	2 to 2.25 qt	2 to 2.75 qt	2 to 3 qt
Lasso 4E	2 to 3 qt	2 to 3 qt	2 to 3.5 qt
Lasso II 15G	Do not use	16 lb	20 lb
Linex 4L	1 to 2 pt	1 to 2 pt	1 to 2 pt
Micro-Tech 4E	2 to 3 qt	2 to 3 qt	2 to 3.5 qt
OpTill	2 oz	2 oz	2 oz
Partner 65G	3 to 3.8 lb	3 to 4.5 lb	3 to 4.5 lb
Prefix	2 to 2.25 pt	2 to 2.5 pt	2 to 2.5 pt
Prowl H_2O 3.8ACS	1.5 to 2 pt	2.5 to 3 pt	3 pt
Pursuit 2AS	4 oz	4 oz	4 oz
Python WDG	0.8 to 1 oz	0.89 to 1.33 oz	0.89 to 1.33 oz
Scepter 70DG	2.8 oz	2.8 oz	2.8 oz
Sencor 4L	Do not use	0.75 to 1.25 pt	1 to 1.5 pt
Sencor 75DF	Do not use	0.5 to 0.8 lb	0.66 to 1 lb
Sequence 5.25L	2.5 to 3.5 pt	3.5 to 4 pt	3.5 to 4 pt
Sharpen	1 oz	1 oz	1 oz
Sonalan 3EC	1.5 to 2 pt	2 to 2.5 pt	2.5 to 3 pt
Sonic	3.2 to 6.4 oz	3.2 to 6.4 oz	3.2 to 8 oz
Spartan 4F	4 oz	4 oz	4 oz
Treflan 4EC	1 pt	1.5 pt	2 pt
Valor 51WDG	2 oz	2 to 2.5 oz	2.5 oz
Valor XLT	3 to 4 oz	3 to 5 oz	3 to 5 oz
Verdict	5 oz	5 oz	5 oz
Warrant	1.25 to 1.7 qt	1.25 to 1.9 qt	1.25 to 2 qt

*Refer to herbicide labels for proper rates on your soil texture and organic matter content, and for tank mixes.

Soybean

Weed control recommendations for double-crop soybeans

A significant percentage of soybeans are grown in a double-crop rotation with winter wheat. Our research suggests a different weed control approach with herbicides is necessary for double-crop soybeans.

Soybeans are produced in a double-crop system with conventional or no-tillage methods. The recommendations that follow can be used for either tillage system. However, no-tillage weed control will require the use of a preemergence application of a "burndown" herbicide to control weeds at the time of planting. You should use Gramoxone Max or glyphosate if weeds are less than 6 inches tall at the time of planting. You should use glyphosate if weeds are taller than 6 inches or if you have rhizome johnsongrass infesting the field at the time of planting.

Preemergence herbicides or postemergence herbicides are the two herbicide strategies used to control weeds in soybeans. Preemergence applications often must be followed with postemergence herbicides applications to control weed escapes. Our research indicates you should strongly consider a postemergence-only approach to weed control in double-crop soybeans (following a preemergence "burndown" application if needed at the time of planting). The postemergence approach is more successful in a double-crop system because of the lower rainfall amounts in late June and July when double-crop soybeans are planted. Lack of rainfall will frequently result in poor "activation" of preemergence herbicides. In addition, if rainfall is low, weeds may not germinate which will eliminate the need to apply postemergence herbicides at all. Our experience suggests low weed germination will occur about 1 in 3 years in Missouri.

If you choose to use a preemergence herbicide program you should consider only using shorter residual herbicides. These herbicides are less likely to have carryover problems for crop rotation than some of the newer, long-residual herbicides. Be aware that crop rotation intervals are extended for many herbicides if they are applied late in the summer. Check the label or the crop rotation guide in this book for more information.

The preemergence and no-till programs listed in this guide will work in double-crop soybeans if you will also follow the above suggestions. Postemergence herbicide listings in this guide will perform the same in any system. However, be aware that postemergence herbicide performance is reduced during the hot, dry weather frequently encountered during late summer. Be sure to use the higher rates listed and the proper additives.

Planting soybeans in narrow or drilled rows has several advantages in double-crop soybeans. One of the main advantages is faster canopy closure, which enhances weed control by shading the soil and preventing late weed germination. We strongly recommend you use narrow (<15 inches) or drilled rows when growing double-crop soybeans.

Soybean, Burndown

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Labeled tank-mix partners	Application method and precautions
The following preemergence soybean herbicides may be used for burndown: Spartan, FirstRate, Pursuit, Python, Scepter, Sencor, Boundary, Canopy EX, Pursuit Plus, Squadron and Valor. Application information is listed in the preemergence herbicide section. In most cases, a broad-spectrum, foliar burndown herbicide such as glyphosate or Gramoxone Max should be tank-mixed with the preemergence herbicide.				
Aim 2E + Nonionic surfactant	0.25 to 2 fl oz/A + 2 pt/100 gal	carfentrazone 0.004 to 0.031 lb/A	No restrictions listed.	Should be applied with a broad-spectrum burndown herbicide.
Canopy EX + Crop oil concentrate or Nonionic surfactant	1.1 to 3 oz/A + 1 gal/100 gal or 2 pt/100 gal	chlorimuron + tribenuron 0.016 + 0.0005 lb/A to 0.04 + 0.012 lb/A	Assure II, glyphosate, Gramoxone, Sencor, 2,4-D	Soybeans may be planted 7 days after application for rates up to 2.2 oz/A. Rates higher than 2.2 oz/A require a 14-day planting interval.
Gramoxone SL2 + Nonionic surfactant or Crop oil concentrate	2 to 4 pt/A + 1 to 2 pt/100 gal or 1 gal/100 gal	paraquat 0.7 to 1.4 lb/A	Aim, Boundary, Command, Dual, Harmony Extra, Lasso, Lorox, Micro-Tech, Prefix, Prowl, Pursuit, Python, Scepter, Sencor, Squadron, Surflan, Valor, 2,4-DB	May be applied early preplant (EPP) through planting, but before crop emergence. See label for specific rates and weed stages for application. Rate should normally be at least 1.67 pt/A.
Harmony SG 50% + Crop oil concertrate or Nonionic surfactant	0.45 to 0.9 oz/A + 1 gal/100 gal or 2 pt/100 gal	thifensulfuron 0.014 to 0.028 lb/A	Dicamba, glyphosate, 2,4-D	Applications up to 0.6 oz/A can be made preplant through planting in soybeans.
Harmony Extra SG 50%	0.4 to 0.9 oz/A	thifensulfuron + tribenuron 0.009 + 0.005 lb/A to 0.018 + 0.01 lb/A	Gramoxone, glyphosate, 2,4-D	Use for control of smartweed and dock. Tank mix with Gramoxone or glyphosate. DO NOT APPLY WITHIN 14 DAYS OF PLANTING.
Liberty 280SL/Ignite 280SL + Ammonium sulfate	29 to 36 fl oz/A + 3 lb/A	glufosinate 0.53 to 0.66 lb/A	Dicamba, 2,4-D	A single application may be made up to 36 fl oz/A, but only one additional in-season application of up to 29 fl oz/A may be made to Liberty Link soybean.

Soybean, Burndown - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Labeled tank-mix partners	Application method and precautions
OpTill + Methylated seed oil + Ammonium sulfate or Urea ammonium nitrate	2 oz/A + 1 gal/100 gal + 8.5 to 17 lb/100 gal or 1.25 to 2.5 lb/100 gal	saflufenacil + imazethapyr 0.02 + 0.06 lb/A	Glyphosate, Ignite	Do not apply after soybeans have emerged. It is suggested to add blyphosate for optimum burndown. If spray volume is 12 GPA or less, use methylated seed oil at 1 pt/A.
Sharpen + Methylated seed oil + Ammonium sulfate or Urea ammonium nitrate	1 oz/A + 1 gal/100 gal + 8.5 to 17 lb/100gal or 1.25 to 2.5 lb/100 gal	saflufenacil 0.02 lb/A	Glyphosate, Ignite	Do not apply after soybeans have emerged. It is suggested to add blyphosate for optimum burndown. If spray volume is 12 GPA or less, use methylated seed oil at 1 pt/A.
Roundup brands/ Touchdown brands/ other glyphosates + Recommended additives	 + See label	glyphosate at least 0.77 lb ae/A	Aim, Command, Dual, Lasso, Lorox, Lorox Plus, Micro-Tech, Prowl, Python, Scepter, Sencor, Squadron, Valor	May be applied early preplant (EPP) through planting. Use lower rate for small, susceptible weeds and higher rates for large or difficult to control weeds.
2,4-D	0.5 to 2.66 pt/A	2,4-D 0.25 to 1.33 lb/A	Aim, Command, Dual, Domain, Glyphosate, Gramoxone, Harmony Extra, Lasso, Lorox, Lorox Plus, Micro-Tech, Prowl, Python, Scepter, Select, Sencor, Squadron, Valor	Be sure to use a formulation labeled for burndown in soybeans. ***Preplant intervals:*** *30 days for greater than 1 pint, 15 days for 1 pint or less of amine, 7 days for 1 pint or less of ester.* Plant soybean seed 1.5 to 2 inches deep and ensure seed slot closure.
Verdict + Methylated seed oil + Ammonium sulfate or Urea ammonium nitrate	5 oz/A + 1 gal/100 gal + 8.5 to 17 lb/100 gal or 1.25 to 2.5 lb/100 gal	saflufenacil + dimethenamid-P 0.02 + 0.2 lb/A	Glyphosate, Clarity, OpTill, Sharpen	A minimum preplant interval of 30 days is required for coarse soils with no more than 2% organic matter. Do not apply after soybeans have emerged.

Fall and early preplant applications of preemergence herbicides for reduced tillage

Many preemergence herbicides may be used two or more weeks before planting in an early preplant (EPP) application. Advantages include: Early preplant applications will prevent weed emergence and aid or eliminate a formal burndown application. They may limit weed growth if weather moderately delays planting. Some preemergence herbicides have significant postemergence, burndown activity (adjuvants are sometimes required). Some preemergence herbicides increase the activity or spectrum of burndown herbicides. Finally, combining a preemergence herbicide with a burndown herbicide may simply save time and costs by eliminating a second trip for the traditional preemergence, after-planting application.

Several herbicides are registered for fall application. A fall herbicide application may be beneficial if it eliminates the need for a burndown application in the spring and soil erosion is not a problem. Fall applications could also benefit drying of the soil in the spring and could reduce the need for tillage before planting.

There are many choices and an option that works well in one field may work poorly in another. For most situations we recommend that growers target early preplant applications 15 or less days before planting. The sooner a herbicide is applied, the sooner it will break down and lose effectiveness. If rain delays planting too long, most advantages of extra-early preplant applications may be lost. Also, after 30 days, there is a much higher probability that a burndown application will be needed and most labels specify that additional preemergence herbicide be applied at planting. Finally, exceptionally long (>30 day) preplant intervals remove winter vegetation and leave the soil vulnerable to erosion and may increase the probability of herbicide contamination of ground and surface water.

Early preplant (EPP) labels for soybean herbicides

Herbicide	Label allows preplant application			
	Burndown activity**	45 days	30 days	15 days
Authority First	Yes	Yes	Yes	Yes
Authority MTZ	Yes	Yes	Yes	Yes
Axiom	No	No	No	Yes
Boundary	Yes	No	No	Yes
Canopy 75DF	Yes	Yes	Yes	Yes
Canopy EX	Yes	Yes	Yes	Yes
Command	No	No	Yes	Yes
Domain	Yes	No	No	Yes
Dual II/ Magnum/Cinch	No	Yes*	Yes*	Yes
Enlite	Yes	Yes	Yes	Yes
Envive	Yes	Yes	Yes	Yes
Express TotalSol	Yes	Yes	Yes	Yes
Fierce 76WDG	Yes	Yes	Yes	Yes
FirstRate	Yes	No	Yes	Yes
Outlook	No	Yes*	Yes*	Yes
Gangster	Yes	Yes	Yes	Yes
Harmony Extra XP	Yes	Yes	Yes	Yes
Harmony GT XP/Unity	Yes	Yes	Yes	Yes
Lasso/Microtech/Intrro	No	Yes*	Yes*	Yes
Linex 4L	Yes	No	Yes	Yes
Prefix	Yes	No	No	Yes
Prowl H_2O	No	No	No	Yes
Pursuit	Yes	Yes	Yes	Yes
Pursuit Plus	Yes	Yes	Yes	Yes
Python	No	No	Yes	Yes
Scepter	Yes	Yes	Yes	Yes
Sencor	Yes	Yes	Yes*	Yes
Sequence	Yes	Yes	Yes	Yes
Spartan	Yes	No	Yes	Yes
Synchrony	Yes	Yes	Yes	No
Treflan/others	No	Yes	Yes	Yes
Valor/Valor XLT	Yes	Yes	Yes	Yes

*Label requires reapplication at the time of planting (Typically 2/3 applied EPP and 1/3 preemergence at planting)
**Burndown activity may not necessarily be broad spectrum.

Soybean, Preplant incorporated

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Preplant incorporated tank-mix partners	Application method and precautions
Sonalan 3EC	1.5 to 3 pt/A	ethalfluralin 0.6 to 1.12 lb/A	Command, Sencor	See label for incorporation directions.
Treflan/others 4EC	1 to 2 pt	trifluralin 0.5 to 1 lb/A	Command, Salute, Scepter, Sencor	See label for incorporation directions. Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils.

Soybean, Preplant or preemergence

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Preplant incorporated or preemergence tank-mix partners	Application method and precautions
Spartan 4F	4.5 to 12 fl oz/A	sulfentrazone 0.14 to 0.37 lb/A	Assure II, Canopy XL, Command, Dual, Lasso, Outlook, Prowl, Sonolan, Treflan, 2,4-D	May be applied preplant, preplant incorporated or preemergence. See label restrictions for coarse (light, sandy) soils with low organic matter.
Command 3ME	2 to 3.33 pt/A	clomazone 0.75 to 1.25 lb/A	Dual, Lasso, Lorox, Micro-Tech, Prowl, Scepter, Sencor, Sonalan, Squadron, trifluralin	See label for incorporation directions. Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils. Do not apply within 1,200 feet of housing developments, commercial vegetable or fruit production, nurseries or greenhouses. See label for precautions for application near other desirable vegetation.

Soybean, Preplant or preemergence - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Preplant incorporated or preemergence tank-mix partners	Application method and precautions
Dual II Magnum 7.64L/ Cinch 7.64L	1 to 2 pt/A	*S*-metolachlor 0.96 to 1.91 lb/A	Command, Lorox, Pursuit, Scepter, Sonalan, trifluralin	May be applied preplant, preplant incorporated or preemergence. Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils.
Fierce 76% WDG	3.0 to 4.5 oz/A	flumioxazin + pyroxasulfone 0.063+0.08 to 0.094 + 0.12 lb/A		Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils.
FirstRate 84DG/Amplify 84 DG	0.6 to 0.75 oz/A (2 to 2.5 A/pkt)	cloransulam 0.031 to 0.039 lb/A	None listed.	Use lower rate on soils with less than 3% organic matter and higher rate on soils more than 3% organic matter.
Outlook	12 to 21 fl oz/A	dimethenamid 0.56 to 1 lb/A	Command, Lorox, Pursuit, Prowl, Scepter, Sonolan, Treflan	May be applied preplant, preplant incorporated or preemergence. May be applied postemergence to crop, but emerged weeds will not be controlled. Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils.
Intrro 4L or Lasso 4EC or Micro-Tech 4L	2 to 3 qt/A or 2 to 4 qt or 1.5 to 3 qt/A	alachlor 2 to 3 lb/A or 2 to 4 lb/A or 2 to 4 lb/A	(Excluding 15G) Canopy, Command, Lorox, Pursuit, Scepter, Sencor, trifluralin	May be applied preplant, preplant incorporated (shallow) or pre-emergence. Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils. Do not use Lasso II (15G) on coarse soils.
Prowl H_2O 3.8 ACS	1.5 to 3 pt/A	pendimethalin 0.7 to 1.4 lb/A	Command, Dual, Lasso, Lorox, Pursuit, Scepter, Sencor	See label for incorporation directions. Caution: Under cool wet conditions, preemergence, surface-applied Prowl may cause stem brittleness.
Pursuit 2 AS	4 fl oz/A	imazethapyr 0.063 lb/A	Dual, Lasso, Outlook, Prowl, Treflan	Use the same rate for all soil types. May be applied preplant, preplant incorporated or preemergence. Incorporation provides better weed control than surface application.
Python 80WDG	0.8 to 1.33 oz/A (5 to 3 A/pkt)	flumetsulam 0.04 to 0.07 lb/A	Not specified	Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils.
Scepter 70DG	2.8 oz/A	imazaquin 0.125 lb/A	Dual, Lasso, Prowl, Sencor, trifluralin	Use the same rate for all soil types.
Sencor 4L or Sencor 75DF	0.75 to 1.5 pt or 0.5 to 1 lb/A	metribuzin 0.38 to 0.75 lb/A	Command, Commence, Dual, Lasso, Prowl, Pursuit, Pursuit Plus, Scepter, Sonalan, trifluralin	Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils. See label for proper rate for your soil type and percent organic matter. Plant seed at least 1.5 inches deep.
Package mixes, preplant or preemergence				
Authority First	3.2 to 8 oz/A	sulfentrazone + cloransulam 0.14 + 0.016 to 0.35 + 0.04	Aim, Glyphosate, Gramoxone Inteon, Gramoxone Max, 2,4-D	Apply at plant or within 3 days after planting.
Authority MTZ	8 to 20 oz/A	sulfentrazone + metribuzin 0.9 + 0.14 lb/A to 0.23 + 0.34 lb/A	Glyphosate, 2,4-D	Apply at 8 to 14 oz/A as a setup in Roundup Ready soybeans. Apply at 10 to 20 oz/A in conventional beans.
Axiom 68DF	8 to 13 oz/A	flufenacet + metribuzin 0.27 + 0.07 to 0.44 + 0.12 lb/A	Authority/Spartan, Canopy XL, Command, FirstRate, Gramoxone, Lorox, Pentagon, Prowl, Pursuit, Python, Roundup, Sencor, Scepter, Sonolan, Treflan	May be applied preplant, preplant incorporated or preemergence. See label statement regarding rate: The 13-ounce rate should provide season-long control of annual grass and small-seeded broadleaf weeds on coarse (light, sandy) soils, but only early-season control on heavier soils.

Soybean, Preplant or preemergence - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Preplant incorporated or preemergence tank-mix partners	Application method and precautions
Boundary 6.5EC	1.5 to 3 pt	*S*-metolachlor + metribuzin 1 + 0.24 to 2 + 0.48 lb/A	Canopy XL, Command, FirstRate, Prowl, Python, Scepter	Plant soybeans at least 1.5 inches deep and do not use rates higher than 1.25 pt/A on soils with pH above 7.
Canopy 75DF	4 to 7 oz/A	metribuzin + chlorimuron 0.16 + 0.03 to 0.28 + 0.05 lb/A	Sencor, Linex	Use low rates on coarse (light, sandy) soils and higher rates on fine (heavy, clay) soils. On soils with a composite pH greater than 7.0, do not exceed 2.25 oz/A.
Domain 60DF	9 to 16 oz/A	metribuzin + flufenacet 0.20 + 0.14 to 0.36 + 0.24 lb/A	Any registered soybean herbicide that does not prohibit a Domain tank mixture.	See label for soybean variety restrictions. Plant soybeans at least 1.5 inches deep. Use rates are designed for a relatively short residual period. See label for discussion of rates.
OpTill PRO	co-pack: 2 oz dry + 21 oz liquid	saflufenacil + imazethapyr + dimethenamid 0.022 + 0.063 + 0.089 lb/A	Clarity, Glyphosate, Prowl	On coarse soils with less than 2% organic matter, a minimum soybean planting interval of 30 days must be followed.
Prefix	2 pts/A	*S*-metolachlor + fomesafen 0.95 lb + 0.25 lb	Canopy, Glyphosate, Gramoxone, Lorox, Lorox Plus, Preview, Pursuit, Scepter, Sencor, Treflan	May also be applied postemergence to soybeans but will control only weeds that have not emerged.
Sonic	3.2 to 8 oz/A	sulfentrazone + cloransulam 0.14 + 0.016 to 0.35 + 0.04	Aim, Glyphosate, Gramoxone, Gramoxone Max, 2,4-D	Apply at plant or within 3 days after planting.
Verdict + Methylated seed oil + Ammonium sulfate or Urea ammonium nitrate	5 oz/A + 1 gal/100 gal + 8.5 to 17 lb/100 gal or 1.25 to 2.5 lb/100 gal	saflufenacil + dimethenamid-P 0.02 + 0.2 lb/A	Glyphosate, Clarity, OpTill, Sharpen	A minimum preplant interval of 30 days is required for coarse soils with no more than 2% organic matter. Do not apply after soybeans have emerged.
Warrant	1.25 to 2 qt/A	acetochlor 0.94 to 1.5 lb/A	Glyphosate, Liberty	Use low rates on coarse soils and higher rates on fine soils.
Preemergence only				
Linex 4L	1 to 2 pt/A	linuron 0.5 to 1 lb/A	Boundary, Classic, Domain, Dual Magnum, Dual II Magnum, Gangster,Prowl, Sencor, Synchrony	Consult label for specific rates according to soil type. For preemergence burndown applications, addition of an adjuvant is required.
Valor 51WDG	2 to 2.5 oz/A	flumioxazin 0.064 to 0.08 lb/A	Command, FirstRate, Gramoxone, Lorox, Prowl, Python, Roundup, Scepter, Sencor, Warrant, 2,4-D	Do not use in combination with Axiom, Boundary, Domain, Dual, Intrro, Micro-Tech, or Outlook unless directed by state 24c labeling.
Package mixes, Preemergence only				
Authority XL	3 to 9.6 oz/A	sulfentrazone + chlorimuron 0.12 + 0.015 lb/A to 0.37 + 0.05 lb/A	Glyphosate, Gramoxone, Ignite, Rage D-Tech, 2,4-D	May be applied preplant, preplant incorporated, or preemergence. Do not use on soil with a pH greater than 7.6.
Canopy EX	1.1 to 33 oz/A	chlorimuron + tribenuron 0.016 + 0.005 to 0.047 + 0.014 lb/A	Command, Lasso, Dual, Outlook, Prowl, Treflan, Sencor, Sonolan, 2,4-D	May be applied after fall harvest anytime up to 7 or 14 days before soybean planting, depending on rate.
Enlite	2 to 4 oz/A	flumioxazin + chlorimuron 0.045 + 0.035 + 0.01 lb/A to 0.089 + 0.007 + 0.02 lb/A	2,4-D	Can be applied in fall or spring up to 3 days after planting.
Envive	2.5 to 5.25 oz/A	flumioxazin + chlorimuron + trifensulfuron 0.045 + 0.014 + 0.0045 lb/A to 0.094 + 0.03 + 0.009 lb/A	2,4-D	Can be applied in fall or spring up to 3 days after planting.

Soybean, Preplant or preemergence - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Preplant incorporated or preemergence tank-mix partners	Application method and precautions
Gangster 51DF+81DF	1.8 to 3.6 oz/A	flumioxazin + cloransulam 0.08 + 0.026 to 0.09 + 0.032 lb/A	Command, Glyphosate, Gramoxone, Prowl, Select, 2, 4-D	Do not apply after soybean emergence, or severe crop injury will occur. Do not use in combination with Axiom, Boundary, Domain, Dual, Intrro, Micro-Tech, or Outlook unless directed by state 24c labeling.
Prefix	2 pt/A	S-metolachlor + fomesafen 1.0 + 0.24 lb/A	Gramoxone, Glyphosate, Fusilade, Fusion, Poast Plus, Select, 2,4-D	Can be applied up to 15 days before planting and postemergence up to V3 soybeans.
Sequence 5.25L	2.5 to 4 pt/A	glyphosate + *S*-metolachlor 0.7 + 0.9 to 1.1 + 1.5 lb/A	Authority, Boundary, Canopy, Canopy XL, Command, Dual, Firstrate, Flexstar, Fusilade, Fusion, Linex, Lorox, Outlook, Prowl, Pursuit, Reflex, Scepter, Sencor, Squadron, Steel, 2,4-D, 2,4-DB	Contains glyphosate. May be applied before, during, or after planting but before the crop emerges on conventional soybeans.
Valor XLT	3 to 5 oz/A	flumioxazin + chlorimuron 0.06 + 0.02 lb/A to 0.09 + 0.03 lb/A	Dicamba, Express, Gramoxone, Glyphosate, Harmony, 2,4-D	On soils with pH >6.8, use at 2.5 oz/A and add 0.5 to 1 oz/A Valor SX. Do not incorporate.

Soybean, Postemergence

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Postemergence tank-mix partners	Application method and precautions
Assure II 0.88EC + Crop oil concentrate or Nonionic surfactant (80%)	4 to 12 oz/A + 4 qt/100 gal or 1 qt/100 gal	quizalofop 0.027 to 0.083 lb/A	Basagran, Classic, Harmony GT/ Pinnacle, Synchrony	See label directions for specific weeds, rates and tank-mix instructions. Use 4 fl oz for volunteer corn control up to 12 inches tall. Do not use more than 18 oz/A in one season. Do not cultivate within 7 days before or 7 days after application.
Basagran 4S + Crop oil concentrate (Optional) or 28% (UAN) nitrogen (optional)	1.5 to 2 pt/A + 1 qt/A (1 pt/A by air) or 1 gal/A	bentazon 0.75 to 1 lb/A	Assure II, Blazer, Fusilade, Fusion, Poast, Poast Plus, Harmony GT, Pinnacle, Pursuit, Scepter, Select, Storm, 2,4-DB	The use of 28% urea is recommended only for velvetleaf and may result in reduced control of other weed species. See label directions for specific weeds, rates, and tank-mix instructions. The split application should be made 10-14 days apart.
Blazer 2L + Nonionic surfactant (80%) or Urea ammonium nitrate	1.5 to 2 pt/A + 1 to 4 pt/100 gal or 2 to 4 qt/A	acifluorfen 0.38 to 0.5 lb/A	Basagran, Fusilade, Fusion, Poast, Poast Plus, Pursuit, Scepter, Select, Storm, 2,4-DB	See label directions for specific weeds, rates and tank-mix instructions. Hemp sesbania may be controlled until bloom with 1 pt/A of Blazer + surfactant. The use of 28% (UAN) nitrogen fertilizer is recommended only for velvetleaf and may result in reduced control of other weed species.
Cadet + Crop oil concntrate or Nonionic surfactant	0.4 to 0.9 oz/A + 1 gal/100 gal or 1 qt/100 gal	fluthiacet 0.003 to 0.006 lb/A	Glyphosate/Ignite	Primarily targets velvetleaf. Consult labels of other products for tank mixes.
Classic 25DF + Nonionic surfactant (80%) or Crop oil concentrate + 28% UAN or 10-34-0 liquid fertilizer (optional)	0.5 to 0.75 oz/A + 1 qt/100 gal or 1 gal/100 gal + 1 gal/A (UAN) or 1 to 2 qt/A (10-34-0)	chlorimuron 0.008 to 0.012 lb/A	Assure II, Basagran, Cobra, FirstRate, Flexstar, Fusilade, Fusion, Harmony GT/Pinnacle, Poast, Reliance, Poast Plus, Reflex, Roundup, Select, 2,4-DB	See label directions for specific weeds, rates and tank-mix instructions. No pH restrictions for Classic in Missouri. The use of 28% nitrogen or 10-34-0 is recommended only for velvetleaf and must be used with a surfactant.
Cobra 2EC + Crop oil concentrate or Nonionic surfactant (80%) and UAN or Ammonium sulfate	6 to 12.5 oz/A + 1 pt/A or 2 pt/100 gal and 4% v/v or 2 to 4 lb/A	lactofen 0.094 to 0.2 lb/A	Assure II, Basagran, Classic, FirstRate Fusilade, Fusion, Harmony GT, Pursuit, Reliance STS, Roundup, Scepter, Select Max, Synchrony STS, 2,4-DB	Crop oil, nonionic surfactant and ammonium sulfate are preferred adjuvants if tank-mixing with any product other than glyphosate. See label for specific adjuvant recommendations according to relative humidity.

Soybean, Postemergence - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Postemergence tank-mix partners	Application method and precautions
FirstRate 84DG + Nonionic surfactant or methylated seed oil + Urea ammonium nitrate or Crop oil concentrate + Ammonium sulfate (optional)	0.3 oz/A (5 A/pkt) + 1 to 2 pt/100 gal or 5 qt/100 gal + 2.5 gal/100 gal or 5 qt/100gal + 2.5 gal/100 gal or 2 lb/A	cloransulam 0.016 lb/A	Assure II, Basagran, Blazer, Classic, Cobra, Flexstar, Fusion, Harmony GT/Pinnacle, Poast Plus, Pursuit, Raptor, Reflex, Reliance, Resource, Roundup/others, Select, Stellar, Synchrony	See label directions for specific weeds, adjuvant and tank-mix instructions. Special labeling allows a 0.6 oz/A rate to be used in the Delta counties of southeast Missouri.
Flexstar 1.88ME + adjuvant	1 to 1.3 pt/A + see label	fomesafen 0.24 to 0.31 lb/A	Fusilade DX, Fusion, Select, Assure, Poast Plus, Basagran, Classic, Harmony GT/Pinnacle, Raptor, Synchrony STS, Scepter, Scepter OT, Butyrac	Same active ingredient as Reflex with increased activity and burn. Consult label for particular adjuvant recommendations.
Fusilade DX 2E + Crop oil concentrate or Nonionic surfactant (80%)	0.375 to 1.5 pt/A + 1 qt/25 gal or 0.5 pt/25 gal	fluazifop 0.094 to 0.375 lb/A	Basagran, Blazer, Classic, Pursuit, Reflex	See label directions for specific weeds, rates and tank-mix instructions.
Harmony SG + Nonionic surfactant (80%) and UAN or 10-34-0 liquid fertilizer (Optional)	1/8 oz/A + 1 pt/100 gal and 1 gal/A	thifensulfuron 0.004 lb/A	Assure II, Basagran, Classic, Fusion	See label directions for specific weeds and rates. The use of 28% nitrogen or 10-34-0 is recommended only for velvetleaf and must be used with a surfactant.
Phoenix 2L + Nonionic surfactant (80%) or Crop oil concentrate	8 to 12.5 fl oz/A + 2 pt/100 gal and 4% v/v or 2 to 4 lb/A	lactofen 0.13 to 0.2 lb/A	Basagran, Classic, FirstRate, Harmony GT, Pursuit, Raptor, Resource, Roundup, Scepter, Select Max, Synchrony, 2,4-DB	Crop oil, nonionic surfactant and ammonium sulfate are preferred adjuvants if tank-mixing with any product other than glyphosate. See label for specific adjuvant recommendations according to relative humidity.
Poast Plus + Crop oil concentrate or Dash	18 to 48 fl oz/A + 2 pt/A or 2 pt/A	sethoxydim 0.14 to 0.38 lb/A	Basagran, Blazer, Classic, Storm	See label directions for specific weed stages, rates and tank-mix instructions. Addition of 28% N or ammonium sulfate may improve control of certain species. Crop oil concentrate or Dash must be used in addition to the fertilizer. Refer to label for specific weeds to control with addition of fertilizer.
Pursuit 2AS + Crop oil concentrate or Nonionic surfactant (80%) + UAN or 10-34-0 or Ammonium sulfate	4 fl oz/A + 1.25 gal/100 gal or 2 pt/100 gal + 1 to 2 qt/A or 2.5 lb/A	imazethapyr 0.063 lb/A	Basagran, Cobra, Fusilade, Fusion, Harmony GT/ Pinnacle, Prestige, Roundup, Scepter, Select	Apply to 1- to 3-inch tall weeds for best performance. Ammonium sulfate may be used at 2.5 lb/A instead of liquid fertilizer. See label directions for specific weed stages, rates and tank-mix instructions.
Python 80WDG + Nonionic surfactant (80%) + Urea ammonium nitrate	0.125 oz/A + 1 qt/100gal + 2 to 5 gal/100 gal	flumetsulam 0.0063 lb/A	None specified	Control of prickly sida, supplemental label.
Raptor 1AS + Crop oil concentrate or Nonionic surfactant + UAN or 10-34-0 or Ammonium sulfate	4 to 5 fl oz/A + 1 gal/100 gal or 2 pt/100 gal + 1 to 2 qt/A or 2.5 lb/A	imazamox 0.031 to 0.039 lb/A	Assure II, Blazer, FirstRate, Fusilade DX, Fusion, Post Plus, Prestige, Select	Apply to 1- to 3-inch tall weeds for best performance. See label directions for specific weed stages, rates, tank-mix instructions and adjuvants.

Soybean, Postemergence - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Postemergence tank-mix partners	Application method and precautions
Reflex 2LC + Nonionic surfactant (80%) or Crop oil concentrate	0.75 to 1.25 pt/A + 0.5 to 1 pt/100 gal or 1 qt/25 gal	fomesafen 0.18 to 0.31 lb/A	Basagran, Classic, Fusilade, Fusion, Scepter, Select, 2,4-DB	The 1.25 pt/A rate may only be used in the Bootheel counties of Missouri. The 1 pt/A rate may give slightly lower weed control than indicated in the performance chart. Do not apply Reflex in the same field more than once every two years.
Resource 0.86 EC + Crop oil concentrate + Ammonium sulfate	2 to 12 fl oz/A + 1 to 2 pt/A + 2.5 lb/A	flumiclorac pentyl, 0.013 to 0.027 lb/A	Cobra, Glyphosate, Phoenix, Select Max	Velvetleaf control and lambsquarters suppression only.
Scepter 70 DG + Nonionic surfactant or Crop oil concentrate	1.4 to 2.8 oz/A + 2 pt/100 gal or 1 qt/A	imazaquin 0.063 to 0.125 lb/A	Basagran, Blazer, Cobra	See label directions for specific weed application stages, rates and tank-mix instructions.
Select 2EC/Clethodim 2EC + Crop oil concentrate + UAN or Ammonium sulfate (optional)	6 to 10 fl oz/A + 1 qt/A + 1 to 2 qt/A or 2.5 to 4 lb/A	clethodim 0.094 to 0.156 lb/A	Basagran, Blazer, Classic, Cobra, FirstRate, Flexstar, Glyphosate, Phoenix, Pursuit, Reflex, Reliance, Resource, Storm, Synchrony	See label directions for specific applications stages, rates, tank-mix and adjuvant instructions
Select Max + Crop oil concentrate + UAN or Ammonium sulfate	9 to 24 fl oz/A 1 qt/A 1 to 2 qt/A 2.5 to 4 lb/A	clethodim 0.09 to 0.18 lb/A	Glyphosate	Nonionic surfactants may be used in place of crop oil concentrate in certain situations. For volunteer Roundup Ready corn control, apply 6 to 12 oz/A with glyphosate. Apply 6 oz rate to corn less than 12 inches tall, 9 oz to 24-inch-tall corn, and 12 oz to 36-inch-tall corn.
Ultra Blazer 2L + Nonionic surfactant (80%) or Crop oil concentrate + UAN or Ammonium sulfate	1 to 1.5 pt/A + 1 to 2 pt/100 gal or 1 to 2 pt/A + 2-4 qt/A or 1.5 lb/A	acifluorfen 0.25 to 0.38 lb/A	Assure, Basagran, Classic, Dual, FirtRate, Fusilade, Fusion, Glyphosate, Harmony GT, Lasso, Outlook, Poast Plus, Pursuit, Resource, Scepter, Select, 2,4-DB	See label directions for specific weeds, rates and tank-mix instructions. Hemp sesbania may be controlled until bloom with 1 pt/A of Blazer + surfactant. The use of 28% (UAN) nitrogen fertilizer is recommended only for velvetleaf and may result in reduced control of other weed species.
Warrant	1.25 to 2 qt/A	acetochlor 0.94 to 1.5 lb/A	Glyphosate/Liberty	Should be applied postemergence to crop (VI-V3 preferably) but preemergence to weeds. Warrant does not control emerged weed seedlings.
Package mixes – Overtop				
Conclude Xact B 4EC + Conclude Xact G 2EC + Crop oil concentrate	1.5 pt/A + 1.5 pt/A + 1 gal/100 gal water	bentazon + acifluorfen + sethoxydim 0.5 + 0.25 + 0.375 lb/A	None	Apply to small, actively growing weeds.
Frontrow 84 + 80 WDG + Crop oil concentrate or Nonionic surfactant + UAN (optional) or Ammonium sulfate (optional)	0.21 oz/A (1 pkt/5A) + 4.75 qt/100 gal or 1 qt/ 100 gal + 2.5 gal/100 gal or 2 lb/A	cloransulam + flumetsulam 0.009 + 0.004 lb/A	Assure II, Basagran, Blazer, Cobra, Flexstar, Fusion, Glyphosate, Harmony GT/Pinnacle, Reflex, Poast Plus, Pursuit, Select, Touchdown	Apply to small, actively growing weeds. Grass control antagonism can occur with Assure II and Fusion tank mixes.
Fusion 2.66 EC + Crop oil concentrate or Nonionic surfactant (80%) + UAN liquid fertilizer or similar (Optional)	6 to 12 fl oz/A + 1 to 2 pt/100 gal or 0.5 to 1 pt/25 gal + 1 gal/100 gal	fluazifop + fenoxaprop 0.094 + 0.031 to 0.188 to 0.062 lb/A	Basagran, Blazer, Classic, Harmony GT/ Pinnacle, Pursuit, Reflex, Storm	See label directions for specific weeds, rates and tank-mix instructions. Only for shattercane and volunteer corn control.

Soybean, Postemergence - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Postemergence tank-mix partners	Application method and precautions
Prefix + Nonionic surfactant	2 pt/A + 1 pt/100 gal	metolachlor + fomesafen 1.09 + 0.24 lb/A	Glyphosate in Roundup Ready soybeans only	Prefix may be applied from cracking to the third trifoliate stage. Necrotic bronzing and spotting may occur after an application of Prefix POST. For broader spectrum weed control, tank-mix with glophosate and add NIS only to unloaded glyphosate formulations. Do not tank-mix Prefix POST with COC as increased crop injury may result.
Storm 4SL + Nonionic surfactant (80%) or Crop oil concentrate or UAN liquid fertilizer	1.5 pt/A + 1 to 2 pt/100 gal or 1 to 2 pt/A or 2 to 4 qt/A	bentazon + acifluorfen 0.5 + 0.25 lb/A	Classic, 2,4-DB	See label directions for specific weeds, rates and tank-mix instructions. The use of 28% UAN fertilizer is recommended only for velvetleaf control, and may result in reduced control of other weed species.
Synchrony XP + Nonionic surfactant + Ammonium sulfate	0.375 oz/A + 1 pt/100 gal + 2 to 4 lb/A	chlorimuron + thifensulfuron 0.005 + 0.002 lb/A	Glyphosate, others	

Herbicide-resistant soybeans

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Labeled tank-mix partners	Application method and precautions
		Liberty Link soybeans		
Liberty 280SL/Ignite 280SL + Ammonium sulfate	22-36 fl oz/A + 3 lb/A	Glufosinate 0.4 to 0.66 lb/A	Assure II, Classic, Cobra, Firstrate, Flexstar, Fusilade DX, Fusion, Harmony, Phoenix, Poast Plus, Pursuit, Raptor, Reflex, Resource, Select Max, Synchrony, Ultra Blazer	Use on Liberty Link soybeans only. Do not apply more than 65 fl oz/A per growing season. Apply from emergence up to but not including the bloom stage at 22 to 29 fl oz/A. A single application of 36 fl oz/A may be made.
		Roundup Ready soybeans		
Roundup brands/ Touchdown brands/ other glyphosates + Recommended additives	 + See label	glyphosate 0.56 to 1.5 lb/A	Consult labels	Use on Roundup Ready soybeans only. Use caution to prevent drift and to avoid spraying the wrong field. Consult label to refine rates for particular weed species and sizes. Roundup has no residual control. Do not apply more than 3 quarts per acre per year to soybeans, including preharvest treatments.
Package mixes				
Extreme 1.67 + Nonionic surfactant (80%) + Urea ammonium nitrate or Ammonium sulfate (optional)	3 pt/A + 1 pt/100 gal + 1 to 2 qt/A or 2.5 lb/A	glyphosate + imazethapyr 0.56 + 0.064 lb/A	None listed	Use on Roundup Ready soybeans only. The formulation stated on the label is 2.17 lb/gal; however, this is for the IPA salt of glyphosate. All other glyphosate listings in this guide are for glyphosate acid. Extreme contains 1.67 lb/gal calculated on a glyphosate-acid basis.
Flexstar GT 3.5 + Ammonium sulfate	3.5 to 4.5 pt/A + 8.5 to 17 lb/100 gal	fomesafen + glyphosate 0.25 to 0.31 lb ai + 1 to 1.23 lb ae)	Touchdown brands/ glyphosate, Fusilade	Under adverse growing conditions or a known population of glyphosate-tolerarant/resistant broadleaf weeds are present, a methylated seed oil or crop oil concentrate should be added at 1 gal/100 gal. Target weeds ≤4 inches tall. The use of drift control agents that affect droplet size and coverage can negatively affect weed control. Do not use Flexstar GT on fields that have already been treated with other fomesafen-containing products.
Sequence 5.25C	2.5 to 3 pt/A	glyphosate + *S*-metolachlor 0.7 + 0.9 to 0.8 + 1.1 lb/A	—	On Roundup Ready soybeans, may be used from cracking up to the 3rd trifoliate stage of soybean growth.

		STS soybeans		
Synchrony XP + Nonionic surfactant + Ammonium sulfate	0.375 to 1.125 oz/A + 1 pt/100 gal + 2 to 4 lb/A	chlorimuron + thifensulfuron 0.005 + 0.002 to 0.015 + 0.005 lb/A	Assure II, Cobra, FirstRate, Flexstar, Fusilade, Fusion, Poast Plus, Select, 2,4-DB	For use only on soybean varieties designated as "STS" in the variety name. The use of crop oil concentrate plus an ammonium nitrogen fertilizer is required. See label directions for specific weeds, rates and tank-mix instructions.

Broadleaf-Grass weed herbicide tank mixes

Many tank-mix combinations are not labeled; however, these applications do not necessarily need to be labeled by the manufacturers for use. When broadleaf and grass herbicides are tank-mixed, antagonism in the form of reduced grass control frequently (but not always) occurs. Some of this antagonism is due to the rapid "burn" of many broadleaf herbicides preventing the slower uptake and translocation of most grass herbicides. There are three recommended ways to avoid antagonism: (1) Apply the grass herbicide first (which allows it to be absorbed and translocated); then apply the broadleaf herbicide a day later. (2) Apply the broadleaf herbicide first and then wait seven days (which allows the grass to resume active growth); then apply the grass herbicide. (3) Increase the rate of the grass herbicide by 50 percent to overcome the antagonism. A tank mix may provide good control of small, actively growing grass, but avoid tank mixes when grass is large or stressed. Package-mixes and co-packages of grass herbicides (Conclude, Typhoon) usually provide a higher-than-normal rate of the grass herbicide at a discounted price. Read the label before tank-mixing a grass and broadleaf herbicide. The manufacturer may not be liable for performance or may restrict certain mixtures. Antagonism is not exclusive to grass-broadleaf herbicide mixtures. Several herbicides will reduce the grass and broadleaf performance of glyphosate in burndown and Roundup Ready soybean situations.

Soybean, Special problems

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Weeds controlled	Application method and precautions
Johnsongrass, Preplant burndown				
Roundup brands/other glyphosates		glyphosate 0.75 to 2.25 lb/A	Seedling and rhizome johnsongrass.	Apply glyphosate when johnsongrass is at least 18 inches tall and has reached the boot-to-head stage of growth. Allow 7 or more days after application before tillage. Roundup may be tank-mixed with several preemergence herbicides.
Glyphosate 3L or Roundup WeatherMax 4.5L or Roundup PowerMax 4.5L + Recommended additives	2 to 6 pt/A or 21 to 64 fl oz/A or 21 to 64 fl oz/A + See label			
Johnsongrass, Preplant incorporated				
Prowl 3.3E/others	2.4 to 4.8 pt/A	pendimethalin 1 to 2 lb/A	Seedling and rhizome johnsongrass, red rice, certain other grass and broadleaf weeds.	Follow rate and incorporation directions on label. Use for two consecutive years. Do not plant winter wheat or winter barley in the fall after application.
Treflan 4HFP, others	2 to 4 pt	1 to 2 lb/A	Seedling and rhizome johnsongrass, red rice, certain other grass and broadleaf weeds.	Follow rate and incorporation directions on label. Use for two consecutive years. In the season following this double-rate treatment, plant only rice and those crops for which Treflan can be applied as a preplant treatment.
Johnsongrass, Postemergence				
Assure II 0.88EC + Crop oil concentrate or Nonionic surfactant (80%)	5 to 10 oz/A + 4 qt/100 gal or 1 qt/100 gal	quizalofop 0.034 to 0.069 lb/A	Seedling and rhizome johnsongrass, certain other grasses.	Use 5-oz rate for seedling johnsongrass that is 2 to 8 inches tall. Apply 10 oz/A rate to 10- to 24-inch rhizome johnsongrass. If regrowth occurs, apply 7 oz/A in a second application when johnsongrass is 6 to 10 inches tall. Follow label directions for tank mixes and sequential applications with postemergence broadleaf herbicides. Do not cultivate within 7 days before or 7 days after application.

Soybean, Special problems - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Weeds controlled	Application method and precautions
Fusilade DX 2E + Crop oil concentrate or Nonionic surfactant (80%)	6 to 12 fl oz/A + 1 qt/25 gal or 0.5 pt/25 gal	fluazifop 0.09 to 0.19 lb/A	Seedling and rhizome johnsongrass, certain other grasses.	Use 0.75 pt/A for seedling johnsongrass that is no more than 8 inches tall. Apply 1.5 pt/A rate to 8- to 18-inch rhizome johnsongrass and before boot stage. If regrowth occurs, apply 1 pt/A in a second application when johnsongrass is 6 to 12 inches tall. Follow label directions for tank mixes and sequential applications with postemergence broadleaf herbicides. Make last application before first bloom.
Fusion 2.66EC + Crop oil concentrate or Nonionic surfactant (80%)	6 to 12 fl oz/A + 1 qt/25 gal or 0.5 pt/25 gal	fluazifop + fenoxaprop 0.09 + 0.03 to 0.19 + 0.05 lb/A	Seedling and rhizome johnsongrass, certain other grasses.	Use 0.75 pt/A for seedling johnsongrass that is no more than 8 inches tall. Apply 1.5 pt/A rate to 8- to 18-inch rhizome johnsongrass and before boot stage. If regrowth occurs, apply 1 pt/A in a second application when johnsongrass is 6 to 12 inches tall. Follow label directions for tank mixes and sequential applications with postemergence broadleaf herbicides. Make last application before first bloom.
Poast Plus 1E + Crop oil concentrate or Dash	1.5 pt/A + 2 pt/A or 2 pt/A	sethoxydim 0.19 lb/A	Seedling and rhizome johnsongrass, certain other grasses.	Apply to 15- to 20-inch-tall rhizome johnsongrass. If regrowth occurs, reapply when johnsongrass is 6 to 12 inches tall. Follow label directions for tank mixes and sequential applications with postemergence broadleaf herbicides.
Roundup/Others Glyphosate 3L or Roundup WeatherMax 4.5L or Roundup PowerMax 45L or Touchdown brands + Recommended additives	 at least 1 qt/A or at least 22 fl oz/A or at least 22 fl oz/A or at least 24 fl oz/A + See label	glyphosate at least 0.77 lb ae/A	Seedling and rhizome johnsongrass and most other broadleaf and grass weeds.	Roundup Ready soybeans only. Apply to 15- to 20-inch-tall rhizome johnsongrass. If regrowth occurs, reapply when johnsongrass is 6 to 12 inches tall.
Select 2EC + Crop oil concentrate	6 to 10 fl oz/A + 1 qt/A	clethodim 0.094 to 0.156 lb/A	Seedling and rhizome johnsongrass, certain other grasses.	Use 6 to 8 oz/A rate for seedling johnsongrass 4 to 10 inches tall. Apply 8 to 10 oz/A rate for rhizome johnsongrass 12 to 24 inches tall. A repeat application of 6 to 8 oz/A can be applied if regrowth occurs when johnsongrass is 6 to 10 inches tall. Follow label directions for tank mixes and sequential applications with postemergence broadleaf herbicides.
Red rice General Comments: Red rice control requires an integrated program. Dual Magnum, Lasso, Outlook or an equivalent product should be applied preemergence. This will provide excellent, early-season red rice control; season-long weed control will be inadequate. Then one of the following postemergence, grass-controlling herbicides should be applied.				
Assure II 0.88EC + Crop oil concentrate or Nonionic surfactant (80%)	9 oz/A + 4 qt/100 gal or 1 qt/100 gal	quizalofop 0.062 lb/A	Red rice and certain other grass weeds.	Apply early postemergence when red rice has 1 to 4 leaves. Repeat if regrowth occurs.

Soybean, Special problems - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Weeds controlled	Application method and precautions
Roundup/Others Glyphosate 3L or Roundup WeatherMax 4.5L or Roundup PowerMax 45L or Touchdown brands + Recommended additives	 at least 1 qt/A or at least 22 fl oz/A or at least 22 fl oz/A or at least 24 fl oz/A + See label	glyphosate at least 0.77 lb ae/A	Red rice and most other grass and broadleaf weeds	Roundup Ready soybeans only. Only use lower rates on red rice less than 2 inches tall under optimum growing conditions.
Select 2EC + Crop oil concentrate	6 to 8 fl oz/A + 1 qt/A	clethodim 0.94 to 0.125 lb/A	Red rice and certain other grass weeds.	Apply early postemergence before red rice is 3 inches tall.
Select 2EC/Section 2EC/ Clethodim 2EC + Crop oil concentrate	4 fl oz/A + 1 qt/A	clethodim 0.0625 lb/A	Late-season seed head suppression of red rice	Timing is critical. Apply from 4" internode elongation up to boot stage of red rice. Seedhead suppression only.
Spot-spray treatment of severe weed infestations				
Roundup/Others Glyphosate 3L or Roundup WeatherMax 4.5L or Roundup PowerMax 45L or Touchdown brands + Recommended additives	 at least 1 qt/A or at least 22 fl oz/A or at least 22 fl oz/A or at least 24 fl oz/A + See label	glyphosate at least 0.77 lb ae/A	Johnsongrass, cocklebur, giant ragweed, pigweed, sunflower, volunteer corn, shattercane, velvetleaf.	Use 0.5% solution on annual weeds less than 6 inches tall and 1% solution when annual weeds are more than 6 inches tall. Apply 2% when johnsongrass is in boot to early head stage, and to other perennial weeds. Cover foliage thoroughly on a spray-to-wet basis.
Harvest aid				
Aim	0.5 to 0.9 fl oz/A	carfentrazone	Desiccation of some green weed foliage.	Do not apply within 3 days of harvest.
Gramoxone SL2 + Nonionic surfactant or Crop oil concentrate	0.5 to 1 pt/A + 1 to 2 pt/100 gal or 1 gal/100 gal	paraquat 0.175 to 0.35 lb/A	Desiccation of green weed foliage.	***Determinate varieties:*** Apply when soybeans are fully mature, at least half of leaves have dropped and remaining leaves are turning yellow. ***Indeterminate varieties:*** Apply when at least 65% of seed pods have mature brown color or when seed moisture is 30% or less. Do not pasture livestock within 15 days of treatment. Mature cocklebur is tolerant of Gramoxone and desiccation will not be complete. Restricted Use Pesticide.
Roundup/Others Glyphosate 3L or Roundup WeatherMax 4.5L or Roundup PowerMax 45L or Touchdown brands + Recommended additives	 at least 1 qt/A or at least 22 fl oz/A or at least 22 fl oz/A or at least 24 fl oz/A + See label	glyphosate at least 0.77 lb ae/A	Suppression of many annual and perennial weeds.	Apply after soybean pods have set and lost all green color. Allow a minimum of 7 days between application and harvest. Do not apply to soybeans grown for seed. A maximum rate of 1 qt/A may be applied by air. Roundup Ready soybeans may be treated 14 days or earlier before harvest.
Sodium chlorate	2 gal/A of 3 lb/gal formulation	sodium chlorate 6 lb/A	Desiccation of green weed foliage.	Apply 7 to 10 days before harvesting.
Seed crops only Reglone 2L	1.5 to 2 pt/A	diquat 0.38 to 0.5 lb/A	Desiccation of green weed foliage.	Apply 1 week before harvest. Do not use treated plants for food feed or oil purposes.

Small grain

Guide to weed response to small-grain herbicides

Herbicide	Annual ryegrass	Cheat/downy brome	Chickweed	Cornflower	Dandelion	Field pennycress	Henbit	Horseweed (marestail)	Prickly lettuce	Shepherdspurse	Wild buckwheat	Wild garlic	Wild mustard	Common lambsquarters	Common ragweed	Giant ragweed	Redroot/smooth pigweed	Annual smartweed species	Velvetleaf
	Winter weeds													Summer weeds					
2,4-D	0	0	5	8	9	1	5	8	9	9	5	6	9	9	9	9	9	6	8
Achieve	8	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aim	-	-	-	3	-	9	-	-	-	-	-	-	-	9	7	6	9	9	9
Axial XL	9	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Banvel/Clarity	0	0	6	-	8	6	6	9	8	8	9	5	6	9	9	9	9	9	7
Buctril	0	0	6	8	8	8	8	6	6	8	9	0	9	9	9	8	7	9	-
Finesse	8	6	8	7	-	8	8	-	-	8	-	4	8	8	-	-	4	-	-
Harmony Extra	0	0	7	2	0	7	9	-	4	9	7	8	9	8	5	4	9	8	9
Hoelon	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MCPA	0	0	5	8	9	9	5	8	9	9	8	5	9	9	9	9	9	7	5
Olympus Flex	9	7	4	-	2	9	6	-	-	9	2	2	9	-	-	-	-	-	-
Osprey	9	2	8	6	-	-	8	-	-	8	-	3	8	-	-	-	-	-	-
Peak	-	-	8	-	5	9	5	0	9	8	8	8	9	7	9	7	8	7	9
Sencor	3	7	8	3	-	8	8	-	-	8	-	0	8	-	-	-	-	-	-
Sierra	6	6	-	-	-	9	6	-	-	9	6	-	9	-	-	-	4	9	-

Weed control: 8 to 10 = good 6 to 7 = Fair* Less than 6 = poor -=No data availablew

*A weed control rating of 6 to 7 indicates partial control or suppression.

Use this table as a guide for comparing the relative effectiveness of herbicides on individual weeds. Herbicides may perform better or worse than indicated due to extreme weather conditions and other variables If you are obtaining satisfactory results under your growing conditions, changing products as a result of information in this table is not necessarily wrecommended.

Due to the overwhelming number of package mixes and tank mixes, it has become impractical to list and distinguish these combinations. In the interest of fairness, we are therefore listing no package mixes in this table. A reasonable accurate estimate may be obtained by combining the control ratings from the individual package or tank-mix components.

Small grain, Burndown

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Labeled tank-mix partners	Application method and precautions
Aim 2E + Nonionic surfactant	0.25 to 2 fl oz/A + 2 pt/100 gal	carfentrazone 0.004 to 0.031 lb/A	No restrictions listed.	Should be applied with a broad-spectrum burndown herbicide.
Gramoxone Inteon + Nonionic surfactant or Crop oil concentrate	2 to 4 pt/A + 1 to 2 pt/100 gal or 1 gal/100 gal	paraquat 0.7 to 1.4 lb/A	not specified	
Roundup/Others Glyphosate 3L or Roundup WeatherMax 4.5L or Roundup PowerMax 45L or Touchdown brands + Recommended additives	 at least 1 qt/A or at least 22 fl oz/A or at least 22 fl oz/A or at least 24 fl oz/A + See label	glyphosate at least 0.77 lb ae/A		May be applied early preplant (EPP) through planting. Use lower rate for small, susceptible weeds and higher rates for large or difficult to control weeds.
Sharpen + Methylated seed oil + Ammonium sulfate or Urea ammonium nitrate	1 to 2 fl oz/A + 1 gal/100 gal + 8.5 to 17 lb/100 gal or 1.25 to 2.5 lb/100 gal	saflufenacil 0.02 to 0.04 lb/A	Clarity, Glyphosate	Should be applied with a broad-spectrum burndown herbicide like glyphosate. Do not apply after small grains have emerged or croop injry will occur. If spray volume is 12 GPA or less, use methylated seed oil at 1 pt/A.

Small grain herbicides

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Weeds controlled	Application method and precautions
Preemergence or fall postemergence				
Finesse 75DF + Nonionic surfactant	0.2 to 0.5 oz/A + 1 qt/100 gal	chlorsulfuron + metsulfuron 0.008 + 0.0016 to 0.02 + 0.004 lb/A	Ryegrass and common broadleaf weeds.	Use on wheat or barley. Use surfactant when applying postemergence to weeds. Read label for crop rotation restrictions. **STS varieties of soybeans must be planted if double-crop soybeans are to follow wheat.**
Hoelon 3EC	Preemergence: 2.7 pt/A 1-3 lf ryegrass: 1.3 pt/A 4-5 lf ryegrass: 2 pt/A 5 lf to 2 tiller ryegrass: 2.7 pt/A	diclofop 0.5 to 1 lb/A	Ryegrass	Use on winter wheat only. Expect slow results. Larger weeds require higher rates. Hoelon will kill oats.
Postemergence, fall only				
Achieve 40DG + Supercharge brand adjuvant	0.44 to 0.6 lb/A + 2 qt/100 gal	tralkoxydim 0.18 to 0.24 lb/A	Ryegrass	Use on winter wheat only. Expect slow results. Achieve will kill oats.
Peak 57 WG + Nonionic surfactant or Crop oil concentrate	0.5 oz/A + 1 to 2 qt/100 gal or 1-4 pt/A	prosulfuron 0.018 lb/A	Wild garlic, field pennycress, chickweed, prickly lettuce, common ragweed, velvetleaf, shepherdspurse, wild mustard, wild buckwheat	Label prohibits the planting of soybeans following application. Apply to oats and wheat from 3-leaf stage to before second node is detectable.
General information for Sencor: Wheat cultivars vary in their tolerance to Sencor. Check Bayer's list of Sencor-tolerant varieties before application.				
Sencor, 75DF	1 to 10.5 oz/A	metribuzin 0.05 to 0.5 lb/A	Cheat, downy brome, shepherdspurse, field pennycress, wild mustard, henbit, other winter annual broadleaf weeds	Contact a Bayer representative to determine if your wheat variety is Sencor-tolerant. See label to refine rates for soil texture, organic matter and crop and weed size. Low rates are for exceptionally early application to small weeds, higher rates require larger wheat.

Small grain herbicides - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Weeds controlled	Application method and precautions
Fall or spring postemergence				
Axial	16.4 fl oz/A	pinoxaden 0.05 lb/A	Annual ryegrass, wild oat, foxtail species	Apply to wheat or barley from the 2-leaf to preboot stage. Grass weed control only.
Finesse Grass & Broadleaf + Nonionic surfactant + UAN or Ammonium sulfate	0.6 tp 0.9 oz/A + 2 pt/100 gal + 2 qt/A or 2 lb/A	chlorsulfuron + flucarbazone 0.009 + 0.018 lb/A to 0.014 + 0.026 lb/A	Ryegrass, mustards, cutleaf eveningprimrose, pennycress, henbit, shepherdspurse	Apply postemergence to crop and weeds. Read label for crop rotation restrictions.
Harmony Extra TotalSol	0.45 to 0.9 oz/A	thifensulfuron + tribenuron 0.00.9 + 0.004 to 0.018 + 0.009 lb/A	Wild garlic, field penneycress, henbit, shepardspurse, wild mustard, smartweed	Apply to wheat or barley. Do not apply to wheat or barley crops underseeded with another crop. Apply from when crop is in the 2-leaf stage up to before the flag leaf is visible. Wild garlic plants should be less than 12 inches tall with 2 to 4 inches of new growth. Refer to label for additional rate information on weed size and density. When applied using liquid nitrogen fertilizer as the carrier, early crop yellowing and stunting may occur. Control is enhanced when applications are made during warm temperatures (60 degrees F or more) to actively growing weeds. Do not harvest sooner than 45 days after application.
Prowl H_2O	1.5 to 3 pt/A	pendemethalin 0.7 to 1.4 lb/A	Henbit, field pennycress	Should be applied before weed emergence. Can be applied from the first-leaf stage of wheat until just beore the flaf leaf is visible.
Olympus 70D + Nonionic surfactant	0.6 to 0.9 oz/A + 1 to 2 qt/100 gal	propoxycarbazone-sodium 0.03 to 0.04 lb/A	Downy brome, cheat, other *Bromus* species, some mustards	May be applied from emergence up to jointing.
Olympus Flex + Nonionic surfactant + Urea ammonium nitrate or Ammonium sulfate	3 to 3.5 oz/A + 2 qt/100 gal + 1 to 2 qt/A or 3 lb/A	propoxycarbazone + mesosulfuron 0.013 + 0.008 to 0.015 + 0.009 lb/A	Downy brome, cheat, wild oat, annual ryegrass, some mustards	May be applied from emergence up to jointing.
Osprey 4.5 D + Methylated seed oil	4.75 oz/A + 1.5 pt/A	mesosulfuron 0.013 lb/A	Ryegrass control and supression of common broadleaf weeds.	See label regarding insecticide and fertilizer restrictions. Apply to winter wheat when ryegrass is between the 1-leaf to the 2-tiller stage.
Sierra + Nonionic surfactant or Methylated seed oil	0.5 to 1 fl oz/A + 2 pt/100 gal or 1% v/v	flucarbazone-sodium 0.014 to 0.027 lb/A	Mustards, field pennycress, shepherd's-purse, mustards, wild oat	Apply from 1-leaf to jointing stage.
Spring postemergence				
Aim 2E + Nonionic surfactant (80%) + UAN (optional)	0.5 to 1 fl oz/A + 2 pt/100 gal + 2 to 4 gal/100 gal	carfentrazone 0.008 to 0.016 lb/A	Catchweed bedstraw, field pennycress, flixweed, tansy mustard, nightshade, pigweed, velvetleaf	Wheat. Apply before jointing.
Special note regarding safe application stages for hormone herbicides: The stage at which winter wheat is treated with growth-regulator-type herbicides such as 2,4-D, Banvel and MCPA is critical if crop damage is to be avoided. This growth stage has traditionally been described as "after fully tillered but before jointing." A newer, more accurate and safer evaluation is based on the distance from the soil surface to the top of the highest exposed leaf sheath. When this distance is between 2 and 4 inches, wheat has the most tolerance to growth-regulator herbicides.				
2,4-D amine (4 lb/gal formulation) or 2,4-D LV ester (4 lb/gal formulation)	1 to 1.5 pt or 0.5 to 1 pt/A	2,4-D 0.5 to 0.75 lb or 0.25 to 0.5 lb/A	Dandelion, field pennycress, shepherdspurse, wild mustard, common and giant ragweed, lambsquarters, pigweed, velvetleaf.	Barley, oats, rye and wheat. Apply in spring after full tillering stage but before jointing (stem elongation). Use lower rates on oats, which are less tolerant than other small grains. Underseeded legumes will be severely injured.

Small grain herbicides - *continued*

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Weeds controlled	Application method and precautions
2,4-D LV ester (4 lb/gal formulation)	1.5 to 2 pt/A	0.75 to 1 lb/A	Wild garlic, vetch, many other broadleaf weeds.	Barley, rye and wheat. Apply in spring after full tillering stage but before jointing (stem elongation). Wild garlic will not be killed, but dockage should be reduced. Do not use unless possible crop injury is acceptable. Underseeded legumes will be severely injured.
Banvel/Clarity (4 lb/gal formulation)	2 to 4 fl oz/A	dicamba 0.0625 to 0.125 lb/A	Field pennycress, wild buckwheat, common and giant ragweed, kochia, lambsquarters, pigweed, smartweed.	Barley and wheat. Apply in spring after winter dormancy but before jointing (stem elongation). Underseeded legumes will be severely injured.
Buctril 2EC or Buctril 4 lb/gal	1.5 to 2 pt or 0.75 to 2 pt	bromoxynil 0.38 to 0.5 lb/A	Wild buckwheat, common ragweed, lambsquarters, velvetleaf.	Apply to wheat or barley from emergence to boot stage. Apply on weeds up to 4-leaf stage or rosettes less than 1.5 inches across. Underseeded legumes will be severely injured.
MCPA 4L	0.3 to 0.5 pt/A	MCPA 0.15 to 0.25 lb/A	Field pennycress, shepherdspurse, wild mustard, common and giant ragweed, lambsquarters, pigweed.	May be applied to oats, barley and wheat. Apply in spring just prior to jointing (stem elongation). Apply in 5 to 10 gallons of water per acre. Some legume tolerance if covered by small grain foliage and weeds.
Bronate 4L	1 to 2 pt/A	bromoxynil + MCPA 0.25 + 0.25 to 0.5 + 0.5 lb/A	Field pennycress, lambsquarters, other broadleaf weeds.	May be applied to oats, barley, rye and wheat. See label for weeds and rates. Apply between the 3- to 4-leaf stage and the boot stage of the crop. Weeds should be less than 6 inches tall and not past the 3- to 4-leaf stage. Underseeded legumes will be severely injured.

Small grain, Special problems

Herbicide and formulation	Formulated material per broadcast acre	Herbicide (lb active per acre)	Weeds controlled	Application method and precautions
Harvest aid				
2,4-D amine (4 lb/gal formulation) or 2,4-D ester (4 lb/gal formulation)	1 to 2 pt or 1 to 2 pt/A	2,4-D 0.5 to 1 lb/A	Suppression of wild garlic and broadleaf weeds that interfere with harvesting.	Apply when small grains are in the hard dough stage. Ester formulation may be more effective on wild garlic than the amine formulation. Best results will be obtained when soil moisture is sufficient to cause succulent weed growth. Underseeded legumes will be severely injured.
Clarity 4L	8 oz/A	dicamba 0.25 lb/A	Suppression of broadleaf weeds that interfere with harvesting.	Apply when wheat is in the hard dough stage and green color is gone from nodes (joints). Do not use wheat for seed unless germination tests are 95% or better. Can be tank-mixed with Roundup or 2,4-D. Do not apply within 7 days of harvest.
Roundup/Others Glyphosate 3L or Roundup WeatherMax 4.5L or Roundup PowerMax 45L or Touchdown brands + Recommended additives	 at least 1 qt/A or at least 22 fl oz/A or at least 22 fl oz/A or at least 24 fl oz/A + See label	glyphosate at least 0.77 lb ae/A	Suppression of grass and broadleaf weeds that interfere with harvesting	Apply when small grains are in the hard dough stage (30% moisture or less). Do not apply to wheat grown for seed.

Crop replant and rotation guide for herbicides

(See end of table for key to abbreviations)

Herbicide	Corn	Cotton	Grain sorghum	Rice	Soybean	Wheat	Unspecified crops	Other crops	Rotation interval	+Additional precautions and information
	Months between application & planting									
2,4-D (various trade names	0.5	-	-	1	+	-	FY	FG	+	+Wait 30 days before planting if more than 1 pint is used, 15 days for 1 pint or less of amine, 7 days for 1 pint or less of ester. +For forage grasses, wait 2 weeks per pint of 2,4-D used before seeding.
Accent Q	0	10	18+	18+	+	4	18+	B, RG O SC, AL SF	4 mo. 8 mo. 10 mo. 18 mo.+	**Grain sorghum** is 10 months if pH is less than 7.5. **Soybeans** are 15 days. **Unspecified crops** are 10 months if pH is less than 6.5 **Sunflower** is 11 months if pH is less than 7.5
Achieve	1	1	1	1	1	1	4+			**Unspecified crops:** Actual wording is that all other rotational crops must be planted 106 days after application.
Aim	0	0	0	0	0	0	1			
Amplify	9	9	9	9	0	3	30	AL, 0 PT T	9 mo. 18 mo. +	**Unspecified crops** require a successful bioassay. **Tobacco:** See label for rates and transplant intervals.
Assure II	4	0	4	4	0	4	4			
Atrazine	0	FY+	0	FY+	FY+	FY	FY+			If applied after June 10, only corn and grain sorghum can be planted the following year.
Authority First	10+	18	12	10	0	4	30	AL, B, RG	12 mo.	+Corn interval is 18 months if Sonic is applied at 6.45 to 8 oz on soils of 1.5% organic matter or less.
Authority MTZ	10+	18	12	10	4	4	18	AL B	12 mo. 4 mo.	+Field corn may be planter after 4 months when applied at 14 oz/A or less.
Authority XL	10+	12	10+	10+	0	4	36	AL	12	Corn, grain sorghum and rice: Rotational intervals are increased to 18 months if soil pH is above 6.8.
Autumn	1	9	9	18	9	4	+	AL	18 mo.	+Unspecified crops may be seeded only after the completion of a successful field bioassay.
Axial XL	4	4	4	4	4	0	4	-	-	
Axiom	0	+	24	12	0	12	24	PT RG, AL, O, B, CL	1 mo. 12 mo.	**Cotton** rotational interval not determined at the time of printing.
Axiom AT	0	+	FY	+	FY	+	+			+No information on label.
Balance Flexx	0	6	6	6	6	4	18	B, SC, PT SF AL	6 mo. 10 mo.	
Banvel	+	+	+	+	+	+	+	Corn Sorghum Wheat	7 da. 14 da. 30 da/pt	Actual label wording is "following normal harvest of crop." **Wheat** planting must be delayed 30 days after application per pint of Banvel used.
Basagran	0	+	+	+	0	+	+			No restrictions on label.
Basis Blend	0	10	10	18	1+	4	18	AL	10	Crop rotation interval for soybeans is intended to support a soybean replant following a failed corn crop where Basis has been applied. Not intended for use as part of a planned soybean herbicide program. For counties along I-70 and south, soybean replant interval is 60 days for 1.25 oz/A rate, 15 days for 0.825 oz/A rate.
Beacon	+	8	8	18	8	3	18	B, RY AL, SC	3 mo. 8 mo.	**Corn** is 14 days. Injury may occur if dry weather prevails during much of the time between Beacon application and seeding of wheat or sorghum.
Bicep II Magnum, Bicep Lite II Magnum/Cinch ATZ	0	FY	0+	NI	FY	15	18	SG	15 mo.	**Grain sorghum**: Use Concep-treated seed. If applied after June 10, only corn and grain sorghum can be planted the following year.
Blazer	FY	FY	FY	FY	0	FA	FY+			**Root crops** (such as carrots, turnips, sweet potatoes, etc.) must not be planted in treated fields for a period of 18 months following treatment.
Boundary	8	8	12	8	0	4.5	18+	AL PT	4.5 mo. 8 mo.	**Root crops** are 18 months.
Bronco	0	FY	0+	FY	0	FA	FA			**Grain sorghum:** use SCREEN-TREATED seed.

Crop replant and rotation guide for herbicides - *continued*

(See end of table for key to abbreviations)

Herbicide	Corn	Cotton	Grain sorghum	Rice	Soybean	Wheat	Unspecified crops	Other crops	Rotation interval	+Additional precautions and information
	Months between application & planting									
Buctril + atrazine	0	NI	0	NI	FY+	NI	+			**Soybean and unspecified crops:** If applied after June 15, plant only corn or grain sorghum the next year. Unspecified crops should not be planted the year following application.
Buctril	0		0			FA				
Bullet	0	16	0+	16	FY	16	16			**Grain sorghum:** use SCREEN-TREATED seed.
Butyrac/ Butoxone (2,4-DB)	-	-	-	-	-	-	-			No restrictions on label.
Cadet	0	FA	FA	FH	0	FHF	FH			
Callisto	0	FY	0+	18	FY	4	18	SC, SF, CA, PT, T	FY	
Callisto Xtra	0	FY	0+	18	FY	FY	18			
Canopy 75DF	10+	10	12	10	0	4	30	AL	10	+Seed corn inbred lines may vary in their sensitivity to trace amounts of herbicide carryover.
Canopy EX	10	10	12	10	0.5	4	30	AL FG	10 mo. 4 mo	Even though Canopy EX may be applied in the fall, for purposes of recropping, do not start counting months for recropping until normal soybean planting time in the spring.
Camix	0	FY	0+	18	FY	4.5	18	RG	FY	If applied after June 10, do not rotate to crops other than corn or sorghum the following year.
Clarity	+	+	+	+	+	+	+			**Corn:** 7 days. **Grain sorghum:** 15 days. **Wheat** planting must be delayed 22 days after each 8 fl oz used. For other crops, actual label wording is "following normal harvest of crop."
Classic (All of MO with soil pH 7 or less)	9+	9+	9+	9+	0	3	18+	SG, RG AL, CL, T	3 mo. 15 mo.+	**Corn, cotton, grain sorghum and rice** intervals must be extended by 2 months if applied after Aug. 1. If applied the same year as Scepter or Pursuit, do not plant anything except soybeans for 15 months. **Unspecified crops** require a successful bioassay. See label for information.
Cobra	1	0	1	1	0	1	-			No restrictions on label
Command	9+	9+	12+	12+	0	12	16+	T DB SC	0 mo. 9 mo. 12 mo.	**Corn** is 9 months at rates of 2 pt/A and less. **Cotton** may be replanted immediately if Disyston or Thimet are applied (reapplied) in-furrow. **Cover crops** may be planted anytime, but stand reductions may occur. **Rice** may be replanted immediately if the Command rate is within the label for rice.
Command Xtra	10	18	10	10	0	12	18	T B, O, RG SC	0 16 mo. 18 mo.	
Conclude Xact B	FY	FY	FY	FY	0	FA	FY+			**Root crops** (such as carrots, turnips, sweet potatoes, etc.) Must not be planted for 18 months following treatment
Conclude Xact G	-	-	-	-	-	-	-			No restrictions on label.
Corvus	0	17	17	17	9	4	17	AL	17 mo.	
Distinct	+	4	4	4	4	4	4			**Corn:** 7 days.
Domain	1	24	12	12	0	24	12	PT	1 mo.	
Dual II Magnum	0	0	0+	FY	0	4.5	FY	SG, AL	4.5 mo.	**Grain sorghum:** Use Concep-treated seed.
Epic	0	6	12	12	6	12	24	PT	6 mo.	See label for specific vegetable crops.
Equip	0.5	9	9	18	9	2	18	AL, SF B, RG O	18 2 9	See label for specific soil insecticide restrictions.
Expert	0	FY	0+	-	FY	15	-			**Grain Sorghum:** Use Concep-treated seed. If applied after June 10, do not rotate to crops other than corn or sorghum the following year.

Crop replant and rotation guide for herbicides - *continued*

(See end of table for key to abbreviations)

Herbicide	Corn	Cotton	Grain sorghum	Rice	Soybean	Wheat	Unspecified crops	Other crops	Rotation interval	+Additional precautions and information
	Months between application & planting									
Extreme	8.5+	18	18	40	0	4	40	AL, RG, DB	4 mo.	Corn: IMI, IR, IT or Clearfield corn may be replanted immediately
Fieldmaster	0	+	+	+	FY	+	+	T	FY	No additional information on label
Fierce 76WDG	+	18	18	18	0	1	18	AL	18	Corn: 7 days
Finesse	11	14	14	NI	14+	0	+			**Soybeans:** STS soybeans may be planted the spring following Finesse **Other crops:** Other crops will require a successful bioassay.
FirstRate	9	9	9	9	0	3	30	AL PT T	9 mo. 18 mo. 30 mo.	**Unspecified crops** require a successful bioassay. **Tobacco:** See label for rates and transplant intervals.
Flexstar	10	0	18+	10	0	4	18	SG AL	4 mo. 10 mo.	**Grain sorghum** is 10 months in Southeast Missouri Delta counties.
Flexstar GT	10	0	18+	10	0	4	18			**Grain sorghum** is 10 months in Southeast Missouri Delta counties.
Frontrow	9	9	9	26	0	3	26+	SG	3 mo.	**Unspecified crops** require a successful bioassay.
Fultime	0	+	FY	+	FY	15	+			**Cotton, rice and soybeans** should not be planted the year following application.
Fusilade DX	2	0	2	2	0	2	2			
Fusion	2	0	2	2	0	2	2			
Gangster	9	9	9	9	0	3	-	SF	30	
Gauntlet	10	18	10	10	0	4	-	AD, DB SC AL, DB	12 mo. 18 mo.+ 30 mo.	**Popcorn** is 9 months
Glyphosate[a]	0	0	0	0	0	0	0+	T	1 mo.	**Tobacco** is an exception to Unspecified crops.
Goal	10	1+	10	10	1+	10	10			**Cotton and soybeans** may be planted 7 days after application if soil is worked 2″ deep. See label for additional rainfall restrictions.
Gramoxone Max	-	-	-	-	-	-	-			No restrictions on label
Guardsman Max	0	FY	FY	+	FY	+	+			**Rice, wheat and unspecified crops:** do not plant the year following application.
G-Max Lite	FY	FY	FY	-	FY	-	+			Do not plant wheat and unspecified crops the year following application.
Halex GT	0	10	0+	18	10	4	18	AL	10 mo.	+If grain sorghum is replanted, it must be Concep treated.
Harmony GT XP/Unity	0	0	0	0	+	1.5	1.5			+**Soybeans** may be planted 7 days after application for rates up to 2.2 oz/A.
Harmony Xtra	1/2	1/2	1/2	2	0+	0	2	B, O	0 mo.	+Soybeans may be planted 7 days after application.
Harness Xtra	0	+	+	+	FY	+	+	T	FY	No additional information on label
Harness	0	+	+	+	FY	+	+	T	FY	No additional information on label
Hoelon	-	-	-	-	-	-	-			No information on label.
Hornet	0	18	12	10.5	10.5	4	26+	B, O, RG AL PT, SF, T	4 mo. 10.5mo. 18 mo.	**Unspecified crops** require a successful bioassay.
Impact/Armezon	0	9	9	18	9	3	18	AL, SF	18 mo.	
Instigate	0	10	10	18	10	4	18			
Intrro	0	FY	0+	FY	0	FA	FY			**Grain Sorghum:** Apply only to grain sorghum planted with seed that has been properly treated with a seed protectant or safener.
Keystone/Breakfree ATZ	0	+	FY	+	FY	15	+	T+	FY	**Cotton, rice and unspecified crops:** Do not plant the year following application. If applied after June 10, only corn may be replanted the following year.
Laddok S-12	+	+	+	+	+	+	+			See label.
Lariat	0	16	0+	16	0	16	16			**Grain sorghum:** use Screen-treated seed.
Lasso	0	FY	0+	FY	0	FA	FY			**Grain sorghum:** use Screen-treated seed.
Liberty	0	4	3+	4	0	3+	4			**Grain sorghum and wheat:** Actual wording is 70 days

Crop replant and rotation guide for herbicides - *continued*

(See end of table for key to abbreviations)

Herbicide	Corn	Cotton	Grain sorghum	Rice	Soybean	Wheat	Unspecified crops	Other crops	Rotation interval	+Additional precautions and information
	Months between application & planting									
Liberty ATZ	0	FY	0	FY	FY	FY	FY			
Lexar EZ	0	FY+	0+	FY+	FY+	FY+	+			**+Cotton, grain sorghum rice soybeans and wheat:** If applied after June 10, do not rotate with crops other than corn the following year. **Other crops** should not be planted the season following application.
Linex	0+	4	0+	4	0+	4	4			**Corn, grain sorghum and soybeans:** Thoroughly rework soil before replanting. Plant corn at least 1.75 inches deep and grain sorghum at least 1 inch deep.
Lumax EZ	0	FY+	0+	FY+	FY+	4.5+	+			**+Cotton, grain sorghum rice soybeans and wheat:** If applied after June 10, do not rotate with crops other than corn the following year. **Other crops** should not be planted the season following application.
Microtech	0	FY	0+	FY	0	FA	FA			**Grain sorghum:** Use screen-treated seed.
NorthStar	+	8	8	18	8	4	18	B AL, SC, DB, PT, SF, T	3 mo. 8 mo.	**Corn** is 14 days, IR corn may be replanted immediately
Olympus	18	12	12	-	12+	0	-			+**STS Soybean** may be planted 4 months after application. Specific mitigation measures are required in certain MO counties where endangered species occur. See label for specific guidelines and restrictions.
Olympus Flex	12	10	9	-	5	0	+	AL, O, PT	24 mo.	+A field bioassay must be conducted for crops not listed on this label and for crops for which the cumulative precipitation requirements are not satisfied.
OpTill	8.5	18	18	40	0+	4	40	AL SF	4 18	+On coarse soils with less than 2% organic matter, the planting interval for soybeans is 1 month.
OpTill PRO	8.5	18	18	40	0+	4	40	AL	9 mo.	+On coarse soils with <2% organic matter, a 1-month preplant interval is required between application and planting.
Option	0.5	2	2	2	0.5	2	2			
Osprey	12	3	-	3	3	0.25	10	B, SF	1 mo.	
Outlook	0	FY	0+	FY	0	4	FY	SG	4 mo.	+Use Concep or Screen-treated seed.
Paramount	10	10	0	10	10	0	24	AL, CL, PT, SF	+	+These crops require 24 months and a successful bioassay
Partner	0	FY	0+	FY	0	FA	FA			**Grain sorghum:** Use Screen-treated seed.
Peak	1+	10	1	10	10	0	18+	SG SC, FG, PT, T, CA AL, CL PT, SF	I 10 mo. 15 mo. 24 mo.	**See label for specific pH and application time restrictions.** **Corn:** IR corn may be replanted immediately. **Sunflower and potato** is an exception to the 18-month-all interval
Permit	1+	4	2	I	9	2	+	SG SC AL, CL, DB, PT CA SF	2 mo. 3 mo. 9 mo. 15 mo. 18 mo.	**Corn:** IR may be replanted immediately. **Unspecified crops**: Label does not have an "Unspecified-crops" interval.
Phoenix	1	0	1	1	0	1	-			No restrictions on label
Pinnacle	1.5	1.5	1.5	1.5	1.5	1.5	1.5			
Poast/ Poast Plus	-	-	-	-	-	-	-			No restrictions on label.
Prefix	10	1	18	10	0	4.5	18	AL	4	
Prequel	0	18	10	18	10	4	18			
Princep	0	+	+	+	+	+	+			**Cotton, grain sorghum, rice, soybean, wheat and unspecified crops:** Do not plant the year following application
Prowl H_2O	FY	0	FY	FY	0	4	FY	B, RG, Al, T, CL	4 mo.	

Crop replant and rotation guide for herbicides - *continued*

(See end of table for key to abbreviations)

Herbicide	Months between application & planting							Other crops	Rotation interval	+Additional precautions and information
	Corn	Cotton	Grain sorghum	Rice	Soybean	Wheat	Unspecified crops			
Prowl (2X Rate)	FY	0	FY	FY	0	FY	FY			Do not rework soil deeper than treated zone.
Pursuit	8.5+	18	18	40	0	3	40	AL, RG T, B O, SC PT	4 mo. 9.5 mo. 18 mo. 26 mo.	**Corn:** IMI, IR, IT and Clearfield corn may be replanted immediately. See label for restrictions regarding the use of other ALS-inhibiting herbicides.
Python	0	18	12	6	0	4	26+	AL, DB, B, O, RG PT SF, SC+	4 mo. 12 mo. 18 mo.	**Popcorn** is 9 months. **Unspecified crops** require a successful bioassay.
Ramrod	0	FY	0	FY	FY	FA	FA			
Raptor	8.5	9	9	9	0	3	18	B, RG AL, SC, DB, O, PT, SF	4 mo. 9 mo.	
Realm Q	0	10	10	18	10	4	18	AL	10	
Reflex	10	0	18	18	0	4	18	SG	4 mo.	All of Missouri except the Boot heel: Do not apply to any field more than once every two years.
Resolve Q	0	10	10	10	10	4	-	AL PT	10 mo. 0 mo.	For alfalfa and grain sorghum, rotational intervals should be extended to 18 months if drought conditions prevail after application.
Resource	-	-	-	-	-	-	-			No restrictions on label.
Scepter	9.5	18	11	FY	0	3	18	T B, O, RG	9.5 mo. 11 mo.	See label for additional dry-weather restrictions.
Select/ Select Max	1+	0	1	1	0	1	1+			+May apply 6 oz Select Max and replant corn in 6 days. **Unspecified crops:** do not plant crops for which Select is not registered for 30 days following application.
Sencor	4	8	12	8	4	8	18+	AL, FG PT, B+	4 mo. 8 mo.	**Barley and wheat** are 4 months if Sencor was applied to soybeans. **Unspecified crops:** Non-root crops are 12 months.
Sequence	0	0	0	FY	0	4.5	-	AL	4 mo.	
Sharpen	0	+	0			0	4			+**Cotton:** 1.5 month for 1 oz/A; 3 months for 2 o/A; 4 months for 3 oz/A. +**Soybean:** 1 to 1 month for 1 oz/A; 1 to 2 months for 2 oz/A; 2 to 3 months for 3 oz/A
Shotgun	+	-	+	-	-	-	-			+Corn and grain sorghum are 3 weeks. Label does not specify rotation intervals for other crops. Use atrazine restrictions as a guideline.
Sierra	1	-	-	-	9	0	-	-		
Sonalan	FY	FY	FY	FY	0	FA	FA			
Sonic	10+	18	12	10	0	4	30	AL, B, RG	12 mo.	+Corn interval is 18 months if Sonic is applied at 6.45 to 8 oz on soils of 1.5% organic matter or less.
Spartan (Midwest areas)	10	30	10	-	0	4	30	AL, B RG, DB CL, SF, SC CA, PT	12 mo. 18 mo. 30 mo.	
Spirit	1+	10	10+	10+	10+	3+	18+	B, O SC FG, DB	3 mo. 8 mo. 10 mo.	+Label includes a June-30-last-application date for rotational crop safety; 10-month rotation to soybean south of I-80. IR or IMR corn may be replanted immediately
Starane	0	4	0	4	4	0	4	B, O	0 mo.	
Status	4	4	4	4	4	4	4			**Corn:** 7 days
Steadfast	0	10	18+	18+	0.5	4	18+	SF	18 mo+	+**Grain sorghum:** 10 months if pH is less than 7.5. +**Rice:** 10 months if pH is less than 6.5. +**Sunflower:** 11 months if pH is less than 7.5. +**Unspecified crops:** 10 months if pH is less than 6.5.
Storm	FY	FY	FY	FY	FY	FA	FA+			**Unspecified crops** do not include root crops which should not be planted for 18 months following application.

Crop replant and rotation guide for herbicides - *continued*

(See end of table for key to abbreviations)

Herbicide	Corn	Cotton	Grain sorghum	Rice	Soybean	Wheat	Unspecified crops	Other crops	Rotation interval	+Additional precautions and information
	Months between application & planting									
Stout	0	10	10	18	0.5	4	18	AL	10+	+Rotational interals should be extended to 12 months if drought conditions prevail after application.
Surestart/TripleFLEX	0	26	12	26	FY	4	26	SF AL	18 mo. FY	
Surpass/Breakfree	0	+	FY	+	FY	4	+	T	FY	**Cotton, rice and unspecified crops:** Do not plant the year following application.
Synchrony	9	9	9	15	0	3	17	SG AL, CL	3 mo. 12 mo.	See label for several exceptions depending on the use of chlorimuron-containing products, soil pH and application date.
Topnotch	0	+	FY	+	FY	4	+	T	FY	**Cotton, rice and unspecified crops:** Do not plant the year following application.
Touchdown HiTech	0	0	0	0	0	0	-			
Touchdown Total	0	0	0	0	0	0	-			
Treflan	FY	0	FY	FY	0	FA	FY	B	Fall	
Treflan (2X rate)	+	0	+	+	0	+	+			+Do not plant for 2 years.
Typhoon	10	10	18	10	0	4	18	SG	4 mo.	
Ultra Blazer	FY	FY	FY	FY	0	FA	FY+			**Root crops** (such as carrots, turnips, sweet potatoes, etc.) must not be planted in treated fields for a period of 18 months following treatment.
Valor, 3 oz rate	2	2	2	2	0	2	12	B, DB, RG, SC	4 mo.	
Valor, 2 oz rate	1+	1	1	1	0	1	12	B, DB, RG, SC	4 mo.	+No-till or minimum till corn can be planted 7 days after application.
Valor XLT	10	10	10	10	0	4	30	AL	12 mo.	
Verdict	0	FY	FY	FY	+	4	FY			+Replant intervals for soybean following Verdict is dependent on rate and soil type but ranges from 1 to 4 months. See label for specific report information for soybeans.
Warrant	FY	0	FY	FY	0	4	FY	AL	9 mo.	
Yukon	1	3	2	3	9	2	NI	RY PC AL, CL, DB, PT CA SF	2 mo. 3 mo.+ 9 mo. 15 mo. 18 mo.	**+Seed corn:** 2 months
Zorial	16	0	16	16	0	16	16			

Key to abbreviations

Crops

AL = Alfalfa
B = Barley
CA = Canola (rape)
CL = Clovers
DB = Dry beans
FG = Forage grasses
FL = Forage legumes
O = Oats
PT = Potatoes
RG = Rye
SC = Sweet corn/Popcorn
SF = Sunflower
SG = Small grains
T = Tobacco

Timings

FA = Fall
FH = Following harvest
FY = Following year

Notes

This table applies to the major field and forage crops of Missouri. Refer to the herbicide labels for the latest recrop and rotation information for horticultural crops. The University of Missouri does not warrant herbicides and regrets any omissions or errors in this guide. Always refer to product labels before using a pesticide or replanting into treated fields.

A "successful bioassay" where the rotational crop is test planted in soil from the field in question is often required for unlisted crops. A bioassay can be performed in the field or in a container (flower pot) indoors. If possible, similar, untreated soil (such as from an adjoining fence row) should also be planted as a check. A bioassay is also advisable if weather conditions have been unfavorable for herbicide breakdown (cool temperatures and little rainfall) or when you are planting extremely close to the specified rotation interval. Soil sampling should be thorough. Use the same procedures as for fertility samples. If possible, a hypersensitive plant should be planted in addition to the desired crop (for example, a grower who is planting wheat but is concerned with potential atrazine carryover should use both wheat and soybeans as test crops since soybeans are also sensitive to atrazine). Field bioassays, where strips are planted perpendicular to the previous crop rows, are also useful.

Forage, feed and grazing restrictions for herbicides

Herbicide	Restrictions
2,4-D	Do not forage or feed corn fodder for 7 days following application. Do not permit dairy animals or meat animals being finished for slaughter to forage treated grain fields within 2 weeks after treatment. Do not feed treated straw to livestock if a preharvest or emergency treatment is used. See label for further information.
Accent	Do not graze or feed forage or grain from the treated areas to livestock within 30 days after application.
Achieve	Mature straw and grain may be fed to livestock 45 days after treatment. Immature crops (forage) may be grazed or cut for hay 30 days after treatment.
Aim	Product is labeled for use on corn for silage. Do not feed treated soybean forage to livestock. No information on other crops.
Amplify	Do not harvest soybeans for forage or hay for 14 days after application.
Assure II	Do not graze treated fields or harvest for forage or hay.
Atrazine	Do not graze or feed forage from treated areas for 60 days following application, or illegal residues may result.
Authority First	Do not feed treated soybean forage or hay to livestock. Do not harvest soybeans for 65 days after application.
Authority MTZ	Do not graze treated fields or harvest for forage or hay.
Authority XL	Do not feed treated soybean forage or soybean hay to livestock.
Axial XL	Do not graze livestock or harvest forage for hay from treated wheat and barley for a minimum of 30 days following application.
Axiom	No restrictions on corn. Do not graze or feed forage, hay or straw to livestock from treated soybeans.
Axiom AT	No restrictions on corn.
Balance Flexx	No information on label.
Banvel	Do not graze or harvest for livestock feed prior to crop maturity.
Basagran	Do not graze treated fields for at least 21 days after application.
Basis	Do not graze or feed forage, grain or stover from treated areas within 30 days of application.
Beacon	Do not graze or feed forage from treated corn to livestock within 30 days after application.
Bicep II Magnum	Do not graze or feed forage from treated areas for 30 days following application.
Bicep Lite II Magnum	Do not graze or feed forage from treated areas for 30 days following application.
Blazer	Do not use treated plants for feed or forage.
Boundary	Soybean plants or hay may be grazed or fed to livestock 40 days after application.
Bronate	Do not graze treated fields for 30 days following application.
Buctril + atrazine	Do not cut crop for feed or graze within 30 days after application.
Buctril	Do not cut for feed or graze within 30 days after application.
Bullet	Do not graze treated area or feed treated forage to livestock for 21 days following application.
Butyrac/Butoxone (2,4-DB)	Do not graze or feed soybean hay within 60 days after application of a 2,4-DB tank-mix application.
Cadet	Do not graze or feed treated soybean forage or hay to livestock. Do not harvest or feed field corn forage until 30 days after the last application.
Callisto	Do not harvest forage, grain or stover within 45 days after application.
Callisto Xtra	Do not graze or feed forage from treated areas for 60 days following applications or illegal residues may result.
Canopy 75DF	Do not graze treated fields or harvest for forage or hay.
Canopy EX	May be grazed 14 dys after application.
Cinch ATZ	Do not graze or feed forage from treated areas for 30 days following application.
Clarity	For lactating dairy animals, do not harvest forage within 37, 51 or 70 days for 1, 2 and 4 pint use rates. No restrictions for other animals.
Classic	Do not graze treated fields or harvest for forage or hay.
Cobra	Do not graze animals on green forage or stubble. Do not use hay or straw for animal feed or bedding.
Command	Do not allow livestock to graze on treated fields or crop residue or feed treated forage to livestock.
Command Xtra	Do not allow livestock to graze on treated soybean vines or feed treated soybean leaves or vine trash to livestock.
Conclude	Do not use treated plants for feed or forage.
Degree	No information on label.
Degree Xtra	No information on label.
Domain	Do not graze or feed forage, hay or straw to livestock.
Distinct	Do not apply within 32 days of forage harvest. Do not apply within 72 days of corn grain and stover harvest.
Dual II Magnum	Do not graze or feed forage from treated areas for 30 days following application.
Epic	No information on label
Equip	Do not harvest corn grain within 70 days and corn forage within 45 days of an application. Do not graze within 45 days of an application.
Expert	Do not graze or feed forage from treated areas for 30 days following application.
Extreme	Do not graze or feed treated soybean forage, hay or straw to livestock.

Forage, feed and grazing restrictions for herbicides - *continued*

Herbicide	Restrictions
Finesse	No grazing restrictions.
FirstRate	Do not harvest soybeans for forage or hay for 14 days after application.
Flexstar	Do not graze treated areas or harvest for forage or hay. Do not graze rotated small grain crops or harvest for livestock forage or straw.
Frontrow	Do not graze or feed treated soybean forage, hay or straw to livestock.
Fultime	No restrictions on label.
Fusilade DX	Do not graze or harvest for forage or hay.
Fusion	Do not graze or harvest for forage or hay.
Gangster	Do not graze treated fields or feed treated forage or hay to livestock.
Gramoxone SL2.0	Soybean post directed: Do not graze treated areas or feed treated forage to livestock. Corn harvest aid: Do not use on corn grown for fodder or forage. Do not pasture livestock in treated fields. Soybean harvest aid: Do not pasture livestock within 15 days of treatment and remove 30 days before animal harvest.
Guardsman Max	May be grazed or fed to livestock at 40 or more days after application.
G-Max Lite	Sorghum may be grazed or fed to livestock 60 days or more after preemergence application or 45 days or more after postemerence application.
Halex GT	Do not graze or feed forage from treated areas for 45 days following application.
Harmony Xtra SG	Do not graze or feed forage for 7 days after application. Do not feed hay for 30 days following application. Harvested straw may be used for bedding 45 days between application and harvest.
Harmony GT XP/Unity	Do not graze or feed forage, hay or straw from treated areas to livestock.
Harness	No restrictions on label.
Harness Xtra	No restrictions on label.
Hoelon	Do not allow livestock to graze treated fields. Do not harvest forage, hay or straw from treated fields.
Hornet	No restrictions on label.
Ignite 280SL	In Liberty Link soybeans if postemergence applications have been made, do not graze the treated crop or cut for hay. In corn, do not apply within 60 days of harvesting corn forage.
Impact	Do not apply within 45 days of corn harvest. Do not graze or feed treated corn forage, silage, fodder or grain for at least 45 days after application.
Intrro	Grain sorghum: Do not graze harvest forage for 70 days following application. Soybeans: Do not feed forage, hay or straw. Do not ensile treated soybeans.
Keystone	No information on label.
Laddok S-12	Do not graze treated areas or feed treated forage to livestock for 21 days following application.
Lariat	Do not graze treated area or feed treated forage to livestock for 21 days following application.
Lasso	Corn: Do not graze treated areas or feed treated forage to livestock for 21 days following application. Grain sorghum: Do not graze harvest forage for 70 days following application. Soybeans: Do not feed forage, hay or straw. Do not ensile treated soybeans.
Lexar EZ	Do not graze or feed forage from treated areas for 45 days following application.
Liberty 280SL	In Liberty Link soybeans if postemergence applications have been made, do not graze the treated crop or cut for hay. In corn, do not apply within 60 days of harvesting corn forage.
Liberty ATZ	Do not harvest corn forage within 60 days of application. Do not feed treated green immature growing soybean plants to livestock.
Linex	Do not graze treated fields or feed forage from treated areas to livestock. Do not feed gin trash to livestock.
Lumax EZ	Do not graze or feed forage from treated areas for 45 days following application.
MCPA	Do not forage or graze meat or dairy animals on treated areas within 7 days of slaughter.
Microtech	Corn: Do not graze treated areas or feed treated forage to livestock for 21 days following application. Grain sorghum: Do not graze harvest forage for 70 days following application. Soybeans: Do not feed forage, hay or straw. Do not ensile treated soybeans.
NorthStar	Do not graze or feed forage from NorthStar-treated corn to livestock within 30 days following application. Do not harvest silage within 45 days after application.
Olympus Flex	Wheat may be harvested for forage 30 days after applciation, or for grain and straw 71 days after application.
OpTill	Do not feed or graze soybeans.
OpTill PRO	Do not graze or feed treated soybean forage, hay or straw to livestock.
Option	Do not harvest corn grain within 70 days and corn forage within 45 days of an application. Do not graze within 45 days of an application.
Osprey	Wheat: Do not apply within 30 days of grazing; 60 days for hay, grain and straw.
Outlook	May be grazed or fed to livestock at 40 or more days after application.
Paramount	No information on label
Partner	Corn: Do not graze treated areas or feed treated forage to livestock for 21 days following application. Grain sorghum: Do not graze harvest forage for 70 days following application. Soybeans: Do not feed forage, hay or straw. Do not ensile treated soybeans.

Forage, feed and grazing restrictions for herbicides - *continued*

Herbicide	Restrictions
Peak	Do not graze or feed forage from treated crops until 30 days following application. Do not harvest for silage until 40 days following application.
Permit	Allow 30 days before grazing and harvest of forage or silage.
Phoenix	Do not graze animals on green forage or stubble. Do not feed treated soybean silage (ensiled soybeans) to cattle. Do not use hay or straw for animal feed or bedding.
Poast/Poast Plus	Do not graze treated fields and do not feed treated soybean forage (green succulent) or ensilage to livestock. Treated soybean hay may be fed. Do not apply within 60 days of harvest for fodder or 45 days for corn forage/silage.
Prefix	Do not graze treated areas or harvest for forage or hay.
Prequel	Do not graze or feed forage, grain, or fodder from treated areas to livestock within 30 days of application.
Princep	Do not graze treated areas, or illegal residues may occur.
Prowl H_2O	Do not graze treated cotton or rice fields. Do not use rice straw for feed or bedding. Livestock can graze or be fed soybean forage from treated corn 21 days following application.
Pursuit	Do not graze or feed treated soybean forage, hay or straw to livestock.
Python	Do not graze or feed treated soybean forage, hay or straw to livestock. No corn information on label.
Raptor	Do not graze treated soybean forage, hay or straw to livestock.
Realm Q	Do not graze, feed forage, grain or fodder (stover) from treated areas to livestock within 45 days of application.
Reflex	Do not graze treated areas or harvest for forage or hay. Do not graze rotated small grain crops or harvest for livestock forage or straw.
Resolve	Do not graze or feed forage for 7 days after application. Do not feed hay for 30 days following application. Harvested straw may be used for bedding 45 days between application and harvest.
Resource	Do not graze animals or green forage or use as a feed fewer than 28 days after application.
Roundup Original Max	Roundup Ready Soybean: Allow a minimum of 14 days between final application and feeding of grain, forage, or hay. Roundup Ready Corn: Do not harvest or feed treated crops for 8 weeks after application. Spot treatment: Allow 14 days following spot treatment or selective equipment before grazing domestic livestock. Corn harvest aid: Allow a minimum of 7 days between application and feeding of treated vegetation. Grain sorghum harvest aid: Allow a minimum of 7 days between application and feeding of treated vegetation. Soybean harvest aid: Do not graze or harvest treated crop for livestock feed within 25 days of last preharvest application. Wheat harvest aid: Wheat stubble may be grazed immediately after harvest.
Scepter	Do not graze or feed treated soybean forage, hay or straw to livestock.
Select/ Select Max	Do not graze treated fields or feed treated forage or hay to livestock.
Sencor	Treated vines may be grazed or fed to livestock 40 days after application.
Sequence	Do not feed treated soybean forage or hay for 30 days after application.
Sharpen	Soybean forage may be fed or grazed 65 or more days after application.
Shotgun	Do not graze for feed forage from treated areas for 21 days following application.
Sodium chlorate	Grain sorghum: Do not graze treated fields or feed treated fodder, forage or seeds within 14 days of application. Rice: No information on label. Soybeans: Do not graze treated fields or feed treated soybean foliage or fodder.
Sonic	Do not feed treated soybean forage or hay to livestock. Do not harvest soybeans for 65 days after application of Sonic.
Spartan	No information on label.
Spirit	Do not graze or feed forage from Spirit-treated crops to livestock until 30 days after application.
Starane	Do not allow livestock to graze treated areas or harvest treated forage within 7 days of application to wheat, barley or oats, 47 days to corn, and 40 days to grain sorghum.
Status	Do not apply within 32 days of forage harvest. Do not apply within 72 days of corn grain and stover harvest.
Steadfast	Do not graze or feed forage, hay or straw from treated areas to livestock within 30 days of application.
Stellar	Do not graze animals on green forage or stubble. Do not use hay or straw for animal feed or bedding.
Storm	Do not use treated plants for feed or forage.
Stout	Do not graze or feed forage, hay, or straw from treated areas to livestock within 30 days of application.
Surestart/TripleFLEX	No restrictions on label.
Surpass EC	No restrictions on label.
Synchrony	Do not graze treated fields for forage or hay.
TopNotch	No restrictions on label.
Touchdown	Do not graze or harvest treated cover crops for feed.
Touchdown HiTech	Roundup Ready Corn: Allow a minimum of 50 days between postemergence application and harvest of forage. Roundup Ready Soybean: Do not graze or harvest for forage or hay.
Touchdown Total	Roundup Ready Corn: Allow a minimum of 50 days between postemergence application and harvest of forage. Roundup Ready Soybean: Do not graze or harvest for forage or hay.
Treflan	No information on label.
Ultra Blazer	Do not use treated plants for feed or forage.
Valor	Do not graze treated fields or feed treated forage or hay to livestock.

Forage, feed and grazing restrictions for herbicides - *continued*

Herbicide	Restrictions
Valor XLT	Do not graze treated fields or feed treated forage or hay to livestock.
Verdict	Corn or popcorn forage and silage can be fed, harvested, or grazed 80 or more days after application. Do not graze or feed soybean forage, hay, or straw to livestock.
Warrant	Do not graze or feed treated soybean or cotton forage to livestock.
Yukon	Following application to forage, corn may be grazed or harvested for feed after the crop reaches the ensilage (milk) stage, at least 30 days after foliar application.
Zemax	Do not graze or feed forage from treated areas for 45 days following application.
Zorial	Do not graze treated cotton fields with livestock or feed treated cotton forage to livestock. Cover crops planted after harvest should be plowed under and not grazed or harvested.

Herbicide compatibility with fertilizers as application carriers*

	Fertilizer	
Herbicide	**Fluid**	**Dry**
Burndown herbicides:		
2,4-D Amine	No	No
2,4-D Ester	Yes	No
Glyphosate	No	No
Gramoxone	Yes	No
Harmony Extra	Yes	No
Sharpen	Yes	Yes
Touchdown	No	No
Verdict	Yes	Yes
Preemergence herbicides:		
Atrazine	Yes	No
Axiom	Yes	Yes
Axiom AT	Yes	Yes
Balance Flexx	Yes	No
Banvel	Yes	No
Bicep II Magnum/Cinch ATZ	Yes	Yes
Bicep LiteII Mag./Cinch Lite ATZ	Yes	Yes
Boundary	Yes	Yes
Bullet	Yes	Yes
Callisto	Yes*	No
Caparol	No	No
Command	Yes	Yes
Command Xtra	Yes	No
Commence	Yes	Yes
Cotoran	Yes	No
Clarity	Yes	No
Degree	Yes	Yes
Degree Xtra	Yes	Yes
Domain	No	Yes
Dual II/ Magnum/Cinch	Yes	Yes
Epic	Yes	Yes
Extreme	No	No
Fieldmaster	Yes	No
FirstRate	Yes	Yes
Fultime	Yes	Yes
Guardsman Max	Yes	Yes
Harness	Yes	Yes
Harness Xtra	Yes	Yes
Hornet	Yes	Yes
Impact/Armezon	Yes	Yes

	Fertilizer	
Herbicide	**Fluid**	**Dry**
Karmex	No	No
Keystone/Breakfree ATZ	Yes	Yes
Lariat	Yes	Yes
Lasso	Yes	Yes
Lexar EZ	Yes*	No
Linex	Yes	Yes
Lumax EZ	Yes*	No
Outlook	Yes	Yes
Paramount	No	No
Partner	Yes	Yes
Prefix	Yes	No
Prowl H_2O	Yes	Yes
Pursuit	Yes	No
Python	Yes	Yes
Ramrod	Yes	No
Scepter	Yes	Yes
Sencor	Yes	Yes
Sonolan	Yes	Yes
Surpass/Breakfree	Yes	Yes
TopNotch	Yes	Yes
Treflan	Yes	Yes
Valor	NI	NI
Verdict	Yes	Yes
Zorial	Yes	Yes
Small grain postemergence herbicides:		
2,4-D Amine	No	No
2,4-D Ester	Yes	No
Achieve	No	No
Aim	No	No
Banvel	Yes	No
Buctril	Yes	No
Bronate	Yes	No
Harmony Extra	Yes	No
Hoelon	Yes	No
MCPA	No information on label	
Olympus	Yes	-
Olympus Flex	Yes	No
Osprey	No	No
Peak	Yes	No
Sencor	Yes	No

Note: There are many specific fertilizer incompatibilities and restrictions with most herbicides. Be sure to read the herbicide label for specific mixing or impregnation instructions. Compatibility agents are required for many mixes. A typical compatibility test procedure for mixing herbicides in fluid fertilizers is given in the introductory section of this publication.

NI: No information on label

*Do not use with suspension fertilizers.

Rainfall-free periods, preharvest intervals (PHI), and crop safety restrictions for postemergence herbicides

Herbicide	Time before rainfall	PHI (crop safety restriction)
2,4-DB	NI*	Soybeans: 60 days
2,4-D and MCPA	6 to 8 hr	Corn: 7 days (Overtop- 8″; drop nozzles- before tasseling) Grain sorghum: (Overtop- 8″; drop nozzles- 15″) Rice: (Before internode exceeds 1/2″) Wheat: (Before jointing) Wheat harvest aid: Hard dough
Accent	4 hr	Corn: 30 days (overtop- before 20″/6 collars; drop nozzles-before 36″/10 collars)
Achieve	1 hr	Wheat: 60 days
Aim	1 hr	Corn: (14 collars) Cotton: 7 days Grain sorghum: (6-leaf stage post; harvest aid: 3 days Rice: 60 days Soybeans: (V3-V10 post; harvest aid: 3 days) Wheat: (Jointing; harvest aid: 3 days)
Assure II	1 hr	Cotton: 80 days Soybeans: 80 days
Atrazine	1 to 2 hr	Corn: (12″) Grain sorghum: (12″)
Authority MTZ	NI*	Soybeans: 120 days
Banvel	6 to 8 hr	Corn: (1 pt- 5″; 1/2 pt- 36″) Grain sorghum: (Overtop- 8″; drop nozzles- 15″) Wheat: (Before jointing)
Basagran	8 hr***	Corn: No Restrictions Rice: No Restrictions Soybeans: No restrictions
Basis	4 hr	Corn: (4-leaf)
Beacon	4 hr	Corn: 60 days (overtop- before 20″; drop nozzles- before tassel emergence)
Bicep products	1 to 2 hr	Corn: NA, (5″)
Blazer	6 hr	Rice: 50 days (Before boot stage) Soybeans: 50 days
Bronate	NI*	Wheat: NI*
Buctril		Corn: 30 days Sorghum: (Before boot stage) Cotton: 60 days Wheat: NI*
Buctril + Atrazine	1 hr	Corn: NI* Grain sorghum: NI*
Callisto	1 hr	Corn: 45 days (30″ or 8-leaf)
Callisto Xtra	1 hr	Corn: Up to 12-inch corn
Clarity	4 hr	Corn: (1 pt- 5″; 1/2 pt- 36″) Grain sorghum: (Overtop- 8″; drop nozzles- 15″) Wheat: (Before jointing)
Classic	1 hr	Soybeans: 45 days
Clincher	2 hr	Rice: 60 days
Cobra	30 min.	Cotton: 70 days Soybeans: 45 days
Concert	1 hr	Soybeans: 60 days
Conclude Xact	4 hr	Soybeans: 75 days
Distinct	4 hr	Corn: 72 days (24″)
Dual II Magnum	NA**	Corn: (5″)
Extreme	NI*	Soybeans: 35 days (before bloom)
FirstRate	2 hr	Soybeans: 65 days for grain, 14 days for forage (50% flowering)
Flexstar	1 hr	Soybeans: 45 days
Flexstar GT 3.5	1 hr	
Fultime	NA**	Corn: 60 days (11″)
Fusilade	1 hr	Cotton: 90 days Soybeans: (First bloom)
Fusion	1 hr	Cotton: 90 days Soybeans: 1st bloom
Frontrow	2 hr	Soybeans: 70 days
Gramoxone	30 min	Burndown: NA** Corn harvest aid: 7 days Soybean harvest aid: 14 days

Rainfall-free periods, preharvest intervals (PHI), and crop safety restrictions for postemergence herbicides - *continued*

Herbicide	Time before rainfall	PHI (crop safety restriction)
Guardsman Max	1-2 hours	Corn: 40 days (8″)
Halex GT	1 hr	Corn: 45 days
Harmony Extra	"Several hours"	Burndown: NA** Wheat: 45 days
Harmony GT XP/Unity	1 hour	Soybeans: 60 days Wheat: Before flag leaf stage
Harness/Degree	NA**	Corn: (11″)
Harness Xtra/ Degree Xtra	1 to 2 hr	Corn: NA (11″)
Hoelon	1 hr	Wheat: 77 days
Hornet	2 hr	Corn: 85 days (20″)
Keystone/Breakfree ATZ	NA**	Corn: 60 days (11″)
Laddok S-12	8 hr***	Corn: 21 days (Fifth leaf) Grain sorghum: NI*
Lexar EZ	1 hr	Corn: 60 days (12″)
Liberty	4 hr	Corn: 70 days for grain, 60 days for forage (Overtop- 24″ or 7 collars, drop nozzles- 36″)
Liberty ATZ	4 hr	Corn: 70 days for grain, 60 days for forage (12″ corn)
Linex	NI*	Corn: NI* Grain sorghum: NI* Soybeans: 60 days
Lumax EZ	1 hr	Corn: 45 days (5″)
NorthStar	4 hr	Corn: 60 days for grain, 45 days for silage (Overtop- 20″ or 4 collars, drop nozzles- 36″)
Olympus	4 hr	Wheat: 71 days
Olympus Flex	4 hr	Wheat: 71 days
OpTill	1 hr	Applications must be made before crop emergence.
Osprey	4 hr	Wheat hay, grain, and straw: 60 days; Wheat forage: 30 days
Outlook	NA**	Corn: 40 days (8″)
Paramount	6 hr	Grain sorghum: (12 inches)
Peak	4 hr	Corn: 60 days (48 inches) Grain sorghum: 60 days (30 inches) Wheat: 60 days (Second node)
Phoenix	30 min.	Soybeans: 45 days
Permit	4 hr	Corn: Forage/Silage- 30 days (grain- lay-by) Grain sorghum: Forage/Silage- 30 days (grain- lay-by) Rice: 28 days (Preflood application only)
Pinnacle	1 hr	Soybeans: 60 days Wheat: Before flag leaf stage
Poast/Poast Plus/ Prestige	1 hr	Corn: Grain- 60 days; Forage/Silage- 45 days Cotton: 40 days Soybeans: 75 days
Prefix	NA**	Soybeans: 90 days
Pursuit	1 hr	Corn: 45 days Soybeans: 85 days (Before bloom)
Raptor	1 hr	Soybeans: 85 days (Before bloom)
Ready Master ATZ	2 hr	Corn: 50 days (12″)
Reflex	4 hr	Soybeans: 45 days
Resource	1 hr	Corn: Forage/Silage- 28 days; Grain- 60 days Soybeans: 60 days
Roundup	2 hr (1 hour UltraMax) (30 min WeatherMax)	Burndown: NA** Corn: 50 days (24 inches or 6 collars) Cotton: 7 days (Overtop- 4 leaf; directed- not specified) Soybeans: 14 days Harvest aid (Corn, Cotton, Grain sorghum, Small grain, Soybeans) : 7 days
Scepter	2 hr	Soybeans: 90 days
Select/ Select Max	1 hr	Cotton: 60 days Soybeans: 60 days (40 days for 4-oz red rice seedhead suppression label)
Sencor	NI*	Wheat: 21 days Corn: prior to tasseling
Sharpen	1 hr	Applications must be made before crop emergence.
Shotgun	NI*	Corn: (Overtop- 4 leaf or 8″, drop nozzles- 12″) Grain sorghum: (Overtop- 4 leaf or 8″, drop nozzles- 12″)
Spirit	4 hr	Corn: Forage/Silage 40 days; Grain- 60 days (Overtop- 20″ or 6 collars, drop nozzles- 24″)
Steadfast	4 hr	Corn: 30 days (12inches or 6 collars)

Rainfall-free periods, preharvest intervals (PHI), and crop safety restrictions for postemergence herbicides - *continued*

Herbicide	Time before rainfall	PHI (crop safety restriction)
Storm	6 hr	Rice: 50 days (End of tillering) Soybeans: 50 days
Surpass/Breakfree XP	NA**	Corn: (11″)
Surestart/TripleFLEX	NI*	Corn: 85 days
Synchrony STS	1 hr	Soybeans: 60 days
Touchdown HiTech		RR Soybean: 14 days with no more than 20 fl oz/A RR Corn: 7 days with no more than 20 fl oz/A Conventional soybean: 7 days with no more than 3.6 Qts/a Conventional corn: 7 days
Touchdown Total	NI*	Corn and soybeans: 7 days
Ultra Blazer	4 hr	Rice: 50 days Soybeans: 50 days
Valor	1 hr	
Valor XLT	1 hr	No information on label
Verdict	1 hr	Applications must be made before corn emergence.
Yukon	4 hr	Corn: 30 days (36″) Grain sorghum: 30 days (Overtop- 8″ drop nozzles 15″)

*No information on label.
**Not applicable
***Label now states that rainfall soon after application may decrease effectiveness.

Corn diseases and their management

Corn diseases can and do occur each year in Missouri. Problems with germination and stand establishment that are related to seed decay, damping-off and seedling blights are often encountered in the field. These losses can be costly, especially if replanting is necessary. Diseases may cause leaf spots or leaf blights, wilts or premature death of plants. Corn diseases also can cause harvest losses, affect the quality of the harvested crop and cause storage losses. The extent of the damage due to corn diseases in a given season depends on a number of factors including the susceptibility of the corn hybrid to the specific disease, the level of pathogen inoculum present and the environmental conditions during that season.

To minimize losses due to corn diseases, it is important to correctly identify the disease or diseases present so that appropriate management steps can be taken. The principal diseases of corn in Missouri can be divided into seed rots and seedling diseases, foliage diseases, stalk rots, ear and kernel rots and a few miscellaneous diseases. For more detailed information including color pictures of diseases of corn in Missouri please see University of Missouri publication IPM 1001, *Corn Diseases.*

Finally, although the common diseases of corn are basically the same, regardless of the type of corn being grown; inbreds, some sweet corn hybrids and some specialty corn hybrids may be more susceptible to some of the common corn diseases than field corn. A pesticide label may also designate that the product is to be used on a specific type of corn. The tables included in this manual cover products registered for use on field corn. For other types of corn, always check the pesticide label and follow label specifications.

Seed rots and seedling blights

Seed rots and seedling blights are caused by a number of different fungal species. Some of these, such as *Pythium* species, *Fusarium* species and *Rhizoctonia solani*, are common soil fungi found wherever corn is grown. Some, such as *Fusarium moniliforme* and *Penicillium oxalicum*, may be either soilborne or seedborne.

Most of the seed rots and seedling blights on corn are more severe in wet soils, in low-lying areas in a field and in soils that have been compacted or remain wet for an extended period of time. Low soil temperatures (below 50–55 degrees F) favor seed rot and seedling blights. Disease severity is also affected by planting depth, soil type, seed quality, mechanical injury to seed, crusting, herbicide injury or other mechanical factors that delay germination and emergence of corn. Residues left on the soil surface may influence the incidence and severity of seedling blight through their effect on soil temperature and soil moisture.

Management options for seed rot and seedling blight

- Plant good-quality seed under good seedbed conditions, especially at soil temperatures above 50-55 degrees F.
- Use fungicide-treated seed. Almost all commercial field corn seed comes with a fungicide treatment already applied to the seed. Bags should have labels that list the products applied to the seed and the rate of each material applied. Occasionally there may be a need to apply additional fungicide treatment or a combination insecticide plus fungicide treatment for added protection. See accompanying table of seed treatment fungicides labeled for use on field corn.

Seed treatment fungicides for corn

Although seed treatment fungicides can be an effective means of preventing or reducing losses from various seedborne and soilborne microorganisms, there are several important laws or guidelines concerning fungicide-treated seed. Always read the pesticide label and follow all directions and restrictions on the label but in particular for seed treatment fungicides remember the following points.

- Do not use treated seed for food, feed or oil purposes.
- All treated seed must be colored with an EPA-approved dye that imparts an unnatural color to the seed.
- Federal law requires that bags containing treated seed shall be labeled with the following information: "This seed has been treated with (common chemical name of active ingredients) fungicide(s). Do not use treated seed for feed, food or oil purposes. Store away from feeds and food stuffs."

For years, seed companies have sold corn seed already treated with a seed treatment fungicide. There has also been the option of adding additional fungicide protection with on-farm planter-box products. Over the years the types of fungicides available have changed, and many seed companies or seed treating operations use a combination of several fungicides with varying modes of action to protect the seed from an array or seedborne and soilborne pathogens. More recently seed treatment insecticides have become available. Again, these seed treatment insecticides may be applied by the seed company or seed treating operation, making it possible to purchase seed treated with a fungicide, an insecticide or a combination of fungicide and insecticide.

Most recently, seed treatment nematicides have come on the market. Now corn seed might be treated with a combination of fungicide, insecticide and/or nematicide seed treatment chemicals.

Marketing strategies are also changing. Some seed treatment products are widely marketed to seed companies and dealers. Other products may be marketed under an exclusive agreement with a single seed company. That seed company has exclusive rights to the use of the particular product for a specified number of years. That product would not be available to other seed companies, dealers or seed treating operations. Some seed companies are putting together package treatments of fungicides, insecticide and nematicides that they are strongly recommending for use on their genetics. This shift to package treatments and exclusive marketing to individual seed companies makes it difficult to compile a table of seed treatment fungicides and nematicides labeled for use on corn in Missouri. Check with your seed salesperson to find out what products are on the seed you are purchasing and to find out if the rates of the various active ingredients are appropriate for disease pressure in the fields

in which the seed will be planted.

The following table was prepared using current product labels and manufacturers' Web sites. However, label registrations can change at any time. Before using any agricultural pesticide, read and follow directions accompanying that product. Product names have been used for clarity. Reference to specific trade names does not imply endorsement by the University of Missouri; discrimination is not intended against similar products not listed.

Seed treatment fungicides and nematode protection products labeled for use on field corn

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Acceleron DC-309 Fungicide Seed Treatment for Corn Monsanto	metalaxyl	28.35%	0.75 fl oz per 100 lb of seed 0.10 to 0.375 fl oz per 100 lb of seed	For Pythium damping-off control. Reduced rates in combination with other fungicides to aid in the control of seed decay and damping-off caused by *Pythium*. Apply only in combination with EPA registered rates of broad-spectrum seed treatment fungicides.
Acceleron DC-509 Fungicide Seed Treatment for Corn Monsanto	ipconazole	40.70%	0.085 fl oz per 100 lb of seed	For protection against seedborne and soilborne fungi that cause seed decay, damping-off and seedling blight. Acceleron DC-509 does not provide activity against *Pythium* spp. to provide best seedling protection against a wide array of fungal pathogens, apply Acceleron DC-509 as a tank mix with Acceleron DE-309.
Acceleron DX-309 Fungicide Seed Treatment for Corn Monsanto	metalaxyl	28.35%	0.75 fl oz per 100 lb of seed 0.10 to 0.375 fl oz per 100 lb of seed	For Pythium damping-off control. Reduced rates in combination with other fungicides to aid in the control of seed decay and damping-off caused by *Pythium*. Apply only in combination with EPA registered rates of broad-spectrum seed treatment fungicides.
Acceleron DX-709 Fungicide Seed Treatment for Corn Monsanto	trifloxystrobin	22.00%	0.32 to 0.64 fl oz per 100 lb of seed	Provides seed and seedling protection against seedborne fungi, *Alternaria* spp., *Aspergillus* spp., *Cladosporium* spp. and *Penicillium* spp. causing seed decay and soilborne pathogens, *Rhizoctonia solani* and *Fusarium* spp.
Acquire BASF	metalaxyl	29.99%	0.75 fl oz per 100 lb of seed 0.10 to 0.375 fl oz per 100 lb of seed	For Pythium damping-off control. Reduced rates in combination with other fungicides to aid in the control of seed decay and damping-off caused by Pythium. Apply only in combination with EPA registered rates of broad-spectrum seed treatment fungicides. Acquire may be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
Allegiance Dry Chemtura AgroSolutions	metalaxyl	12.50%	1.5 to 2.0 oz per 100 lb of seed	For Pythium damping-off control. For planters with electronic eye monitors, periodically clean them with brushes provided by the planter manufacturer, according to their directions. Treat only those seeds needed for immediate use, minimizing the interval between treatment and planting. Do not carry over excess treated seed to next season. Do not use this product on seed that has been commercially treated with metalaxyl (Allegiance) fungicide. Hopper box seed treatment.
Allegiance-FL Bayer CropScience	metalaxyl	28.35%	0.75 fl oz per 100 lb of seed	For Pythium damping-off control. Allegiance-FL is a systemic fungicide seed dressing specifically for control of downy mildews, *Pythium* and *Phytophthora* spp. For control of other soilborne diseases, combination with Bayer CropScience Captan and Vitavax registered formulations are compatible. Do not use with other seed treatment products unless previous experience ensures compatibility. Allegiance-FL may be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
Apron XL Syngenta	mefenoxam	33.30%	0.0425 or 0.085 fl oz per 100 lb of seed	For Pythium seed rot and damping-off protection in field corn. If expected Pythium pressure is low to moderate use 0.0425 fl oz per 100 lb of seed. If expected Pythium pressure is high use 0.085 fl oz per 100 lb of seed. For a greater spectrum of seedling disease protection combine Apron XL with Maxim XL, Dynasty, or Maxim FS. Apron XL may be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.

Seed treatment fungicides and nematode protection products labeled for use on field corn - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Avicta Complete Corn Syngenta				Avicta Complete Corn is a promotional combination of separately registered products containing Avicta Duo Corn nematicide/insecticide and one or more of the following Cruiser insecticide, Apron XL, Maxim XL and/or Dynasty fungicide(s). Avicta Duo Corn is a restricted use pesticide. For use by certified applicators only. Growers planting Avicta Duo Corn treated seed are not required to be certified applicators.
Belmont 2.7 FS Chemtura AgroSolutions	metalaxyl	28.98%	0.75 fl oz per 100 lb of seed	For Pythium damping-off control. For the control of other soilborne diseases, use in combination with other seed treatment fungicides. Vitavax and RANCONA products are compatible with Belmont 2.7 FS. Do not use in combination with other seed treatment products unless compatibility and safety to crop has been verified. Belmont 2.7 FS may be applied on its own, as a water-based slurry or in combination with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
Concur Winfield Solutions, LLC	imidacloprid metalaxyl	25.00% 1.00%	1.5 oz per 42 lb of seed	For the protection of seeds and seedlings of field corn against damping-off, seed decay caused by *Pythium*. Concur may be used on seed previously treated with a full dosage of protective fungicide to give added protection against Pythium damping-off or seed decay. Treat only those seeds needed for immediate use, minimizing the interval between treatment and planting. Do not store excess treated seed beyond planting time. See label for rotational crop restrictions. Hopper box seed treatment.
Dithane F-45 Rainshield Dow AgroSciences	mancozeb	37.00%	4.3 to 8.6 fl oz per 100 lb of seed	For control of damping-off, seed rots and seedling blights. May be applied to dry seed with conventional slurry or mist seed treating equipment or as a planter box application.
Dithane M45 Dow AgroSciences	mancozeb	80.00%	2.7 to 5.4 oz per 100 lb of seed	
Dyna-Shield Metalaxyl Loveland Products Inc.	metalaxyl	28.35%	0.75 fl oz per 100 lb of seed	For Pythium damping-off control apply at the rate of 0.75 fl oz per 100 lb of seed. Reduced rate: to aid in the control of seed decay and damping-off caused by *Pythium* apply Dyna-Shield Metalaxyl Fungicide as a commercial seed treatment at the rate of 0.10 to 0.375 fl oz per 100 lb of seed. Apply only in combination with EPA registered rates of Loveland Products Inc. broad-spectrum seed treatment fungicides. May be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
Dyna-Shield Metalaxyl 318 FS Loveland Products Inc.	metalaxyl	30.14%	0.75 fl oz per 100 lb of seed	For Pythium damping-off control apply at the rate of 0.75 fl oz per 100 lb of seed. Reduced rate: to aid in the control of seed decay and damping-off caused by *Pythium* apply Dyna-Shield Metalaxyl 318 FS Fungicide as a commercial seed treatment at the rate of 0.10 to 0.375 fl oz per 100 lb of seed. Apply only in combination with EPA registered rates of Loveland Products Inc. broad-spectrum seed treatment fungicides. May be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
Dynasty Syngenta	azoxystrobin	9.60%	0.153 fl oz per 100 lb of seed	Target diseases: seedborne and soilborne fungi causing decay, damping-off and seedling blight as well as seedling damping-off (*Rhizoctonia* spp., *Pythium* spp., *Fusarium* spp., and *Penicillium* spp.). For optimum disease control, use Dynasty in combination with labeled rates of Maxim 4FS, Maxim XL and Apron XL products. Apply as a water-based slurry using seed treatment application equipment that will provide uniform coverage on the seed surface.

Seed treatment fungicides and nematode protection products labeled for use on field corn - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Kernel Guard Supreme Chemtura AgroSolutions	permethrin carboxin	10.42% 14.00%	1.5 oz canister per 42 lb of seed	Kernel Guard Supreme may be used on seed previously treated with a full dosage of protective funcicide, to give added protection against seedling blight, damping-off or seed decay. Treat only those seed needed for immediate use, minimizing the interval between treatment and planting. Kernel Guard Supreme is a planter box or hopper box seed treatment for on-farm use only on field corn immediately before planting.
KickStart VP Helena Chemical Company	carboxin permethrin	14.00% 10.42%	1.5 oz per 42 lb of seed	KickStart VP may be used on seed previously treated with a full dosage of protective fungicide to give added protection against seedling blight, damping-off or seed decay. Apply KickStart VP to seed at planting time with the canister applicator tube system. For best results, fill planter box with seed, add KickStart VP through applicator tube and mix so all seeds are covered. Do not mix with bare hands. Use only at the recommended rate. Lower amounts may not give desired control. Excessive amounts may cause seed injury.
Kodiak HB Chemtura AgroSolutions (formerly Trace Seed Protection Products)	*Bacillus subtilis* GB03	0.30%	4.0 oz per 100 lb of seed	For suppression of root diseases caused by *Fusarium* and *Pythium*. Contains bacteria that colonize the developing root system, suppressing disease organisms such as *Fusarium* and *Pythium* that attack root systems. When used with a chemical seed treatment, the combination of chemicals and Kodiak provides protection to the root for a much longer time than with chemicals alone. Kodiak HB is a hopper box seed treatment.
Latitude Chemtura AgroSolutions (formerly Trace Seed Protection Products)	imidacloprid carboxin metalaxyl	25.00% 14.00% 1.00%	1.5 oz per 42 lb of seed	For protection of seeds and seedlings against damping-off, seed decay and seedling blight caused by *Pythium* and *Rhizoctonia*. Latitude may be used on seed previously treated with a full dosage of protective fungicide to give added protection against seedling blight, Rhizoctonia and Pythium damping-off or seed decay. See label for rotational crop restrictions. Hopper box seed treatment.
Maxim Quattro Syngenta	fludioxonil mefenoxam azoxystrobin thiabendazole	3.32% 2.65% 1.33% 26.50%	0.39 to 0.53 fl oz per 80,000 kernel count	Target diseases: seedborne and soilborne fungi causing decay, damping-off and seedling blight; seedborne head smut (*Sporisorium reilianum*); and seedling damping-off (*Rhizoctonia* spp., *Penicillium* spp., *Pythium* spp. and *Fusarium* spp.). Apply Maxim Quattro as a water-based slurry using seed treatment application equipment that will provide uniform coverage on the seed surface. For commercial use only. Do not use in hopper box, planter box, slurry box or other farmer-applied applications.
Maxim 4FS Syngenta	fludioxonil	40.30%	0.08 to 0.16 fl oz per 100 lb of seed	For protection against seedborne and soilborne fungi that cause seed decay, damping-off and seedling blight as well as seedborne head smut (*Sphacelotheca reiliana*). Maxim 4FS is active against *Fusarium, Rhizoctonia, Helminthosporium* and weakly pathogenic fungi such as *Aspergillus* and *Penicillium*. When rate ranges are given, use higher rate when disease pressure is expected to be severe. For *Pythium* spp. control use Maxim 4FS in combination with labeled rates of Apron XL and Dynasty.
MetaStar ST Chemtura AgroSolutions (formerly Trace Seed Protection Products)	metalaxyl	29.99%	0.75 fl oz per 100 lb of seed	For Pythium damping-off control. MetaStar ST is a systemic fungicide seed dressing specifically for control of systemic downy mildews, *Pythium* and *Phytophthora* spp. For control of other soilborne diseases, combination of Captan and Vitavax registered formulations are compatible. Do not use with other seed treatment products unless previous experience assures compatibility. MetaStar ST may be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
Penncozeb 4FL United Phosphorus, Inc.	mancozeb	37.00%	4.3 to 8.6 fl oz per 100 lb of seed	For control of damping-off, seed rots and seedling blights. May be applied to dry seed with conventional slurry or mist seed treating equipment or as a planter box application.
Penncozeb 75DF United Phosphorus, Inc.	mancozeb	75.00%	2.9 to 5.8 oz per 100 lb of seed	
Penncozeb 80WP United Phosphorus, Inc.	mancozeb	80.00%	2.7 to 5.4 oz per 100 lb of seed	

Seed treatment fungicides and nematode protection products labeled for use on field corn - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Poncho/VOTiVO Bayer CropScience	clothianidin *Bacillus firmus* I-1582	40.30% 8.10%	2.7 fl oz per 80,000 seeds	Poncho/VOTiVO is a combination insecticide and biological seed treatment that, when applied to seed, protects the seed and seedling against certain early-season insects and provides early-season protection from listed plant pathogenic nematodes that attack the root system. As a result of the dual protection, there is an improvement in plant vigor, which often results in more uniform plants and greater yields. In areas of high nematode infestation additional control measures may be warranted. For corn the nematode pests include dagger, lance, needle, pin, ring, root know, root lesion, spiral, sting, stubby root and stunt nematodes. See label for plant-back restrictions. For use only in commercial seed treatment equipment. Not for use in hopper box, planter box, slurry box or other on-farm seed treatment applications.
Prevail Chemtura AgroSolutions	carboxin PCNB metalaxyl	15.00% 15.00% 3.12%	1.5 to 3.0 oz per bushel of seed	For protection against Pythium and Rhizoctonia seedling disease complex. Do not graze or feed livestock on treated areas for six weeks after planting. Prevail may be applied at planting time, using an on-farm mechanical treater to maximize seed coverage.
Raxil 2.6F Bayer CropScience	tebuconazole	28.30%	0.075 to 0.10 fl oz per 100 lb of seed for soilborne and seedborne *Fusarium* 0.37 to 0.74 fl oz per 100 lb of seed for soilborne and seedborne head smut (*Sphacelotheca reiliana*)	Apply as a seed treatment using standard slurry or mist-type seed treatment equipment. Uniform application of seed is necessary to ensure seed safety and best disease protection. Seed should be sound and well-cured before treatment. Product should be diluted with sufficient water to ensure complete seed coverage. Add dye to the resulting slurry. The length of control will vary depending on the rate used. For use only by commercial seed treaters.
Sativa 309 FS Nufarm Americas Inc.	tebuconazole	28.30%	0.075 to 0.1 fl oz per 100 lb of seed	For control or suppression of certain designated seed and soilborne diseases of corn including soilborne and seedborne *Fusarium* and soilborne and seedborne head smut. For head smut use 0.37 to 0.74 fl oz per 100 lb of seed. For use by commercial seed treaters only. Apply this product as a water-based slurry through standard slurry or mist-type commercial seed treatment equipment. Not for use on agricultural establishments in hopper-box, planter-box, slurry-box or other seed treatment applications at or immediately before planting. Uniform application to seed is necessary to ensure seed safety and best disease protection. The length of control will vary depending on the rate used.
Sebring 2.65 ST Nufarm Americas Inc.	metalaxyl	28.35%	0.75 fl oz per 100 lb of seed	For Pythium damping-off control. For control of other soilborne diseases, combination of captan, and Vitavax registered products are compatible. Do not use with other seed treatment products unless previous experience assures compatibility. May be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
Sebring 318 FS Nufarm Americas Inc.	metalaxyl	30.14%	0.75 fl oz per 100 lb of seed	For Pythium damping-off control. For control of other soilborne diseases, combination of captan, and Vitavax registered products are compatible. Do not use with other seed treatment products unless previous experience assures compatibility. May be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
Sebring 480 FS Nufarm Americas Inc.	metalaxyl	44.08%	0.50 fl oz per 100 lb of seed	For Pythium damping-off control. For control of other soilborne diseases, combination of captan, thiram and carboxin registered products are compatible. Do not use with other seed treatment products unless previous experience assures compatibility. Apply at the specified rate and premix with the seed directly in the planter box at planting. May be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.

Seed treatment fungicides and nematode protection products labeled for use on field corn - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Signet 480 FS Nufarm Americas Inc.	thiram	44.00%	1.50 fl oz per bushel of seed	Used according to directions, this product will usually increase stands and yields by reducing losses from seed decay, damping-off and seedling blights caused by many seedborne and soilborne organisms. This product should be applied with water as a suspension in the slurry-type treater specifically designed and approved for this purpose. For sale to and use by professional applicators only.
Stamina BASF	pyraclostrobin	18.40%	0.4 to 0.8 fl oz per 100 lb of seed	Target diseases: seed and seedling disease (damping-off) caused by *Rhizoctonia solani*, seedborne fungi causing seed decay, seedling damping-off as well as suppression of seed and seedling diseases caused by *Pythium* spp. and *Fusarium* spp. Stamina can be used in both commercial seed treatment facilities and on-farm systems. Apply Stamina as a water-based mixture using standard slurry or mist-type seed treatment application equipment.
System[3] Helena Chemical Company	PCNB metalaxyl *Bacillus subtilis*	16.67% 4.25% 0.10%	2.0 to 3.0 oz per bushel of seed	For Pythium and Rhizoctonia seedling disease complex. Use the higher rate of application in fields with a history of severe disease pressure. Apply at the specified rate and premix with the seed directly in the planter box at planting. May be applied at planting time using commercial seed treating equipment to maximize seed coverage.
Trilex Bayer CropScience	trifloxystrobin	22.00%	0.32 to 0.64 fl oz per 100 lb of seed	Provides seed and seedling protection against seedborne fungi causing seed decay and the soilborne pathogen, *Rhizoctonia solani* and *Fusarium* spp. The length of control will vary depending on the rate used. Use in combination with broad spectrum product and/or a product effective against *Pythium* spp. to improve overall disease control. Apply as a seed treatment using standard slurry or mist-type seed treatment equipment.
VITAFLO-280 Chemtura AgroSolutions	carboxin thiram	15.59% 13.25%	4.5 fl oz per 100 lb of seed 8.5 to 11.0 fl oz per 100 lb of seed for protection against head smut (*Sphacelotheca reiliana*)	Combination of a systemic fungicide (carboxin) and a contact fungicide (thiram) providing plant protection against seedborne and soilborne seedling diseases including damping-off and seed decay. 8.5 to 11.0 fl oz per 100 lb of seed controls only seedborne head smut. Do not graze or feed livestock on treated areas for six weeks after planting. Formulated for both on-farm and commercial use. DO NOT apply VITAFLO-280 as a planter box or hopper box treatment. VITAFLO-280 may be applied with mechanical, slurry, or mist-type seed treating equipment, provided that the equipment can be calibrated to accurately and uniformly apply the product to seed.
Vitavax-34 Chemtura AgroSolutions	carboxin	34.00%	2.0 to 4.0 fl oz per 100 lb of seed	2.0 to 4.0 fl oz per 100 lb of seed for *Rhizoctonia solani* seed rots, damping off and seedling blights. The higher rate will provide increased protection on highly infected seeds. The 4.0 fl oz rate provides systemic control of seedborne head smut. May be used for application to seed that has been or will be treated with protectant fungicides such as captan or thiram to obtain a wider spectrum of control. Follow the more restrictive labeling of any tank mix partner. May be applied with mechanical, slurry, or mist-type seed treating equipment provided that the equipment can be calibrated to accurately and uniformly apply the product to the seed. Do not graze or feed livestock on treated areas for 6 weeks after planting.

Corn foliage diseases

A number of fungi and a few bacteria can cause foliage diseases of corn. These various foliar pathogens cause leaf spots, leaf blights and similar symptoms on corn. Symptoms may range from the small, oval to elliptical water-soaked lesions of Holcus leaf spot to the long, elliptical, grayish-green or tan lesions of northern corn leaf blight. Lesion size, shape and color may vary among hybrids and with environmental conditions.

The fungi that cause most of these corn foliage diseases survive in infested corn residues left on the soil surface. The following growing season, spores are produced during moist periods and are carried by wind currents to susceptible corn leaves where infection may begin. Disease problems tend to be more severe when corn is planted in fields with infested corn residue left on the soil surface. Eventually spores that are produced in initial lesions on leaves are wind blown to other leaves or plants, causing secondary infection.

Common rust and southern rust of corn are two exceptions to this simplified explanation of disease development. The rust fungi do not survive in infested residues left in a field and, in fact, do not survive the winter months in Missouri. Rather, the rust fungi are reintroduced into this area each season when spores are carried on air currents from the southern United States.

Most of these foliage diseases of corn are favored by warm temperatures and wet or humid weather or heavy dews. They tend to start on the lower leaves and, if weather conditions are favorable, move up through the plant.

Generally, if foliage diseases do not become established until six weeks after tasseling, yield losses are minimal. If disease is established before tasseling or becomes severe within two to three weeks after tasseling and pollination, significant yield losses may occur.

Management options for corn foliage diseases

- Plant disease-resistant corn hybrids.
- Rotate crops with at least one year between corn crops.
- Manage corn residues. In reduced tillage systems, hybrid selection and crop rotation are especially important.
- Apply foliar fungicides if warranted. Foliar fungicides tend to give the best economic return on specialty corns such as seed corn, white corn or popcorn rather than on field corn. See accompanying table for foliar fungicides labeled for use on field corn.

Foliar fungicides for corn

In addition to crop rotation, residue management and resistant hybrids, foliar fungicides can be used to control corn foliage diseases. Products labeled for use on field corn are listed in the following table. Fungicide labels do differentiate among field corn, popcorn, seed corn, sweet corn and processing sweet corn. Other products not listed in this table may be labeled for use on other types of corn.

The following table was prepared using current company product labels and manufacturers' Web sites. However, label registrations can change at any time. Before using any agricultural pesticide, read and follow directions accompanying that product. Product names have been used for clarity. Reference to specific trade names does not imply endorsement by the University of Missouri; discrimination is not intended against similar products not listed.

Foliar fungicides labeled for use on field corn

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
AVARIS Helena Chemical Company	azoxystrobin propiconazole	7.00% 11.70%	7.0 to 14.0 fl oz per acre	Apply 7.0 to 14.0 fl oz per acre for northern corn leaf blight, northern corn leaf spot and southern corn leaf blight. Apply 10.5 to 14.0 fl oz per acre for anthracnose leaf blight, rusts (*Puccinia* spp.), gray leaf spot and eyespot. Apply AVARIS when disease first appears. If conditions favorable for disease persist, continue to apply on a 14-day schedule. Under heavy disease pressure or if conditions are favorable for diseases, apply the highest labeled rate. Apply no more than 2 applications of AVARIS or any other Group 11 fungicide per year. Do not apply more than 56.0 fl oz per acre per season of AVARIS. Do not apply more than 28.0 fl oz per acre per season for field corn harvested for forage. See label for additional information on resistance management. AVARIS is most effective when applied and allowed to dry before a rainfall. For best results, sufficient coverage is important. Use a higher water volume for aerial application (greater than 2 GPA) if equipment and/or conditions would not provide good coverage. AVARIS may be applied by ground, air or chemigation. AVARIS is extremely toxic to certain apple varieties. Extreme care must be used to prevent injury to apple trees. See label for additional information. Do not apply within 30 days of harvest for forage, grain or stover.

Foliar fungicides labeled for use on field corn - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Bumper 41.8 EC Makhteshim Agan of North America, Inc.	propiconazole	41.80%	2.0 to 4.0 fl oz per acre	For control of Helminthosporium leaf blights (*Helminthosporium maydis*, *H. turcicum*, and *H. carbonum*), apply 2.0 to 4.0 fl oz per acre. Apply when disease first appears and continue on a 7- to 14-day schedule. Use the low rate when disease pressure is low. Under heavy disease pressure or when conditions favor disease development, apply the high rate. Apply Bumper 41.8 EC at recommended rates by ground, air or chemigation. For control of rusts (*Puccinia* spp.), gray leaf spot and eyespot, apply 4.0 fl oz per acre. Apply Bumper 41.8 EC at recommended rates by ground, air or chemigation, when rust pustules first appear and continue on a 7- to 14-day schedule when conditions favor disease development. For best disease control, early applications at initial disease onset perform better. Do not apply more than 16.0 fl oz of Bumper 41.8 EC per acre per season. Do not apply more than 8.0 fl oz of Bumper 41.8 EC per acre per season on field corn harvested for forage. Do not apply within 30 days of harvest for forage, grain and stover.
Dithane DF Rainshield Dow AgroSciences	mancozeb	75.00%	1.5 lb per acre	For control of common corn rust and Helminthosporium leaf blight on field corn and hybrid seed corn. Start applications when disease symptoms first appear and, depending on severity of infection, continue on a 4- to 14 day schedule. The addition of Latron CS-7 will improve performance. Amount of product that can be applied over course of season will vary with formulation — see label.
Dithane F-45 Rainshield Dow AgroSciences	mancozeb	37.00%	1.2 qt per acre	
Dithane M45 Dow AgroSciences	mancozeb	80.00%	1.5 lb per acre	Do not apply within 40 days of harvest.
Domark 230 ME Valent	tetraconazole	20.50%	4.0 to 6.0 fl oz per acre	For use against gray leaf spot, common rust, southern rust, anthracnose leaf blight, eye spot, northern corn leaf blight, northern corn leaf spot and southern corn leaf blight. Apply prior to disease onset when conditions favor disease development. Curative applications are most effective when disease incidence does not exceed 5% of the plants at the time of application. Apply as a foliar spray or via chemigation in sufficient water to obtain thorough coverage of plants. Do not make more than one application per year. Do not apply more than 6.0 fl oz Of Domark per acre per year. Do not apply Domark after corn growth stage R3 (milk). Do not use adjuvants in sprays made between V8 (8 leaf collar) and VT (lowest branch of tassel visible but silks have not emerged) growth stage. See label for further information.
EVITO 480 SC Arysta LifeScience North America, LLC	fluoxastrobin	40.3%	2.0 to 5.7 fl oz per are	Disease control of common rust, southern rust, anthracnose leaf blight, gray leaf spot, northern corn leaf blight, northern corn leaf spot, southern corn leaf blight and eyespot. Apply a maximum of two applications preventatively, with the final application no later than the R4 early dough stage. Do not apply more than 11.4 fl oz per acre per year. There is a maximum number of two applications per season, and a minimum interval of 7 days between applications. EVITO 480 SC may be applied by ground, air or chemigation. Do not apply after the R4 stage (early dough). Do not apply within 30 days of harvest.
EVITO T Fungicide Arysta LifeScience North America, LLC	fluoxastrobin tebuconazole	18.00% 25.00%	4.0 to 9.0 fl oz per acre	Disease control of common rust, southern rust, anthracnose leaf blight, gray leaf spot, northern corn leaf blight, northern corn leaf spot, southern corn leaf blight and eyespot. Apply a maximum of two applications preventatively, with the final application no later than the R4 early dough stage. Minimum retreatment interval is 7 days. Do not apply more than 18.0 fl oz per acre per year. There is a maximum number of two applications per season. EVITO T may be applied by ground, air or chemigation. Do not apply after the R4 stage (early dough). Restricted-entry (REI) is 12 hours. EVITO T Fungicide may be applied up to 36 days before harvest of grain or fodder.

Foliar fungicides labeled for use on field corn - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Folicur 3.6 F Bayer CropScience	tebuconazole	38.70%	4.0 to 6.0 fl oz per acre	Rust (*Puccinia* spp.), northern leaf blight, southern leaf blight, northern leaf spot and gray leaf spot. Apply Folicur 3.6 F in a protective spray schedule or when weather conditions are favorable for disease development. Repeat applications at 7- to 14-day intervals, or as necessary to maintain control. For optimum disease control, the lowest labeled rate of a spray surfactant should be tank-mixed with Folicur 3.6 F. Folicur 3.6 F must have at least two hours of drying time on corn foliage for the active ingredient to move systemically into plant tissue before rain or irrigation occurs. After this time period, Folicur 3.6 F will be resistant to weathering. A maximum of 24.0 fl oz (1.5 pt) of Folicur 3.6 F may be applied per acre per season. Restricted-entry interval (REI) for field corn is 12 hours. For field corn: Folicur 3.6 F may be applied up to 21 days before the harvest of forage and 36 days before the harvest of grain or fodder.
Headline BASF	pyraclostrobin	23.60%	6.0 to 9.0 fl oz per acre or 9.0 to 12.0 fl oz per acre	The 6.0 to 9.0 fl oz per acre rate targets common rust, southern rust and gray leaf spot. The 9.0 to 12.0 fl oz per acre rate targets anthracnose, northern corn leaf blight, northern corn leaf spot, Physoderma brown spot, southern corn leaf blight and yellow leaf blight. For optimal disease control, begin applications of Headline before disease development and continue on a 7- to 14- day interval if conditions are conducive for disease development. Use the higher rate and shorter interval when disease pressure is high. The optimal application timing for Headline in corn is VT through R2 stages (full tassel through blister) and/or the onset of disease. An adjuvant may be used with Headline only after corn reaches the VT stage or later. Do **not** use adjuvants before the VT stage. Before the VT stage, do **not** combine other products or additives with Headline. At the VT stage or later, Headline may be mixed with other products. Consult the label for products tank mixed with Headline. See label for information on resistance management. Minimum time from last application to harvest (PHI) is seven days.
Headline AMP BASF	pyraclostrobin metconazole	13.64% 5.14%	10.0 to 14.4 fl oz per acre	Target diseases: anthracnose, eyespot, gray leaf spot, northern corn leaf blight, Physoderma brown spot, rust (*Puccinia* spp.) southern corn leaf blight and yellow leaf blight. For optimal disease control, begin applications of Headline AMP before disease development and continue on a 7- to 14-day schedule if conditions for disease development persist. Use the higher rate and shorter interval when disease pressure is high. To limit the potential for development of resistance, do not make more than two sequential applications of Headline AMP before alternating to another fungicide with a different mode of action. See label for additional information on resistance management. Do not use adjuvants after the V8 stage and before the VT stage of corn growth. (The VT stage is defined as when the last branch of the tassel is completely visible outside of the whorl). A compatibility agent, another fungicide or an insecticide may be included in the tank mix, if needed and labeled for use in corn. See label for additional application instructions and restrictions. Do not enter or allow worker entry into treated areas during the restricted-entry interval (REI) of 12 hours. Minimum time from application to harvest (PHI) for field corn grain and field corn stover is 20 days.
Manzate Pro-Stick United Phosphorus, Inc. **Manzate Flowable** United Phosphorus, Inc.	mancozeb mancozeb	75.00% 37.00%	1.5 lb per acre 1.2 qt per acre	For control of common rust, Helminthosporium leaf blight and gray leaf spot on field corn and field corn for hybrid seed production. Use sufficient water for thorough coverage. Start applications when disease first appears and repeat at 4- to 7-day intervals. Do not apply more than 15 lb or 12 qt per acre per season. Do not feed treated forage to livestock. Do not apply within 40 days of harvest.

Foliar fungicides labeled for use on field corn - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Monsoon Loveland Products Inc.	tebuconazole	38.70%	4.0 to 6.0 fl oz per acre	Target diseases: rust (*Puccinia* spp.), northern leaf blight, southern leaf blight, northern leaf spot and gray leaf spot. Apply Monsoon in a protective spray schedule or when weather conditions are favorable for disease development. Repeat applications at 7- to 14-day intervals, or as necessary to maintain control. For optimum disease control, the lowest labeled rate of a spray surfactant should be tank-mixed with Monsoon. Monsoon must have two to four hours of drying time on corn foliage for the active ingredient to move systemically into plant tissue before rain or irrigation occurs. After this period of time Monsoon will be resistant to weathering. A maximum of 24.0 fl oz (1.5 pt) of Monsoon may be applied per acre per season. Restricted-entry interval (REI) for all corn except sweet corn is 12 hours. For field corn: Monsoon may be applied up to 21 days before the harvest of forage and 36 days before the harvest of grain or fodder.
Orius 3.6F Makhteshim Agan of North America, Inc.	tebuconazole	38.70%	4.0 to 6.0 fl oz per acre	Target diseases: rust (*Puccinia* spp.), northern leaf blight, southern leaf blight, northern leaf spot and gray leaf spot. Apply Orius 3.6F in a protective spray schedule or when weather conditions are favorable for disease development. Repeat applications at 7- to 14-day intervals, or as necessary to maintain control. For optimum disease control, the lowest labeled rate of a spray surfactant should be tank-mixed with Orius 3.6F. Orius 3.6F must have two to four hours of drying time on corn foliage for the active ingredient to move systemically into plant tissue before rain or irrigation occurs. After this period of time Orius 3.6F will be resistant to weathering. A maximum of 24.0 fl oz (1.5 pt) of Orius 3.6F may be applied per acre per season. Restricted-entry interval (REI) for all corn except sweet corn is 12 hours. For field corn: Orius 3.6F may be applied up to 21 days before the harvest of forage and 36 days before the harvest of grain or fodder.
Penncozeb 4FL United Phosphorus, Inc.	mancozeb	37.00%	0.8 to 1.2 fl oz per acre	For control of common rust, gray leaf spot and Helminthosporium leaf blight on field corn and corn grown for seed. Start application at the onset of disease and repeat as needed. Amount of product that can be applied over course of season will vary with formulation — see label. Do not apply within 40 days of harvest.
Penncozeb 75DF United Phosphorus, Inc.	mancozeb	75.00%	1.0 to 1.5 lb per acre	
Penncozeb 80WP United Phosphorus, Inc.	mancozeb	80.00%	1.0 to 1.5 lb per acre	
Priaxor Xemium Brand Fungicide BASF	fluxapyroxad pyraclostrobin	14.33% 28.58%	4.0 to 8.0 fl oz per acre	Target diseases: anthracnose, eyespot, gray leaf spot, northern corn leaf blight, northern corn leaf spot, Physoderma brown spot, common rust, southern ruts and yellow leaf blight. For optimal disease control, begin applications prior to disease development and continue on a 7 to 14 day interval if conditions are conducive for disease development. DO NOT use adjuvants or crop oil after the V8 stage and prior to the VT stage unless specifically recommended on BASF labeling. Do not apply more that 6.0 fl oz per acre per season. Do not make more than two consecutive applications of Priaxor before alternating to a labeled fungicide with a different mode of action. Do not harvest for forage within 7 days of last application. Minimum time from application to harvest is 21 days.
Proline 480 SC Fungicide Bayer CropScience	prothioconazole	41.00%	5.7 fl oz per acre	Diseases controlled: anthracnose leaf blight, eye spot, gray leaf spot, northern corn leaf blight, northern corn leaf spot, southern corn leaf blight and rusts. Apply at the first sign of disease. Repeat applications as needed on a 7- to 14-day interval if favorable conditions for disease development persist. Application of Proline 480 SC is not recommended at times when corn is under severe environmental stress conditions. May be applied by either ground, aerial or chemigation application equipment. Do not apply more than 22.8 fl oz per acre per season. For field corn do not apply within 14 days of harvest for grain and fodder. Forage may be harvested the same day of application.

Foliar fungicides labeled for use on field corn - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Propiconazole 41.8% AmTide LLC	propiconazole	41.80%	2.0 to 4.0 fl oz per acre	2.0 to 4.0 fl oz per acre for Helminthosporium leaf blights. 4.0 fl oz per acre for rusts (*Puccinia* spp.), eyespot and gray leaf spot. Apply by air, ground or chemigation. Best control of disease is obtained when AmTide Propiconazole 41.8% is applied early in the season (when disease is first detected. Reapply every 7 to 14 days if conditions remain favorable for disease development. Use sufficient volumes of water to ensure a thorough, uniform coverage of foliage. For best results allow residues to dry on foliage before a rainfall event. Preharvest interval (PHI) for field corn is 30 days for corn harvested as forage, grain and stover.
PropiMax EC Dow AgroSciences	propiconazole	41.80%	2.0 to 4.0 fl oz per acre	For control of Helminthosporium leaf blights (*Helminthosporium maydis, H. turcicum* and *H. carbonum*), rusts (*Puccinia* spp.), gray leaf spot (*Cercospora zeae maydis*), and eyespot (*Kabatiella zeae*), apply PropiMax EC by ground, aerial or chemigation equipment. Helminthosporium leaf blights: apply PropiMax EC at the rate of 2.0-4.0 fl oz per acre when disease first appears. Continue on a 7- to 14-day schedule. Use the low rate when disease pressure is low. Apply the high rate under heavy disease pressure or if conditions are favorable for disease. Rusts, eyespot and gray leaf spot: apply PropiMax EC at the rate of 4.0 fl oz per acre when disease first appears. If conditions favorable for disease persist, continue to apply on a 7- to 14-day schedule. For best disease control, early applications at initial disease onset perform better. Do not apply more than 16.0 fl oz of PropiMax EC per acre per season. Do not apply more than 8.0 fl oz of PropiMax EC per acre per season on field corn harvested for forage. Do not apply within 30 days of harvest for forage, grain and stover.
Quadris Syngenta	azoxystrobin	22.90%	6.2 to 9.0 fl oz per acre	Target diseases: rust (*Puccinia sorghi*), anthracnose leaf blight, gray leaf spot, northern corn leaf blight, northern corn leaf spot, southern corn leaf blight and eyespot. See label for information on integrated pest management and resistance management. Application directions: for gray leaf spot apply Quadris at the onset of disease. A second application may be required 14 days later if disease pressure persists. For all other diseases, Quadris applications should begin before disease development and may continue throughout the season every 7 to 14 days following the resistance management guidelines. Applications may be made by ground, air or chemigation. An adjuvant may be added at recommended rates. Quadris is extremely toxic to certain apple varieties. See "General Use Instructions" on the label for additional information on safety precautions to avoid injury to apple trees. Do not apply more than 123.0 fl oz per acre per season. Do not apply within seven days of harvest.

Foliar fungicides labeled for use on field corn - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Quilt Syngenta	azoxystrobin propiconazole	7.00% 11.70%	7.0 to 14.0 fl oz per acre for northern corn leaf blight, northern corn leaf spot and southern corn leaf blight 10.5 to 14.0 fl oz per acre for rusts (*Puccinia* spp.), gray leaf spot and eyespot	For leaf blights apply Quilt when disease first appears. Continue on a 7- to 14-day schedule. Use the low rate when disease pressure is low. Under heavy disease pressure or if conditions are favorable for disease apply the high rate. Apply no more than two applications of Quilt or any other Group 11 fungicide per year. Quilt is most effective when applied and allowed to dry before a rainfall. For best results, sufficient water volume should be used to provide adequate coverage. Quilt may be applied by ground, air or chemigation. Do not apply to field corn and field corn grown for seed after brown silk. Quilt is extremely toxic to certain apple varieties. See "General Use Instructions" on label for additional information on safety precautions to avoid injury to apple trees. Do not apply more than 56.0 fl oz per acre per season of Quilt. Do not apply within 30 days of harvest for forage, grain or stover.
Quilt Xcel Syngenta	azoxystrobin propiconazole	13.50% 11.70%	10.5 to 14.0 fl oz per acre	For rusts (*Puccinia* spp.), gray leaf spot, eyespot, anthracnose leaf blight, Diplodia ear rot, northern corn leaf blight, northern corn leaf spot and southern corn leaf blight. For gray leaf spot, rusts, anthracnose, ear rot and eyespot, apply 10.5 to 14.0 fl oz per acre when disease first appears. If conditions favorable for disease persist, continue to apply on a 14-day schedule. For leaf blights apply 10.5 to 14.0 fl oz per acre when disease first appears. Continue on a 7- to 14-day schedule. Use the low rate when disease pressure is low. Under heavy disease pressure or if conditions are favorable for disease apply the high rate. Applications before tasseling may impose stress on the plant that could inhibit proper kernel development, especially under environmentally stressful conditions. Do not apply more than 56.0 fl oz per acre per season. Do not apply within 30 days of harvest for forage, grain or stover.
Stratego Bayer CropScience	propiconazole trifloxystrobin	11.40% 11.40%	10.0 to 12.0 fl oz per acre	For control of anthracnose leaf blight, rust (*Puccinia* spp.), eyespot, gray leaf spot, northern corn leaf blight, northern corn leaf spot and southern corn leaf blight. Apply when disease first appears and continue on a 7- to 14- day interval if favorable conditions for disease development persist. Use the higher rates and shorter intervals when disease pressure is severe. Application of Stratego is not recommended at times when corn is under severe environmental stress conditions. Stratego may be applied by ground, air or chemigation. Do not apply more than 24.0 fl oz of Stratego per acre per crop. Do not apply more than two sequential applications of Stratego. Limit the number of Stratego or other Group 11 containing fungicide applications to no more than two per acre per crop. Do not apply within 30 days of harvest for forage, grain and stover.

Foliar fungicides labeled for use on field corn - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Stratego YLD Fungicide Bayer CropScience	prothioconazole trifloxystrobin	10.80% 32.30%	4.0 to 5.0 fl oz per acre	For control of anthracnose leaf blight, rust (*Puccinia* spp.), eyespot, gray leaf spot, northern corn leaf blight, northern corn leaf spot and southern corn leaf blight. Apply Stratego YLD Fungicide when disease first appears and continue on a 7- to 14-day interval if conditions for disease development persist. Use the higher rate and shorter intervals when disease pressure is severe. Use of an adjuvant may enhance the performance of Stratego YLD Fungicide. If utilized, apply the lowest label recommended rate of a NIS adjuvant to enhance disease control. Application is not recommended at times when corn is under severe environmental stress conditions. Stratego YLD Fungicide may be applied by ground, air or chemigation. Do not apply more than 10.0 fl oz per acre per season. Do not apply more than two sequential applications. Forage may be harvested the same day of application. Do not apply within 14 days of harvest for grain and fodder.
TEBU 3.6F AmTide, LLC	tebuconazole	40.53%	4.0 to 6.0 fl oz per acre	For rust (*Puccinia* spp.), northern leaf blight, southern leaf blight, northern leaf spot and gray leaf spot. Apply TEBU 3.6F Foliar Fungicide in a protective spray schedule or when weather conditions are favorable for disease development. Repeat applications at 7- to 14-day intervals or as necessary to maintain control. For optimum disease control, the lowest label rate of a spray surfactant should be tank-mixed with TEBU 3.6F. TEBU 3.6F must have two to four hours of drying time on corn foliage for the active ingredients to move systemically into plant tissue before rain or irrigation occurs. After this period of time, TEBU 3.6F will be resistant to weathering. A maximum of 24.0 fl oz of TEBU 3.6F may be applied per acre per season. Restricted-entry interval (REI) is 12 hours. Preharvest interval (PHI) for field corn is 21 days for forage and 36 days for grain or fodder.
Tebuzol 3.6F Fungicide United Phosphorus, Inc.	tebuconazole	38.70%	4.0 to 6.0 fl oz per acre	For rust (*Puccinia* spp.), northern leaf blight, southern leaf blight, northern leaf spot and gray leaf spot. Apply Tebuzol 3.6F in a protective spray or when weather conditions are favorable for disease development. Repeat applications at 7- to 14-day intervals, or as necessary to maintain control. For optimum disease control, the lowest specified rate of a spray surfactant should be tank-mixed with Tebuzol 3.6F. Tebuzol 3.6F must have two to four hours of drying time on corn foliage for the active ingredient to move systemically into plant tissue before rain or irrigation occurs. After this period of time, it will be resistant to weathering. A maximum of 24.0 fl oz of Tebuzol 3.6F may be applied per acre per crop season. Restricted-entry interval (REI) for all corn except sweet corn is 12 hours. On field corn, Tebuzol 3.6F may be applied up to 21 days before harvest of forage and 36 days before the harvest of grain or fodder.

Foliar fungicides labeled for use on field corn - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Tilt Syngenta	propiconazole	41.80%	2.0 to 4.0 fl oz per acre	Northern corn leaf blight, northern corn leaf spot and southern corn leaf blight (also known as Helminthosporium leaf blights): 2.0 to 4.0 fl oz per acre. For leaf blights apply Tilt when disease first appears. Continue on a 7- to 14- day schedule. Use the low rate when disease pressure is low. Under heavy disease pressure or if conditions are favorable for disease, apply the high rate. Rusts (*Puccinia* spp.), gray leaf spot and eyespot: 4.0 fl oz per acre. Apply Tilt when disease first appears. If conditions favorable for disease persist, continue to apply on a 7- to 14-day schedule. For best disease control, early applications (at initial disease onset) perform better. Tilt is most effective when applied and allowed to dry before a rainfall. For best results, sufficient water volume should be used to provide thorough coverage. Tilt may be applied by ground, air or chemigation. Do not apply more than 16.0 fl oz per acre per season of Tilt. Do not apply more than 8.0 fl oz per acre per season of Tilt on field corn harvested for forage. Do not apply within 30 days of harvest for forage, grain and stover.
Toledo Rotam North America, Inc.	tebuconazole	38.70%	4.0 to 6.0 fl oz per acre	For rusts, northern leaf blight, southern leaf blight, northern leaf spot and gray leaf spot. Apply Toledo in a protective spray schedule or when weather conditions are favorable for disease development. Repeat applications at 7-14 day interval, or as necessary to maintain control. For optimum disease control, the lowest labeled rate of a spray surfactant should be tank-mixed with Toledo. Toledo must have two to four hours of drying time on corn foliage for the active ingredient to move systemically into the plant tissue before rain or irrigation occurs. After this period of time, Toledo will be resistant to weathering. Do not apply more than 24.0 fl oz of Toledo per acre per crop season. Restricted-entry interval (REI) for all corn except sweet corn is 12 hours. For field corn Toledo may be applied up to 21 days before harvest of ears or forage and 36 days before the harvest of fodder.

Fungicide efficacy for control of corn diseases

The Corn Disease Working Group (CDWG) has developed the following information on fungicide efficacy for control of major corn diseases in the United States. Members of the Corn Disease Working Group (formerly the North Central Development Committee 214- Corn Diseases) are corn pathologists within the United States and Canada who meet annually to discuss important issues related to corn diseases and who shared data from corn foliar fungicide trials to prepare the following table fungicide efficacy table. Efficacy ratings for each fungicide listed in the table were determined by field testing the materials over multiple years and locations by the members of the committee. Efficacy ratings are based upon level of disease control achieved by product, and are not necessarily reflective of yield increases obtained from product application. Efficacy depends upon proper application timing, rate, and application method to achieve optimum effectiveness of the fungicide as determined by labeled instructions and overall level of disease in the field at the time of application. Differences in efficacy among fungicide products were determined by direct comparisons among products in field tests and are based on a single application of the labeled rate as listed in the table. The following table includes the most widely marketed products available, but is not intended to be a list of all labeled products (see table note 1).

Fungicide efficacy for control of corn diseases — June 2012

Fungicide(s)				Anthracnose leaf blight	Common rust	Eyespot	Gray leaf spot	Northern leaf blight	Southern rust	Diplodia ear rot	Fusarium ear rot	Gibberella ear rot	Harvest restriction[6]
Class	Active ingredient (%)	Product/Trade name	Rate/A (fl oz)										
Strobilurin Group 11	Azoxystrobin 22.9%	Quadris 2.08 SC	6.0 - 15.5	VG	E	VG-E	E[2]	G	G	NL	NL	NL	7 days
	Pyraclostrobin 23.6%	Headline 2.09 EC/SC	6.0 - 12.0	--[3]	E	E	E	VG	E	NL	NL	NL	7 days
Triazole Group 3	Propiconazole 41.8%	Tilt 3.6 EC PropiMax 3.6 EC Bumper 41.8 EC	2.0 - 4.0	NL	VG	E	G	G	G	NL	NL	NL	30 days
	Prothioconazole 41.0%	Proline 480 SC	5.7	--[3]	--[3]	--[3]	--[3]	VG	--[3]	NL	--[3,4]	--[3,4]	14 days
	Tebuconazole 38.7%	Folicur 3.6 F[5] Orius 3.6 F	4.0 - 6.0	NL	--[3]	NL	--[3]	VG	--[3]	NL	NL	NL	36 days
Mixed mode of action	Azoxystrobin 7.0% Propiconazole 11.7%	Quilt 200 SC	7.0 - 14.0	NL	VG-E	E	E	VG	VG	NL	NL	NL	30 days
	Azoxystrobin 13.5% Propiconazole 11.7%	Quilt Xcel 2.2 SE	10.5 - 14.0	VG	VG-E	VG-E	E	VG	VG	--[3]	NL	NL	30 days
	Pyraclostrobin 13.6% Metconazole 5.1%	Headline AMP 1.68 SC	10.0 - 14.4	--[3]	E	E	E	VG	VG	NL	NL	NL	20 days
	Trifloxystrobin 11.4% Propiconazole 11.4%	Stratego 250 EC	10.0 - 12.0	--[3]	VG	E	VG	G	G	NL	NL	NL	14 days
	Trifloxystrobin 32.3% Prothioconazole 10.8%	Stratego YLD 4.18 SC	4.0 - 5.0	VG	E	VG	E	VG	VG	NL	NL	NL	30 days

Notes:

[1]Additional fungicides labeled on corn include Domark (tetraconazole), Evito (fluoxastrobin) and Evito T (fluoxastrobin + tebuconazole). Insufficient data is available at this time to make statements about efficacy of these products for diseases listed in the table.

[2]Efficacy categories: NR=Not Recommended; P=Poor; F=Fair; G=Good; VG=Very Good; E=Excellent; NL = Not Labeled for use against this disease

[3]Insufficient data to make statement about efficacy of this product for this disease.

[4]Applications of Proline 480 SC for use on ear rots requires a FIFRA Section 2(ee) and is only approved for use in Illinois, Indiana, Iowa, Louisiana, Maryland, Michigan, Mississippi, North Dakota, Ohio, Pennsylvania, and Virginia.

[5]Multiple generic products containing tebuconazole may also be labeled in some states.

[6]Harvest restrictions are listed for field corn harvested for grain. Restrictions may vary for other types of corn (sweet, seed or popcorn, etc.), and corn for other uses such as forage or fodder.

Many products have specific use restrictions about the amount of active ingredient that can be applied within a period of time or the amount of sequential applications that can occur. Please read and follow all specific use restrictions prior to fungicide use.

This information is provided only as a guide. It is the responsibility of the pesticide applicator by law to read and follow all current label directions. Reference to products in this publication is not intended to be an endorsement to the exclusion of others that may be similar. Persons using such products assume responsibility for their use in accordance with current directions of the manufacturer. Members or participants in the CDWG assume no liability resulting from the use of these products.

Corn virus diseases

Maize dwarf mosaic is a virus disease of corn that is spread by several species of aphids. Although the symptoms of maize dwarf mosaic are highly variable, the most common symptom is a light green to yellow mottling or mosaic pattern in the leaf tissue.

Scattered, individual plants with symptoms of maize dwarf mosaic may be found in most years. Periodically, weather conditions favor the large-scale movement of virus-carrying aphids from southern regions of the United States. These aphids may then "rain out" or be deposited in large numbers in fields in Missouri or more northern areas of the Corn Belt. Under these conditions, maize dwarf mosaic virus may be prevalent and serious over a significant acreage.

Maize dwarf mosaic is caused by several strains of the maize dwarf mosaic virus (MDMV). Corn and sorghum are the main crop hosts of MDMV; however, johnsongrass and other wild grasses are also hosts. Some strains of MDMV overwinter in johnsongrass and are spread from the johnsongrass to corn by the aphid vectors. More than 15 species of aphids can transmit MDMV.

Many commercial corn hybrids have high levels of tolerance to MDMV.

Maize chlorotic dwarf is caused by a virus that is spread by the leafhopper, *Graminella nigrifrons*. Again, symptoms of maize dwarf chlorotic are highly variable. The most characteristic symptom of maize chlorotic dwarf is veinbanding or veinclearing, but other symptoms that may occur include reddening or yellowing of leaf tissue, distortion of leaf tissue and shortening of the upper internodes of the plant.

The maize dwarf chlorotic virus can overwinter in johnsongrass. It is transmitted to corn by its leafhopper vector. Although proso millet, pearl millet, sorghum, Sudan grass and wheat are also hosts of the maize chlorotic dwarf virus, corn appears to the principal host in the field.

Management options for corn virus diseases

- Plant resistant or tolerant hybrids.
- Plant early.
- Maintain good weed control, especially of johnsongrass.
- In some cases, control of the insect vectors through application of an appropriate insecticide may be warranted.

Crazy top of corn

Crazy top of corn is caused by the downy mildew fungus, *Sclerophthora macrospora*. The pathogen is a soilborne fungus that causes infection when corn plants are subjected to saturated soil conditions for 24 to 48 hours from planting to about the five-leaf stage of growth.

The disease causes a deformation of plant tissues, including excessive tillering and rolling or twisting of leaves. On severely infected plants, leaves may be narrow and straplike. There may be a proliferation of the tassel until it resembles a mass of leafy structures. Plants may produce numerous ear shoots. Infected plants are frequently stunted.

In seasons with wet springs, young corn plants subjected to saturated soil conditions may show symptoms of crazy top. Occasionally a band of affected plants may encircle a drowned out spot in a field. Some hybrids may be more susceptible to crazy top. This disease is seldom severe enough to cause significant losses.

Management options for crazy top

- Provide good soil drainage.

Stewart's bacterial wilt of corn

Stewart's bacterial wilt of corn is caused by the bacterium *Erwinia stewartii* and is spread by corn flea beetles. Foliage symptoms include linear, pale green to yellow streaks that tend to follow the veins of leaves and originate from feeding marks of the corn flea beetle. These streaks soon become dry and brown and tend to be irregular and vary in size and shape.

The bacterium that causes Stewart's bacterial wilt overwinters in the guts of corn flea beetles. Adult corn flea beetles feed on corn seedlings in late spring and early summer and contaminate the feeding wounds with the bacterium. Warm winter weather conditions favor the survival of the corn flea beetle and disease development the following spring. Cold winters reduce beetle populations and limit disease development and spread.

Although the foliage symptoms of Stewart's bacterial wilt are common on field corn in Missouri, the damage is seldom of economic significance. Stewart's bacterial wilt can be especially destructive on some sweet corn hybrids and corn inbreds.

Management options for Stewart's bacterial wilt

- Plant resistant hybrids. Most commercial field corn hybrids have good tolerance to Stewart's bacterial wilt.
- Maintain good weed control in and around corn fields.
- Although insecticide applications to control the flea beetle vector may be warranted on sweet corn and corn inbreds, decisions to treat flea beetles on field corn should be based more on direct insect feeding damage than potential damage from Stewart's bacterial wilt.

Common smut of corn

Common smut caused by the fungus *Ustilago maydis* results in the formation of galls on the aboveground portions of the corn plant. Initially the galls are firm and silver to grayish white in color throughout. As the galls age, the center of the gall turns into a mass of powdery, black spores while the outer covering of the gall remains silver to grayish white.

The black, resting spores (known as chlamydospores or teliospores) fall from the smut galls to the soil where they overwinter. The spores may be spread by surface drainage water, farm machinery, insects and wind. Under favorable conditions, the resting spores germinate and produce another type of spores (sporidia) which are spread by wind or splashing water to young, actively dividing corn tissues. Moisture is needed for the spores to germinate and penetrate the host, so rainfall or humid conditions are assumed to

be critical during this phase of the disease cycle. The spores of the common smut fungus are able to infect only tissue that has been damaged by insects, hail, blowing soil particles, herbicides, detasseling or other factors, or young meristematic tissues (such as young silks, young cob tissues and young developing kernels). Visible galls may develop within a few days of infection.

Common smut usually causes only small yield losses (less than 2 percent), but in rare years it may cause yield losses of 10 percent or more depending on where gall formation occurs and the number of ears infected.

Management options for common smut

- Plant tolerant or resistant hybrids.
- Avoid mechanical injury to plants.
- Maintained balanced fertility. Excessive nitrogen tends to increase disease incidence and severity.

Corn nematodes

Several species of nematodes, or microscopic roundworms, can cause damage on corn. Some corn nematode species spend most of their lives in the soil, while others live mostly in the roots. During feeding nematodes may directly harm plants or they may cause wounds through which fungi and bacteria can enter plants and cause secondary rots.

Corn nematodes

lesion nematode	*Pratylenchus* spp.
stunt nematode	*Tylenchorhynchus* spp.
lance nematode	*Hoplolaimus* spp.
spiral nematode	*Helicotylenchus* spp.
ring nematode	*Criconemella* spp.
dagger nematode	*Xiphinema* spp.
root-knot nematode	*Meloidogyne* spp.
stubby-root nematode	*Paratrichodorus* spp.
needle nematode	*Longidorus breviannulatus*
sting nematode	*Belonolaimus* spp.

The presence of nematodes in a field depends on the soil type and its properties, other soil microorganisms, cropping history, tillage, the use of pesticides and climatic factors such as temperature and rainfall. Although damage can occur in any soil type, corn growing in well-drained soils, especially sandy soils, is most susceptible to damage. In poorly drained soils, nematode populations usually increase slowly or may even decline. The extent of nematode damage is often related to the growing conditions of the plant. Corn that is stressed by poor fertility or lack of moisture cannot withstand the additional stress of nematode feeding and will show more pronounced symptoms.

It is difficult to generalize about the symptoms caused by nematodes because they vary with the nematode species, the number of nematodes present and the soil environmental factors. Aboveground symptoms are due to nematode injury to the roots. Early-season symptoms may include stunting or off-color leaves. Symptoms later in the season include a ragged or uneven appearance to the field, lodging, general unthriftiness and reduced yields. Common evidence of nematode feeding on roots includes root pruning, especially of feeder roots, proliferation of fibrous roots, thickening or swelling of the smaller roots, and slight to severe discoloration of roots. Damage may be localized in one part of a field or spread over large areas of a field.

Because nematodes cannot be seen with the naked eye and because symptoms of nematode injury are easily confused with other types of corn production problems, nematode problems should be diagnosed by submitting soil and root samples to a laboratory qualified to run a nematode analysis on the samples.

Management options for corn nematodes

- Rotate to a crop other than corn in fields with nematode problems. The length of the rotation may vary with nematode species and population levels.
- Maintain good weed control.
- Fertilize according to soil test recommendations, because corn suffering from improper fertility is more susceptible to injury from nematodes.
- Although several soil-applied nematicides are labeled for use on corn, economic and environmental concerns limit their use.
- More recently, seed treatment products have become available to aid in managing some corn nematodes. See preceding seed treatment table.

Corn stalk rots

Stalk rots are important worldwide and are among the most destructive diseases of corn. A number of different fungi and bacteria cause stalk rots of corn. Although many of these pathogens cause distinctive symptoms, certain general symptoms are common to all stalk rot diseases. Early symptoms, which occur a few weeks after pollination, usually start with premature dying of bottom leaves. Eventually, the entire plant may die and appear light green to gray. Diseased stalks usually begin losing firmness during August. The cells in the interior of the stalk are dissolved, resulting in a loss of stalk firmness and strength. Stalks may then lodge, particularly if harvest is delayed or wind storms occur.

Stalk rots are caused by several different fungi and bacteria that are part of the complex of microorganisms that decompose dead plant material in the soil. They survive from one growing season to the next in soil, in infested corn residues or on seed. Stalk rot pathogens enter the corn plant in a variety of ways. The spores may be blown into the base of the leaf sheath, where they may germinate and grow into the stalk. Spores may enter directly into a plant through wounds made by corn borers, hail or mechanical injury. When fungi are present in soil or infested residue as either spores or mycelium, they may infect the root system, causing root rot early in the growing season and later grow up into the stalk causing stalk rot.

Stalk rot becomes a problem when plants are stressed during the grain filling stage of development. Water shortage, extended periods of cloudy weather, temperature stresses, hail damage, corn borer infestation, low potassium in relation to nitrogen, leaf diseases and other stresses that occur in August and September may be associated with an

increase in stalk rot.

Losses from stalk rots vary from season to season and from region to region. Yield losses of 10 to 20 percent may occur on susceptible hybrids. Tolls greater than 50 percent have been reported in localized areas. Losses may be direct losses due to poor filling of the ears or lightweight and poorly finished ears or indirect through harvest losses because of stalk breakage or lodging. Harvest losses may be reduced if fields are scouted 40 to 60 days after pollination to check for symptoms of stalk rot. Stalk rot can be detected by either pinching stalks or pushing on stalks. If more than 10 to 15 percent of the stalks are rotted, the field should be harvested as soon as possible.

Management options for corn stalk rots

- Select hybrids with good stalk strength and lodging characteristics.
- Plant at recommended plant populations for that hybrid.
- Follow proper fertility practices.
- Maintain good insect and weed control.
- If irrigating, try to deliver optimum water from silking to late dough stage.
- Avoid or minimize stress to corn (especially during pollination and grain fill).
- Harvest in a timely manner.

Ear and kernel rots of corn

A number of fungi can invade and cause damage to corn ears or kernels. Field fungi invade the kernels before harvest while the corn is still in the field. These fungi may affect the appearance and quality of kernels. Usually damage caused by field fungi occurs before harvest, can be detected by routine inspection of corn in the field and does not continue to develop in storage if the grain is stored at proper moisture content and temperature. Some of the field fungi on corn in Missouri include species of *Alternaria*, *Cladosporium*, *Aspergillus*, *Penicillium*, *Diplodia*, *Fusarium* and *Gibberella*. Most of these fungi are more prevalent when rainfall is above normal from silking to harvest. One exception is *Aspergillus flavus*, which is favored by drought stress to corn during pollination and by warm temperatures as kernels mature. For all field fungi, damage tends to be more severe on ears with insect, bird or hail damage. Ears well covered by husks and maturing in a downward position usually have less rot than ears with open husks or ears maturing in an upright position. Some of these fungi, in particular species of *Penicillium* and *Aspergillus*, can also be problems on corn in storage. If grain is not stored at the proper moisture content and temperature, these fungi can cause extensive damage to the stored grain.

Mycotoxins associated with ear and kernel rots of corn

An additional concern with ear and kernel rots of corn is the possibility of mycotoxin production. Mycotoxins are naturally produced chemicals that in small amounts may be deleterious to animal or human health. Three genera of fungi – *Aspergillus*, *Penicillium* and *Fusarium (Gibberella)* – are most frequently involved in cases of mycotoxin contamination in corn. The presence of molds or their spores on or in corn does not necessarily mean that mycotoxins will be produced. Circumstances that favor mold growth may allow production of mycotoxins in some situations but frequently mold growth occurs with little or no mycotoxin production. Once formed, mycotoxins are stable and may remain in grain long after the fungus has died. In general, swine and poultry are more susceptible than ruminants to mycotoxin-induced health problems at an equivalent dosage. Where mycotoxin problems are suspected, a sample should be submitted to a qualified laboratory for mycotoxin analysis.

Little can be done to prevent or reduce the invasion of corn by field fungi. However, the following recommendations should help minimize damage from field fungi on corn, especially corn going into storage.

Management options for corn ear and kernel rots

- Plant locally adapted hybrids with husks that close over ear tips.
- Plant at recommended plant populations for that hybrid and maintain good plant vigor over the growing season.
- Use a balanced fertility program.
- Select planting dates appropriate for your area.
- Follow recommended management practices to limit damage by ear feeding insects.
- If irrigating, try to deliver optimum water from silking to late dough stage.
- Harvest in a timely fashion.
- Adjust the harvesting equipment for minimum kernel damage and maximum cleaning.
- Clean the grain and bins thoroughly before storage to remove dirt, dust and other foreign matter, crop debris, chaff and cracked or broken kernels.
- Store grain in watertight structures that are free from insects and rodents.
- Store grain at proper moisture content and temperature.
- Monitor grain on a regular basis throughout storage life to ensure moisture content and temperature are maintained at correct levels.

Cotton disease and nematode management

Cotton sales are important to the economy of many states, including Missouri. Unfortunately, diseases of cotton can interfere with production and greatly affect farmer profits. Although the effects of cotton diseases on the Missouri economy are not as dramatic as in some other states, cotton yield loss due to diseases can seriously affect an individual producer's profit. Fortunately, most cotton diseases can be managed through use of the proper management options.

An accurate diagnosis is essential when selecting cotton disease and nematode management options. For help with diagnosis of cotton diseases, consult a University of Missouri Extension specialist or someone at the University of Missouri Plant Diagnostic Laboratory at 23 Mumford Hall, Columbia, MO 65211 (phone: 573-882-3019).

This section provides information about general cotton disease management options and detailed information about labeled fungicides and nematicides for management of cotton diseases. For additional information see University of Missouri Extension publications G4261, *Cotton Disease and Nematode Management*; G4259, *Cotton Nematodes in Missouri: Your Hidden Enemies*; and MP734, *Cotton Seedling Diseases: Answers to Frequently Asked Questions.*

Management methods

There are several strategies for managing cotton disease and nematode problems in cotton. The three most important are to rotate crops, plant resistant varieties, and plant in warm, well-drained soil. An integrated approach that uses all of these methods usually is the most effective and profitable.

Improved varieties immune to all or most cotton diseases do not exist. However, newer cotton varieties often have improved levels of resistance to Fusarium wilt. Farmers should choose varieties based on MU yield trials in their area and resistance to locally significant diseases (see results of variety trials online).

Rotating cotton with corn or certain soybean varieties will help manage several cotton diseases. Unfortunately, this will not help manage root-knot nematodes.

Boll rot is most prevalent during warm, humid, rainy weather, especially when insect feeding injures bolls. To avoid boll rot, plants should be protected from insects and managed to avoid rank growth, which can increase humidity in the canopy. Certain growth regulators alter cotton growth patterns and prevent rank growth, thereby increasing air movement, reducing canopy humidity and reducing boll rot.

Seed treatment with fungicides and in-furrow application of fungicides at planting can be helpful in managing cotton seedling disease. Most cotton seed sold commercially is treated with a fungicide, but more fungicide may be applied and may be especially beneficial if planting early or in clay soil.

The following tables provide a brief description of the fungicides, nematicides, and other products labeled for managing cotton diseases in Missouri. It was prepared using currrent product label books and Web sites. However, label registrations can change at any time. Before using any agricultural pesticide, read and follow directions accompanying that product. Product names have been used for clarity. Reference to specific trade names does not imply endorsement by the University of Missouri; discrimination is not intended against similar products not listed.

Seed treatment fungicides and nematicides labeled for use on cotton

Trade name Company	Common chemical name	Rate	Additional label information
Acquire BASF	metalaxyl 29.9%	0.75-1.5 fl oz/100 lb seed	Commercial application
Aeris Bayer CropScience	thiodicarb 24% imidacloprid 24%	25.6 fl oz per 100 lb seed	For management of early-season nematodes and insects.
Allegiance FL Bayer CropScience	metalaxyl 28.35%	0.75-1.5 fl oz/100 lb seed	Commercial application. For management of *Pythium*.
Apron XL Syngenta	mefenoxam 33.3%	Commercial application only	For management of *Pythium*.
Avicta Complete Cotton Syngenta	abamectin thiamethoxam azoxystrobin mefenoxam	Commercial application only	For management of early-season nematodes, insects, and seedling rot due to *Pythium* and *Rhizoctonia*.
Baytan 30 Bayer CropScience	triadimenol 30%	0.25-3.0 fl oz/100 lb seed	Commercial application.
Dividend Extreme Syngenta	difenoconazole 7.73% mefenoxam 1.93%	Commercial application only	
Dynasty CST Syngenta	azoxystrobin 6.64% fludioxonil 1.11% mefenoxam 3.32%	Commercial application only	
Maxim 4FS Syngenta	fludioxonil 40.3%	Commercial application only	
Poncho/VOTIVO Bayer CropScience	clothianidin 40.3% *Bacillus firmus* 8.1%	2.4 fl oz per 100,000 seed	For management of early-season nematodes and insects.

Seed treatment fungicides labeled for use on cotton - *continued*

Trade name Company	Common chemical name	Rate	Additional label information
Trilex Advanced Bayer CropScience	trifloxystrobin 8.55% triadimenol 4.27% metalaxyl 12.82%	1.6 fl oz/100 lb seed	Commercial application. For management of *Pythium* and *Rhizoctonia*.

This information was current as of October 1, 2012, and applies only to Missouri and may not be appropriate for other states. The listing of any product in this publication does not imply endorsement of that product or discrimination against any other product. The user of any crop protection product must read and follow the most current label on the product.

Cotton in-furrow fungicides

Trade name Company	% active ingredient(s)	Rate	Additional information
Headline BASF	pyraclostrobin 23.6%	0.1 to 0.8 fl oz/1000 row foot	For management of *Pythium* and *Rhizoctonia*.
Quadris Syngenta	azoxystrobin 22.9%	0.4 to 0.6 fl oz/1000 row ft	For control of seedling diseases caused by *Rhizoctonia solani* and *Phythium aphanidermatum*
Reason Bayer CropScience	fenamidone 44.4%	0.45 fl oz/1000 row ft	For management of *Pythium*-caused seedling diseases.
Ridomil Gold GR Syngenta	mefenoxam 2.50%	1.25 to 2.5 lb per 13,000 linear ft. of row (1.5 to 3 oz per 1,000 linear ft) as an in-furrow application at the time of planting.	For control of seed rots and seedling diseases caused by *Pythium* species. For broader spectrum disease control, Ridomil Gold GR can be applied with Terraclor. Rotational crop restrictions may apply.
Ridomil Gold PC GR Syngenta	PCNB 10% + menfenoxam 0.50%	7 to 10 lb per 13,000 linear ft of row (8.6 to 12.3 oz per 1,000 linear ft) at the time of planting.	For control of damping-off and seed and seedling rot diseases caused by *Pythium* species and *Rhizoctonia solani*. Higher rates should be used when environmental conditions are expected to be unfavorable for rapid seed germination, fields having a history of disease, or minimum/no-till programs are used. Rotational crop restrictions may apply.
Uniform Syngenta	azoxystrobin 28.2% plus mefenoxam 10.9%	0.32-0.48 fl oz per 1000 foot row	For management of *Rhizoctonia* and *Pythium*

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Foliar fungicides labeled for use on cotton

Trade name Company	Common chemical name	Rate	Additional label information
Headline BASF	pyraclostrobin 23.6%	6 to 12 fl oz/acre	Apply prior to or in the early stages of leaf spot, boll rot hardlock, and rust development.
Quadris Syngenta	azoxystrobin 22.9%	6.0 to 9.0 fl oz/acre	Apply prior to or in the early stages of leaf spot, boll rot hardlock, and rust development.

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Cotton nematicides

Trade name Company	Common chemical name	Rate	Additional information
Telone C-17 **Telone II** **Telone C-35** **In Line** Dow AgroSciences	1,3 dichloropropene (% active varies)	Rates vary	Restricted Use Pesticide. For control of nematodes, and wireworms. See label for more detailed information on application directions and safety concerns.
Vydate C-LV DuPont	oxamyl 42%	8.5 to 17 fl oz/acre at first to seventh true leaf.	For nematode suppression. Should be used only if a fumigant such as Telone II was applied preplant or an at-plant application of contact nematicide.

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Grain sorghum diseases and their management

Grain sorghum diseases can and do occur each year in Missouri. Problems with germination and stand establishment that are related to seed decay, damping-off and seedling blights are often encountered in the field. These losses can be costly, especially if replanting is necessary. Diseases may cause leaf spots or leaf blights, wilts or premature death of plants. Sorghum diseases also can cause harvest losses, affect the quality of the harvested crop and cause storage losses. The extent of the damage due to sorghum diseases in a given season depends on a number of factors including the susceptibility of the sorghum cultivar to the specific disease, the level of pathogen inoculum present and the environmental conditions during that season.

To minimize losses due to sorghum diseases, it is important to correctly identify the disease or diseases present so that appropriate management steps can be taken. The principal diseases of sorghum in Missouri can be divided into seed and seedling diseases, foliage diseases, root and stalk rot diseases, head blights and molds and a few miscellaneous diseases. Descriptions and management strategies for each of these categories of sorghum diseases are given below. For additional information see MU publication G4356, *Management of Grain Sorghum Diseases in Missouri.*

Seed and seedling diseases

There are a number of pathogens that live in the soil or can be carried on or in seed that can cause seed and seedling diseases of sorghum. The symptoms may include discolored and/or rotted seed, seedlings may show a general rotting, they may have discolored embryos, leaves and roots or they may die. Stands may be thin and uneven.

Seed and seedling diseases tend to be more severe in poorly drained soils. They may be more severe if prolonged periods of wet, cool weather follow planting or if hot weather occurs when seedlings are emerging and secondary roots are developing.

Management options for sorghum seed and seedling diseases

- Plant high-quality seed that is free of undersized, cracked or discolored kernels.
- Plant in good seedbed conditions, especially in warm (above 70 degrees F), well-drained soils.
- Plant into fertile soils that have a pH of 6.0 to 6.5. Plants growing in low pH soil (e.g., pH 5.0) are more likely to be infected by *Fusarium* sp.
- Avoid excessively high plant populations.
- Use fungicide seed treatments. Almost all commercial grain sorghum seed comes with a fungicide treatment already applied to the seed. Seed bags should have labels that list the products applied to the seed and the rate of each material applied. Occasionally there may be a need to apply additional fungicide treatment or a combination of insecticide plus fungicide treatment for added protection. See accompanying table of seed treatment fungicides labeled for use on grain sorghum.

Seed treatment fungicides for grain sorghum

Although seed treatment fungicides can be an effective means of preventing or reducing losses from various seed- and soilborne microorganisms, there are several important laws or guidelines concerning fungicide-treated seed. Always read the pesticide label and follow all directions and restrictions on the label; for seed treatment fungicides in particular, remember the following points.

1. Do not use treated seed for food, feed or oil purposes.
2. All treated seed must be colored with an EPA-approved dye that imparts an unnatural color to the seed.
3. Federal law requires that bags containing treated seed shall be labeled with the following information: "This seed has been treated with (common chemical name of active ingredients) fungicide(s). Do not use treated seed for feed, food or oil purposes. Store away from feeds and food stuffs."

The following table was prepared using current company product label books and Web sites. However, label registrations can change at any time. Before using any agricultural pesticide, read and follow directions accompanying that product. Product names have been used for clarity. Reference to specific trade names does not imply endorsement by the University of Missouri; discrimination is not intended against similar products not listed.

Seed treatment fungicides and nematicides labeled for use on grain sorghum

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Acquire BASF	metalaxyl		0.375 to 1.5 fl oz per 100 lb of seed	For control of Pythium. Commercial supplied only.
Allegiance FL Bayer	metalaxyl	28.35%	0.375 to 0.75 fl oz per 100 lb of seed	For control of Pythium damping-off.
Apron XL Syngenta	mefenoxam	33.30%	0.32 to 0.64 fl oz per 100 lb of seed	For Pythium damping-off protection on all sorghum cultivars use 0.32 to 0.64 fl oz per 100 lb of seed.
Dynasty Syngenta	azoxystrobin	9.6 %	0.3 to 3.1 fl oz per 100 lb of seed	For management of seedling diseases caused by *Rhizoctonia*.
Maxim 4FS Syngenta	fludioxonil	40.30%	0.08 to 0.16 fl oz per 100 lb of seed	For protection against seedborne and soilborne fungi that cause seed decay, damping-off and seedling blight. Maxim 4FS is active against *Fusarium, Rhizoctonia, Helminthosporium* and weakly pathogenic fungi such as *Aspergillus* and *Penicillium*. When rate ranges are given, use higher rate when disease pressure is expected to be severe. Apply Apron XL seed treatment in combination with Maxim 4FS for protection against *Pythium* spp. See label for additional information of the addition of Apron XL to control downy mildew of sorghum.
Poncho/VOTIVO Bayer CropScience	clothianidin *Bacillus firmus*	40.3% 8.1%	6.13 fl oz per 100 lb of seed	Commercial application. For management of early-season nematodes and insects.
Stamina BASF	pyraclostrobin	18.4%	commercial application only	For management of seedling diseases caused by *Rhizoctonia*.
Trilex Bayer CropScience	trifloxystrobin	22%	0.32 to 0.64 fl oz per 100 lb of seed	Commercial application.

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Foliage diseases

Sorghum is susceptible to a large number of both fungal and bacterial foliage diseases. Symptoms range from small, insignificant spots and stripes on leaves to extensive damage of large areas of leaf tissue that may result in premature death of leaves and even entire plants. Diagnosing specific leaf diseases on sorghum can be difficult because cultivars respond differently to the same pathogen, symptoms may vary with environmental conditions and several foliage diseases may occur on the same leaf at the same time. Severity of these foliage diseases depends on the specific disease, the susceptibility of the cultivar and the weather conditions during the growing season. Foliage diseases are usually favored by warm temperatures and wet weather or high humidity.

Fungal foliage diseases of sorghum in Missouri include anthracnose, leaf blight, gray leaf spot, zonate leaf spot, rough spot and sooty stripe. Symptoms range from small, circular to elliptical spots to large elongated spots that may extend several inches in length. Symptoms usually develop on lower, older leaves first.

Zonate leaf spot, caused by the fungus *Gloeocercospora sorghi*, forms circular lesions that have concentric bands of reddish brown and light tan. These lesions have irregular borders and usually develop along the leaf margins. Both leaf blades and leaf sheaths may be infected. Zonate leaf spot is favored by wet conditions. When it develops early in the season on young plants, defoliation and even death of plants may occur. If disease is severe late in the season loss of leaf tissue can lead to poorly filled seed. The fungus that causes zonate leaf spot of sorghum can also affect corn, millet and numerous other grasses. The pathogen forms survival structures called sclerotia in infected leaf tissue of sorghum, millet and other grass hosts.

The initial symptoms of rough leaf spot of sorghum are small, somewhat circular to oblong, reddish lesions with well-defined margins. As the lesions mature fruiting bodies of the causal fungus, *Ascochyta sorghina*, develop in the lesions. These pycnidia are evident as small black bumps or specks within the infected tissue. As the disease progresses, lesions may merge killing larger areas of leaf tissue. Rough leaf spot is favored by wet weather. The fungus that causes this leaf spot on sorghum has also been found on sudangrass, johnsongrass and other wild sorghum species. It survives in infested crop residues of sorghum and perennial weed hosts.

Bacterial foliage diseases of sorghum include bacterial spot, bacterial streak and bacterial stripe. Bacterial spot tends to produce water-soaked elliptical spots on leaves. Bacterial streak and bacterial stripe both result in long, narrow stripes on leaves. Lesions from all three bacterial foliage diseases tend to have a reddish color or reddish margin.

Management options for foliage diseases of sorghum

- Plant disease-free seed of locally adapted, resistant cultivars.
- Rotate crops with at least one year out of susceptible crops.
- Manage crop residues.
- Eliminate alternate or weed hosts of these diseases, especially weed grasses such as johnsongrass.
- Use a foliar fungicide if needed (see table).

Foliar fungicides labeled for use on grain sorghum

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Quadris Syngenta	azoxystrobin	22.9%	6.0 to 15.5 fl oz per acre	For management of anthracnose and gray leaf spot.
Quilt Syngenta	azoxystrobin propiconazole	7% 11.7%	14 oz per acre	For management of anthracnose and gray leaf spot.
Quilt Xcel Syngenta	azoxystrobin propiconazole	13.5% 1.7%	10.5 to 14 fl oz per acre	For management of zonate leaf spot, leaf blight, anthracnose and gray leaf spot.

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Root and stalk rot diseases

Several root and stalk rot diseases occur on sorghum. These diseases are usually most evident late in the season as plants are maturing. Stalk rots likely to occur on sorghum in Missouri include charcoal rot, Fusarium stalk rot, anthracnose or Colletotrichum stalk rot and Rhizoctonia stalk rot. Stalks tend to be soft, discolored and deteriorated. Plants may die prematurely. Lodging may be a problem in fields with high levels of stalk rot. Stress to plants at flowering and grain-filling stages may increase the incidence and severity of stalk rots.

The charcoal rot fungus, *Macrophomina phaseolina*, can cause seedling blight, damping-off and dry rot early in the season. Later in the season symptoms include root rot with infected roots turning brown or black and stalk rot with stalks becoming soft and spongy. Plants tend to lodge. If infected plants are spilt open, the pith usually shows signs of deterioration and small, dark sclerotia (survival structures of the fungus) are evident in the disintegrating tissues. Charcoal rot is favored by high soil temperatures (95 to 98 degrees F) and low soil moisture. The fungus that causes charcoal rot of sorghum can also infect corn and soybean.

Fusarium root and stalk rot may begin as small, circular to elongate, light red to dark purple lesions on roots, seed, stalks and peduncles. Plants with insect damage or other injuries may show more severe symptoms of Fusarium root and stalk rot. Leaves may turn off color or gray-green and plants may die prematurely. When stalks are split open, the lowest internodes may have large areas of pith that is reddish in color and the upper internodes may show a red to reddish brown discoloration of the vascular bundles. Lodging may occur.

Management options for root and stalk rots of sorghum

- Select cultivars with good stalk strength and tolerance to stalk rots.
- Plant at proper plant populations.
- Provide adequate moisture at planting and adequate irrigation through season.
- Maintain balanced soil fertility.
- Control weeds.
- Harvest in timely fashion to minimize lodging and harvest losses.

Miscellaneous diseases of sorghum

Crazy top, caused by the fungus *Sclerophthora macrospora*, is another disease likely to occur in sorghum in wet seasons. This disease develops on young seedlings growing in saturated soils. The first symptom of crazy top is a mottled yellowing of the leaves. Leaves become thickened and puckered, and plants may tiller excessively. Infected plants may be stunted and have a bunched appearance. Diseased plants typically either do not produce heads or produce barren heads.

Management options for crazy top of sorghum

- Plant cultivars tolerant to crazy top if available.
- Land prone to flooding should not be planted to sorghum unless adequate drainage is provided.

Maize dwarf mosaic virus (MDMV) is the most common virus disease of sorghum in Missouri. MDMV produces a distinct mottling of the leaf tissue. Infected leaves have a light green to yellow mottled pattern. Symptoms are most evident on young leaves. Red leaf, a red discoloration that may appear on leaves, sheaths and peduncles, may develop in infected plants if night temperatures fall below 55 degrees F. Infected plants may be stunted, tillering may be reduced and yield may be reduced.

Many annual and perennial grasses, including corn and johnsongrass, are susceptible to maize dwarf mosaic virus. The virus that causes this disease is transmitted mechanically and vectored by more than 20 species of aphids.

Management options for sorghum virus diseases

- Plant resistant or tolerant cultivars.
- Follow cultural practices that eliminate johnsongrass and other susceptible annual grasses in and around sorghum fields.

Sorghum downy mildew, caused by the fungus *Peronosclerospora sorghi*, is a serious problem in the southern United States but is not typically found on sorghum in Missouri. Sorghum downy mildew may occur as either a systemic or a localized infection within the plant. Systemic infections may occur early in the season and affected seedlings are yellow, stunted and may die prematurely. During periods of cool, humid weather the lower surfaces of infected yellow leaves may be covered with a white, cottony mold growth. Infected

leaves may also show striking patterns of long green and white stripes running the length of the leaves.

Localized infections of sorghum downy mildew begin as small brown spots on leaves. Under cool, humid conditions, the white, cottony mold growth may be evident on lower leaf surfaces and the disease may become systemic within the plants.

Sorghum downy mildew is caused by a soil fungus that invades the roots of sorghum seedlings. The pathogen survives in the soil and in perennial host plants.

Management options for sorghum downy mildew

- In areas where downy mildew is a serious problem, plant resistant cultivars.
- Rotate crops to help manage sorghum downy mildew.
- Apply appropriate fungicide seed treatments. See accompanying table of seed treatment fungicides labeled for use on grain sorghum.

Plant parasitic nematodes such as root-knot nematode, root lesion nematode and stunt nematode may occur on sorghum. With these nematodes, aboveground symptoms depend on the level of nematode infestation. At high levels, plants may be stunted, yellowed and have an unthrifty appearance. Yields may be reduced. These symptoms may be mistaken for herbicide injury, root rots, nutrient deficiencies and drought. Root growth may be limited and roots may be discolored or have small brown to black lesions. With root-knot nematode, galls and excessive branching may be evident on roots. When nematode injury is suspected, it is important to collect soil and root samples and send them to a nematology laboratory for identification of the nematode species involved.

Management options for sorghum nematodes

- Rotate crops. Effectiveness of crop rotation may vary depending on the nematode species present.
- Although there are several nematicides labeled for use for the control of nematodes in grain sorghum, environmental and economic concerns limit their use. Two products labeled for management of nematodes attacking grain sorghum are the seed treatment Poncho/VOTIVO and the soil fumigant Telone II by Dow.

Head smut, blights and molds

Head smut primarily affects the head although foliage symptoms may occur on occasion. Smut galls replace part or all of the sorghum panicle. Initially the galls are protected by a thin, white covering. Eventually this covering ruptures, releasing masses of powdery black spores of the causal fungus, *Sporisorium reilianum*. Plants may be stunted and may produce excessive tillers. Smutted plants may also have more root and stalk rots. Smut spores can survive for long periods of time in the soil.

Management options for head smut of sorghum

- Plant the most resistant or least susceptible cultivars in areas where the disease occurs.
- Rotate crops to help reduce the level of smut in subsequent crops. Crop rotation will not eliminate the disease.

Covered kernel smut is found in every sorghum-growing region of the world. Before the use of fungicide seed treatments, covered kernel smut was a serious disease of sorghum. The fungus, *Sporisorium sorghi*, replaces individual sorghum kernels with smut balls of sori. These sori vary in size and shape but resemble elongated sorghum seeds. They range in color from white to gray to brown. The entire sorghum head may be affected or only portions of the head. The fungus that causes covered kernel smut is seedborne.

Management options for covered kernel smut of sorghum

- Use an appropriate fungicide seed treatment. See accompanying table of seed treatment fungicides labeled for use on grain sorghum.
- Cultivars vary in their susceptibility to covered kernel smut, so cultivar selection may also help reduce losses from covered kernel smut.

Several fungi cause **head blights and molds** on sorghum. Pink, gray, white or black mold growth on the heads or grain surface is the most obvious sign of a problem. The development of these head blights and molds is favored by wet weather and high relative humidity during flowering and grain fill. There is some variation in susceptibility among sorghum hybrids to head molds.

Management options for head blights and molds on sorghum

- Plant adapted, tolerant cultivars.
- Rotate crops.
- Manage residues.
- Harvest in a timely manner.

Rice disease management

Unfortunately, diseases of rice can reduce yield and greatly affect farmer profits. Although the effects of rice diseases on the Missouri economy are not as dramatic as in some other states, rice yield loss due to diseases can seriously affect an individual producer's profit. Fortunately, most rice diseases can be managed if proper management options are used.

An accurate diagnosis is essential to when selecting rice disease management options. Whenever possible, consult a University of Missouri Extension specialist for help with diagnosis of rice diseases or someone at the University of Missouri Plant Diagnostic Laboratory at 23 Mumford Hall, Columbia, MO 65211 (phone: 573-882-3019).

This section provides information about general rice disease management options and detailed information about labeled fungicides for management of rice diseases. For additional information, see University of Missouri Extension publication MP645, *Rice Blast Control*, and MP646, *Rice Sheath Blight Control*.

Management methods

There are several strategies for managing disease in rice. The three most important are to rotate crops, plant disease-resistant varieties, and provide proper levels of fertilizer. An integrated approach that uses all of these methods usually is the most effective and profitable.

Improved varieties immune to all or most rice diseases do not exist. However, newer rice varieties often have improved levels of resistance to blast, sheath blight, stem rot, kernel smut and brown spot. Farmers should choose varieties based on yield trials in their area and resistance to locally significant diseases.

Rotating rice with soybean or other crops will help manage several rice diseases but not all.

Fungicide seed treatments can be very helpful in managing rice seedling disease. Most rice seed sold commercially is not treated with a fungicide, but some seed cleaning companies will treat the seed with fungicides.

Sheath blight is the most destructive disease Missouri rice growers face. Crop losses may range from slight to heavy each year, depending on weather, the plant growth stage when infection occurs, the extent of infection and the rice varieties grown.

The severity of sheath blight in Missouri has increased in recent years due to increased use of highly susceptible varieties, a lack of crop rotation, thicker stands and use of higher nitrogen rates, and earlier planting dates.

The disease can be controlled by following some simple production steps:

- Plant the least susceptible high-yielding varieties.
- Seed to a stand of 15 to 20 plants per square foot for all but hybrid varieties.
- Plant at the optimum time for a specific variety. Avoid extremely early planting.
- Time nitrogen applications so 30 pounds or less are applied at internode elongation (IE).
- Scout fields for symptoms from IE to a few days before heading and use a labeled fungicide when the incidence of sheath blight has reached a threshold level.

Blast, also called rotten neck, is the second most destructive disease of Missouri rice. Losses due to this disease have been on the increase since 2000. Blast does not develop every year but is very destructive when it occurs. Rice blast can be controlled by a combination of preventive measures and foliar fungicides applied when rice is in the late boot stage and again when it is 80 to 90 percent headed. Preventive measures for blast management include the following:

- Incorporate or roll the rice stubble soon after harvest to promote early decomposition.
- Plant the least-susceptible varieties and use a broad-spectrum seed treatment.
- Grow rice in open fields free of tree lines particularly on east side.
- Grow rice in fields where flood levels are easily maintained. Damage from blast can be reduced by keeping soil flooded 2 to 4 inches deep from the time rice plants are 6 to 8 inches tall until draining for harvest. Draining for straighthead is incompatible with the flooding required for blast control, so avoid fields with a history of straighthead and varieties susceptible to straighthead, or plant blast-resistant varieties in these fields.
- Seed over a range of time to spread the heading dates. However, avoid planting late, because blast will be more severe.
- Seed to a stand of 15 to 20 plants per square foot for all but hybrid varieties.
- Avoid excessive nitrogen application rates and apply no more than 30 pounds per acre of nitrogen per application at midseason. In fields with a history of blast, always split applications.

The following tables provide a brief description of the fungicides for application to seed and to foliage for managing rice diseases in Missouri. It was prepared using current company product label books and Web sites. However, label registrations can change at any time. Before using any agricultural pesticide, read and follow directions accompanying that product. Product names have been used for clarity. Reference to specific trade names does not imply endorsement by the University of Missouri; discrimination is not intended against similar products not listed.

Seed treatment fungicides labeled for use on rice

Trade name Company	Common chemical name	Rate	Additional label information
Allegiance FL Bayer CropScience	metalaxyl 28.35%	0.75–1/5 fl oz/100 lb seed	For commercial application
Apron XL Syngenta	mefenoxam 33.3%	0.04–0.08 fl oz/100 lb seed	For commercial application
CruiserMaxx Rice Syngenta Crop Protection, LLC	thiamethoxam 26.4% fludioxonil 0.28% azoxystrobin 1.32% mefenoxam 1.65%	7.0 fl oz/100 lb seed	For management of some early-season insect pests and seedling diseases caused by *Pythium* and *Rhizoctonia*.
Dynasty Syngenta	azoxystrobin 9.6%	0.153–1.53 fl oz/100 lb seed	For commercial application
Maxim 4FS Syngenta Crop Protection, LLC	fludioxonil 40.3%	0.02–0.08 fl oz/100 lb seed	For management of seedling diseases. Add another product for management of *Pythium*.
Maxim XL Syngenta	mefenoxam 8.4% fludioxonil 21%	0.17–0.33 fl oz/100 lb seed	For commercial application
Trilex Bayer CropScience	trifloxystrobin 22%	0.32–0.96 fl oz/100 lb seed	For commercial application

This information was current as of October 1, 2012 and applies only to Missouri and may not be appropriate for other states. The listing of any product in this publication does not imply endorsement of that product or discrimination against any other product. The user of any crop protection product must read and follow the most current label on the product.

Foliar fungicides labeled for use on rice

Trade name Company	% active ingredient(s)	Rate	Additional information
Gem 500 SC Bayer CropScience	trifloxystrobin 42.6%	Use 3.8 to 4.7 fl oz/acre for management of sheath blight and 3.1 to 4.7 fl oz/acre for management of blast. Use higher rates when disease pressure is severe.	Do not apply within 35 days of harvest.
PropiMax EC Dow	propiconazole (41.8%)	Use 6 fl oz per acre at IE and again 10-14 days later. Use 10 fl oz per acre at IE	For control of sheath blight, brown leaf spot, narrow brown leaf spot and brown blotch, leaf smut, sheath spot, and black sheath rot. It also suppresses stem rot.
Quadris Syngenta	azoxystrobin 22.9%	9.0–12.5 fl oz/acre for sheath and stem diseases. 12.5–15.5 fl oz/acre for blast and other diseases.	For control of sheath blight, leaf and panicle blast and other leaf and stem diseases.
Quilt or Quilt Xcel Syngenta	azoxystrobin propiconazole	14–34.5 fl oz/acre, rates vary based on product used. Consult label about time of application.	Should not be applied once head has emerged. Do not drain water from treated fields into catfish ponds or used for irrigating other crops.
Stratego Bayer CropScience	trifloxystrobin 11.4% propiconazole 11.4%	Use 14.0–19.0 fl oz/acre for management of sheath blight, sheath spot, black sheath rot, brown spot, narrow brown leaf spot, leaf smut, leaf blast, neck blast, kernal smut, and suppression of false smut and stem rot. Use higher rates when disease pressure is severe.	Do not apply Stratego once the rice seed head has emerged.
Tilt Syngenta	propiconazole 41.8%	6–10 fl oz/acre	For control of sheath blight, brown leaf spot, narrow brown leaf spot and brown blotch, leaf smut, sheath spot, kernal smut, and black sheath rot. Tilt also suppresses stem rot and false smut.

This information was current as of October 1, 2012 and applies only to Missouri and may not be appropriate for other states. The listing of any product in this publication does not imply endorsement of that product or discrimination against any other product. The user of any crop protection product must read and follow the most current label on the product.

Soybean diseases and their management

Soybean diseases can and do occur each year in Missouri. Problems with germination and stand establishment that are related to seed decay, damping-off and seedling blights are often encountered in the field. These losses can be costly, especially if replanting is necessary. Diseases may cause leaf spots or leaf blights, wilts or premature death of plants. Soybean diseases also can affect the quality of the harvested crop and cause storage losses. The extent of the damage due to soybean diseases in a given season depends on a number of factors, including the susceptibility of the soybean variety to the specific disease, the level of pathogen inoculum present and the environmental conditions during that season.

To minimize losses due to soybean diseases, it is important to correctly identify the disease or diseases present so that appropriate management steps can be taken. The soybean diseases most likely to occur in Missouri include early-season seed and seedling diseases, foliage diseases, virus diseases, root and lower stem diseases, and stem, pod and seed diseases. For more detailed information including color pictures of soybean diseases in Missouri please see University of Missouri publication IPM 1002, *Soybean Diseases*.

Seed and seedling diseases

The early-season soybean diseases include those that cause seed decay, seedling blights and soybean root rots. Most of these early-season soybean diseases are caused by fungi that are found in the soil wherever soybeans are grown. *Pythium*, *Phytophthora*, *Rhizoctonia* and *Fusarium* are the most common of these early-season pathogens, although *Phomopsis* (pod and stem blight fungus) and *Macrophomina* (charcoal rot fungus) may also cause early-season seedling problems. Symptoms of these early-season soybean diseases may range from seed decay to preemergence or postemergence damping-off to wilt and death of established seedlings.

Pythium seed decay and damping-off are generally associated with wet soil conditions. At least three of the *Pythium* species involved in these early-season diseases on soybean have an optimum temperature range for infection of 50 to 59 degrees F. Because of this lower optimum temperature range, these species are more common problems in northern areas or on early-planted soybean. The other *Pythium* species prefer soil temperatures in the range of 86 to 95 degrees F and are more common in southern areas, in late-planted fields or on plants later in the season. Crusting, deep planting, compaction, herbicide injury and similar factors that delay germination and seedling emergence may lead to an increase in incidence and severity of Pythium seed decay and damping-off.

Management options for Pythium seed decay and damping-off

- Plant good-quality seed with a good germination rate.
- Plant in good seedbed conditions. Delaying planting until soil temperatures are above 59 degrees F may reduce infection by some *Pythium* species.
- Pythium diseases may be more likely to develop in low, wet areas or compacted areas of a field. Tiling to improve drainage and taking steps to reduce or prevent compaction may help minimize problems with this disease.
- Fungicide seed treatment or at-planting fungicide treatment may help protect seedlings from this disease. Products containing either metalaxyl or mefenoxam as an active ingredient are particularly effective against water mold fungi such as *Pythium* species. See accompanying tables of seed treatment fungicides and at-planting fungicides labeled for use on soybean.

Phytophthora seedling blight is caused by another soil-inhabiting fungus. *Phytophthora* can cause seed decay, preemergence or postemergence damping-off and seedling blight of soybean. This fungus produces structures called oospores, which enable it to survive from year to year in crop residues or in the soil. In the spring, the oospores germinate to produce sporangia. When soils are flooded or saturated, the sporangia release zoospores, which are attracted to the growing soybean root tip where infection occurs.

Phytophthora root rot is more severe in areas that are low or poorly drained, in compacted areas or in clay or heavy soils, but the disease can appear on plants growing in lighter soils or higher ground if the soil remains wet after planting. Significant rain after planting favors the development of *Phytophthora* in all sites. A dry period after planting drastically reduces this disease. *Phytophthora* may occur at soil temperatures as low as 50 degrees F, but greatest root damage occurs when soil temperatures are 59 degrees F or above.

Management options for Phytophthora seedling blight

- Plant varieties with race-specific resistance, tolerance or a combination of race-specific resistance and tolerance in fields with a history of *Phytophthora*. Many races of *Phytophthora sojae* have been identified based on their ability to overcome specific Rps genes or combinations of Rps genes in soybean varieties. Race-specific varieties contain a single gene or combination of genes (i.e., Rps1c, Rps1d, Rps1k or Rps3a) that confer resistance to specific races of *Phytophthora sojae*. Tolerant varieties have a non-race-specific, partial resistance and may also be called field-resistant varieties.
- Plant in good seedbed conditions.
- *Phytophthora* is more likely to occur in low, wet areas, poorly drained areas or compacted areas of a field. Tiling to improve drainage and taking steps to reduce or prevent compaction may help minimize disease problems.
- Avoid the application of high levels of manure or fertilizer (KCl) just before planting.
- Rotate crops to prevent the increase of inoculum levels in a field.
- Use an appropriate fungicide seed treatment or at planting fungicide treatment. Products containing either metalaxyl or mefenoxam as an active ingredient are particularly effective against water mold fungi such as *Phytophthora sojae*. See accompanying tables of seed treatment fungicides and at-planting fungicides labeled for use on soybean.

Rhizoctonia seedling blight, caused by *Rhizoctonia solani* another common soil-inhabiting fungus, can result in seed decay and preemergence damping-off of soybean seedlings. The causal fungus can survive well in the absence of host plants because it grows well in the soil, colonizes many types of plant debris and can also survive as resting mycelium or sclerotia in the soil.

Rhizoctonia solani can survive under a wide range of soil moistures and soil temperatures. Populations of the fungus may decline when soils are flooded or when soil temperatures are unusually high. Symptoms, especially on aboveground portions of the seedlings, are usually more severe during periods of drying winds or warm to hot weather. During such conditions seedlings may wilt, yellow or die.

Crusting, hardpan layers, herbicide injury, deep planting, poor seed quality, hail damage, insect damage, mechanical injuries, poor fertility or other factors that delay germination and emergence favor the development of Rhizoctonia root rot. Rhizoctonia root rot is frequently found in combination with other diseases such as soybean cyst nematode or Fusarium root rot. Damage from *Rhizoctonia* may be more severe when it occurs in combination with other diseases.

Management options for Rhizoctonia seedling blight

- Plant good-quality seed with a good germination rate.
- Plant in good seedbed conditions.
- Minimize or avoid stresses that delay germination or emergence, i.e., avoid or prevent herbicide injury and insect injury, correct soil compaction and hardpan layer problems, and reduce injury from soybean cyst nematode.
- Use an appropriate fungicide seed treatment. See accompanying table of seed treatment fungicides labeled for use on soybean.

Fusarium seedling blight and root rot of soybean may be caused by either *Fusarium oxysporum* or *Fusarium solani*. These two fungi can persist in the soil, colonize various plant residues and survive as chlamydospores (fungal survival structures) or mycelium.

Fusarium root rot can occur at any time during the growing season, but it is most common on seedlings and young plants. Disease is most severe when the soil is saturated and soil temperatures are around 57 degrees F. Crusting, hardpan layers, herbicide injury, deep planting, poor seed quality, hail damage, insect damage, mechanical injuries, poor fertility or other factors that delay germination and emergence favor the development of Fusarium seedling blight and root rot. Fusarium root rot is frequently found in combination with other diseases such as Rhizoctonia root rot or soybean cyst nematode. Damage from *Fusarium* may be more severe when it occurs in combination with other diseases or stresses.

Management options for Fusarium seedling blight

- Plant good-quality seed with a good germination rate.
- Plant in good seedbed conditions.
- Minimize or avoid stresses that delay germination or emergence, i.e., avoid or prevent herbicide injury and insect injury, correct soil compaction and hardpan layer problems, and reduce injury from soybean cyst nematode.
- Use an appropriate fungicide seed treatment. See accompanying table of seed treatment fungicides labeled for use on soybean.

Charcoal rot, caused by the fungus *Macrophomina phaseolina*, occurs worldwide. The fungus is widely distributed in soils and has a wide host range attacking a number of crops, including soybean, corn and sorghum. *Macrophomina phaseolina* produces small survival structures called microsclerotia, which allow it to survive in soil or in host residues for long periods of time.

Charcoal rot may be more commonly recognized as a mid- to late-season disease on maturing soybeans (see charcoal rot in section on Root and Lower Stem Diseases), but it can also occur early in the season on young seedlings. *Macrophomina phaseolina* grows best at temperatures between 82-95 degrees F. Infection of seedlings is most likely to occur if conditions of high soil temperatures and low soil moisture exist during the first two to three weeks after planting.

Management options for charcoal rot

- Rotate to cereals, cotton or other non-host crops for one to two years.
- Maintain good crop vigor to reduce losses from charcoal rot.
- In irrigated fields, watering during periods of high temperatures and drought stress when soybean plants are in bloom to pod fill may help reduce charcoal rot.

Phomopsis longicolla and the other *Phomopsis* and *Diaporthe* species that cause Phomopsis seed decay and pod and stem blight can survive in infested crop residues and in the soil. These fungi can also survive on the seed and Phomopsis seedling blight is more likely to be a serious problem if infected seed is planted. Phomopsis seedling blight tends to be more severe if weather conditions after planting are cool and wet.

Management options for Phomopsis seedling blight

- Plant disease-free seed with a good germination rate.
- Plant in good seedbed conditions.
- Use an appropriate fungicide seed treatment. See accompanying table of seed treatment fungicides labeled for use on soybean.

Seed treatment fungicides for soybean

Although seed treatment fungicides can be an effective means of preventing or reducing losses from various seedborne and soilborne microorganisms, there are several important laws or guidelines concerning fungicide-treated seed. Always read the pesticide label and follow all directions and restrictions on the label but in particular for seed treatment fungicides remember the following points.

- Do not use treated seed for food, feed or oil purposes.
- All treated seed must be colored with an EPA-approved dye that imparts an unnatural color to the seed.

- Federal law requires that bags containing treated seed shall be labeled with the following information: "This seed has been treated with (common chemical name of active ingredients) fungicide(s). Do not use treated seed for feed, food or oil purposes. Store away from feeds and food stuffs."

Until recently most soybean seed was not treated prior to sale. Treatment was done at the dealer level or on-farm. However, as the cost of soybean seed increased, companies began either offering soybean seed treatments on their seed or treating seed prior to sale. Over the years, the types of fungicides available have changed and many seed companies or seed treating operations use a combination of several fungicides with varying modes of action to protect the seed from an array or seedborne and soilborne pathogens. More recently, seed treatment insecticides have become available. Again, these seed treatment insecticides may be applied by the seed company or seed treating operation, making it possible to purchase seed treated with a fungicide, an insecticide or a combination of fungicide and insecticide.

Most recently seed treatments for nematode protection have come on the market. Now soybean seed might be treated with a combination of fungicide, insecticide and nematode seed treatment chemicals.

Marketing strategies are also changing. Some seed treatment products are widely marketed to seed companies and dealers. Other products may be marketed under an exclusive agreement with a single seed company. That seed company has exclusive rights to the use of the particular product for a specified number of years. That product would not be available to other seed companies, dealers and seed treating operations. Some seed companies are putting together package treatments of fungicides, insecticide and nematicides that they are strongly recommending for use on their genetics. This shift to package treatments and exclusive marketing to individual seed companies makes it difficult to compile a table of seed treatment fungicides and nematicides labeled for use on soybean in Missouri. Check with your seed salesperson to find out what products are on the seed you are purchasing and to find out if the rates of the various active ingredients are appropriate for disease pressure in the fields in which the seed will be planted.

The following table was prepared using current company product label books and manufacturers' Web sites. However, label registrations can change at any time. Before using any agricultural pesticide, read and follow directions on the label accompanying that product. Product trade names have been used for clarity. Reference to specific trade names does not imply endorsement by the University of Missouri; discrimination is not intended against similar products not listed.

Seed treatment fungicides and nematode protection products labeled for use on soybean

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Acceleron DX-109 Fungicide Seed Treatment Monsanto	pyraclostrobin	18.40%	0.4 to 1.5 fl oz per 100 lb of seed	For seed and seedling disease (damping-off) caused by *Rhizoctonia solani,* seedborne fungi causing seed decay, seedling damping-off. For suppression of seed and seedling disease caused by *Pythium* spp., *Fusarium* spp. and *Phomopsis* spp.
Acceleron DX-309 Fungicide Seed Treatment Monsanto	metalaxyl	28.35%	0.75 to 1.5 fl oz per 100 lb of seed 0.10 to 0.375 fl oz per 100 lb of seed	For Pythium damping-off and early-season Phytophthora control. Reduced rate in combination with other fungicides to aid in the control of seed decay and damping-off caused by Pythium. Apply in combination with EPA registered rates of broad-spectrum seed treatment fungicides.
Acceleron DX-612 Monsanto	fluxapyroxad	28.70%	0.24 to 0.47 fl oz per 100 lb of seed	Seed and seedling disease (damping-of) caused by *Rhizoctonia solani.* Suppression of seed and seedling disease caused by *Fusarium* spp.
Acquire BASF	metalaxyl	29.99%	0.75 to 1.5 fl oz per 100 lb of seed	For Pythium damping-off and early-season Phytophthora control. Do not use with other seed treatment fungicides unless previous experience assures compatibility. Acquire may be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
Allegiance Dry Chemtura AgroSolutions	metalaxyl	12.50%	1.5 to 2.0 oz per 100 lb of seed	For Pythium damping-off and early-season Phytophthora control. For control of other soilborne diseases, such as *Rhizoctonia* spp., Allegiance Dry should be applied in combination with other registered seed dressing fungicides. Treat only those seeds needed for immediate use, minimizing the interval between treatment and planting. Do not carry over excess treated seed to next season. Do not use this product on seed that has been commercially treated with metalaxyl fungicide. Hopper box treatment.

Seed treatment fungicides and nematode protection products labeled for use on soybean - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Allegiance-FL Bayer CropScience	metalaxyl	28.35%	0.75 to 1.5 fl oz per 100 lb of seed	For Pythium damping-off and early-season Phytophthora control. For control of other soilborne diseases, combination with Bayer CropScience Captan and Vitavax registered formulations are compatible. Do not use with other seed treatment products unless previous experience assures compatibility. Allegiance-FL may be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
Apron XL Syngenta	mefenoxam	33.30%	0.16 to 0.64 fl oz per 100 lb of seed	For Pythium damping-off and early-season Phytophthora control. For best early-season control of *Phytophthora*, use the higher rate. For control of other soilborne diseases, such as *Rhizoctonia* species, Apron XL should be applied in combination with other registered seed dressing fungicides. Apron XL may be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
ApronMAXX RFC Syngenta	fludioxonil mefenoxam	2.31% 3.46%	1.5 fl oz per 100 lb of seed	Provides protection against damping-off and seed rots due to *Pythium, Phytophthora, Fusarium, Rhizoctonia* spp. and early-season Phytophthora root rot and suppresses seedborne *Sclerotinia* and *Phomopsis* spp. Additional Apron XL may be necessary depending on the type of pathogen and the level of disease pressure. Use label for further information on use rates. ApronMAXX RFC is especially formulated for on-farm or commercial treatment to be used with liquid rhizobia products, using standard mechanical slurry or mist-type seed treatment equipment.
ApronMAXX RTA Syngenta	mefenoxam fludioxonil	1.10% 0.73%	5.0 fl oz per 100 lb of seed	Seed treatment fungicide that protects against damping-off and seed rots due to *Pythium, Phytophthora, Fusarium, Rhizoctonia* spp. and early-season Phytophthora root rot. ApronMAXX RTA also suppresses seedborne *Sclerotinia* and *Phomopsis* spp. If the target fields have a history of high Phytophthora pressure, then use 5.0 fl oz of ApronMAXX RTA with 0.16 to 0.48 fl oz of Apron XL per 100 lb of seed. ApronMAXX RTA is especially formulated for on-farm treatment, using standard mechanical slurry or mist-type seed treatment equipment.
ApronMAXX RTA + Moly Syngenta	mefenoxam fludioxonil	1.02% 0.68%	5.0 fl oz per 100 lb of seed	Provides protection against damping-off and seed rots due to *Pythium, Phytophthora, Fusarium, Rhizoctonia* spp. and early-season Phytophthora root rot and suppresses seedborne *Sclerotinia* and *Phomopsis* spp. If the target fields have a history of high Phytophthora pressure, then use 5.0 fl oz of ApronMAXX RTA + Moly with 0.16 to 0.48 fl oz of Apron XL per 100 lb of seed. ApronMAXX RTA + Moly is especially formulated for on-farm treatment, using standard mechanical slurry or mist-type seed treatment equipment.
Avicta Complete Beans Syngenta				Avicta Complete Beans is a combination of separately registered products containing Avicta 500 FS nematicide, plus one or more of the following products: CruiserMaxx premix; Cruiser 5FS insecticide, Apron XL fungicide and Maxim 4FS fungicide; or Cruiser 5FS and an ApronMaxx brand fungicide.
Bean Guard/ Allegiance Chemtura AgroSolutions	captan carboxin metalaxyl	24.45% 12.50% 3.75%	2.0 oz per bushel of seed	Bean Guard/Allegiance combines the systemic action of carboxin and metalaxyl with the contact action of captan to control certain seed and seedling diseases of soybeans. It is particularly effective against *Pythium* and *Rhizoctonia* and shows good activity against *Fusarium* and *Helminthosporium*. It also provides 0.2 oz of molybdenum per acre for plant nutrition and nitrogen fixation. Treat only seed for immediate use, minimizing the interval between treatment and planting. Do not store excess treated seeds beyond planting time. Hopper box seed treatment.
Belmont 2.7 FS Chemtura AgroSolutions	metalaxyl	28.98%	0.75 to 1.5 fl oz per 100 lb of seed	For Pythium damping-off and early-season Phytophthora control. For the control of other soilborne diseases, use in combination with other seed treatment fungicides. Vitavax and RANCONA products are compatible with Belmont 2.7 FS. Do not use in combination with other seed treatment products unless compatibility and safety to crop has been verified. Belmont 2.7 FS may be applied on its own, as a water-based slurry or in combination with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.

Seed treatment fungicides and nematode protection products labeled for use on soybean - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
CruiserMaxx Syngenta	thiamethoxam mefenoxam fludioxonil	22.6% 1.70% 1.12%	3.0 fl oz per 100 lb of seed	CruiserMaxx is a seed treatment product containing the active ingredients thiamethoxam (insecticide) and fludioxonil and mefenoxam (fungicides). It protects against damage from certain early-season insects, soilborne and seedborne diseases including damping-off and seedborne rots due *to Pythium, Phytophthora, Fusarium, Rhizoctonia* species and early-season Phytophthora root rot. It also suppresses seedborne *Sclerotinia* and *Phomopsis* species. If target fields have a history of high Phytophthora pressure, add additional Apron XL as directed in the rate table on the label. Apply CruiserMaxx as a water-based slurry using standard slurry seed treatment equipment which provides uniform seed coverage.
CruiserMaxx Advanced Syngenta	thiamethoxam mefenoxam fludioxonil	21.50% 3.21% 1.07%	3.2 fl oz per 100 lb of seed	CruiserMaxx Plus provides protection against damping-off and seedborne rots due to *Pythium, Phytophthora, Fusarium, Rhizoctonia* sspecies and early-season Phytophthora root rot. CruiserMaxx Advanced also suppresses seedborne *Sclerotinia* and *Phomopsis* species. If target fields have a history of high Phytophthora pressure, add additional Apron XL as directed in the rate table the Apron XL label. Apply as a water-based slurry using standard slurry seed treatment equipment which provides uniform seed coverage.
CruiserMaxx Beans Syngenta				CruiserMaxx Beans is an on-seed application of one of the following: CruiserMaxx Advanced; CruiserMaxx Plus; CruiserMaxx and Apron XL; CruiserMaxx 5FS, Maxim Xl and Apron XL; or Cruiser 5FS and an ApronMaxx brand fungicide such as ApronMaxx RTS + Moly.
CruiserMaxx EZ Syngenta	thiamethoxam mefenoxam fludioxonil	23.10% 3.46% 1.15%	3.15 fl oz per 100 lb of seed	CruiserMaxx EZ provides protection against damping-off and seedborne rots due to *Pythium, Phytophthora, Fusarium, Rhizoctonia* species and early-season Phytophthora root rot. CruiserMaxx EZ also suppresses seedborne *Sclerotinia* and *Phomopsis* species. If target fields have a history of high Phytophthora pressure additional Apron XL as directed in the rate table and the Apron XL label. Apply as a water-based slurry using standard slurry seed treatment equipment which provided uniform seed coverage.
CruiserMaxx Plus Syngenta	thiamethoxam mefenoxam fludioxonil	21.50% 3.21% 1.07%	3.2 fl oz per 100 lb of seed	Provides protection against damping-off and seedborne rots due to *Pythium, Phytophthora, Fusarium, Rhizoctonia* spp. and early-season Phytophthora root rot. CruiserMaxx Plus also suppresses seedborne *Sclerotinia* and *Phomopsis* spp. If target fields have a history of high Phytophthora pressure, add additional Apron XL as directed in the rate table on the label. Apply CruiserMaxx Plus as a water-based slurry using standard slurry seed treatment equipment which provides uniform seed coverage.
Dyna-Shield Metalaxyl Loveland Products Inc.	metalaxyl	28.35%	0.75 to1.5 fl oz per 100 lb of seed	For Pythium damping-off and early-season Phytophthora control. Reduced rate: to aid in control of seed decay and damping-off caused by Pythium, apply Dyna-Shield Metalaxyl Fungicide as a commercial seed treatment at the rate of 0.10 to 0.375 fl oz per 100 lb of seed. Apply in combination with EPA registered rates of broad-spectrum seed treatment fungicides. May be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
Dyna-Shield Metalaxyl 318 FS Loveland Products Inc.	metalaxyl	30.14%	0.75 to1.5 fl oz per 100 lb of seed	For Pythium damping-off and early-season Phytophthora control. Reduced rate: to aid in control of seed decay and damping-off caused by Pythium, apply Dyna-Shield Metalaxyl 318 FS Fungicide as a commercial seed treatment at the rate of 0.10 to 0.375 fl oz per 100 lb of seed. Apply in combination with EPA registered rates of broad-spectrum seed treatment fungicides. May be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
Dynasty Syngenta	azoxystrobin	9.60%	0.153 to 0.459 fl oz per 100 lb of seed	Target diseases are seedborne and soilborne fungi causing decay, damping-off and seedling blight; seedling damping-off (*Rhizoctina solani* and *Pythium* spp.) and suppression of white mold (*Sclerotium rolfsii*). It is recommended that Dynasty be combined with a Pythium-active seed treatment such as Apron XL to offer broad-spectrum protection against the seed and seedling disease complex (*Rhizoctonia* spp. and *Pythium* spp.). Apply Dynasty as a water-based slurry using seed treatment application equipment that will provide uniform coverage on the seed surface.
Enhance Chemtura AgroSolutions	captan carboxin	19.55% 20.00%	5.0 oz per 100 lb of seed	Protects soybean seed from seedborne and soilborne fungi that cause seed decay, damping-off and seedling blights (including *Fusarium, Rhizoctonia* and *Pythium*). Do not graze or feed livestock on soybean forage or hay.

Seed treatment fungicides and nematode protection products labeled for use on soybean - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Enhance AW Chemtura AgroSolutions (formerly Trace Seed Protection Products)	captan carboxin imidacloprid	19.55% 20.00% 20.00%	5.0 oz per 100 lb of seed	Protects soybean seed from seedborne and soilborne fungi that cause seed decay, damping-off and seedling blights (including *Fusarium, Rhizoctonia* and *Pythium*). Do not graze or feed livestock on soybean forage or hay.
EverGol Energy Bayer CropScience	prothioconazole penflufen metalaxyl	7.18% 3.59% 5.74%	1.00 fl oz per 100 lb of seed	Effective against seed rot and damping-off caused by *Rhizoctonia, Fusarium* and *Pythium*; seed rot, damping-off and seedling blight caused by seedborne *Botrytis cinerea*; seed decay caused by Phomopsis; and suppression of Ascochyta blight. Also, effective against early-season Phytophthora; for longer season control add sufficient metalaxyl product, such as Allegiance, to supply a total metalaxyl amount of 15 to 30 gai/100 kg of seed. For use only in commercial seed treatment equipment. Not for use in hopper box, planter box, slurry box or other on-farm seed treatment applications.
Hi Moly/Captan-D Chemtura AgroSolutions (formerly Trace Seed Protection Products)	captan molybdenum	48.92% 10.20%	3.3 oz per 100 lb of seed	To protect against seedborne and soilborne diseases such as seedling blights, damping-off and seed decay. Also provides 0.2 oz of molybdenum per acre for plant nutrition and nitrogen fixation. Treat only those seeds needed for immediate use, minimizing the interval between treatment and planting. Do not store excess treated seed beyond planting time. Hopper box seed treatment.
INOVATE System Valet Chemtura AgroSolutions	clothianidin ipconazole metalaxyl	47.80% 1.029% 1.647%	4.78 fl oz per 100 lb of seed	INOVATE System is a combination of two separately registered products including Nipsit INSIDE (clothianidin insecticide) + RANCONA Xxtra (ipconazole and metalaxyl fungicides). Protects against seed and soilborne diseases including *Phomopsis, Pythium, Phytophthora, Fusarium* and *Rhizoctonia*.
Kernel Guard Supreme Chemtura AgroSolutions	permethrin carboxin	10.42% 14.00%	3.0 oz per 100 lb of seed	Kernel Guard Supreme may be used on seed previously treated with a full dosage of protective fungicide, to give added protection against seedling blight, damping-off or seed decay. Treat only those seed needed for immediate use, minimizing the interval between treatment and planting. Do not store excess treated seeds beyond planting time. Kernel Guard Supreme is a planter box or hopper box seed treatment for on-farm use immediately before planting.
KickStart VP Helena Chemical Company	carboxin permethrin	14.00% 10.42%	1.5 oz per 50 lb of seed	KickStart VP may be used on seed previously treated with a full dosage of protective fungicide to give added protection against seedling blight, damping-off or seed decay. Apply KickStart VP to seed at planting time with the canister applicator tube system. For best results, fill planter box with seed, add KickStart VP through applicator tube and mix so all seeds are covered. Do not mix with bare hands. Use only at the recommended rate. Lower amounts may not give desired control. Excessive amounts may cause seed injury.
Kodiak HB Chemtura AgroSolutions (formerly Trace Seed Protection Products)	*Bacillus subtilis* GB03	0.30%	4.0 to 8.0 oz per 100 lb of seed	For suppression of root diseases caused by *Rhizoctonia* and *Fusarium* and for improvement of nodulation by *Bradyrhizobium*. Contains bacteria that colonize the developing root system, suppressing disease organisms such as *Fusarium* and *Pythium* that attack root systems. When used with a chemical seed treatment, the combination of chemicals and Kodiak provides protection to the root for a much longer time than with chemicals alone. Kodiak HB is a hopper box seed treatment.
Latitude Chemtura AgroSolutions (formerly Trace Seed Protection Products)	imidacloprid carboxin metalaxyl	25.00% 14.00% 1.00%	4.0 oz per 100 lb of seed	For the protection of seeds and seedlings against seed and seedling diseases caused by *Pythium* and *Rhizoctonia*. Use only at the recommended rate. Lower amounts may not give desired control. Excessive amounts may cause seed injury. Do not graze or feed livestock on forage and hay on treated areas for six weeks after planting soybeans. Do not graze or feed livestock on vines grown from treated soybean seed.
Maxim XL Syngenta	fludioxonil mefenoxam	21.00% 8.40%	0.167 to 0.334 fl oz per 100 lb of seed	For protection against seedborne and soilborne fungi that cause decay, damping-off and seedling blight, and early-season Phytophthora protection. See label for specific rate recommendations depending on expected disease pressure. Apply as a water-based slurry using standard slurry seed treatment equipment that provides uniform seed coverage.

Seed treatment fungicides and nematode protection products labeled for use on soybean - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Maxim 4FS Syngenta	fludioxonil	40.30%	0.08 to 0.16 fl oz per 100 lb of seed	For protection against seedborne and soilborne fungi that cause decay, damping-off and seedling blight. Maxim 4FS does not control diseases caused by *Pythium* spp. or *Phytophthora* spp. If these diseases are expected to be a problem, apply Maxim 4FS tank mixed with Apron XL. Apply as a water-based slurry using standard slurry seed treatment equipment that provides uniform seed coverage.
MetaStar ST Chemtura AgroSolutions (formerly Trace Seed Protection Products)	metalaxyl	29.99%	0.75 to 1.5 fl oz per 100 lb of seed	For Pythium damping-off and early-season Phytophthora control. MetaStar ST is a systemic fungicide seed dressing specifically for control of systemic downy mildews, *Pythium* and *Phytophthora* spp. For control of other soilborne diseases, combinations with Captan and Vitavax registered formulations are compatible. Do not use with other seed treatment products unless previous experience assures compatibility. MetaStar ST may be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
Poncho/VOTiVO Bayer CropScience	clothianidin *Bacillus firmus* I-1582	40.30% 8.10%	0.13 mg ai/seed	Poncho/VOTiVO is a combination insecticide and biological seed treatment that, when applied to seed, protects the seed and seedling against certain early-season insects and provides early-season protection from listed plant pathogenic nematodes that attack the root system. As a result of the dual protection, there is an improvement in plant vigor, which often results in more uniform plants and greater yields. In areas of high nematode infestation additional control measures may be warranted. For soybean the nematode pests include reniform, root knot and soybean cyst nematodes. See label for plant-back restrictions. For use only in commercial seed treatment equipment. Not for use in hopper box, planter box, slurry box or other on-farm seed treatment applications. Do not graze or feed soybean forage and hay to livestock
Prevail Chemtura AgroSolutions	carboxin PCNB metalaxyl	15.00% 15.00% 3.12%	2.0 to 4.0 oz per bushel of seed	For protection against Pythium and Rhizoctonia seedling disease complex. Do not graze or feed livestock on hay grown from treated seed. May be used as a planter box treatment or applied at planting time using on farm mechanical treater to maximize seed coverage.
Protector-D Chemtura AgroSolutions (formerly Trace Seed Protection Products)	thiram	35.00%	2.0 oz per bushel of seed	Contains thiram to protect against seedborne and soilborne diseases, such as seedling blights, damping-off and seed decay organisms, as well as 0.2 oz of molybdenum per acre for plant nutrition and to aid in nitrogen fixation. Plant as soon as possible after treating. Hopper box seed treatment.
Protector-L-Allegiance Chemtura AgroSolutions	thiram metalaxyl	14.29% 1.61%	6.7 fl oz per 100 lb of seed	A ready-to-use product combining the action of thiram and metalaxyl to reduce seed rot/seedling blight diseases including *Pythium* and *Rhizoctonia* and providing molybdenum to aid in nitrogen fixation. Apply as a pour-on hopper box application or through on-farm seed treatment equipment.
RANCONA Summit Chemtura AgroSolutions	ipconazole metalaxyl	0.902% 1.443%	4.0 fl oz per 100 lb of seed	For protection against seed rot, damping-off and seedling blight including *Fusarium* (seed and soilborne), *Rhizoctonia solani,* and seedborne *Diaporthe* (*Phomopsis*). Also protects against general seed rots caused by saprophytic organisms such as *Penicillium* and *Aspergillus*. RANCONA Summit provides control of Pythium and protection against Phytophthora. However, if the target field has a history of high Phytophthora pressure, RANCONA Summit may be applied in combination with a product containing metalaxyl (such as MetaStar ST) at the rate registered for your crop for increased protection. RANCONA Summit may be applied with mechanical, slurry or mist-type seed treating equipment provided that the equipment can be calibrated to accurately and uniformly apply the product to the seed.
RANCONA Xxtra Chemtura AgroSolutions	ipconazole metalaxyl	1.029% 1.647%	3.5 fl oz per 100 lb of seed	For protection against seed rot, damping-off and seedling blight including *Fusarium* (seed and soilborne), *Rhizoctonia solani,* and seedborne *Diaporthe* (*Phomopsis*). Also protects against general seed rots caused by saprophytic organisms such as *Penicillium* and *Aspergillus*. RANCONA Xxtra may be applied with mechanical, slurry or mist-type seed treating equipment provided that the equipment can be calibrated to accurately and uniformly apply the product to the seed. This product is for both commercial and on-farm application. Do not graze or feed livestock soybean forage or hay.

Seed treatment fungicides and nematode protection products labeled for use on soybean - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
RANCONA 3.8 FS Chemtura AgroSolutions	ipconazole	40.70%	0.085 fl oz per 100 lb of seed	For protection against seed rot, damping-off and seedling blight including *Fusarium* (seed and soilborne), *Rhizoctonia solani,* and seedborne *Diaporthe* (*Phomopsis*). Also protects against general seed rots caused by saprophytic organisms such as *Penicillium* and *Aspergillus*. RANCONA 3.8 FS may be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment. Not for use on agricultural establishments in hopper-box, planter-box, slurry-box or other seed treatment applications at or immediately before planting.
Sebring 2.65 ST Nufarm Americas Inc.	metalaxyl	28.35%	0.75 to 1.5 fl oz per 100 lb of seed	For Pythium damping-off and early-season Phytophthora control. For control of other soilborne diseases, combination of Captan and Vitavax registered formulations are compatible. Do not use with other seed treatment products unless previous experience assures compatibility. This product may be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
Sebring 318 FS Nufarm Americas Inc.	metalaxyl	30.14%	0.75 to 1.5 fl oz per 100 lb of seed	For Pythium damping-off and early-season Phytophthora control. For control of other soilborne diseases, combination of captan, thiram and carboxin registered formulations are compatible. Do not use with other seed treatment products unless previous experience assures compatibility. For planter box treatment apply at the specified rate and premix with the seed directly in the planted box at planting. This product may be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
Sebring 480 FS Fungicide Nufarm Americas Inc.	metalaxyl	44.08%	0.50 to 1.00 fl oz per 100 lb of seed	For Pythium damping-off and early-season Phytophthora control. For control of other soilborne diseases, combination of captan, thiram and carboxin registered formulations are compatible. Do not use with other seed treatment products unless previous experience assures compatibility. For planter box treatment apply at the specified rate and premix with the seed directly in the planted box at planting. This product may be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
Seed Shield Soybean Helena Chemical Company	mefenoxam fludioxonil azoxystrobin thiamethoxam	1.70% 1.12% 0.90% 22.60%	3.0 fl oz per 100 lb of seed	Provides early season protection against damping-off and seed borne rots due to *Pythium, Phytophthora, Fusarium, Rhizoctonia* species and early-season Phytophthora root rot. Seed Shield Soybean also suppresses seed-borne *Sclerotinia* and *Phomopsis* species. If target fields have a history of high *Phytophthora* pressure, add additional Apron XL as directed in the rate table and the Apron XL label. Apply as a water-based slurry utilizing standard slurry seed treatment equipment which provides uniform seed coverage.
System[3] Helena Chemical Company	PCNB metalaxyl *Bacillus subtilis*	16.67% 4.25% 0.10%	2.0 to 4.0 oz per bushel of seed	For Pythium and Rhizoctonia seedling disease complex and early-season Phytophthora. Use the higher rate of application in fields with a history of severe disease pressure. Apply at the specified rate and premix with seed directly in the planter box at planting. May also be applied at planting time using commercial seed treating equipment to maximize seed coverage.
Thiram 480 DP Chemtura AgroSolutions	thiram	42.00%	2.00 fl oz per 100 lb of seed	Used according to directions, Thiram 480 DP will usually increase stands and yields by reducing losses from seed decay, damping-off and seedling blights caused by many seedborne and soilborne organisms. Intended for use by professional applicators only. Not for sale or use by homeowners/consumers. Apply with mechanical, slurry, or mist-type seed treating equipment provided that the equipment is calibrated to accurately apply the product to seed.
Trilex Flowable Fungicide Bayer CropScience	trifloxystrobin	22.00%	0.32 fl oz per 100 lb of seed	Provides seed and seedling protection against seedborne fungi causing seed decay and the soilborne pathogen *Rhizoctonia solani* and *Fusarium* spp. Apply as a seed treatment using standard slurry or mist-type seed treatment equipment. Uniform application of seed is necessary to ensure seed safety and best disease protection. Product should be diluted with sufficient water to ensure complete seed coverage.

Seed treatment fungicides and nematode protection products labeled for use on soybean - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Vibrance Syngenta	sedaxane	45.45%	0.08 to 0.16 fl oz per 100 lf of seed	For control of seed decay, seedling blight and damping-off caused by *Rhizoctonia solani*. Vibrance does not control diseases caused by *Pythium* spp. or *Phytophthora* spp. If these diseases are expected to be a problem, apply with Apron XL or seed treatment products that contain mefenoxam as active ingredients. Apply as a water-based slurry using standard slurry seed treatment equipment which provides uniform seed coverage.
VITAFLO-280 Chemtura AgroSolutions	carboxin thiram	15.99% 13.25%	4.0 fl oz per 100 lb of seed	A combination of a systemic fungicide and a contact fungicide to control general seed rot, seedling blight and damping off including *Fusarium, Rhizoctonia, Pythium* and *Phomopsis/Diaporthe* (seedborne). Protects from seed rot caused by the seedborne storage fungi *Aspergillus* and *Penicillium*. Formulated both for on-farm and commercial use. DO NOT apply VITAFLO-280 as a planter box or hopper box treatment. VITAFLO-280 may be applied with mechanical, slurry, or mist-type seed treating equipment provided that the equipment can be calibrated to accurately and uniformly apply the product to seed. Do not graze or feed livestock on treated areas for six weeks after planting.
Vitavax M Helena Chemical Corporation	carboxin thiram molybdenum	5.70% 5.70% 2.90%	12.0 fl oz per 100 lb of seed	For control of various seed and seedling diseases, including *Rhizoctonia solani*. Do not graze or feed livestock on forage and hay on treated areas. Ready-to-use seed treatment for hopper box application.
Vitavax-34 Chemtura AgroSolutions	carboxin	34.00%	3.0 to 4.0 fl oz per 100 lb of seed	For control of *Rhizoctonia solani* seed rots and seedling blight. The higher rate will provide increased protection when high disease pressure is expected. May be applied with mechanical, slurry, or mist-type seed treating equipment, provided that the equipment can be calibrated to accurately and uniformly apply the product to the seed. DO NOT apply this product as a planter box or hopper box treatment. Do not graze or feed livestock on forage or hay grown from treated seed.
Warden CZ Winfield Solutions, LLC	thiamethoxam mefenoxam fludioxonil	21.50% 3.21% 1.07%	3.2 fl oz per 100 lb of seed	Provides protection against damping-off and seedborne rots due to *Pythium, Phytophthora*, *Fusarium* and *Rhizoctonia* species and early-season Phytophthora root rot. Warden CZ also suppresses seedborne *Sclerotinia* and *Phomopsis* species. If target fields have a history of high Phytophthora pressure, add additional Apron XL as directed in the rate table or on the Apron XL label. Apply Warden CZ as a water-based slurry using standard slurry seed treatment equipment.
Warden RTA Winfield Solutions, LLC	mefenoxam fludioxonil	2.15% 0.72%	5.0 fl oz per 100 lb of seed	Protects against damping-off and seed rots due to *Pythium, Phytophthora, Fusarium, Rhizoctonia* spp. and early-season Phytophthora root rot. Also suppresses seedborne *Sclerotinia* and *Phomopsis* spp. Especially formulated for on-farm treatment, using standard mechanical or mist-type seed treatment equipment.

At-planting fungicides for soybean

The following table was prepared using current company product label books and manufacturers' Web sites. However, label registrations can change at any time. Before using any agricultural pesticide, read and follow directions accompanying that product. Product names have been used for clarity. Reference to specific trade names does not imply endorsement by the University of Missouri; discrimination is not intended against similar products not listed.

At-planting fungicides labeled for use on soybean

Trade name Company	Common chemical name	% active ingredients	Rate	Additional label information
Ridomil Gold GR Syngenta	mefenoxam	2.50%	6.0 oz per 1,000 linear feet of row in a 7-inch band over the row or as a seed-furrow application at the time of planting for full-season control. 1.5 to 3.0 oz per 1,000 linear feet of row in the seed furrow for early to mid-season control. When making the seed furrow applications, position the applicator tubes so the granules are mixed with the soil covering the seed or are applied in a "T-band."	For use in the control of Phytophthora root and stem rot and Pythium damping-off. It may be applied in a 7-inch band over the row at planting or in the seed furrow before seeds are covered. The seed-furrow applications will provide more consistent results if rain is not expected before the seeds germinate. Ridomil Gold GR is specific for *Pythium* and *Phytophthora* and will not control other diseases that may attack soybeans.vFor best results against Phytophthora root and stem rot, use Ridomil Gold GR with soybean varieties that have some tolerance to the races of *Phytophthora* present in the field. The higher rate of Ridomil Gold GR should be used in areas with a history of heavy *Phytophthora* damage. Under heavy late-season *Phytophthora* pressure, Ridomil Gold GR may not provide complete control. Rotational restrictions may apply. See label for additional information on application techniques and restrictions.
Ridomil Gold SL Syngenta	mefenoxam	45.30%	0.08 to 0.28 fl oz per 1,000 row feet for in-furrow application or 0.37 to 1.25 pt per acre for soil spray application	For use in the control of Phytophthora root and stem rot and Pythium damping-off. In-furrow spray: apply in-furrow with water or liquid fertilizer. Position the spray so fungicide is mixed with the soil covering the seed directly or crop injury may occur. Use the high rate for full-season control. Use 0.08 to 0.15 fl oz for early- to mid-season control. Soil spray (broadcast or band): apply in water or liquid fertilizer. Use the high rate for full-season control. Use 0.37 to 0.75 pt for early- to mid-season control. For banded applications, a 7-inch band is recommended. For best results, use soybean varieties that have some degree of resistance to races of *Phytophthora* present in the field. Use the higher rate in areas with a history of heavy Phytophthora damage. Under heavy late-season Phytophthora pressure, Ridomil Gold SL may not provide complete control.

Soybean foliage diseases

Foliage diseases such as Septoria brown spot, bacterial blight, bacterial pustule, frogeye leaf spot, downy mildew, powdery mildew and Asian soybean rust can occur on soybeans in Missouri. Generally these diseases occur in low levels or late in the season and do not cause significant losses. However, under environmental conditions favorable for disease development and especially on susceptible varieties, losses can be serious.

The fungi that cause most of these soybean foliage diseases survive in infested soybean residues left on the soil surface. The following growing season, spores are produced during moist periods and are carried by wind currents to susceptible soybean leaves. Foliage disease problems tend to be more severe when soybeans are planted in fields with infested soybean residue left on the soil surface. Eventually spores that are produced in initial lesions are windblown to other leaves or plants, causing secondary infection.

Asian soybean rust is an exception to this simplified explanation of disease development. The soybean rust fungus does not survive in infested residues left in a field and, in fact, does not survive the winter months in Missouri. Rather, the rust fungus is reintroduced each season when spores are carried on air currents from the southern United States to Missouri. Whether Asian soybean rust develops in Missouri or not, as well as the severity of the disease if it does develop, depends on when during the season spores are blown into the state and whether weather conditions are favorable for disease development.

Most of the foliage diseases of soybeans are favored by moderate to warm temperatures, wet or humid weather and heavy dews. They tend to start on the lower leaves and, if weather conditions are favorable, move up through the canopy of the plants.

Management options for soybean foliage diseases

- Plant disease-free seed.
- Plant resistant varieties.
- Rotate crops with at least one year between soybean crops.
- There are foliar fungicides labeled for use on soybean to control fungal foliage diseases. Use of these foliar fungicides may be more economical on high-value fields or in years when weather is quite favorable for disease development.

When soybean rust was first found in the continental United States, a number of fungicides were granted Section

18 labels (quarantine exemption labels) for use on soybeans only if there was a threat of soybean rust and only for management of soybean rust. All of these Section 18 labels have expired. The products that had Section 18 labels have either received full federal registration and now have Section 3 labels or have been withdrawn from the market.

The following table lists foliar fungicides that have Section 3 labels and are labeled for use on soybean. This table was prepared using current company product label books and manufacturers' Web sites. However, label registrations can change at any time. Before using any agricultural pesticide, read and follow label directions accompanying the product. Product names have been used for clarity. Reference to specific trade names does not imply endorsement by the University of Missouri; discrimination is not intended against similar products not listed.

Foliar fungicides labeled for use on soybean

Products with Sec. 3 labels (full federal registrations)

Trade name Company	Common chemical name	% active ingredients	Rate	Additional label information
Alto 100SL Syngenta	cyproconazole	8.9%	2.75 to 5.5 fl oz per acre	For soybean rust: Apply 2.75 to 5.5 fl oz per acre before disease development. Repeat at 14 to 28-day interval if conditions persist for rust development. Depending on the conditions, application timing should be R1 (beginning flowering, approximately 50 days after planting) up to the R6 stage (seed fully developed), but could be earlier. Tank mixes with a strobilurin fungicide such as Quadris will optimize performance against rust. Use the 2.75 fl oz per acre rate when disease is present in the vegetative stage. For diseases other than soybean rust including aerial blight, Alternaria leaf spot, anthracnose, Septoria brown spot, Cercospora blight and leaf spot, frogeye leaf spot and pod and stem blight: use 4.0 to 5.5 fl oz per acre. For best results, begin Alto 100SL applications before disease development. Apply a minimum of 4.0 fl oz per acre based on local recommendations for timing and thresholds. Tank mixes with a strobilurin fungicide such as Quadris will enhance performance on these diseases. For maximum performance, Alto 100SL applications should begin before disease development. Use the high rates under conditions favorable for severe disease pressure, dense plant canopies or when disease is present. Application directions: A spreading/penetrator type adjuvant is recommended when used solo or in tank mix. NIS at 0.25% v/v is the recommended adjuvant. Coverage and penetration are important for best results. Use sufficient water volume to provide thorough and uniform plant coverage. Applications may be made by ground, air or chemigation. Resistance management: Do not alternate or tank mix with fungicides to which resistance has developed in the pathogen population. Do not apply more than 11.0 fl oz Alto 100LS per acre per season. Do not apply more than 0.072 lb a.i. per acre per year of cyproconazole containing products. Do not graze forage within 14 days of application. Do not use soybean forage or hay as livestock feed if making more than one application at the 5.5 fl oz per acre rate. Do not apply within 30 days of harvest of soybeans (beans).
AVARIS Helena Chemical Company	azoxystrobin propiconazole	7.00% 11.70%	14.0 to 20.5 fl oz per acre	Aerial web blight: Apply 14.0 to 20.5 fl oz per acre at first appearance of disease and repeat the application 14-21 days later. Under severe disease conditions use the higher rate and shorter interval. Anthracnose, Septoria brown spot, frogeye leaf spot, Alternaria leaf spot, Cercospora blight and leaf spot and pod and stem blight: Apply 20.5 fl oz per acre at growth stage R3 (early pod set when pods are ⅛ to ¼ inch long and 14-21 days later at growth stage R5 (pod fill). Soybean rust: Apply 14.0 to 20.5 fl oz per acre at the first indication that disease is in the area. For best control, preventive applications work best. Repeat on a 14-21 day interval. Use higher rate and shorter interval when disease is present in the field and incidence is less than 2% (2 plants in 100 are infected). If incidence is greater than this or if disease is in mid canopy, control will not be acceptable. On certain varieties, AVARIS applications may cause crinkled, smaller and/or greener leaves. Yields of beans displaying these characteristics have not been reduced due to AVARIS treatments. Do not apply more than 42.0 fl oz per acre per season of AVARIS. See label for additional information on resistance management. AVARIS is most effective when applied and allowed to dry before a rainfall. For best results, sufficient coverage is important. Use a higher water volume for aerial application (greater than 2 GPA) if equipment and/or conditions would not provide good coverage. AVARIS may be applied by ground, air or chemigation. AVARIS is extremely toxic to certain apple varieties. Extreme care must be used to prevent injury to apple trees. See label for additional information. Do not apply within 21 days of harvest for seed and 0 days for forage and hay.

Foliar fungicides labeled for use on soybean - *continued*

Products with Sec. 3 labels (full federal registrations)

Trade name Company	Common chemical name	% active ingredients	Rate	Additional label information
Bravo Ultrex Syngenta	chlorothalonil	82.50%	rate varies with diseases targeted for control and application program-see next column	1.4 to 2.2 lb per acre for control of anthracnose, Diaporthe pod and stem rot, frogeye leaf spot, purple seed stain, Cercospora leaf blight and Septoria brown spot with two application program. For determinate varieties, make the first application at R3 stage (early pod set) and the second application at R5. For indeterminate varieties, make the first application when largest pods are 1-1¼ inches in length. Make the second application 14 days later. 0.9 to 1.4 lb per acre for control of anthracnose, Diaporthe pod and stem rot, frogeye leaf spot, purple seed stain, Cercospora leaf blight and Septoria brown spot with three application program. For determinate varieties, make the first application at the beginning of flowering (R1), the second at early pod set (R3) and the third at beginning of seed formation (R5). For indeterminate varieties, make the first application one week after first flowering and continue applications at 14-day intervals. 0.9 lb per acre for control of stem canker. Apply in 10 to 20 gallons of water per acre, as a band treatment directing the spray to provide coverage of entire plant. Make the first application at the time of emergence of the second trifoliolate leaves (V2). If conditions favor stem canker disease make a second and a third application. Make all applications at 14-day intervals. Do not apply more than 5.4 lb Bravo Ultrex per acre during each growing season. Do not apply within 6 weeks of harvest. Do not feed soybean hay or threshings from treated fields to livestock.
Bravo Weather Stik Syngenta **Chloronil 720** Syngenta	chlorothalonil chlorothalonil	54.00% 54.00%	rate varies with diseases targeted for control and application program-see next column	1.5 to 2.25 pt per acre for control of anthracnose, Diaporthe pod and stem rot, frogeye leaf spot, purple seed stain, Cercospora leaf blight, Septoria brown spot and rust(suppression) with two-application program. For determinate varieties, make the first application at early pod set (R3 stage when majority of pods are ⅛ to ⅜ inch in length) and the second at beginning of seed formation (R5) which occurs about 14 days later. For indeterminate varieties, make the first application when largest pods are 1-1½ inches in length. Make the second application 14 days later. 1.0 to 2.0 pt per acre for control of anthracnose, Diaporthe pod and stem rot, frogeye leaf spot, purple seed stain, Cercospora leaf blight, Septoria brown spot and rust (suppression) with three-application program. For determinate varieties, make the first application at the beginning of flowering (R1), the second at early pod set (R3) and the third at beginning of seed formation (R5). For indeterminate varieties, make the first application one week after first flowering and continue applications at 14 day intervals. 1.0 pt per acre for control of stem canker on determinate varieties. Apply in 10 to 20 gallons of water per acre, as a band treatment directing the spray to provide coverage of entire plant. Make the first application at the time of emergence of the second trifoliolate leaves (V2). If conditions favor stem canker disease make a second and a third application. Make all applications at 14-day intervals. Check label for other restrictions.
Bumper 41.8 EC Makhteshim Agan of North America, Inc.	propiconazole	41.80%	4.0 to 6.0 fl oz per acre	For control of aerial web blight, anthracnose, Septoria brown spot, frogeye leaf spot and soybean rust. Applications may be made using ground or aerial application equipment. Use dilution rates found in the "Application Instructions" section of the label. When applying by air, adding an oil-based additive is recommended for improved coverage and penetration. Aerial web blight: Apply 5.0 to 6.0 fl oz at the first appearance of aerial web blight and repeat the application 14 to 21 days later. Under severe conditions, use the higher rate and shorter interval. Other foliage diseases: Apply 6.0 fl oz at growth stage R3 (early pod set) when pods are ⅛ to ¼ inch long and 21 days later at growth stage R5 (pod fill). Soybean rust: apply 4.0 to 6.0 fl oz at first indication that soybean rust is in the area. For best control, preventative applications work best. Repeat on a 14- to 21-day interval using the higher rate and shorter interval when disease is present in field and incidence is less than 2% (2 plants in 100 infected). If incidence is greater than this or if disease is mid-canopy, control will not be acceptable. On certain varieties, Bumper 41.8 EC applications may cause crinkled or smaller green leaves. Yields of beans displaying these characteristics have not been reduced due to propiconazole treatments. Do not apply more than 12.0 fl oz of Bumper 41.8 EC per acre per season. Do not apply more than 0.34 lb a.i. propiconazole per acre per season. Applications may be made up to growth stage R6.

Foliar fungicides labeled for use on soybean - *continued*

Products with Sec. 3 labels (full federal registrations)

Trade name Company	Common chemical name	% active ingredients	Rate	Additional label information
Domark 230 ME Valent	tetraconazole	20.50%	4.0 to 5.0 fl oz per acre	Target diseases: Asian soybean rust, Cercospora blight, purple seed stain, frogeye leaf spot, white mold/Sclerotinia stem rot, powdery mildew, Septoria brown spot and anthracnose. Apply prior to disease development when infections are likely to occur. If necessary repeat with a second application before growth stage R6. Curative applications are most effective when disease incidence does not exceed 5% of the soybean plants at time of application. Make application at soybean growth stage R3 (early pod fill) or when conditions are favorable for disease development. Repeat application 15 to 21 days after first application if disease pressure is heavy. Under severe disease conditions the higher rate and shorter spray interval should be used. Apply as a foliar spray or via chemigation in sufficient water to obtain thorough coverage of soybeans. Do not make more than two (2) applications of Domark 230 ME to soybeans per year. Do not apply more than 10 fl oz of Domark 230 ME per acre per season. A restricted entry interval (REI) of 12 hours is to be followed. Do not graze or feed soybean forage or hay to livestock. Do not harvest immature soybeans for consumption once plants are treated with Domark 230 ME. Do not use on vegetable soybean varieties grown for their immature pods. Do not apply Domark 230 ME after soybean growth stage R5 (beginning seed).
Echo 90DF SIPCAM AGRO USA, INC.	chlorothalonil	90.00%	rate varies with diseases targeted for control and application program-see next column	1.25 to 2.0 lb Echo 90 DF per acre, 1.5 to 2.5 pt Echo 720 per acre or 2.0 to 3.5 pt Echo Zn per acre for control of anthracnose, Diaporthe pod and stem rot, frogeye leaf spot, purple seed stain, Cercospora leaf blight, Septoria brown spot and rust with two-application program. For determinate varieties, make the first application at early pod set (R3 stage) and the second seed formation (R5). For indeterminate varieties, make the first application when largest pods are 1 to 1½ inches in length. Make the second application 14 days later.
Echo 720 SIPCAM AGRO USA, INC.	chlorothalonil	54.00%		
Echo Zn SIPCAM AGRO USA, INC.	chlorothalonil	38.50%		0.875 to 1.625 lb Echo 90 DF per acre, 1.0 to 2.0 pt Echo 720 per acre or 1.5 to 2.75 pt Echo Zn per acre for control of anthracnose, Diaporthe pod and stem rot, frogeye leaf spot, purple seed stain, Cercospora leaf blight, Septoria brown spot and rust with three-application program. For determinate varieties, make the first application at early flowering (R1), the second at early pod set (R3) and the third at beginning of seed formation (R5). For indeterminate varieties, make the first application one week after first flowering and continue applications at 14 day intervals. 0.875 lb Echo 90 DF per acre, 1.0 pt Echo 720 per acre or 1.5 pt Echo Zn per acre for control of stem canker. Apply in 10 to 20 gallons of water per acre, as a band treatment directing the spray to provide coverage of entire plant. Make the first application at the time of emergence of the second trifoliolate leaves (V2). If conditions favor stem canker disease make a second and a third application. Make all applications at 14-day intervals. Do not feed soybean hay or threshings from treated fields to livestock. Preharvest interval (PHI) of 42 days.

Foliar fungicides labeled for use on soybean - *continued*

Products with Sec. 3 labels (full federal registrations)

Trade name Company	Common chemical name	% active ingredients	Rate	Additional label information
Equus DF Makhteshim Agan of North America, Inc.	chlorothalonil	82.50%	rate varies with diseases targeted for control and application program-see next column	1.4 to 2.1 lb Equus DF per acre, 2.1 to 3.4 pt per acre Equus 500 Zn or 1.5 to 2.4 pt per acre Equus 720 SST for control of anthracnose, Diaporthe pod and stem blight, frogeye leaf spot, purple seed stain, Cercospora leaf blight and Septoria brown spot with two-application program. Make the first application at early pod set (R3) stage, when majority of pods are ⅛ to ¾ inch in length) and the second at beginning of seed formation (R5) which occurs about 14 days later.
Equus 500 Zn Makhteshim Agan of North America, Inc.	chlorothalonil	38.50%		0.9 to 1.4 lb Equus DF, 1.4 to 2.8 pt per acre of Equus 500 Zn per acre or 1.0 or 2.0 pt per acre of Equus 720 SST for control of anthracnose, Diaporthe pod and stem blight, frogeye leaf spot, purple seed stain, Cercospora leaf blight and Septoria brown spot with three-application program. Make the first application at the beginning of flowering (R1), the second at early pod set (R3) and the third at the beginning of seed formation (R5). Make all applications at 14-day intervals.
Equus 720 SST Makhteshim Agan of North America, Inc.	chlorothalonil	54.00%		For control of stem canker apply 0.9 lb Equus DF per acre or 1.0 pt per acre Equus 720 SST on determinate or indeterminate soybean varieties or 1.4 pt per acre of Equus 500 Zn on determinate soybean varieties. Apply in 10 to 20 gallons of water per acre, as a directed band treatment, directing spray to provide coverage of entire plant. Make the first application at the time of emergence of the second trifoliolate leaves (V2). If conditions favor stem canker disease, make a second and a third application. Make all applications at 14-day intervals. 1.25 to 2.2 lb Equus DF per acre or 1.37 to 2.25 pt per acre Equus 720 SST for control of soybean rust. Apply in sufficient water to obtain complete coverage, generally 10 to 20 gallons per acre. Make first application at first sign of disease and retreat at 14-day intervals. For resistance management of rust, alternate with another fungicide registered for soybean rust control. Do not exceed a total of three applications per season. Do not apply within 6 weeks of harvest. Do not feed treated parts to live stock or allow grazing in treated fields.
EVITO 480 SC Arysta LifeScience North America, LLA	fluoxastrobin	40.3%	2.0 to 5.7 fl oz per acre	Diseases controlled: Alternaria leaf spot, anthracnose, Septoria brown spot, Cercospora blight, frogeye leaf spot, pod and stem blight, Rhizoctonia aerial blight and rust. Begin applications preventively and continue as needed on a 14- to 21-day interval. Apply a maximum of two applications per season no later than growth stage R5. May be used in combination with a registered triazole fungicide to increase efficacy for soybean rust. Do not apply more than 11.4 fl oz per acre per year. There is a maximum number of 2 applications per year and a minimum interval of 14 days between applications. May be applied by ground, air or through chemigation. Do not apply after R5. Do not apply within 3 days of forage harvest or 30 days of seed harvest.
EVITO T Fungicide Arysta LifeScience North America, LLC	fluoxastrobin tebuconazole	18.00% 25.00%	4.0 to 6.0 fl oz per acre	Diseases controlled: Alternaria leaf spot, anthracnose, Septoria brown spot, Cercospora blight, frogeye leaf spot, pod and stem blight, Rhizoctonia aerial blight and rust. Begin applications preventively and continue as needed on a 14- to 21-day interval. Apply a maximum of two applications per season no later than growth stage R5. Do not apply more than 12.0 fl oz per acre per crop season. Maximum retreatment interval is 14 days. Do not apply EVITO T Fungicide within 21 days of forage harvest or 30 days of seed harvest.
Folicur 3.6 F Bayer CropScience	tebuconazole	38.70%	3.0 to 4.0 fl oz per acre	For soybean rust and powdery mildew. Apply as a broadcast foliar spray, as a preventative spray or at first visible symptoms of disease. Repeat applications on a 10- to 14-day spray interval if environmental conditions are favorable for continued disease development. Use of the higher rates and shorter spray intervals are recommended when disease pressure is severe. The lowest label recommended rate of a spray adjuvant must be tank-mixed with Folicur 3.6F. Folicur 3.6F should be applied in a minimum of 10 gallons of spray solution per acre by ground sprayer or in a minimum of 5 gallons of spray solution by aircraft spray equipment. Do not apply more than 12.0 fl oz per acre per use season. Do not apply more than three applications per season. Restricted-entry interval (REI) is 12 hours. Applications may not be made within 21 days of harvest.

Foliar fungicides labeled for use on soybean - *continued*

Products with Sec. 3 labels (full federal registrations)

Trade name Company	Common chemical name	% active ingredients	Rate	Additional label information
Headline BASF	pyraclostrobin	23.60%	6.0 to 12.0 fl oz per acre	Target diseases: Alternaria leaf spot, anthracnose, Septoria brown spot, Cercospora blight, frogeye leaf spot, pod & stem blight, Rhizoctonia aerial blight and Asian soybean rust. The 12.0 fl oz per acre rate is for suppression only of southern blight. For optimal disease control, apply Headline at early flowering (R1-R3 growth stage) or before disease development, whichever is earlier. Make a second application 7 to 21 days later if monitoring shows disease development or if conditions are conducive for disease infection. Use the higher labeled rate and shorter interval when disease pressure is high. Headline may be applied with adjuvants. It may be applied by ground sprayer, aerial equipment or through sprinkler irrigation systems. See label for information on resistance management. Soybean forage may be fed no sooner than 14 days after last application. Soybean hay may be fed no sooner than 21 days after last application. The minimum time from application to harvest (PHI) is 21 days.
Incognito 4.5F Fungicide Makhteshim Agan of North America, Inc.	thiophanate-methyl	46.20%	rate varies with diseases targeted for control and application program- see next column	10.0 to 20.0 fl oz of Incognito 4.5F Fungicide or 0.4 to 0.8 lb of Incognito 85WDG Fungicide per acre for anthracnose, Septoria brown spot, frogeye leaf spot, stem and pod blight and purple seed stain. Apply from full bloom when pods are ⅛ to ¼ inch in length. Make a second application 14 to 21 days later. Do not make the second application later than 14 days after pods average ¼ inch in length or when beans form in the pod. Use the high rate under severe disease pressure.
Incognito 85WDG Fungicide Makhteshim Agan of North America, Inc.	thiophanate-methyl	85.00%		Use 15.0 to 20.0 fl oz of Incognito 4.5F Fungicide or 0.6 to 0.8 lb of Incognito 85WDG Fungicide per acre for white mold. Make one application at early bloom (R1 to R2 stage) followed by a second application 14 days later if conditions are favorable for continued disease pressure. Thorough coverage of the flowers, stems and branches is essential for disease control. Use 20.0 fl oz of Incognito 4.5 F Fungicide or 0.8 lb or Incognito 85WDG per acre for aerial blight suppression. Make initial application when disease threatens (before visual symptoms appear) and repeat 14-21 days later if needed. Applications later than 14 days after pods average ¼ inch in length are prohibited. Do not apply more than 40.0 fl oz of Incognito 4.5F Fungicide per acre per year. Do not make more than two applications per year. Do not graze or feed treated vines or hay to livestock. The REI is 1 day. The PHI is 21 days.
Initiate 720 Flowable Fungicide Loveland Products Inc.	chlorothalonil	54.00%	rate varies with diseases targeted for control and application program- see next column	1.5 to 2.25 pt per acre for anthracnose, Diaporthe pod and stem blight, frogeye leaf spot, purple seed stain, Cercospora leaf blight, Septoria brown spot soybean rust (suppression) with a two application program. For determinate varieties make the first application at early pod set (R3 stage when majority of pods are ⅛ to ⅜ inch in length) and the second at the beginning of seed formation (R5) which occur about 14 days later. For indeterminate varieties make the first application when largest pods are 1 to 1½ inches in length and make the second application 14 days later. Use 1.0 to 2.0 pt per acre for anthracnose, Diaporthe pod and stem blight, frogeye leaf spot, purple seed stain, Cercospora leaf blight, Septoria brown spot soybean rust (suppression) with a three application program. For determinate varieties make the first application at the beginning of flowering (R1), the second at early pod set (R3) and the third at the beginning of seed formation (R5). For indeterminate varieties make the first application one week after first flowering and continue applications at 14-day intervals. Use 1.0 pt per acre for stem canker. For determinate varieties apply in 10 to 20 gallons of water per acre, as a band treatment directing spray to provide coverage of entire plant. Make the first application at the time of emergence of the second trifoliolate leaves (V2). If conditions favor stem canker disease make a second and third application. Make all applications at 10- to 14-day intervals. Apply in sufficient water to obtain complete coverage, using at least five gallons of water per acre for aerial application. Use the three application program in areas having a history of moderate to severe disease intensity. Initiate 720 Flowable Fungicide may be applied through sprinkler irrigation equipment- see label for directions. The minimum re-treatment interval is 14 days. Do not exceed a total of three applications per season. Do not apply more than 6 pt per acre during each growing season. Do not feed treated parts to livestock or allow grazing in treated areas. Do not apply within 6 weeks of harvest.

Foliar fungicides labeled for use on soybean - *continued*

Products with Sec. 3 labels (full federal registrations)

Trade name Company	Common chemical name	% active ingredients	Rate	Additional label information
Initiate ZN Flowable Fungicide Loveland Products Inc.	chlorothalonil	38.50%	rate varies with diseases targeted for control and application program- see next column	2.25 to 3.25 pt per acre for anthracnose, Diaporthe pod and stem blight, frogeye leaf spot, purple seed stain, Cercospora leaf blight, Septoria brown spot soybean rust (suppression) with a two-application program. For determinate varieties make the first application at R3 (early pod set) and the second application at R5 (seed formation). For indeterminate varieties make the first application when largest pods are 1 to 1¼ inches in length and make the second application 14 days later. Use 1.5 to 2.75 pt per acre for anthracnose, Diaporthe pod and stem blight, frogeye leaf spot, purple seed stain, Cercospora leaf blight, Septoria brown spot soybean rust (suppression) with a three-application program. For determinate varieties make the first application at the beginning of flowering (R1), the second at early pod set (R3) and the third at the beginning of seed formation (R5). For indeterminate varieties make the first application one week after first flowering and continue applications at 14-day intervals. Use 1.5 pt per acre for stem canker. Apply in 10 to 20 gallons of water per acre, as a band treatment directing spray to provide coverage of entire plant. Make the first application at the time of emergence of the second trifoliate leaves (V2). If conditions favor stem canker disease make a second and third application. Make all applications at 10- to14-day intervals. Apply in sufficient water to obtain complete coverage, using at least five gallons of water per acre for aerial application. Use the three application program in areas having a history of moderate to severe disease intensity. Initiate ZN may be applied by ground, air or chemigation. The minimum re-treatment interval is 14 days. Do not apply more than 8.5 pt per acre during each growing season. Do not feed hay or threshings from treated fields to livestock. Do not apply within 6 weeks of harvest.
Laredo EC Dow AgroSciences	myclobutanil	25.00%	4.0 to 8.0 fl oz per acre	For control of soybean rust. Apply using ground or aerial equipment, in an adequate spray volume to achieve good coverage and canopy penetration. For aerial application, apply Laredo EC in a minimum spray volume of 5 gallons per acre. For best results apply preventively or as early as possible after an infection has occurred (a delay in fungicide application after an infection period has already occurred may result in yield loss), and make a subsequent application 14 to 21 days later. For maximum residual activity when used as a preventive treatment or optimum activity on established disease, use the higher rate in the rate range. Do not allow worker entry into treated areas during the restricted entry interval of 24 hours. Do not feed soybean forage or hay to livestock. Do not make more than two applications of myclobutanil-containing products to soybeans per season. Do not apply more than 16.0 fl oz of Laredo EC to soybeans per acre per year. Do not make applications within 28 days of harvest.
Microthiol United Phosphorus, Inc.	sulfur	80.00%	10.0 to 15.0 lb per acre	For leaf spot and powdery mildew. Apply at early leaf stage and repeat at 14-day intervals or as needed.
Monsoon Loveland Products Inc.	tebuconazole	38.70%	3.0 to 4.0 fl oz per acre	For soybean rust and powdery mildew. Apply Monsoon as a broadcast foliar spray, as a preventative spray or at first visible symptoms of disease. Repeat applications on a 10- to14-day spray interval if environmental conditions are favorable for continued disease development. Use of the higher rates and shorter spray interval are recommended when disease pressure is severe. The lowest label recommended rate of a spray surfactant must be tank-mixed with Monsoon. Monsoon should be applied in a minimum of 10 gallons of spray solution per acre by ground sprayer of in a minimum of 5 gallons per acre by aircraft spray equipment. Do not apply more than three applications per season. Do not apply more than 12 fl oz per acre per use season. Restricted-entry interval (REI) is 12 hours. Applications may not be made within 21 days of harvest.

Foliar fungicides labeled for use on soybean - *continued*

Products with Sec. 3 labels (full federal registrations)

Trade name Company	Common chemical name	% active ingredients	Rate	Additional label information
Muscle 3.6F SIPCAM AGRO USA, Inc.	tebuconazole	38.70%	3.0 to 4.0 fl oz per acre	For soybean rust. At the first sign of rust pustules on foliage make a spray application of this product. If environmental conditions are favorable for continued development, make a second application after 10-21 days dependent upon the severity of the disease pressure. Observe fields closely for early disease symptoms. For optimum benefit, the lowest specified rate of a spray surfactant should be tank mixed with this product. Do not apply more than 0.225 fl of the active ingredient, tebuconazole, per acre per year and make no more than three applications of this product per season. Apply this product in a minimum of 10 gallons of spray suspension per acre by ground sprayer or in a minimum of 5 gallons of spray suspension per acre by aircraft. Do not enter the treated fields within 12 hours of application. Preharvest interval (PHI) is 21 days.
Orius 3.6F Makhteshim Agan of North America, Inc.	tebuconazole	38.70%	3.0 to 4.0 fl oz per acre	Soybean rust and powdery mildew. Apply Orius 3.6F as a broadcast foliar spray, as a preventative spray or at first visible symptoms of disease. Repeat applications on a 10- to 14-day spray interval if environmental conditions are favorable for continued disease development. Use of the higher rates and shorter spray intervals are recommended when disease pressure is severe. The lowest labeled rate of a spray surfactant must be tank-mixed with Orius 3.6F. Orius 3.6F should be applied in a minimum of 10 gallons of spray solution per acre by ground sprayer or in a minimum of 5 gallons per acre by aircraft spray equipment. Do not apply more than three applications per season. Do not apply more than 12.0 fl oz per acre per season. Restricted-entry interval (REI) is 12 hours. Applications may not be made within 21 days of harvest.
Priaxor Xemium Brand Fungicide Syngenta	fluxapyroxad pyraclostrobin	14.33% 28.58%	4.0 to 8.0 fl oz per acre	Target diseases: Alternaria leaf spot, anthracnose, Asian soybean rust, Septoria brown spot, Cercospora blight, frogeye leaf spot, pod and stem blight and Rhizoctonia aerial blight. For suppression only of Scelrotinia blight and 8.0 fl oz rate for suppression only of southern blight. For optimal disease control, begin applications prior to disease development and continue on a 7- to 14-day interval if conditions are conducive for disease development. Use the higher rate and shorter interval when disease pressure is high. Priaxor may be used with adjuvants. Do not apply more than 16.0 fl oz per acre per season. Do not make more than two consecutive applications of Priaxor before alternating to a labeled fungicide with a different mode of action. Soybean forage may be fed no sooner than 14 days after last application. Soybean hay may be fed no sooner than 21 days after last treatment. Minimum time from application to harvest is 21 days.
Proline 480 SC Bayer CropScience	prothioconazole	41.00%	2.5 to 3.0 fl oz per acre	For control of Asian soybean rust, frogeye leaf spot and powdery mildew. Apply Proline 480 SC as a broadcast foliar spray, as a preventative spray or at first visible symptoms of disease. Repeat applications on a 10- to 21-day spray interval if environmental conditions are favorable for continued disease development. Use of the higher rate and shorter spray intervals are recommended when disease pressure is severe. Proline 480 SC may be applied by either ground, aerial or chemigation application equipment. For aerial application apply in a minimum spray volume of 2 gallons per acre. Do not apply more than three applications per season. Do not apply more than 9.0 fl oz per use season. Applications may not be made within 21 days of harvest.

Foliar fungicides labeled for use on soybean - *continued*

Products with Sec. 3 labels (full federal registrations)

Trade name Company	Common chemical name	% active ingredients	Rate	Additional label information
Propiconazole 41.8% AmTide LLC	propiconazole	41.80%	4.0 to 6.0 fl oz per acre	For aerial web blight, anthracnose, Septoria brown spot, frogeye leaf spot and soybean rust. Aerial web blight: Time applications to occur when disease first develops and apply 5.0 to 6.0 fl oz per acre. Make one repeat application at 14- to 21-day interval. Use the highest rate and shorter spray interval when disease conditions are severe. Other foliage diseases: Time applications to begin at growth stage R3 (early pod set: pods are ⅛ to ¼ inch long) and apply 6.0 fl oz per acre. Make one repeat application at 14- to 21-day interval when growth stage in R5 (pod fill). Soybean rust: Time applications to occur when disease has been reported in the area since preventative applications will provide the best results. Use 4.0 to 6.0 fl oz per acre. Make repeat applications at 14- to 21-day intervals. Use the highest rate and shorter spray interval when disease is detected in the field or if less than 2 out of every 100 plants are infected. Control will be less acceptable when more plants are infected or if the disease is mid-canopy. Some varieties may develop crinkled, smaller and/or greener leaves from applications of AmTide Propiconazole 41.8%, however bean yields are not reduced as a result of the applications. Maximum application rate is 12.0 fl oz per acre per season. Do not apply after Stage 6.
Quadris Syngenta	azoxystrobin	22.90%	6.0 to 15.4 fl oz per acre 0.40 to 0.80 fl oz per 1000 row feet for soilborne diseases-southern blight or *Rhizoctonia solani*	Target diseases include aerial blight, anthracnose, Alternaria leaf spot, Septoria brown spot, Cercospora blight and leaf spot, frogeye leaf spot, pod and stem blight and rust. Quadris applications should begin before disease development. Use the high rates under conditions favorable for disease pressure, dense plant canopies, or when susceptible varieties are planted. Resistance management: Follow the resistance management guidelines in the resistance management section of the Quadris label. Applications may be made by ground, air or chemigation. An adjuvant may be added at recommended rates. Use of a crop oil concentrate or nonionic surfactant with the lower use rate is recommended. Soybean rust: Quadris may be used at 4.0 fl oz per acre when tank mixed with triazole registered for use on soybean rust. Quadris is extremely toxic to certain apple varieties. See "Ground Use Instructions" on label for additional information on safety precautions to avoid injury to apple trees. Do not apply more than 1.5 lb a.i. per acre per season. Do not make more than one application of 15.4 fl oz product/acre to soybean forage and hay. May be applied the day of harvest to soybean forage and hay. Do not apply within 14 days of harvest of soybeans (beans).
Quadris Top Syngenta	azoxystrobin difenoconazole	18.20% 11.4%	8.0 to 14.0 fl oz per acre	Target diseases: Alternaria leaf spot, anthracnose, brown spot, Cercospora blight and leaf spot, frogeye leaf spot, pod and stem blight and powdery mildew. Begin applications prior to disease onset when conditions are conducive for disease. Apply Quadris Top on a 7- to 10-day schedule making no more than 2 sequential applications before alternating to another fungicide with a different mode of action. If disease pressure is high, use the shortest interval and highest rate. Do not apply more than 26.5 fl oz per acre per season. Do not feed soybean hay, forage and silage. Do not apply within 14 days of harvest (14-day PHI).

Foliar fungicides labeled for use on soybean - *continued*

Products with Sec. 3 labels (full federal registrations)

Trade name Company	Common chemical name	% active ingredients	Rate	Additional label information
Quadris Xtra Syngenta	azoxystrobin cyproconazole	18.20% 7.30%	4.0 to 6.8 fl oz per acre	For soybean rust: Apply 4.0 to 6.8 fl oz per acre. Repeat at 14- to 28-day interval, if conditions persist for rust development. Lower use rates may require a shorter spray interval. Depending on the conditions, application timing should be R1 (beginning flowering, approximately 50 days after planting) up to the R6 stage (seed development), but could be earlier. For disease other than soybean rust including aerial blight, Alternaria leaf spot, anthracnose, Septoria brown spot, Cercospora blight and leaf spot, frogeye leaf spot and pod and stem blight: Apply 5.0 to 6.8 fl oz per acre. For best results begin Quadris Xtra applications before disease development. Use the higher rates under conditions favorable for severe disease pressure, dense plant canopies or when disease is present. An adjuvant may be added at recommended rates to improve coverage. Application directions: Coverage and penetration are important for best results. Use sufficient water volume to provide thorough and uniform plant coverage. Applications may be made by ground, air or chemigation. Addition of an additive with spreading and penetrating qualities will enhance coverage and efficacy. Resistance management: No more than two foliar applications of Quadris Xtra or other strobilurin fungicides should be made per growing season. Do not alternate or tank mix with fungicides to which resistance has developed in the pathogen population. Do not apply more than 13.6 fl oz Quadris Xtra per acre per season. Do not apply more than 0.072 lb a.i. per acre per year of cyproconazole-containing products. Do not apply more than 1.5 lb a.i. per acre per year of azoxystrobin-containing products. Quadris Xtra is extremely toxic to certain apple varieties. See "General Use Instructions" on label for additional information on safety precautions to avoid injury to apple trees. Do not graze forage within 14 days of application. Do not use soybean forage or hay as livestock feed if making more than one application at 6.8 fl oz per acre rate. Do not apply within 30 days of harvest of soybeans (beans).
Quilt Syngenta	azoxystrobin propiconazole	7.00% 11.70%	14.0 to 20.5 fl oz per acre	Target diseases: Aerial web blight (*Rhizoctonia solani*), anthracnose (*Colletotrichum truncatum*), brown spot (*Septoria glycines*), frogeye leaf spot (*Cercospora sojina*), soybean rust (*Phakopsora pachyrhizi*), Alternaria leaf spot (*Alternaria* spp.) Cercospora blight and leaf spot (*Cercospora kickuchii*) and pod and stem blight (*Diaporthe* spp.). Aerial web blight: Apply 14.0 to 20.5 fl oz per acre at the first appearance of disease and repeat the application 14 to 21 days later. Under severe disease conditions use the higher rate and the shorter interval. Other foliar diseases (except rust): apply 20.5 fl oz per acre at growth stage R3 (early pod set when pods are ⅛ to ¼ inch long) and 14 to 21 days later at growth stage R5 (pod fill). Soybean rust: Apply 14.0 to 20.5 fl oz per acre at first indication that disease is in the area. For best control, preventive applications work best. Repeat on a 14- to 21-day interval. Use the higher rate and shorted interval when disease is present in the field and incidence is less than 2% (2 plants in 100 are infected). If incidence is greater than this or disease is in mid canopy, control will not be acceptable. Scouting for the disease and/or being aware of the proximity of the disease via monitoring systems will aid in the proper timing to maximize the effectiveness of the fungicide applications. On certain varieties, Quilt applications may cause crinkled, smaller and/or greener leaves. Yields of beans displaying these characteristics have not been reduced due to Quilt treatments. Quilt is extremely toxic to certain apple varieties. See "General Use Instructions" on label for additional information on safety precautions to avoid injury to apple trees. Do not apply more than 42.0 fl oz per acre per season of Quilt. Do not apply within 21 days of harvest for seed and 0 days for forage and hay.

Foliar fungicides labeled for use on soybean - *continued*

Products with Sec. 3 labels (full federal registrations)

Trade name Company	Common chemical name	% active ingredients	Rate	Additional label information
Quilt Xcel Syngenta	azoxystrobin propiconazole	13.50% 11.70%	10.5 to 21.0 fl oz per acre	For aerial web blight, anthracnose, Septoria brown spot, frogeye leaf spot, soybean rust, Alternaria leaf spot, Cercospora and pod and stem blight. Foliar diseases (except rust): apply 14.0 to 21.0 fl oz per acre at growth stage R3 (early pod set) when pods are ⅛ to ¼ inch long and 14-21 days later at growth stage R5 (pod fill). Quilt Xcel may be applied earlier should conditions be conducive for disease. Soybean rust: apply 14.0 to 21.0 fl oz per acre at first indication that disease is in the area. For best control, preventive applications work best. Repeat on a 14-21 day interval. Use higher rate and shorter interval when diseases are present in the field and incidence is less than 2% (2 plants in 100 are infected). If incidence is greater than this or if disease is in mid-canopy, control will not be acceptable. On certain varieties, Quilt Xcel applications may cause crinkled, smaller and/or greener leaves. Yields of beans displaying these characteristics have not been reduced due to Quilt Xcel treatments. Do not apply more than 42.0 fl oz per acre of Quilt Xcel per crop. Apply up to R6 soybean stage of growth.
Stratego Bayer CropScience	propiconazole trifloxystrobin	11.40% 11.40%	10.0 fl oz per acre	For control of Alternaria leaf spot, anthracnose, Asian soybean rust, Septoria brown spot, Cercospora blight, frogeye leaf spot, pod & stem blight, powdery mildew and Rhizoctonia aerial blight. Apply Stratego as a broadcast foliar spray at early flowering (R1 to R3 growth stage) or before disease development, whichever is earlier. Repeat applications on a 10- to 21-day spray interval if disease monitoring or environmental factors indicate favorable conditions for continued disease development. Use of adjuvants may enhance the performance of Stratego. If utilized, apply the lowest label recommended rate of the adjuvant to enhance disease control. Applications may be made by ground, air or chemigation. Do not apply more than three applications per season. Do not apply more than 30.0 fl oz per acre per season. Do not apply more than two sequential applications of Stratego or any other QoI Group 11 fungicide without alternation with a fungicide from another group. Applications may not be made within 21 days of harvest.
Stratego YLD Fungicide Bayer CropScience	prothioconazole trifloxystrobin	10.80% 32.30%	4.0 to 4.65 fl oz per acre	For control of Alternaria leaf spot, anthracnose, Asian soybean rust, Septoria brown spot, Cercospora blight, frogeye leaf spot, pod & stem blight, powdery mildew and Rhizoctonia aerial blight. Apply Stratego YLD Fungicide as a broadcast foliar spray at early flowering or before disease development, whichever is earlier. Repeat applications on a 10- to 21-day spray interval if disease monitoring or environmental factors indicate favorable conditions for continued disease development. Use of the higher rates and shorter spray intervals are recommended when disease pressure is severe. Stratego YLD Fungicide may be applied by ground, air or chemigation. Do not apply more than three applications per season. Do not apply more than 13.95 fl oz per acre per use season. Do not graze or feed soybean forage or hay. Applications may not be made within 21 days of harvest.
TEBU 3.6F AmTide, LLC	tebuconazole	40.53%	3.0 to 4.0 fl oz per acre	For soybean rust and powdery mildew. Apply TEBU 3.6F as a broadcast foliar spray, as a preventative spray or at first visible symptoms of disease. Repeat applications on a 10 to 14-day spray interval if environmental conditions are favorable for continued disease development. Use of the higher rates and shorter spray intervals are recommended when disease pressure is high. For optimum disease control, the lowest label rate of a spray surfactant should be tank-mixed with TEBU 3.6F. TEBU 3.6F should be applied in a minimum of 10 gallons of spray solution per acre by ground sprayer or in a minimum of 5 gallons per acre by aircraft spray equipment. Do not apply more than 12.0 fl oz per acre per use season. Do not make more than three applications per season. Restricted-entry interval (REI) is 12 hours. Preharvest interval (PHI) is 21 days.

Foliar fungicides labeled for use on soybean - *continued*

Products with Sec. 3 labels (full federal registrations)

Trade name Company	Common chemical name	% active ingredients	Rate	Additional label information
Tebuzol 3.6F Fungicide United Phosphorus, Inc.	tebuconazole	38.70%	3.0 to 4.0 fl oz per acre	For soybean rust and powdery mildew. Apply Tebuzol 3.6F as a broadcast spray, as a preventative spray or at first visible symptoms of disease. Repeat applications on a 10- to 14-day spray interval if environmental conditions are favorable for continued disease development. Use of higher rates and shorter spray intervals are recommended when disease pressure is severe. The lowest label recommended rate of a spray surfactant must be tank-mixed with Tebuzol 3.6F. Tebuzol 3.6 F should be applied in a minimum of 10 gallons of spray solution per acre by ground or in a minimum of 5 gallons of spray solution by aircraft spray equipment. Do not apply more than three applications per season. Do not apply more than 12.0 fl oz per acre use season. Restricted-entry interval (REI) is 12 hours. Applications may not be made within 21 days of harvest.
Thiophanate Methyl 85 WDG Makhteshim Agan of North America, Inc.	thiophanate methyl	85.00%	0.4 to 0.8 lb per acre	For anthracnose, Septoria brown spot, frogeye leaf spot, stem and pod blight and purple seed stain apply 0.4 to 0.8 lb per acre. Apply from full bloom when pods are ⅛ to ¼ inch in length. Make a second application 14 to 21 days later. Do not make the second application later than 14 days after pods average ¼ inch in length or when beans form in the pod. Use the high rate under severe disease pressure. For seed beans only make a single application at the high rate when beans form in the pod. For *Sclerotinia*, apply 0.6 to 0.8 lb per acre. Make one application at early bloom (R1 to R2 stage) followed by a second application 7 to 14 days later if conditions are favorable for continued disease pressure. Use a minimum of five gallons by air. For aerial blight (suppression), apply 0.8 lb per acre. Make initial application when disease threatens and repeat 14 to 21 days later if needed. Do not make more than two applications per year. Do not graze or feed treated vines to livestock.
Tilt Syngenta	propiconazole	41.80%	4.0 to 6.0 fl oz per acre	Target diseases: aerial web blight (*Rhizoctonia solani*), anthracnose (*Colletotrichum truncatum*), brown spot (*Septoria glycines*), frogeye leaf spot (*Cercospora sojina*) and soybean rust (*Phakopsora pachyrhizi*). Aerial web blight: apply 5.0 to 6.0 fl oz per acre at the first appearance of disease and repeat the application 14 to 21 days later. Under severe disease conditions use the higher rate and the shorter interval. Other foliar diseases (except rust): apply 6.0 fl oz per acre at growth stage R3 (early pod set when pods are ⅛ to ¼ inch long) and 14 to 21 days later at growth stage R5 (pod fill). Soybean rust: apply 4.0 to 6.0 fl oz per acre at first indication that disease is in the area. For best control, preventive applications work best. Repeat on a 14- to 21-day interval. Use the higher rate and shorter interval when disease is present in the field and incidence is less than 2% (2 plants in 100 are infected). If incidence is greater than this or disease is in mid canopy, control will not be acceptable. Scouting for the disease and/or being aware of the proximity of the disease via monitoring systems will aid in the proper timing to maximize the effectiveness of the fungicide applications. On certain varieties, Tilt applications may cause crinkled, smaller and/or greener leaves. Yields of beans displaying these characteristics have not been reduced due to Tilt treatments. Tilt is most effective when applied and allowed to dry before a rainfall. For best results, sufficient water volume should be used to provide thorough coverage. Tilt may applied by either ground or aerial application. Addition of an oil-based additive is recommended for improved coverage and penetration when applying by air. Do not apply more than 12.0 fl oz per acre per season of Tilt. Apply up to Stage R6.

Foliar fungicides labeled for use on soybean - *continued*

Products with Sec. 3 labels (full federal registrations)

Trade name Company	Common chemical name	% active ingredients	Rate	Additional label information
Toledo Rotam North America, Inc.	tebuconazole	38.70%	3.0 to 4.0 fl oz per acre	For soybean rust and powdery mildew. Apply Toledo as a broadcast foliar spray, as a preventative spray or at first visible symptoms of disease. Repeat applications on a 10- to 14-day spray interval if environmental conditions are favorable for continued disease development. Use of the higher rates and shorter spray interval are recommended when disease pressure is severe. The lowest labeled rate of a spray surfactant must be tank-mixed with Toledo. Toledo should be applied in a minimum of 10 gallons of spray solution per acre by ground sprayer or in a minimum of 5 gallons per acre by aircraft spray equipment. Restricted-entry interval (REI) is 12 hours. Do not apply more than three applications per season. Do not apply more than 12 fl oz per acre per use season. Applications may not be made within 21 days of harvest.
TOPGUARD Cheminova	flutriafol	11.80%	7.0 to 14.0 fl oz per acre	For soybean rust: apply TOPGUARD as a broadcast foliar spray when conditions are favorable for development of soybean rust. Repeat after first application if environmental conditions are favorable for continued disease development. May be tank mixed with other approved fungicides, herbicides or insecticides unless prohibited on the label of the tank mix partner. 21 to 35 days minimum retreatment interval. For frogeye leaf spot, Cercospora blight and leaf spot, Septoria brown spot and powdery mildew: apply as a broadcast foliar spray to soybean plants in R3 growth stage (early pod fill) or when environmental conditions are favorable for disease development. Apply second application if conditions are conducive for heavy disease development. Use the higher rate and the shorter spray interval under severe sustained disease pressure. 14 to 21 days minimum retreatment interval. Apply in a minimum of 10 gallons of spray solution per acre by ground sprayer or in a minimum of 5 gallons per acre by aircraft equipment. Do not add adjuvants to the spray solution. Do not apply more than 28.0 fl oz per acre per season. Do not apply more than three applications per growing season. Do not rotate to any other crop. Only soybeans may be rotated to treated fields. Apply only to soybeans harvested for dry seed. Preharvest interval: do not apply within 21 days of harvest.
Topsin M 70WP United Phosphorus, Inc.	thiophanate-methyl	70.00%	rate varies with diseases targeted for control and application program-see next column	0.5 to 1.0 lb of Topsin M 70WP, Topsin M 70WDG or Topsin M WSB or 10.0 to 20.0 fl oz per acre of Topsin 4.5FL per acre for anthracnose, Septoria brown spot, frogeye leaf spot, pod and stem blight and purple seed stain. Apply from full bloom to when pods are ⅛ to¼ inch in length. Make a second application 14 to 21 days later. Do not make the second application later than 14 days after pods average ¼ inch in length or when beans form in the pod. Use the high rate under severe disease pressure. For seed beans only: for seed quality, make a single application at the high rate when beans form in the pod. 0.75 to 1.0 lb of Topsin M 70WP, Topsin M 70WDG or Topsin M WSB or 15.0 to 20.0 fl oz of Topsin 4.5FL per acre for white mold (*Sclerotinia*). Make one application at early bloom (R1 to R2 stage) followed by a second application 7 to 14 days later if conditions are favorable for continued disease pressure. Use a minimum of 5 gallons of water by air. 1.0 lb of Topsin M 70WP, Topsin M 70WDG or Topsin M WSB or 20.0 fl oz of Topsin 4.5FL per acre for suppression of aerial blight. Make initial application when disease threatens and repeat 14 to 21 days later if needed. Preharvest interval: 21 days. Do not make more than two applications per year. Do not graze or feed treated vines or hay to livestock.
Topsin M 70WDG United Phosphorus, Inc.	thiophanate-methyl	70.00%		
Topsin M WSB United Phosphorus, Inc.	thiophanate-methyl	70.00%		
Topsin 4.5FL United Phosphorus, Inc.	thiophanate-methyl	45.00%		

Foliar fungicides labeled for use on soybean - *continued*

Products with Sec. 3 labels (full federal registrations)

Trade name Company	Common chemical name	% active ingredients	Rate	Additional label information
Topsin XTR United Phosphorus, Inc.	thiophanate-methyl tebuconazole	37.50% 7.50%	20.0 fl oz per acre	Target diseases: aerial blight, Asian soybean rust, anthracnose, Septoria brown spot, frogeye leaf spot, pod & stem blight, powdery mildew, purple seed stain and white mold. Closely observe soybean fields beginning at the early reproductive growth stages, scouting for early disease symptoms especially when conditions favor disease development. Apply Topsin XTR either as a preventative application or at first visible symptoms of disease as a broadcast foliar application for control of leaf and pod diseases. For control of white mold begin applications at R1-R2. For control of Asian soybean rust, begin Topsin XTR applications at R3 (beginning pod growth) or pre/early post ASR infection. Repeat applications on a 14-day interval if environmental conditions favor disease development. Applications later than 14 days after pods average ¼ inch in length are prohibited. Do not graze or feed treated vines or hay to livestock. Pre-harvest interval (PHI): 21 days.

Soybean virus diseases

Bean pod mottle, soybean mosaic, tobacco ringspot and bean yellow mosaic are among several viruses that occur on soybean in Missouri. These virus diseases tend to cause green to yellow mottling of leaf tissue, stunting of plant growth and deformation of plant tissues. Symptoms of bean pod mottle and soybean mosaic are similar and difficult to distinguish in the field. Also, these viruses may occur in combination. Laboratory tests are the only means of accurately identifying which virus or combination of viruses is present in infected plants.

Bean pod mottle causes a green to yellow mottling of young leaves in the upper canopy. This virus is sap-transmissible and vectored by beetle species such as the bean leaf beetle. The host range of bean pod mottle virus is limited to legumes. In addition to soybean, other possible hosts are lespedeza, alfalfa and clover. The bean pod mottle virus is not considered to be seedborne at very high levels.

Soybean mosaic causes a green to yellow mottling or mosaic pattern on leaf tissue as well as puckering and distortion of the leaf shape. Soybean mosaic virus is sap-transmissible and vectored by several aphid species. Soybean mosaic virus may also be seedborne. Infected seed may show a bleeding hilum symptom or a brown to black mottling of the seed coat. However, seed coat discoloration is not a definite indication of seed infection because infected seed can be symptomless and seed coat discoloration can be caused by factors other than soybean mosaic virus.

When bean pod mottle and soybean mosaic occur in combination in the same plant, symptoms are more severe and yield losses higher than those caused by either virus alone.

Soybean budblight, caused by the tobacco ringspot virus, results in the curving of the terminal in the shape of a crook. Plants are usually stunted with a bushy appearance, leaves are rugose and rolled and pods may be poorly developed or aborted. Plants tend to remain green after uninfected plants have matured and turned in color. Tobacco ringspot virus is readily sap-transmissible. Although no efficient insect vector has yet been discovered, thrips are implicated in the spread of the virus. The soybean budblight virus has a wide host range including a number of weed species. Pastures or uncultivated areas containing other hosts for tobacco ringspot virus may serve as sources of inoculum for nearby soybean fields. The virus may also be seedborne.

Soybean yellow mosaic is caused by the bean yellow mosaic virus. The leaves exhibit brilliant yellow mosaic patches. The virus has a wide host range and is transmitted by several aphids. Seed transmission has not been reported.

Management options for soybean virus diseases

- Plant disease-free seed.
- Plant varieties resistant to soybean mosaic virus.
- Maintain good weed control.
- In some situations, the control of insect vectors may be warranted.

Soybean cyst nematode (SCN)

The soybean cyst nematode, *Heterodera glycines*, is a serious problem throughout the state and in most soybean-producing areas of the United States. Symptoms of soybean cyst nematode (SCN) range from no obvious symptoms to subtle differences in plant height and vigor or unexpected decreases in yield to severe stunting and discoloration of plants. Plants with SCN may have poorly developed root systems. If plants are carefully dug up, females may be evident on the roots. The females appear as tiny (smaller than nitrogen-fixing nodules), whitish to yellow to brownish, lemon-shaped structures on the roots. Symptom expression may be more severe if plants are subjected to other stresses such as mois-

ture stress, nutrient deficiencies or herbicide injury.

The cysts are the bodies of the dead female nematodes. The cysts are actually protective egg cases, which contain up to 250 SCN eggs. Eggs in cysts may survive in the soil for extended periods even in the absence of soybean crops. Anything that moves cyst-infested soil can spread SCN including machinery, animals, migratory birds, people, wind, water and soil peds associated with seed. Once in a field, SCN may take several years to build up to damaging levels.

For more detailed information on SCN, soil sampling for SCN and strategies for managing SCN, please refer to MU publication G4450, *Soybean Cyst Nematode: Diagnosis and Management.*

Management options for soybean cyst nematode

- Employ a program of soil sampling to identify problem fields and to determine the extent and severity of the problem in the field.
- Select resistant varieties. If at all possible, it is important to rotate sources of genetic resistance to SCN in soybean varieties grown.
- Rotate to non-host crops (the length of time out of susceptible soybean varieties will depend on population levels of the soybean cyst nematode in a given field).
- Maintain good plant vigor.
- Although several soil-applied nematicides are labeled for use on soybean, economic and environmental concerns limit their use.
- More recently seed treatment products have become available to aid in managing some soybean nematodes. See preceding seed treatment table.

Sudden death syndrome (SDS)

In Missouri, sudden death syndrome (SDS) tends to be a continual problem in river bottom fields in the central and eastern portions of the state. However, the pathogen, *Fusarium virguliforme* (formerly known as *Fusarium solani* f. sp. *glycines)*, appears to be present in soybean-producing areas throughout the state. In years when environmental conditions are favorable for infection and symptom development, SDS may be found in most areas of the state.

SDS has been associated with maximum yield potential soybean production, i.e., fields with optimum fertility, irrigation and lime application. Field observations suggest that SDS is more likely to occur and to be more severe with high soil moisture, whether that is supplied by rainfall or by irrigation. High soil moisture during vegetative stages of soybean growth seems to be the most conducive to disease development. The onset of SDS symptoms frequently is associated with wet conditions and below normal temperatures at or near bloom.

Management options for sudden death syndrome

- Plant varieties that have performed well where sudden death syndrome has been a problem.
- Improve drainage in poorly drained fields and avoid compacting soils.
- Stagger planting dates and delay planting until soils are warm and dry.
- Avoid continuous cropping soybean.
- Maintain good crop vigor and avoid crop stress including stress from soybean cyst nematode.
- Harvest fields with sudden death syndrome in a timely fashion.

Charcoal rot

Charcoal rot may cause a seedling infection, but is more commonly considered a mid- to late-season soybean disease. Symptoms typically begin to develop as plants move into reproductive stages of growth.

The fungus that causes charcoal rot, *Macrophomina phaseolina*, is a common soil fungus in Missouri. Corn and grain sorghum are also hosts of the charcoal rot fungus. Charcoal rot is favored by hot, dry weather, so symptoms usually appear when temperatures are in the range of 82 to 95 degrees F.

Management options for charcoal rot

- Rotate to cereals, cotton or other non-hosts for one or two years; with corn or grain sorghum a rotation of three years may be necessary.
- Maintain good crop vigor to help reduce losses from charcoal rot.
- Irrigate properly from just before bloom to pod fill.

Sclerotium blight (southern blight)

Sclerotium blight, also called southern blight or white mold, is caused by the fungus *Sclerotium rolfsii.* This disease tends to be a problem primarily in the southeastern part of Missouri. *Sclerotinia rolfsii* produces small, tan to brown sclerotia (small survival structures) that allow it to survive for extended periods of time in the soil.

Management options for Sclerotium blight

- Rotate crops with at least one year between soybean crops. If Sclerotium blight has been severe, a three- to four-year rotation may be necessary.

Sclerotinia stem rot (white mold)

Sclerotinia stem rot or white mold, caused by *Sclerotinia sclerotiorum*, is a problem for soybean farmers in Michigan, Wisconsin, Minnesota, northern Iowa and northern Illinois. It has been reported in Missouri but has not been a widespread or serious problem in the state's soybean crop. The disease appears to be favored by moderate temperatures in the canopy (less than 82 degrees F) and frequent rainfalls especially as the crop begins to flower and set pods. When those conditions occur during the growing season, Sclerotinia white mold certainly may occur in Missouri soybean fields.

This fungus has a wide host range including dry beans, potatoes, canola, sunflower, peas and many broadleaf weeds. *Sclerotinia sclerotiorum* produces small, black survival structures called sclerotia. These sclerotia can survive in the soil for years.

Management options for Sclerotinia stem rot

- Plant resistant varieties.
- Rotate crops with at least one year between soybean crops and do not plant soybean after common bean, sunflower or other susceptible crops.
- Plant disease-free seed that is free of sclerotia.
- Maintain good weed control.

Brown stem rot

Although brown stem rot has been reported in Missouri, it is not a widespread or serious problem in the state. When brown stem rot is found in Missouri, it tends to be in the northern part of the state. Brown stem rot is caused by the fungus *Phialophora gregata*, which survives in infested crop residues and in the soil.

Development of brown stem rot is favored by temperatures in the range of 59 to 81 degrees F. As air temperatures increase above 81 degrees F, both incidence and severity of brown stem rot decrease. Leaf symptoms are most pronounced if cool weather occurs as the crop enters the reproductive stages of growth. Internal browning of stem tissues is greatly reduced at higher temperatures.

Management options for brown stem rot

- Plant resistant varieties.
- Rotate crops with at least one year between soybean crops. Longer rotations may be necessary in fields with established brown stem rot problems.

Pod and stem blight and Phomopsis seed decay

Phomopsis longicolla and the other *Diaporthe* and *Phomopsis* species that cause pod and stem blight and Phomopsis seed decay can survive in infested crop residues, in the soil and in seed. Symptoms usually develop on stems of plants during later reproductive stages of growth.

Prolonged periods of warm, wet weather during flowering and pod fill favor the development of pod and stem blight. If wet weather continues through harvest, levels of Phomopsis seed decay may be high.

Management options for pod and stem blight

- Rotate crops with at least one year out of soybeans.
- Use disease-free seed (pathogen may survive on infested seed and cause seedling blights if that seed is planted the next year).
- Use an appropriate fungicide seed treatment. See accompanying table of seed treatment fungicides labeled for use on soybean.
- Use of a foliar fungicide during the growing season is seldom warranted, except in seed production fields in seasons favorable for pod infection.

Anthracnose

Colletotrichum truncatum and several other *Colletotrichum* species cause anthracnose of soybean. Typically, anthracnose develops as a stem and pod disease on soybean plants during later reproductive stages of growth. However, in some seasons anthracnose may cause a tip blight on plants in early pod filling stages of growth.

Anthracnose is favored by warm, wet weather. Symptoms on the stems will be more severe if wet weather continues through harvest. The tip blight phase tends to occur when warm to hot weather mid season is followed by a period of rainy weather.

Management options for anthracnose

- Rotate crops with at least one year between soybean crops.
- Plant disease-free seed (pathogen may survive on infested seed and cause seedling blights if that seed is planted the next year).
- Use an appropriate fungicide seed treatment. See accompanying table of seed treatment fungicides labeled for use on soybean.
- Use of a foliar fungicide during the growing season is seldom warranted, except in seed production fields in seasons favorable for pod infection.

Cercospora blight, leaf spot and purple seed stain

Cercospora kikuchii can infect soybean seeds, pods, stems and leaves but is most commonly found on the seed. The pathogen survives in infested crop residues and on seed.

Warm, humid weather favors disease development. Yields are not usually reduced, but a high percentage of seed stain may be evident at harvest. Heavily infected seed, if planted, could produce diseased seedlings resulting in stand problems.

Management options for Cercospora blight, leaf spot and purple seed stain

- Rotate crops with at least one year between soybean or other legumes.
- If infected seed must be planted, use an appropriate fungicide seed treatment. See accompanying table of seed treatment fungicides labeled for use on soybean.

Stem canker

Although stem canker can occur in Missouri, this disease is usually not widespread or serious in the state. *Diaporthe phaseolina*, the fungus that causes stem canker, survives in infested residues. Infection by the stem canker pathogen is favored by extended periods of rainy weather during early vegetative stages of soybean growth. However, symptoms may not be evident until later in the season.

Management options for stem canker

- Rotate crops with at least one year between soybean crops.
- Plant resistant varieties.

Winter wheat diseases and their management

Wheat diseases can and do occur each year in Missouri. Problems with germination and stand establishment that are related to seed decay, damping-off and seedling blights may be encountered in the field. Diseases may cause leaf spots or leaf blights, wilts or premature death of plants. Wheat diseases can also cause harvest losses, affect the quality of the harvested crop and cause storage losses. The extent of the damage due to wheat diseases in a given season depends on a number of factors, including the susceptibility of the wheat variety to the specific diseases, the level of the pathogen inoculum present and the environmental conditions during that season.

To minimize losses due to wheat diseases, it is important to correctly identify the disease or diseases present so that appropriate management steps can be taken. The principal diseases of wheat in Missouri are of five types: (1) seedling diseases, (2) virus diseases, (3) foliage diseases, (4) root, crown and wilt diseases, and (5) head diseases. For more detailed information including color pictures of winter wheat diseases in Missouri, see University of Missouri publication IPM 1022, *Management of Soft Red Winter Wheat*.

Seedling diseases of winter wheat

There are a number of seedborne and soilborne pathogens that can cause seedling diseases in wheat. Seed may be rotted before germination or developing seedlings may be infected before or after emergence. Stands may be thin or uneven. Seedlings may be yellow and stunted. Root systems may be poorly developed with root and crown tissue brown to black in color and soft or rotted. Seedling diseases tend to be more severe if poor quality or diseased seed is used and if conditions at planting are not favorable for quick germination and stand establishment. Planting good-quality, disease-free seed is the most effective means of preventing problems from seedborne pathogens. If seed contaminated with a seedborne pathogen must be used for planting, it is important to clean the seed lot thoroughly to remove as much of the small, damaged seed as possible, to have a germination test done on the cleaned seed lot and to consider the use of a fungicide seed treatment.

Management options for wheat seedling diseases

- Plant good-quality, disease-free seed under good seedbed conditions.
- Use a fungicide seed treatment. See accompanying table of seed treatment fungicides labeled for use on winter wheat.

Seed treatment fungicides labeled for use on winter wheat

Although seed treatment fungicides can be an effective means of preventing or reducing losses from various seed- and soilborne microorganisms, there are several important laws or guidelines concerning fungicide-treated seed. Always read the pesticide label and follow all directions and restrictions on the label, but in particular for seed treatment fungicides remember the following points:

- Do not use treated seed for food, feed or oil purposes.
- All treated seed must be colored with an EPA-approved dye that imparts an unnatural color to the seed.
- Federal law requires that bags containing treated seed shall be labeled with the following information: "This seed has been treated with (common chemical name of active ingredients) fungicide(s). Do not use treated seed for feed, food or oil purposes. Store away from feeds and food stuffs."

The following table was prepared using current company product labels and manufacturers' Web sites. However, label registrations can change at any time. Before using any agricultural pesticide, read and follow directions accompanying that product. Product names have been used for clarity. Reference to specific trade names does not imply endorsement by the University of Missouri; discrimination is not intended against similar products not listed.

Seed treatment fungicides labeled for use on winter wheat

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Acquire BASF	metalaxyl	29.99%	0.75 fl oz per 100 lb of seed	For Pythium damping-off control. Acquire may be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment
Allegiance Dry Chemtura AgroSolutions	metalaxyl	12.50%	1.5 to 2.0 oz per 100 lb of seed	For Pythium damping-off control. Treat only those seeds needed for immediate use, minimizing the interval between treatment and planting. Do not carry over excess treated seed to next season. Do not use this product on seed that has been commercially treated with metalaxyl (Allegiance) fungicide. Hopper box seed treatment.
Allegiance-FL Bayer CropScience	metalaxyl	28.35%	0.75 fl oz per 100 lb of seed	Allegiance-FL is a systemic fungicide seed dressing specifically for control of downy mildews, *Pythium* and *Phytophthora* spp. For control of other soilborne diseases, combination of Bayer CropScience Captan and Vitavax registered formulations are compatible. Do not use with other seed treatment products unless previous experience assures compatibility. Allegiance-FL may be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
Apron XL Syngenta	mefenoxam	33.30%	0.0425 to 0.085 fl oz per 100 lb of seed	For Pythium damping-off protection in wheat when applied in combination with Dividend or other seed treatment products labeled for disease control in this crop: apply Apron XL as a seed treatment at 0.0425 to 0.085 fl oz per 100 lb of seed. Apron XL may be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
Belmont 2.7 FS Chemtura AgroSolutions	metalaxyl	28.98%	0.75 fl oz per 100 lb of seed	For Pythium damping-off control. For the control of other soilborne diseases, use in combination with other seed treatment fungicides. Vitavax and RANCONA products are compatible with Belmont 2.7 FS. Do not use in combination with other seed treatment products unless compatibility and safety to crop has been verified. Belmont 2.7 FS may be applied on its own, as water-based slurry or in combination with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
Charter BASF	triticonazole	2.40%	3.1 fl oz per 100 lb of seed	Charter Fungicide is a liquid seed treatment used for the control of loose smut and common bunt in wheat; will generally increase emergence and plant stands by controlling seedling blights and will also suppress early-season infections caused by Fusarium crown and root rot and control seed rot and seedborne seedling blight caused by *Fusarium* sp. Do not store treated seed for more than 18 months. Charter Fungicide may be applied using standard commercial seed treatment equipment or on-farm seed treatment equipment, but is not intended for direct application into a planter box.
Charter F^2 BASF	triticonazole metalaxyl	1.32% 0.79%	5.40 fl oz per 100 lb of seed	Charter F^2 fungicide seed treatment is a liquid seed treatment used for control or suppression of certain seedborne and soilborne diseases of wheat. It will generally increase emergence and plant stands by controlling or suppressing these diseases. Diseases controlled: Common bunt, flag smut, Fusarium seed rot, Fusarium seedling blight, loose smut and Pythium damping-off. Diseases suppressed: Common root rot, dry seed decay, Fusarium crown rot, Fusarium root rot and Rhizoctonia root rot. Charter F^2 may be applied using standard commercial seed treatment equipment (such as, but not limited to, slurry or mist-type equipment) or on-farm seed treatment equipment. Maximum usage when applying multiple metalaxyl-containing and mefenoxam-containing products to the same crop within the same season: do not apply more than the maximum seasonal total for the active ingredient as stated on the label of the lowest seasonal total for that crop.

Seed treatment fungicides labeled for use on winter wheat - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Charter PB BASF	triticonazole thiram	1.25% 12.50%	5.5 fl oz per 100 lb of seed	Charter PB is a liquid seed treatment used for the control of loose smut and common bunt in wheat. It will increase emergence and plant stands by reducing seed- and soilborne seed rots (*Cochliobolus* spp.) seedling blights (*Fusarium* spp.) and damping-off (*Pythium* spp.). Charter PB may be applied using standard commercial seed treatment equipment (such as, but not limited to, slurry or mist-type equipment) or on-farm seed treament equipment including "On the Go" type air seeder treatment systems. This product is not intended for direct application into a planter box.
CruiserMaxx Cereals Syngenta	thiamethoxam mefenoxam difenoconazole	2.80% 0.56% 3.36%	5.0 fl oz per 100 lb of seed	For winter wheat diseases, including general seed rots, seedling blight, root rot and damping-off caused by seedborne and soilborne *Fusarium* and soilborne *Pythium*, common and dwarf bunt and loose smut. Diseases suppressed include common root rot, Fusarium crown and foot rot and take-all. For additional *Pythium* protection, add 0.0425 fl oz of Apron XL per 100 lb of seed. CruiserMaxx Cereals is a ready-to-use water-based formulation for use in commercial seed treatment facilities utilizing closed-system application techniques. In addition, CruiserMaxx Cereals may also be applied by on-site/on-farm applications.
CruiserMaxx Vibrance Cereals Syngenta	sedaxane difenoconazole mefenoxam thiamethoxam	0.72% 3.34% 0.86% 2.78%	5.0 to 10.0 fl oz per 100 lb of seed	For protection against seed, soil and early season foliar disease of wheat. Diseases controlled include: seedling blight, root rot and damping-off caused by seed- and soilborne *Fusarium* and *Rhizoctonia* and soilborne *Pythium*. Also controlled are bunt, smut and *Septoria* diseases. Diseases suppressed include common root rot (*Cochliobolus* spp.), Fusarium crown and foot rot and take-all. Early season foliar disease protection for first 4 weeks after planting. For full season protection, apply a foliar fungicide according to label directions. CruiserMaxx Vibrance Cereals may be applied by professionals at commercial seed treatment facilities according to label instructions.
Dithane M45 Dow AgroSciences	mancozeb	80.00%	2.2 to 3.3 oz. per 100 lb of seed	For control of bunt, damping-off, seed rots and seedling blights. May be applied to dry seed with conventional slurry or mist seed treating equipment or as a planter box application.
Dividend XL Syngenta	difenoconazole mefenoxam	16.50% 1.38%	1.0 fl oz per 100 lb of seed or 2.0 fl oz per 100 lb of seed	Dividend XL is a combination of Dividend and Apron XL. The Apron XL provides Pythium damping-off activity and the Dividend provides activity on the remaining diseases claimed on the label. The 1.0 fl oz rate of Dividend XL is for control of common bunt, dwarf bunt, flag smut, seedborne Septoria, loose smut, general seed rots, Fusarium seed scab and Pythium damping-off and for early-season control of common root rot and Rhizoctonia root rot. The 2.0 fl oz rate of Dividend XL is for control of common bunt, dwarf bunt, flag smut, seedborne Septoria, loose smut, general seed rots, Fusarium seed scab and Pythium damping-off and for early-season control of common root rot, Fusarium root rot, Fusarium crown rot, take-all and Rhizoctonia root rot as well as fall season powdery mildew, leaf rust and Septoria leaf blotch. Dividend XL provides control of the fall season foliage diseases for the first six weeks after planting. Green wheat forage may not be grazed until 55 days after planting. Apply Dividend XL as a water-based slurry through standard slurry or mist-type seed treatment equipment.

Seed treatment fungicides labeled for use on winter wheat - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Dividend Extreme Syngenta	difenoconazole mefenoxam	7.73% 1.93%	Rate varies with diseased targeted; see next column.	Use 1.0 fl oz per 100 lb of seed for control of common bunt and loose smut. Use 2.0 fl oz per 100 lb of seed for control of common bunt, dwarf bunt, karnal bunt, flag smut, seedborne Septoria, loose smut, general seed rots, Fusarium seed scab and Pythium damping-off as well as early-season control of common root rot and Rhizoctonia root rot. Use 4.0 fl oz per 100 lb of seed for control of common bunt, karnal bunt, dwarf bunt, loose smut, flag smut, seedborne Septoria, general seed rots, Fusarium seed scab and Pythium damping-off. Also for fall season control of powdery mildew, leaf rust and Septoria leaf blotch. Control of early-season common root rot, Fusarium root rot, Fusarium crown rot, take-all and Rhizoctonia root rot. Dividend Extreme provides control of fall season powdery mildew, fall season leaf rust and fall season Septoria leaf blotch in winter wheat for the first 6 weeks after planting. For full season control of these foliar diseases, use Tilt fungicide according to label directions. Apply Dividend Extreme as a water-based slurry using standard slurry treatment equipment which provides uniform seed coverage.
Dividend XL RTA Syngenta	difenoconazole mefenoxam	3.21% 0.27%	Rate varies with diseased targeted; see next column.	Use 2.5 fl oz per 100 lb of seed for control of common bunt and loose smut. Use 5.0 fl oz per 100 lb of seed for control of common bunt, dwarf bunt, flag smut, seedborne Septoria, loose smut, general seed rots, Fusarium seed scab and Pythium damping-off as well as for partial control of common root rot and Rhizoctonia root rot. Use 10.0 fl oz per 100 lb of seed for control of common bunt, dwarf bunt, loose smut, flag smut, seedborne Septoria, general seed rots, Fusarium seed scab and Pythium damping-off. Also for fall season control of powdery mildew, leaf rust and Septoria leaf blotch. For partial control of early-season common root rot, Fusarium root rot, Fusarium crown rot, take-all and Rhizoctonia root rot. Dividend XL RTA provides control of fall season powdery mildew, fall season leaf rust and fall season Septoria leaf blotch in winter wheat for the first 6 weeks after planting. For full season control of these foliar diseases, use Tilt fungicide according to label directions.
Dyna-Shield Foothold Loveland Products Inc.	tebuconazole metalaxyl	0.499% 0.699%	5.0 to 6.5 fl oz per 100 lb of seed	Aids in the control or suppression of the following seed, seedling or soilborne diseases of wheat: stinking smut, flag smut, loose smut, early-season Septoria disease complex, general seed rots, Pythium damping-off, early-season Rhizoctonia root rot, early-season common root rot, seedborne Fusarium scab, early-season Fusarium foot rot and early-season suppression of powdery mildew and rust. Uniform application to seed is necessary to ensure seed safety and best disease control. This product is for commercial or on-farm application. Applications should be made using standard slurry or mist-type seed treatment equipment. This product is not intended for direct application into a planter box. Wheat green forage may not be grazed or harvested until 31 days after seeding.
Dyna-Shield Foothold Extra Loveland Products Inc.	tebuconazole metalaxyl imidacloprid	0.455% 0.607% 11.374%	3.4 to 5.0 fl oz per 100 lb of seed	Disease control: early-season disease control of Pythium damping-off, stinking smut, flag smut, loose smut, early-season Septoria disease complex, early-season Rhizoctonia root rot, early-season common root rot, early-season Fusarium foot rot, early-season suppression of powdery mildew and early-season suppression of wheat leaf rust. Apply before planting as a slurry treatment. This product is to be used in liquid or slurry treaters. Ensure thorough coverage. Do not graze of feed livestock on treated areas for 45 days after planting.
Dyna-Shield Metalaxyl Loveland Products Inc.	metalaxyl	28.35%	0.75 fl oz per 100 lb of seed	For Pythium damping-off control. Reduced rate: to aid in the control of seed decay and damping-off caused by Pythium apply Dyna-Shield Metalaxyl Fungicide as a commercial seed treatment at the rate of 0.10 to 0.375 fl oz per 100 lb of seed. Apply only in combination with EPA registered rates of Loveland Products Inc. broad-spectrum seed treatment fungicides. May be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.

Seed treatment fungicides labeled for use on winter wheat - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Dyna-Shield Metalaxyl 318 FS Loveland Products Inc.	metalaxyl	30.14%	0.75 fl oz per 100 lb of seed	For Pythium damping-off control. Reduced rate: to aid in the control of seed decay and damping-off caused by Pythium apply Dyna-Shield Metalaxyl 318 FS Fungicide as a commercial seed treatment at the rate of 0.10 to 0.375 fl oz per 100 lb of seed. Apply only in combination with EPA registered rates of Loveland Products Inc. broad-spectrum seed treatment fungicides. May be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
Dyna-Shield Small Grains Fungicide Loveland Products Inc.	tebuconazole metalaxyl	0.48% 0.64%	5.0 to 6.5 fl oz per 100 lb of seed	Aids in the control or suppression of the following seed, seedling or soilborne diseases of wheat: stinking smut, flag smut, loose smut, early-season Septoria disease complex, general seed rots, Pythium damping-off, early-season Rhizoctonia root rot, early-season common root rot, seedborne Fusarium scab, early-season Fusarium foot rot and early-season suppression of powdery mildew and rust. Uniform application to seed is necessary to ensure seed safety and best disease control. This product is for commercial or on-farm application. Applications should be made using standard slurry or mist-type seed treatment equipment. This product is not intended for direct application into a planter box.
Dynasty Syngenta	azoxystrobin	9.60%	0.153 to 0.382 fl oz per 100 lb of seed	Target diseases: seedborne and soilborne fungi causing decay, damping-off and seedling blight; seedling damping-off caused by *Rhizoctonia solani*, dwarf bunt and common bunt. Where appropriate, use Dynasty in combination with Dividend Extreme and/or Maxim seed treatment products. Apply as a water-based slurry using seed treatment application equipment that will provide uniform coverage on the seed surface.
Enhance Chemtura AgroSolutions	captan carboxin	19.55% 20.00%	4.0 oz per 100 lb of seed	Enhance Seed Protectant is a formulation specifically designed for treatment of wheat on the farm at planting time. It controls covered smut (*Tilletia caries* and *Tilletia foetida*) and loose smut (*Ustilago nuda*) on wheat. Apply as a planter-box treatment (including air and vacuum planters), mixing thoroughly with the seed before planting. For best results, follow application directions on label. Do not graze or feed livestock on treated areas for 45 days after planting.
Enhance AW Chemtura AgroSolutions (formerly Trace Seed Protection Products)	captan carboxin imidacloprid	19.55% 20.00% 20.00%	4.0 oz per 100 lb of seed	Enhance Seed Protectant is a formulation specifically designed for treatment of wheat on the farm at planting time. It controls covered smut (*Tilletia caries* and *Tilletia foetida*) and loose smut (*Ustilago nuda*) on wheat. Protects against seedborne and soilborne fungi that cause seed decay, damping-off and seedling blights (including *Fusarium, Cochliobolus sativus, Rhizoctonia* and *Pythium*). Apply as a planter-box treatment (including air and vacuum planters), mixing thoroughly with the seed before planting. For best results, follow application directions on label. Do not graze or feed livestock on treated areas for 45 days after planting.
EverGol Energy Bayer CropScience	prothioconazole penflufen metalaxy	7.18% 3.59% 5.74%	1.0 fl oz per 100 lb of seed	Effective against early season *Rhizoctonia*, *Fusarium*, *Pythium*, leaf stripe, cereal smuts and common bunt; also early season suppression of rust, *Septoria* and powdery mildew. For use only in commercial seed treatment equipment. Not for use in hopper box, planter box, slurry box or other on-farm seed treatment equipment.
Gaucho XT Bayer CropScience	imidacloprid metalaxyl tebuconazole	12.70% 0.82% 0.62%	3.4 fl oz per 100 lb of seed	Early-season disease control of Pythium damping-off, stinking smut, flag smut, loose smut, early-season Septoria disease complex, early-season Rhizoctonia root rot, early-season common root rot, early-season Fusarium root rot, early-season suppression of powdery mildew and early-season suppression of leaf rust. Do not graze or feed livestock on treated areas for 45 days after planting. See label for rotational crop restrictions. Apply as a slurry treatment prior to planting.
Grain Guard Chemtura AgroSolutions	mancozeb	50.00%	3.3 oz per bushel of seed	For control of bunt of wheat, and damping-off and seedling blights. Treat only those seeds needed for immediate use, minimizing the interval between treatment and planting. Do not store excess treated seeds beyond planting time. Apply as a drill-box treatment mixing thoroughly so all seeds are covered.

Seed treatment fungicides labeled for use on winter wheat - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Incentive RTA Winfield Solutions, LLC	difenoconazole mefenoxam	3.21% 0.27%	2.5 fl oz per 100 lb of seed or 5.0 fl oz per 100 lb of seed or 10.0 fl oz per 100 lb of seed	Incentive RTA is a combination of Incentive and Apron XL. The Apron XL provides Pythium damping-off activity, and the Incentive provides activity on the remaining diseases claimed on the label. The 2.5 fl oz rate of Incentive RTA is for control of common bunt and loose smut. The 5.0 fl oz rate of Incentive RTA is for control of common bunt, dwarf bunt, flag smut, seedborne Septoria, loose smut, general seed rots, Fusarium seed scab and Pythium damping-off and for partial control of common root rot and Rhizoctonia root rot. The 10.0 fl oz rate of Incentive RTA is for control of common bunt, dwarf bunt, flag smut, seedborne Septoria, loose smut, general seed rots, Fusarium seed scab and Pythium damping-off and for partial control of common root rot, Fusarium root rot, Fusarium crown rot, take-all and Rhizoctonia root rot as well as fall season powdery mildew, leaf rust and Septoria leaf blotch. Incentive RTA provides control of the fall season foliage diseases for the first six weeks after planting. Green wheat forage may not be grazed until 55 days after planting. Incentive RTA is especially formulated for on-farm treatment, using standard mechanical slurry or mist-type seed treatment equipment.
Kodiak HB Chemtura AgroSolutions (formerly Trace Seed Protection Products)	*Bacillus subtilis* GB03	0.30%	4.0 to 8.0 oz per 100 lb of seed	For suppression of root diseases caused by *Fusarium* and *Pythium*. Contains bacteria that colonize the developing root system, suppressing disease organisms such as *Fusarium* and *Pythium* that attack root systems. When used with a chemical seed treatment, the combination of chemicals and Kodiak provides protection to the root for a much longer time than with chemicals alone. Kodiak HB is a hopper-box seed treatment.
ManKocide DuPont	mancozeb copper hydroxide	15.00% 46.10%	4.0 oz per 100 lb of seed	Target diseases: *Pseudomonas syringae*, *Xanthomonas translucens* and *Tilletia caries*. ManKocide may be applied to dry seed with conventional slurry or mist seed treating equipment or as a planter-box application.
Manzate Pro-Stick United Phosphorus, Inc. **Manzate Flowable** United Phosphorus, Inc.	mancozeb mancozeb	75.00% 37.00%	2.2 to 3.3 oz per 100 lb of seed 3.5 to 5.2 fl oz per 100 lb of seed	For protection against bunt, covered smut, damping-off, seed rots and seedling blights. For commercial seed treatments, seeds should be clean and well-cured before treatment. Apply to dry seed with conventional slurry or mist seed treating equipment. Manzate Pro-Stick may also be applied as planter-box applications.
Maxim XL Syngenta	fludioxonil mefenoxam	21.00% 8.40%	0.167 to 0.334 fl oz per 100 lb of seed	For protection against damping-off caused by *Fusarium* spp., *Rhizoctonia* spp. and *Pythium* spp. and general seed rots caused by *Aspergillus* spp. and *Penicillium* spp. and for protection against *Tilletia* (common bunt). Maxim XL at the 0.084 fl oz may be combined with labeled rates of Dividend XL for a broader spectrum of seedling disease protection. Apply Maxim XL as a water-based slurry using standard slurry seed treatment equipment that provides uniform coverage.
Maxim 4FS Syngenta	fludioxonil	40.30%	0.08 to 0.16 fl oz per 100 lb of seed	For protection against seedborne and soilborne fungi that cause seed decay, damping-off and seedling blight. Cereal forage may not be grazed until 30 days after planting. Apply Maxim 4FS as a water-based slurry using standard slurry seed treatment equipment .
MetaStar ST Chemtura AgroSolutions (formerly Trace Seed Protection Products)	metalaxyl	29.99%	0.75 fl oz per 100 lb of seed	For Pythium damping-off control. MetaStar ST is a systemic fungicide seed dressing specifically for control of systemic downy mildews, *Pythium* and *Phytophthora* spp. For control of other soilborne diseases, combination of Captan and Vitavax registered formulations are compatible. Do not use with other seed treatment products unless previous experience assures compatibility. MetaStar ST may be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.

Seed treatment fungicides labeled for use on winter wheat - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Nipsit Suite Cereals OF Valent	clothianidin metalaxyl metconazole	2.93% 0.88% 0.44%	5.0 fl oz per 100 lb of seed	Nipsit Suite Cereals OF contains three Valent components including an insecticide and two fungicides, in addition to a polymer and colorant. The fungicides protect against Rhizoctonia root rot and damping off, Fusarium seed/seedling dieback, smuts and bunt and other seed-decay fungi. Ready-to-use formulation for commercial or on farm use. Apply as a water-based slurry using seed treatment application equipment that will provide uniform coverage of the seed surface. See label for additional restrictions.
Penncozeb 75DF United Phosphorus, Inc.	mancozeb	75.00%	2.3 to 3.5 oz per 100 lb of seed	For control of bunt, damping off, seed rots and seedling blights. For planter-box treatment only.
Penncozeb 80WP United Phosphorus, Inc.	mancozeb	80.00%	2.2 to 3.3 oz per 100 lb of seed	
Prevail Chemtura AgroSolutions	carboxin PCNB metalaxyl	15.00% 15.00% 3.12%	1.5 to 3.0 oz. per bushel of seed	For protection against Pythium and Rhizoctonia seedling disease complex and loose smut and common bunt or stinking smut. Do not graze or feed livestock on treated areas for six weeks after planting. Prevail may be applied at planting time, using an on-farm mechanical treater to maximize seed coverage.
Proceed Concentrate Bayer CropScience	prothioconazole tebuconazole metalaxyl	6.88% 1.38% 2.75%	1.0 to 1.5 fl oz per 100 lb of seed	Aids in the control or suppression of the following: seed, seedling and soilborne diseases: stinking smut, flag smut, loose smut, covered smut, early-season Septoria disease complex, general seed rots, Pythium damping-off, early-season Rhizoctonia root rot, early-season common root rot, seedborne Fusarium scab, early-season Fusarium foot rot. Early-season suppression of powdery mildew and rust. Wheat green forage may be grazed or harvested for hay 31 days after seeding. Dilute with sufficient water to achieve uniform application to seed, which is necessary to ensure seed safety and best disease control. This product is for commercial or on-farm application. Applications must be made using standard slurry or mist-type seed treatment equipment. Do not apply this product with a hopper box, planter box, slurry box or any other at-plant methods.
RANCONA Apex Chemtura AgroSolutions	ipconazole	0.44%	5.0 to 8.33 fl oz per 100 lb of seed	For control of general seed rots (such as those caused by *Aspergillus* and *Penicillium*), seed rot, damping off and seedling blight caused by seed- and soilborne *Fusarium* and *Cochliobolus sativus,* early-season root rot (*Rhizoctonia*), loose smut and common bunt as well as for suppression of common root rot (*Cochliobolus sativus*) and crown and foot rot (*Fusarium*). For Pythium protection, use RANCONA Apex in combinations with a product that contains metalaxyl at the label rate registered for your crop and disease complex. RANCONA Apex is for both commercial and on-farm application.
RANCONA Crest Chemtura AgroSolutions	ipconazole metalaxyl imidacloprid	0.421% 0.562% 14.100%	5.0 to 8.33 fl oz per 100 lb of seed	For general seed rots (including those caused by *Penicillium* and *Aspergillus*), seed rot, damping-off and seedling blight (seed- and soilborne *Fusarium, Pythium* and *Cochliobolus sativus*), loose smut, common bunt and early-season root rot (*Rhizoctonia*) as well as suppression of common root rot (*Cochliobolus sativus*) and crown and foot rot (*Fusarium*). RANCONA Crest is formulated both for commercial and for on-farm applications. Do not apply this product as a planter box or hopper box treatment. Apply RANCONA Crest with mechanical, slurry or mist-type seed treating equipment, provided that the equipment can be calibrated to accurately and uniformly apply the product to the seed. Do not graze or feed livestock on treated areas for 45 days after planting.
RANCONA Crest WR Chemtura AgroSolutions	ipconazole metalaxyl imidacloprid	0.439% 0.585% 2.950%	5.0 to 8.33 fl oz per 100 lb of seed	For general seed rots (including those caused by *Penicillium* and *Aspergillus*), seed rot, damping-off and seedling blight (seed- and soilborne *Fusarium, Pythium* and *Cochliobolus sativus*), loose smut, common bunt and early-season root rot (*Rhizoctonia*) as well as suppression of common root rot (*Cochliobolus sativus*) and crown and foot rot (*Fusarium*). RANCONA Crest WR is formulated both for commercial and for on-farm applications. Do not apply this product as a planter box or hopper box treatment. Apply RANCONA Crest WR with mechanical, slurry or mist-type seed treating equipment, provided that the equipment can be calibrated to accurately and uniformly apply the product to the seed. Do not graze or feed livestock on treated areas for 45 days after planting.

Seed treatment fungicides labeled for use on winter wheat - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
RANCONA Pinnacle Chemtura AgroSolutions	ipconazole metalaxyl	0.434% 0.578%	5.0 to 8.33 fl oz per 100 lb of seed	For general seed rots (including those caused by *Penicillium* and *Aspergillus*), seed rot, damping-off and seedling blight (seed- and soilborne *Fusarium, Pythium and Cochliobolus sativus*), loose smut, common bunt and early-season root rot (*Rhizoctonia*) as well as suppression of common root rot (*Cochliobolus sativus*) and crown and foot rot (*Fusarium*). Use the higher rate when disease pressure is expected to be high, or when there is a history of high disease levels in the field. RANCONA Pinnacle is formulated both for commercial and for on-farm applications. Apply RANCONA Pinnacle with mechanical, slurry or mist-type seed treating equipment, provided that the equipment can be calibrated to accurately and uniformly apply the product to the seed.
RANCONA 3.8 FS Chemtura AgroSolutions	ipconazole	40.70%	0.051 to 0.085 fl oz per 100 lb of seed	For general seed rots (including those caused by *Penicillium* and *Aspergillus*), seed rot, damping-off and seedling blight (seed- and soilborne *Fusarium, Pythium* and *Cochliobolus sativus*), loose smut, common bunt and early-season root rot (*Rhizoctonia*) as well as suppression of common root rot (*Cochliobolus sativus*) and crown and foot rot (*Fusarium*). RANCONA 3.8 FS may be applied with mechanical, slurry or mist-type seed treating equipment, provided that the equipment can be calibrated to accurately and uniformly apply the product to the seed. Not for use on agricultural establishments in hopper-box, planter-box, slurry-box or other seed treatment applications at or immediately before planting.
Raxil MD Bayer CropScience	tebuconazole metalaxyl	0.48% 0.64%	5.0 to 6.5 fl oz per 100 lb of seed	Aids in the control or suppression of the following seed, seedling and soilborne diseases of wheat: stinking smut, flag smut, loose smut, early-season Septoria disease complex, general seed rots, Pythium damping-off, early-season Rhizoctonia root rot, early-season common root rot, seedborne Fusarium scab, early-season Fusarium foot rot, early-season suppression of powdery mildew and rust. Wheat green forage may be grazed or harvested for hay 31 days after seeding. Applications should be made using standard slurry or mist-type seed treatment equipment. This product is for commercial or on-farm application. This product is not intended for direct application into a planter box.
Raxil XT Wettable Powder Bayer CropScience	tebuconazole metalaxyl	15.00% 20.00%	0.16 to 0.20 oz per 100 lb of seed	Targeted diseases: Stinking smut, flag smut, loose smut, early-season Septoria disease complex, early-season Rhizoctonia root rot, early-season common root rot, early-season Fusarium foot rot, early-season suppression of powdery mildew, early-season suppression of wheat leaf rust, seedborne Fusarium scab, general seed rots and Pythium damping-off. Wheat green forage may be grazed or harvested for hay 31 days after seeding. The pouches of Raxil XT are water soluble. Applications should be made using standard slurry or mist-type seed treatment equipment.
Sativa IM Max Nufarm Americas Inc.	tebuconazole metalaxyl imidacloprid	0.455% 0.607% 11.374%	3.4 to 5.0 fl oz per 100 lb of seed	Early-season disease control of Pythium damping-off, stinking smut, flag smut, loose smut, early-season Septoria disease complex, early-season Rhizoctonia root rot, early-season common root rot, early-season Fusarium foot rot, early-season suppression of powdery mildew and early-season suppression of wheat leaf rust. Apply before planting as a slurry treatment. This product is to be used in liquid or slurry treaters. Do not graze or feed livestock on treated areas for 45 days after planting.
Sativa IM RTU Seed Treatment Nufarm Americas Inc.	tebuconazole metalaxyl imidacloprid	0.474% 0.632% 1.581%	5.0 fl oz per 100 lb of seed	Aids in the control or suppression of stinking smut, flag smut, loose smut, early-season Septoria disease complex, general seed rots, Pythium damping-off, early-season Rhizoctonia root rot, early-season common root rot, seedborne Fusarium scab, early-season Fusarium foot rot, early-season suppression of powdery mildew and rust. Apply using standard slurry or mist-type seed treatment equipment. This product is for commercial or on-farm applications. This product is not intended for direct application into a planter box. Do not graze or feed livestock on treated areas for 45 days after planting.
Savita M Seed Treatment Nufarm Americas Inc.	tebuconazole metalaxyl	0.614% 1.832%	5.0 fl oz per 100 lb of seed	Aids in the control or suppression of stinking smut, flag smut, loose smut, early-season Septoria disease complex, general seed rots, Pythium damping-off, early-season Rhizoctonia root rot, early-season common root rot, seedborne Fusarium scab, early-season Fusarium foot rot, early-season suppression of powdery mildew and rust. Apply using standard slurry or mist-type seed treatment equipment. This product is for commercial or on-farm applications. This product is not intended for direct application into a planter box.

Seed treatment fungicides labeled for use on winter wheat - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Savita M RTU Seed Treatment Nufarm Americas Inc.	tebuconazole metalaxyl	0.499% 0.668%	5.0 to 6.5 fl oz per 100 lb of seed	Aids in the control or suppression of stinking smut, flag smut, loose smut, early-season Septoria disease complex, general seed rots, Pythium damping-off, early-season Rhizoctonia root rot, early-season common root rot, seedborne Fusarium scab, early-season Fusarium foot rot, early-season suppression of powdery mildew and rust. Apply using standard slurry or mist-type seed treatment equipment. This product is for commercial or on-farm applications. This product is not intended for direct application into a planter box.
Savita 309 FS Fungicide Nufarm Americas Inc.	tebuconazole	28.30%	0.80 to 0.10 fl oz per 100 lb of seed	Aids in the control or suppression of stinking smut, flag smut, loose smut, early-season Septoria disease complex, general seed rots, Pythium damping-off, early-season Rhizoctonia root rot, early-season common root rot, seedborne Fusarium scab, early-season Fusarium foot rot, early-season suppression of powdery mildew and early-season suppression of wheat leaf rust. Apply this product as a water-based slurry through standard slurry or mist-type commercial seed treatment equipment. For use only by commercial seed treaters.
Sativa 318 FS Fungicide Nufarm Americas Inc.	tebuconazole	28.30%	0.08 to 0.10 fl oz per 100 lb of seed	Aids in the control or suppression of stinking smut, flag smut, loose smut, early-season Septoria disease complex, general seed rots, Pythium damping-off, early-season Rhizoctonia root rot, early-season common root rot, seedborne Fusarium scab, early-season Fusarium foot rot, early-season suppression of powdery mildew and early-season suppression of wheat leaf rust. Apply this product as a water-based slurry through standard slurry or mist-type commercial seed treatment equipment. For use only by commercial seed treaters.
Sebring 2.65 ST Nufarm Americas Inc.	metalaxyl	28.35%	0.75 fl oz per 100 lb of seed	For Pythium damping-off control. For control of other of other soilborne diseases, combination of captan and Vitavax registered formulations are compatible. Do not use with other seed treatment products unless previous experience assures compatibility. This product may be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment.
Sebring 318 FS Nufarm Americas Inc.	metalaxyl	30.14%	0.75 fl oz per 100 lb of seed	For Pythium damping-off control. For control of other of other soilborne diseases, combination of captan, thiram and carboxin registered formulations are compatible. Do not use with other seed treatment products unless previous experience assures compatibility. This product may be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment. As a planter box treatment apply at the specified rate and premix with the seed directly in the planter box at planting.
Sebring 480 FS Nufarm Americas Inc.	metalaxyl	44.08%	0.50 fl oz per 100 lb of seed	For Pythium damping-off control. For control of other of other soilborne diseases, combination of captan, thiram and carboxin registered formulations are compatible. Do not use with other seed treatment products unless previous experience assures compatibility. This product may be applied as a water-based slurry with other registered seed treatment insecticides and fungicides through standard slurry or mist-type commercial seed treatment equipment. As a planter-box treatment apply at the specified rate and premix with the seed directly in the planter box at planting.
Signet 480 FS Seed Treatment Nufarm Americas Inc.	thiram	44.00%	2.0 fl oz per bushel of seed	Used according to label directions, this product will usually increase stands and yields by reducing losses from seed decay, damping-off and seedling blights caused by many seedborne and soilborne organisms. This product will usually control covered smuts or bunts of wheat. This product should be applied with water as a suspension in the slurry-type treater specifically designed and approved for this purpose. Plant treated wheat seed a minimum of 1 inch deep. For sale to and use by professional applicators only.

Seed treatment fungicides labeled for use on winter wheat - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Stamina BASF	pyraclostrobin	18.4%	0.4 to 0.8 fl oz per 100 lb of seed	Target diseases include seed and seedling disease (damping-off) caused by *Rhizoctonia solani*, seedborne fungi causing seed decay and seedling blight. Also suppression of common root rot, Fusarium seed rot and seedling blight, dry seed decay (*Penicillium* spp.), common bunt and seedling damping-off (*Pythium* spp.). Stamina may be tank mixed with Charter fungicide seed treatment. Refer to Charter label for application rates and other use directions. Stamina can be used both in commercial seed treatment facilities and on-farm systems. Apply Stamina as a water-based mixture using standard slurry or mist-type seed treatment application equipment.
Stamina F^3 Cereals BASF	pyraclostrobin triticonazole metalaxyl	1.59% 1.59% 0.93%	4.6 fl oz per 100 lb of seed	For control of common bunt, common root rot, dry seed decay, Fusarium seed rot, Fusarium seedling blight, loose smut, Pythium damping off and Rhizoctonia root rot and suppression of Fusarium crown rot and Fusarium root rot. For commercial and on-farm use. Direct application into a planter box is prohibited.
Stamina F^3 HL BASF	pyraclostrobin triticonazole metalaxyl	7.57% 7.57% 4.54%	1.0 fl oz 100 lb of seed	Stamina F^3 HL is a liquid seed treatment used for control or suppression of certain seedborne and soilborne diseases of wheat. Stamina F^3 HL will generally increase emergence and plant stands by controlling or suppressing these diseases. Diseases controlled: common bunt, common root rot, dry seed decay, flag smut, Fusarium seed rot, Fusarium seedling blight, loose smut Pythium damping-off and Rhizoctonia root rot. Diseases suppressed: Fusarium crown rot and Fusarium root rot. Stamina F^3 HL fungicide seed treatment is for use at commercial seed treatment facilities using standard commercial seed treatment equipment (such as, but not limited to, slurry or mist-type equipment). Not for use on farm.
System^3 Helena Chemical Company	PCNB metalaxyl *Bacillus subtilis*	16.67% 4.25% 0.10%	2.0 to 3.0 oz per bushel of seed	Pythium and Rhizoctonia seedling disease complex, common smut or bunt. Use the higher rate of application in fields with a history of severe disease pressure. Apply at the specified rate and premix with the seed directly in the planter box at planting. May be applied at planting time utilizing commercial seed treating equipment to maximize seed coverage.
Thiram 480 DP Chemtura AgroSolutions	thiram	42.00	3.3 fl oz per 100 lb of seed	Used according to directions, Thiram 480 DP will usually increase stands and yields by reducing losses from seed decay, damping-off and seedling blights caused by many seedborne and soilborne organisms. Thiram 480 DP will usually control covered smuts or bunts of wheat. Intended for use by professional applicators only. Not for sale or use by homeowners/consumers. Apply with mechanical, slurry or mist-type seed treating equipment, provided that the equipment can be calibrated to accurately apply the product to seed. Plant treated wheat seed a minimum of 1 inch deep.
Vibrance Syngenta	sedaxane	45.45%	0.08 to 0.16 fl oz per 100 lb of seed	For control of seed decay, seedling blight and damping-off caused by *Rhizoctonia solani* and of loose smut caused by *Ustilago tritici*. Use the low rate for control of pre-emergent damping-off, seed decay or seedling blight. For extended control of post-emergent damping-off and seedling blight or high disease pressure due to short cropping rotations, or high levels of seedborne infections like smuts, use the high rate. Tank mix when a problem is expected with the diseases that are not controlled by Vibrance. Vibrance does not control diseases caused by *Pythium* spp. or *Phytophthora* spp. If these diseases are expected apply with Apron XL or seed treatment products that contain mefenoxam as active ingredients. Apply as a water-based slurry using standard slurry seed treatment equipment which provides uniform seed coverage.

Seed treatment fungicides labeled for use on winter wheat - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Vibrance Extreme Syngenta	sedaxane difenoconazole mefenoxam	1.22% 5.86% 1.46%	2.8 to 5.6 fl oz per 100 lb of seed	For protection against general seed rots; seedling blight, root rot and damping-off caused by seed- and soilborne *Fusarium* spp. or *Rhizoctonia* spp.; seedling blight, root rot and damping-off caused by soilborne *Pythium* spp.; seedborne *Septoria*; Septoria leaf blotch; common bunt; dwarf bunt; karnal bunt; flag smut; Fusarium seed scab and loose smut, as well as suppression of common root rot (*Cochliobolus* spp.), Fusarium crown and foot or root rot and take-all. For Septoria leaf blotch provides early season foliar disease protection for the first 4 weeks after planting. For full season protection, apply a foliar fungicide according to label directions. Apply Vibrance Extreme as a water-based slurry using standard slurry treatment equipment which provides uniform seed coverage.
Vitaflo-280 Chemtura AgroSolutions	carboxin thiram	15.59% 13.25%	3.5 to 5.0 fl oz per 100 lb of seed	Combination of a systemic fungicide (carboxin) and a contact fungicide (thiram) providing control of loose smut (*Ustilago tritici*) and common bunt as well as general seed rot, seedling blight and damping off including *Fusarium*, *Cochliobolus sativus* and *Pythium*. Also protects from seed rot caused by the seed borne storage fungi *Aspergillus*, *Alternaria* and *Penicillium*. Use the high rate for control of loose smut of wheat. The low rate will provide partial control of loose smut of wheat. The high rate will provide increased protection on highly infected seed. Formulated both for on-farm and commercial use. DO NOT apply Vitaflo-280 as a planter-box or hopper-box treatment. Vitaflo-280 may be applied with mechanical, slurry, or mist-type seed treating equipment, provided that the equipment can be calibrated to accurately and uniformly apply the product to the seed. Plant wheat seed a minimum of 1 inch deep. Do not graze or feed livestock on treated areas for six weeks after planting.
Vitaflo-280C Chemtura AgroSolutions	carboxin thiram	15.59% 13.25%	3.5 to 5.0 fl oz per 100 lb of seed	Combination of a systemic fungicide (carboxin) and a contact fungicide (thiram) providing control of loose smut (*Ustilago tritici*) and common bunt as well as general seed rot, seedling blight and damping off including *Fusarium*, *Cochliobolus sativus* and *Pythium*. Also protects from seed rot caused by the seed borne storage fungi *Aspergillus*, *Alternaria* and *Penicillium*. Use the high rate for control of loose smut of wheat. The low rate will provide partial control of loose smut of wheat. The high rate will provide increased protection on highly infected seed. Formulated both for on-farm and commercial use. DO NOT apply Vitaflo-280C as a planter-box or hopper-box treatment. Vitaflo-280C may be applied with mechanical, slurry, or mist-type seed treating equipment, provided that the equipment can be calibrated to accurately and uniformly apply the product to the seed. Plant wheat seed a minimum of 1 inch deep. Do not graze or feed livestock on treated areas for six weeks after planting.
Vitavax M Helena Chemical Corporation	carboxin thiram molybdenum	5.70% 5.70% 2.90%	9.0 to 12.0 fl oz per 100 lb of seed	Provides control of loose smut and common bunt. Use the higher rate under conditions of expected heavy disease pressure. Also contains the micronutrient molybdenum. Do not graze or feed livestock on treated area for six weeks after planting. Ready-to-use seed treatment for hopper-box application.
Vitavax-34 Chemtura AgroSolutions	carboxin	34.00%	2.0 to 3.0 fl oz per 100 lb of seed	For control of loose smut (*Ustilago tritici*), common bunt (*Tilletia caries*, *T. foetida*), flag smut (*Urocystis agropyri*), seed rots, damping off and seedling blight caused by *Cochliobolus sativus*. The higher rate will provide increased protection on highly inflected seed. May be applied with mechanical, slurry, or mist-type seed treating equipment, provided that the equipment can be calibrated to accurately and uniformly apply the product to seed. DO NOT apply this product as a planter-box or hopper-box treatment. Do not graze or feed livestock on treated areas for six weeks after planting.

Seed treatment fungicides labeled for use on winter wheat - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Warden Cereals Winfield Solutions, LLC	ipconazole metalaxyl	0.434% 0.579%	5.0 to 8.33 fl oz per 100 lb of seed	For control of general seed rots (including those caused by *Penicillium* and *Aspergillus*), seed rot, damping off and seedling blight (seed- and soilborne *Fusarium*, *Pythium* and *Cochliobolus sativus*), loose smut (*Ustilago tritici*), common bunt (*Tilletia caries, T. foetida*) and early season root rot (*Rhizoctonia*). For suppression of common root rot (*Cochlibolus sativus*) and crown and foot rot (*Fusarium*). Use the higher rate when disease pressure is expected to be high, or when there is a history of high disease levels in the field. Both for commercial and for on-farm application. It may be applied with mechanical, slurry, or mist-type seed treating equipment, provided that equipment can be calibrated to accurately and uniformly apply the product to seed.
Warden Cereals HR Winfield Solutions, LLC	ipconazole metalaxyl imidacloprid	0.421% 0.562% 14.100%	5.0 to 8.33 fl oz per 100 lb of seed	A systemic and contact broad spectrum fungicide plus systemic insecticide for seed treatment that protects against a wide variety of listed diseases and insects. For control of general seed rots (including those caused by *Penicillium* and *Aspergillus*), seed rot, damping off and seedling blight (seed- and soilborne *Fusarium, Pythium* and *Cochliobolus sativus*), loose smut (*Ustilago tritici*), common bunt (*Tilletia caries, T. foetida*) and early-season root rot (*Rhizoctonia*). For suppression of common root rot (*Cochlibolus sativus*) and crown and foot rot (*Fusarium*). Use the higher rate when disease pressure is expected to be high, or when there is a history of high disease levels in the field. Both for commercial and for on-farm application. DO NOT apply this product as a planter-box or hopper-box treatment. It may be applied with mechanical, slurry, or mist-type seed treating equipment, provided that equipment can be calibrated to accurately and uniformly apply the product to seed. Do not graze or feed livestock on treated areas for 45 days after planting.
Warden Cereals WR Winfield Solutions, LLC	ipconazole metalaxyl imidacloprid	0.439% 0.585% 2.950%	5.0 to 8.33 fl oz per 100 lb of seed	A systemic and contact broad spectrum fungicide plus systemic insecticide for seed treatment that protects against a wide variety diseases and wireworms. For control of general seed rots (including those caused by *Penicillium* and *Aspergillus*), seed rot, damping off and seedling blight (seed- and soilborne *Fusarium, Pythium* and *Cochliobolus sativus*), loose smut (*Ustilago tritici*), common bunt (*Tilletia caries, T. foetida*) and early-season root rot (*Rhizoctonia*). For suppression of common root rot (*Cochlibolus sativus*) and crown and foot rot (*Fusarium*). Use the higher rate when disease pressure is expected to be high, or when there is a history of high disease levels in the field. Both for commercial and for on-farm application. DO NOT apply this product as a planter-box or hopper-box treatment. It may be applied with mechanical, slurry, or mist-type seed treating equipment, provided that equipment can be calibrated to accurately and uniformly apply the product to seed. Do not graze or feed livestock on treated areas for 45 days after planting.

Virus diseases of winter wheat

The virus diseases most likely to occur on winter wheat in Missouri are wheat spindle streak mosaic, wheat soilborne mosaic, barley yellow dwarf and wheat streak mosaic. Symptoms of barley yellow dwarf may be evident on young wheat plants in the fall, may show up on young plants early in the spring or may be evident later in the season primarily on the flag leaves of plants. Symptoms of wheat spindle streak mosaic and wheat soilborne mosaic typically show up during spring green-up and are most pronounced when air temperatures are around 50 degrees F. Wheat streak mosaic symptoms tend to become obvious as air temperatures increase later in the spring.

Both **wheat spindle streak mosaic** and **wheat soilborne mosaic** are vectored or spread by the soilborne organism Polymyxa graminis. This vector prefers wet conditions and is most likely to infect wheat roots during wet falls.

Symptoms of wheat spindle streak mosaic appear in early spring as yellow green streaks or mottling on the dark green background of the leaves. These lesions usually run parallel to the leaf veins and tend to be tapered at the ends giving the lesions a spindle-shaped appearance. Plants may be slightly stunted, off-color and have fewer tillers than normal.

Wheat soilborne mosaic causes light green to yellow green to bright yellow mosaic patterns in leaf tissues. Symptoms of wheat soilborne mosaic are not always distinctive and might occur as a more general yellowing, similar to that caused by nitrogen deficiency. Infected plants may be stunted and slow to green up in the spring.

Plants infected in the fall usually show symptoms the following spring. Spring infections may occur during wet springs but usually spring infections occur too late to cause

significant injury. In most years the symptoms of these two wheat virus diseases are evident as the wheat crop is greening-up and tend to fade as air temperatures increase. In years with late, cool springs, symptoms may be evident much later in the season, even on plants that have headed.

Barley yellow dwarf (also called yellow dwarf and red leaf) is an extremely widespread virus disease of cereals. Symptoms include leaf discoloration ranging from a light-green or yellowing to a red or purple discoloration of leaf tissue. Symptoms are most pronounced when temperatures are in the range of 50-65 degrees F. The barley yellow dwarf virus persists in small grains, corn and perennial and annual weed grasses. More than 20 species of aphids can transmit the barley yellow dwarf virus. Symptoms may be more severe and yield losses higher if plants are infected in the fall or early in the spring. Infections developing in late spring or summer may cause discoloration of upper leaves but little stunting of plants or yield loss.

Wheat streak mosaic is the other virus disease likely to occur on winter wheat in Missouri. It causes a light-green to yellow-green mottling and streaking of leaves. The wheat streak mosaic virus is spread by the wheat curl mite. Symptoms are frequently found along the edges of fields where the mite vector first entered the field. Both the wheat streak mosaic virus and the wheat curl mite survive in susceptible crop and weed hosts including winter and spring wheat, barley, corn, rye, oats and a number of perennial grasses. Thus, the destruction of volunteer wheat and grass weed control are important management options for wheat streak mosaic.

Mixed infections of wheat viruses in the same field or even the same plant are common in Missouri. When plants are infected with more than one virus disease, it may not be possible to identify the specific viruses present by symptoms. It may be necessary to submit a plant sample to a plant diagnostic laboratory for virus testing.

Most of the management options for virus diseases in wheat are preventative measures such as planting resistant or tolerant wheat varieties, avoiding continuous wheat production, destroying volunteer wheat and weed grasses near wheat production fields, delaying wheat planting until all corn is harvested and avoiding early fall planting of wheat. Proper fertility may help reduce the impact of virus diseases on wheat.

Management options for virus diseases of wheat

- Plant good-quality seed of resistant varieties.
- Avoid planting too early in the fall to minimize opportunity for vectors to transmit viruses to young wheat plants.
- Destroy volunteer wheat and control weed grasses that may be hosts of the virus pathogens or insect vectors.
- Rotate crops.
- Maintain good plant vigor with adequate fertility.
- For barley yellow dwarf, insecticide applications (either as a seed treatment or foliar application) to control the aphid vectors may be warranted.

Foliage diseases of winter wheat

Many different fungi and bacteria can cause foliage diseases on wheat. These pathogens cause a wide range of leaf spots, leaf blights and similar symptoms on wheat. Foliage diseases that can cause significant injury to wheat in Missouri include Septoria leaf blotch, Stagonospora glume blotch, tan spot, leaf rust, stem rust, stripe rust, powdery mildew and bacterial stripe or black chaff.

The fungi that cause most of these wheat foliage diseases survive in infested wheat residues left on the soil surface. The next growing season spores are produced during moist periods and are carried by wind currents to susceptible wheat leaves, where infection may begin. Disease problems tend to be more severe when wheat is planted in fields with infested wheat residue left on the soil surface. Eventually spores that are produced in the initial lesions on plants are wind blown to other leaves or other plants causing secondary infection.

Leaf rust, stem rust and stripe rust are exceptions to this simplified explanation of disease development. The rust fungi do not survive in infested residue left in a field and, in fact, do not survive the winter months in this area at all. Rather, the rust fungi are reintroduced into this area each season when spores are carried up on air currents from the southern United States.

Most of the foliage diseases of wheat are favored by warm, wet or humid weather. Frequently infection begins on the lower portion of the plant. If weather conditions are favorable for disease development, the disease may move up through the plant. Severely infected leaves may yellow and die prematurely. Yield losses tend to be highest when the flag leaves are heavily infected.

There are several fungicides that are labeled for use on wheat to control fungal foliage diseases. It is important to scout wheat fields and determine which leaf diseases are occurring as well as the level of their severity before making a decision to apply a foliar fungicide. In particular be on the lookout for Septoria leaf blotch, Stagonospora glume blotch, tan spot, leaf rust and stripe rust. When scouting fields, try to identify the disease or diseases that are present, determine the average percent of infection on a leaf and the number of leaves showing infection and determine the stage of growth of the crop.

Generally, the profitable use of foliar fungicides on wheat depends on a number of factors, including varietal resistance, disease severity, effectiveness of the specific fungicides and timing of fungicide application. The greatest increases in yield are usually obtained when fungicides are applied to disease-susceptible varieties with high-yield potential at the early boot to head emergence growth stage when the flag leaf is in danger of severe infection. Fungicide applications are seldom beneficial if applied after flowering or after the flag leaf is already severely infected. It is also important to read the fungicide label for specific information on rates, recommended timing of application, frequency of applications, preharvest intervals and grazing restrictions.

Management options for foliage diseases of wheat

- Plant disease-free seed of varieties with resistance to diseases likely to occur in your area.
- Rotate with non-host crops.

- Manage residues: if tillage system is a conservation tillage system, particular care should be given to rotation and variety selection.
- Maintain good plant vigor with adequate fertility.
- Use foliar fungicides if warranted. See table of foliar fungicides labeled for use on winter wheat.

Black chaff (also called bacterial stripe) is a bacterial disease which produces symptoms on both leaves and heads. Water-soaked lesions that turn into reddish-brown to brown to brownish black streaks develop on the leaves. Glumes and awns show brown-black blotches or streaks. The bacterium that causes this disease, *Xanthomonas campestris* pv. *translucens*, is seedborne; therefore the use of disease-free seed is a primary control measure. Use of resistant or tolerant varieties and crop rotation should also reduce the incidence of bacterial stripe and black chaff.

Foliar fungicides labeled for use on winter wheat

The following table was prepared using current company product labels and manufacturers' Web sites. However, label registrations can change at any time. Before using any agricultural pesticide, read and follow directions accompanying that product. Product names have been used for clarity. Reference to specific trade names does not imply endorsement by the University of Missouri; discrimination is not intended against similar products not listed.

Foliar fungicides labeled for use on winter wheat

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Absolute 500 SC Bayer CropScience	tebuconazole trifloxystrobin	22.63% 22.63%	5.0 fl oz per acre	Diseases controlled: glume blotch, Septoria leaf blight, powdery mildew, rusts and tan spot. Begin applications preventatively when conditions are favorable for disease development. Early season leaf disease suppression: apply 3.0 to 4.0 fl oz per acre for suppression of tan spot, leaf blight and powdery mildew. May be applied by ground, aerial or chemigation. Do not apply more than 5.0 fl oz per season. Do not allow livestock to graze within the treated area within 30 days after application, and do not harvest the treated crop for forage within 30 days after application or for hay and wheat straw within 45 days after application. Restricted entry interval (REI) = 12 hours. Do not apply within 35 days of harvest.
AVARIS Helena Chemical Company	azoxystrobin propiconazole	7.00% 11.70%	7.0 to 14.0 fl oz per acre	Use 7.0 to 14.0 fl oz per acre for early-season suppression of powdery mildew, Septoria leaf blight, glume blotch and tan spot. Apply AVARIS in the spring for suppression of early-season diseases and follow up with a second application for full season control. Use 10.5 to 14.0 fl oz per acre for control of leaf diseases including rust (*Puccinia* spp.), powdery mildew, Septoria leaf blight, glume blotch, tan spot, Helminthosporium leaf blight, and Alternaria kernel blight. Protecting the flag leaf is important for maximizing the potential yield. Highest yields are normally obtained when AVARIS is applied when the flag leaf is 50% to fully emerged. If disease pressure is low, 10.5 fl oz per acre may be applied. Applications may be made no closer than a 14-day interval. AVARIS can be applied through full head emergence (Feekes growth stage 10.5). Do not apply after this stage to avoid possible illegal residues. Use 14.0 fl oz per acre for foot rot/eyespot. Apply full rate of AVARIS plus half the rate recommended of other EPA registered fungicides such as Topsin M. Apply at tillering but before elongation has occurred. Apply no more than two applications of AVARIS or any other Group 11 fungicide per year. Do not apply more than 28.0 fl oz per acre per season of AVARIS. See label for additional information on resistance management. AVARIS is most effective when applied and allowed to dry before a rainfall. For best results, sufficient coverage is important. Use a higher water volume for aerial application (greater than 2 GPA) if equipment and/or conditions would not provide good coverage. AVARIS may be applied by ground, air or chemigation. AVARIS is extremely toxic to certain apple varieties. Extreme care must be used to prevent injury to apple trees. See label for additional information. Under certain environmental conditions, tank mixes of AVARIS plus herbicides and/or fertilizers may cause crop injury. Do not apply within 30 days of harvest for forage or hay. Do not apply after Feekes growth stage 10.5.

Foliar fungicides labeled for use on winter wheat - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Bumper 41.8 EC Makhteshim Agan of North America, Inc.	propiconazole	41.80%	4.0 fl oz per acre	Use 4.0 fl oz per acre for control of rust (*Puccinia* spp.), powdery mildew (*Blumeria* spp., *Erysiphe* spp.), leaf blight (Septoria tritici) glume blotch (*Stagonospora nodorum*), tan spot (*Pyrenophora tritici-repentis*), Helminthosporium leaf blight (*Drechslera tritici-repentis*), spot blotch (*Bipolaris sorokiniana*) and net blotch (*Pyrenophora teres*). Protecting the flag leaf is important for maximizing yield. When Bumper 41.8 EC is applied at 50% to fully emerged, the highest yields are normally obtained. Applications may be made at no closer than at 14-day intervals. The use of an oil-based adjuvant may improve spray coverage. Use 2.0 to 4.0 fl oz per acre for early season suppression of powdery mildew (*Blumeria* spp., *Erysiphe* spp.), leaf blight (*Septoria tritici*), glume blotch (*Stagonospora nordorum*) and tan spot (*Pyrenophora tritici-repentis*). Apply in the spring. Make a second application up to Feekes growth stage 10.5 for season-long control. Applications may be made no closer than at 14-day intervals. Use 4.0 fl oz per acre for suppression only of Fusarium head blight. Apply at approximately 50% flowering. Addition of a penetrating type adjuvant may increase Fusarium head blight suppression. Application may be made using ground, air or chemigation equipment. Do not apply more than 8.0 fl oz of Bumper 41.8 EC per acre per season. Do not apply more than 4.0 fl oz per acre per season if forage or hay will be harvested. Do not apply after Feekes growth stage 10.5 in wheat.
Caramba BASF	metconazole	8.60%	10.0 to 17.0 fl oz per acre	Target diseases: black point, powdery mildew, rust, Septoria leaf and glume blotch and tan spot 10.0 to 14.0 fl oz per acre. For optimum disease control, begin applications of Caramba before disease development. To maximize yields in cereals, it is important to protect the flag leaf. For diseases other than head scab, apply Caramba immediately after flag leaf emergence for optimum results. Suppression only of head scab (*Fusarium* spp.): 13.5 to 17.0 fl oz per acre. For optimum suppression of Fusarium head blight, apply Caramba at the beginning of anthesis. When head blight is a concern, growers should manage this disease with fungicides that are labeled for and effective in managing this disease and with cultural practices like crop rotation and plowing to reduce crop residues that serve as an inoculum source. Rates up to 17.0 fl oz per acre of Caramba may be used under severe disease pressure. The minimum treatment interval is 6 to 8 days. Resistance management: To limit the potential for development of resistance, do not make more than two applications of Caramba or other DMI (Group 3) fungicides per season. Maximum number of applications per season is two. Maximum product rate per season is 34 fl oz per acre. No livestock feeding restrictions. Minimum time from application to harvest is 30 days.
Dithane DF Rainshield Dow AgroSciences	mancozeb	75.00%	2.1 lb per acre	For control of Helminthosporium leaf spot, leaf rust, Septoria glume blotch, Septoria leaf spot and tan spot. Start applications at the onset of disease or when plants are in the tillering to jointing stage and repeat at 7- to 10-day intervals. The addition of Latron CS-7 to spray solutions will improve performance. Do not make more than three applications during the season. Do not apply after Feekes growth stage 10.5 or heading, but not less than 26 days of harvest. Do not graze livestock in treated area before harvest.
Dithane F-45 Rainshield Dow AgroSciences	mancozeb	37.00%	1.6 qt per acre	
Dithane M45 Dow AgroSciences	mancozeb	80.00%	2.0 lb per acre	
EVITO T Arysta LifeScience North America, LLC	fluoxastrobin tebuconazole	18.00% 25.00%	4.0 to 6.0 fl oz per acre	For control of leaf rust, stripe rust, stem rust, Septoria leaf and glume blotch and tan spot. For optimum results, apply the first application at approximately Feekes growth stage 5 (Zadok's 31) and a second application no later than Feekes growth stage 10.5 Do not apply more than 12.0 fl oz per acre per crop season.There is a maximum of two applications per crop season. Restricted-entry interval (REI) is 12 hours. Do not apply after Feekes growth stage 10.5. Do not apply within 40 days of harvest for grain and straw. Do not apply within 7 days of harvest for forage or hay. Do not allow livestock to graze or feed on green forage within 7 days after treatment with EVITO T.

Foliar fungicides labeled for use on winter wheat - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
EVITO 480 SC Arysta LifeScience North America, LLC	fluoxastrobin	40.30%	2.0 to 4.0 fl oz per acre	For control of leaf rust, stripe rust, stem rust, Septoria leaf and glume blotch and tan spot. For powdery mildew control use 2.5 to 4.0 fl oz per acre. For optimum results, begin applications preventively and continue as needed on a 14- to 21-day interval. Use the higher rates and shorter interval when disease pressure is high. Apply prior to disease development from Feekes 5 (Zadok's 31) up to late head emergence at Feekes 10.5 (Zadok's 59). Do not apply more than 8.0 fl oz per acre per year. There is a maximum number of two applications per season, and a minimum interval of 14 days between applications. May be applied by ground, air or through chemigation. Do not apply within 40 days of harvest for grain and straw. Do not apply within 7 days of harvest for forage and hay. Make no more than one application before harvest of wheat forage. Do not apply later than Feekes growth stage 10.5.
Folicur 3.6F Bayer CropScience	tebuconazole	38.70%	4.0 fl oz per acre	For rusts (*Puccinia* spp.) and suppression of head blight (*Fusarium* spp.) Rusts: Apply Folicur 3.6F at the earliest sign of rust pustules on foliage. Fusarium head blight: Optimal timing for Fusarium head blight suppression is the beginning of flowering on main stem heads (Feekes 10.51). Apply in a minimum of 10 gallons of spray solution per acre by ground or in a minimum of 5 gallons of spray solution by air. A maximum of 4.0 fl oz of Folicur 3.6F may be applied per acre per crop season. Straw cut after harvest may be fed or used for bedding. Grazing livestock or feeding of green forage is permitted 6 or more days after the last application. Do not apply within 30 days of harvest.
Headline BASF	pyraclostrobin	23.60%	6.0 to 9.0 fl oz per acre	For control of leaf rust, powdery mildew, Septoria leaf and glume blotch, spot blotch, stem rust, stripe rust and tan spot. For optimal disease control, begin Headline applications before disease development. To maximize yields in cereals it is important to protect the flag leaf. Apply Headline immediately after flag leaf emergence for optimum results. Headline does not control Fusarium head blight (head scab) or prevent the reductions in grain quality that can result from this disease. Resistance management: To limit the potential for development of resistance, do not make more than two applications of Headline or other strobilurin fungicides per season. Do not harvest wheat hay or feed green-chopped wheat within 14 days after last application. Apply no later than the beginning of flowering (Feekes 10.5, Zadok's 59).
Kocide 2000 DuPont	copper hydroxide	53.80%	1.0 to 1.5 lb per acre	Target diseases: Helminthosporium spot blotch, powdery mildew suppression, Stagonospora leaf and glume blotch and stem rust. Make applications for early-season disease control through heading. Minimum retreatment interval is 10 days. Use higher rates when conditions favor disease. Addition of adjuvants is recommended.
Kocide 3000 DuPont	copper hydroxide	46.10%	0.5 to 0.75 lb per acre	
Kumulus DF Arysta Life Science North America, LLC	sulfur	80.00%	6.0 to 15.0 lb per acre	For the control of powdery mildew. Apply when disease first appears and repeat as necessary or with the regularly scheduled insecticide program.
ManKocide DuPont	mancozeb copper hydroxide	15.00% 46.10%	2.0 to 2.5 lb per acre	Helminthosporium leaf spot, Septoria leaf spot and glume blotch. Make first application at early heading and follow with second spray 10 days later. Use higher rates when conditions favor disease. Maximum rate per season in 32 lb per acre. Do not graze livestock in treated areas before harvest. Do not apply within 26 days of harvest.

Foliar fungicides labeled for use on winter wheat - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Manzate Pro-Stick United Phosphorus, Inc. **Manzate Flowable** United Phosphorus, Inc.	mancozeb mancozeb	75.00% 37.00%	2.0 lb per acre 1.6 qt per acre	For control of Helminthosporium leaf spot, leaf rust, Septoria glume blotch, Septoria leaf spot and tan spot. Start applications at the onset of disease or when plants are in the tillering to jointing stage and repeat at 7- to 10-day intervals. Do not make more than three applications during the season. Do not apply more than 6 lb or 4.8 qt per acre per crop. Do not graze livestock in treated areas before harvest. Do not apply within 26 days of harvest.
Monsoon Loveland Products Inc.	tebuconazole	38.70%	4.0 fl oz per acre	For leaf, stem and stripe rusts (*Puccinia* spp.), and suppression of Fusarium head blight or scab (*Fusarium* spp.), apply 4.0 fl oz per acre. Wheat fields should be observed closely for early disease symptoms, particularly when susceptible varieties are planted and/or under prolonged conditions favorable for disease development. Rusts: Apply Monsoon at the earliest sign of rust pustules on foliage. Fusarium head blight: optimal timing of Monsoon for Fusarium head blight suppression is the beginning of flowering on main stem heads (Feekes 10.51). Apply Monsoon in a minimum of 10 gallons of spray solution per acre by ground or in a minimum of 5 gallons of spray solution per acre by air. For optimum disease control, the lowest specified rate of a spray surfactant should be tank-mixed with Monsoon. Monsoon must have two to four hours of drying time on plant foliage for active ingredient to move systemically into plant tissue before rain or irrigation occurs. After this period of time, Monsoon will be resistant to weathering. A maximum of 4.0 fl oz of Monsoon may be applied per acre per crop season. Straw may be fed or used for bedding. Do not allow livestock to graze or feed green forage to livestock prior to six days after treatment with Monsoon. Restricted-entry interval (REI) is 12 hours. Do not apply within 30 days of harvest.
Muscle 3.6F SIPCAM AGRO USA, Inc.	tebuconazole	38.70%	4.0 fl oz per acre	For leaf, stem and stripe rusts (*Puccinia* spp.), and suppression of Fusarium head blight or scab (*Fusarium* spp.). Rusts: Make an application of this product at the first sign of rust pustules on the foliage. Fusarium head blight: The best time to apply this product to suppress Fusarium head blight is at the beginning of anthesis (flowering) of the main head. Feekes growth stage 10.51. Apply this product in a minimum of 10 gallons of spray suspension per acre by ground sprayer or in a minimum of 5 gallons of spray suspension per acre by aircraft. The plant will absorb the active ingredient systemically after two to four hours following application prior to irrigation or rain, after which, this product will resist weathering. Maximum 4.0 fl oz per acre per crop season for this product. Do not allow livestock to graze or feed green forage to livestock for 6 days after application of this product. Straw cut after harvest may be fed to livestock or used for bedding. Preharvest interval (PHI) is 30 days.

Foliar fungicides labeled for use on winter wheat - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Orius 3.6F Makhteshim Agan of North America, Inc.	tebuconazole	38.70%	4.0 fl oz per acre	For leaf, stem and stripe rusts (*Puccinia* spp.), and suppression of Fusarium head blight or scab (*Fusarium* spp.), apply 4.0 fl oz per acre. Wheat fields should be observed closely for early disease symptoms, particularly when susceptible varieties are planted and/or under prolonged conditions favorable for disease development. Rusts: Apply Orius 3.6F at the earliest sign of rust pustules on foliage. Fusarium head blight: Optimal timing of Orius 3.6F for Fusarium head blight suppression is the beginning of flowering on main stem heads (Feekes 10.51). Apply Orius 3.6F in a minimum of 10 gallons of spray solution per acre by ground or in a minimum of 5 gallons of spray solution per acre by air. For optimum disease control, the lowest specified rate of a spray surfactant should be tank-mixed with Orius 3.6F. Orius 3.6F must have two to four hours of drying time on plant foliage for active ingredient to move systemically into plant tissue before rain or irrigation occurs. After this period of time, Orius 3.6F will be resistant to weathering. A maximum of 4.0 fl oz of Orius 3.6F may be applied per acre per crop season. Straw may be fed or used for bedding. Do not allow livestock to graze or feed green forage to livestock prior to six days after treatment with Orius 3.6F. Do not apply within 30 days of harvest.
Penncozeb 4FL United Phosphorus, Inc.	mancozeb	37.00%	0.8 to 1.6 qt per acre	For control of Helminthosporium leaf spot, Septoria leaf spot, Septoria glume blotch, leaf rust and tan spot. Start application at the onset of disease or when plants are in tillering to jointing stage and repeat at 7- to 10-day intervals. Do no apply more than three applications in one season. Do not apply more than 6.4 lb Penncozeb 75DF or 6.0 lb Penncozeb 80WP per acre per crop. Do not apply within 26 days of harvest. Do not graze livestock in treated areas before harvest. Do not apply after heading (around Feekes 10.5).
Penncozeb 75DF United Phosphorus, Inc.	mancozeb	75.00%	1.0 to 2.0 lb per acre	
Penncozeb 80WP United Phosphorus, Inc.	mancozeb	80.00%	1.0 to 2.0 lb per acre	
Priaxor Xemium Brand Fungicide Syngenta	fluxapyroxad pyraclostrobin	14.33% 28.58%	4.0 to 8.0 fl oz per acre	Target diseases: black point, leaf rust, powdery mildew, Septoria leaf and glume blotch, spot blotch, stem rust, stripe rust and tan spot. For suppression only of eyespot (6.0 to 8.0 fl oz per acre). Priaxor does not control Fusarium head blight (head scab) or prevent the reductions in grain quality that can result from this disease. For early season-control of Septoria leaf and glume blotch, spot blotch and tan spot when conditions favor disease development, apply 2.0 to 4.0 fl oz per acre of Priaxor either in combination with a herbicide application or when conditions favor disease development. When the 2.0 to 4.0 fl oz early-season application is used, a second application of Priaxor may be required to protect the emerged flag leaf. Environmental conditions for disease or current disease pressure at the time of flag-leaf emergence should be used to determine the rate for the second application. For high disease pressure, use the higher rate. Do not apply more than 16.0 fl oz per acre per season. Do not make more than two consecutive applications before alternating to a labeled fungicide with a different mode of action. Do not harvest wheat hay or feed green-chopped wheat within 14 days after last application. Apply no later than the beginning of flowering (Feekes 10.5, Zadok's 59).
Proline 480 SC Bayer CropScience	prothioconazole	41.0%	4.3 to 5.7 fl oz per acre	Leaf and stem diseases including powdery mildew, rusts, Septoria leaf and glume blotch, Stagonospora blotch and tan spot: 4.3 to 5.0 fl oz per acre. Apply Proline 480 SC as a preventive foliar spray when the earliest disease symptoms appear on the leaves or stems. Wheat fields should be observed closely for early disease symptoms, particularly when susceptible varieties are planted and/or under prolonged conditions favorable for disease development. Fusarium head blight (suppression only): apply 5.0 to 5.7 fl oz per acre. The optimal time to apply Proline 480 SC Fungicide is as a preventative foliar spray at early flower (Feekes Growth Stage 10.51). Spray equipment must be set up to provide good coverage to wheat heads- see label for details. Apply up to two applications of Proline 480 SC per year. Repeat applications using a 14-day spray interval if conditions remain favorable for continued or increased disease development. Applications may be made by ground or aerial spray equipment. A maximum of 9.37 fl oz of Proline 480 SC may be applied per acre per year. Do not apply two applications at 5.7 fl oz per acre per year. Do not apply within 30 days of harvest.

Foliar fungicides labeled for use on winter wheat - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Propiconazole 41.8% AmTide LLC	propiconazole	41.80%	2.0 to 4.0 fl oz per acre	Use 2.0 to 4.0 fl oz per acre for early season suppression of powdery mildew, leaf blight, glume blotch and tan spot. Apply by air, ground or chemigation. For season-long control make application in the spring and make one repeat application up to Feekes growth stage 10.5. Use sufficient volumes of water to ensure thorough coverage. Use 4.0 fl oz per acre for control of leaf diseases including rust, powdery mildew, leaf blight, glume blotch and tan spot as well as foot root and suppression of Fusarium head blight. Apply by air, ground or chemigation. Use sufficient volumes of water to ensure a thorough, uniform coverage of foliage, especially the flag leaf. Optimum yields are obtained when AmTide Propiconazole is applied when the flag leaf is between 50% to 100% emerged. For best results allow residues to dry on foliage before a rainfall event. Improved spray coverage and canopy penetration is achieved using an oil-based adjuvant. Suppression of Fusarium head blight: apply close to 50% flowering. Increased suppression may result by adding a penetrating-type adjuvant. Maximum application rate per season is 4.0 fl oz per acre per season when forage or hay is harvested. Minimum days between treatments is 14 days. Preharvest interval (PHI) is 30 days for forage, 40 days for grain and straw and 45 days for hay.
PropiMax EC Dow AgroSciences	propiconazole	41.80%	2.0 to 4.0 fl oz per acre	Early-season suppression of powdery mildew, Septoria leaf blight, Stagonospora glume blotch and tan spot: Apply 2.0 to 4.0 fl oz per acre. Apply in the spring. Follow up with a second application up to Feekes growth stage 10.5 for season-long control. Applications may be made no closer than a 14-day interval. Control of leaf diseases including rust, powdery mildew, Septoria leaf blight, Stagonospora glume blotch and tan spot: Apply 4.0 fl oz per acre. Protecting the flag leaf is important for maximizing the potential yield. Highest yields are normally obtained when PropiMax EC is applied when the flag leaf is 50% to fully emerged. Applications may be made no closer than a 14-day interval. The use of oil-base adjuvant may improve the spray coverage and canopy penetration. Foot rot: Apply 4.0 fl oz per acre. Apply PropiMax EC plus half rates of other EPA registered fungicides such as thiophanate-methyl. Apply at tillering, but before elongation has occurred. Fusarium head blight suppression: 4.0 fl oz per acre. Apply PropiMax EC at approximately 50% flowering. Addition of a penetrating type adjuvant may increase Fusarium head blight suppression. Do not apply more than 8.0 fl oz per acre per season of PropiMax EC. Do not apply more than 4.0 fl oz of PropiMax EC per acre per season if forage or hay will be harvested. Do not apply within 30 days of harvest for forage, 40 days before harvest for grain and straw and 45 days before harvest for hay.
Prosaro 421 SC Bayer CropScience	prothioconazole tebuconazole	19.0% 19.0%	6.5 to 8.2 fl oz per acre	Leaf and stem diseases including powdery mildew, rusts, Septoria leaf and glume blotch, Stagonospora blotch and tan spot. Apply Prosaro 421 SC as a preventive foliar spray when the earliest disease symptoms appear on the leaves and stems. Wheat fields should be observed closely for early disease symptoms, particularly when susceptible varieties are planted and/or under prolonged conditions favorable for disease development. Fusarium head blight (suppression only): The optimal time to apply is as a preventative foliar spray at early flower (Feekes Growth Stage 10.51). Spray equipment must be set up to provide good coverage to wheat heads- see label for details. For optimum disease control the lowest labeled rate of a spray surfactant must be tank mixed with Prosaro 421 SC. Applications may be made by ground or aerial spray equipment. Chemigation use is allowed only for application made before early flower. A maximum of 8.2 fl oz of Prosaro 421 SC may be applied per acre per crop year. Straw may be fed or used for bedding. Do not allow livestock to graze or feed green forage to livestock prior to 6 days after treatment with Prosaro 421 SC. Do not apply within 30 days of harvest.

Foliar fungicides labeled for use on winter wheat - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Quadris Syngenta	azoxystrobin	22.90%	4.0 to 12.0 fl oz per acre or 7.5 to 11.0 fl oz per acre	Use 4.0 to 12.0 fl oz per acre for leaf rust, stripe rust, stem rust, Septoria leaf and glume blotch and tan spot. Use 7.5 to 11.0 fl oz per acre for powdery mildew. Quadris should be applied before disease development up to late head emergence (Feekes 10.5 or Zadok's 59). Applications may be made by ground, air or chemigation. A crop oil concentrate adjuvant may be added at 1.0% v/v to optimize efficacy. Resistance Management: Follow the resistance management guidelines in the resistance management section of the Quadris label. Quadris is extremely toxic to certain apple varieties. See "General Use Instructions" on label for additional information on safety precautions to avoid injury to apple trees. For wheat only: do not apply later than Feekes growth stage 10.5 (Zadok's growth stage 59).
Quilt Syngenta	azoxystrobin propiconazole	7.00% 11.70%	7.0 to 14.0 fl oz per acre	7.0 to 14.0 fl oz per acre for early-season suppression of powdery mildew, Septoria leaf blotch, Stagonospora glume blotch and tan spot. 14.0 fl oz per acre for control of leaf diseases (rusts, powdery mildew, Septoria leaf blotch, Stagonospora glume blotch and tan spot). Protecting the flag leaf is important for maximizing the potential yield. Highest yields are obtained when Quilt is applied when the flag leaf is 50% to fully emerged. Applications may be made no closer than a 14-day interval. For wheat only, Quilt may be applied through full head emergence (Feekes growth stage 10.5). Do not apply after this stage to avoid illegal residues. Quilt is most effective when applied and allowed to dry before a rainfall. For best results, sufficient water volume should be used to provide thorough coverage. Quilt may be applied by ground, air or chemigation. Under certain environmental conditions, tank mixes of Quilt plus herbicides and/or fertilizers may cause crop injury in barley, triticale and wheat. Quilt may be extremely toxic to certain apple varieties. See "General Use Instructions" on label for additional information on safety precautions to avoid injury to apple trees. Do not apply more than two applications per acre per year. Do not apply more than 28.0 fl oz per acre per season. Do not apply within 30 days for forage or hay. Do not apply after Feekes 10.5
Quilt Xcel Syngenta	azoxystrobin propiconazole	13.50% 11.70%	7.0 to 14.0 fl oz per acre	7.0 to 14.0 fl oz per acre for early-season suppression of powdery mildew, Septoria leaf blight, glume blotch and tan spot. Apply Quilt Xcel in the spring for suppression of early-season diseases. Follow up with a second application (see below) for full season control. 10.5 to 14.0 fl oz per acre for control of leaf diseases including rust (*Puccinia* spp.), powdery mildew, Septoria leaf blight, glume blotch, tan spot, Helminthosporium leaf blight and spot blotch. Protecting the flag leaf is important for maximizing the potential yield. Highest yields are normally obtained when Quilt Xcel is applied when the flag leaf is 50% to fully emerged. Applications may be made no closer than a 14-day interval. Do not apply more than two applications per acre per year. Do not apply more than 28.0 fl oz per acre per season. Do not apply to wheat after Feekes growth stage 10.5.

Foliar fungicides labeled for use on winter wheat - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Regalia Marrone Bio Innovations	extract of *Reynoutria sachalinensis*	5.00%	2.0 to 4.0 qt per acre	For powdery mildew, rust, smut, bacterial blight and streak, leaf spots, smuts and Septoria leaf spot apply 2.0 to 4.0 qt of Regalia. Regalia is an extract from the plant *Reynoutria* spp. (knotweed). Regalia applied to actively growing plants (see label for directions for use) will help make the treated leaves and buds resistant to certain plant diseases. The extract increases the plant's natural defense system due to a fivefold increase in phenolics. This induced resistance against some important diseases is not systemic, but there is some translaminar protection. Repeat applications at 7- to 14-day intervals to protect new plant growth. The resistance induction takes place in one to two days. Use Regalia as a preventative rather than a curative application. Apply before disease infestation to protect the growing leaf tissue. Can be used in organic production. Apply Regalia preventatively in 50-100 gallons of water per acre when the first disease symptoms are visible. When plants are under high disease pressure, tank mix Regalia with another registered fungicide for more effective control. Repeat applications in 7-14 day intervals depending upon crop growth and disease pressure. Regalia has a pre-harvest interval (PHI) of zero days.
Stratego Bayer CropScience	propiconazole trifloxystrobin	11.40% 11.40%	10.0 fl oz per acre	For control of glume blotch, leaf blight, powdery mildew, rusts and tan spot. Begin applications preventively when conditions are favorable for disease development. A second application (minimum interval of 14 days) may be made if needed. Early-season leaf disease suppression: Apply 6.0 to 8.0 fl oz per acre of Stratego for suppression of tan spot, Septoria and powdery mildew. Do not apply more than two applications per season. Do not apply Stratego after Feekes growth stage 10.5 (full head emergence). See label for grazing restrictions. Do not apply Stratego within 35 days of harvest.
Stratego YLD Fungicide Bayer CropScience	prothioconazole trifloxystrobin	10.80% 32.30%	4.0 fl oz per acre	Disease controlled: Stagonospora blotch, Septoria blotch, powdery mildew, rusts and tan spot. Begin applications preventatively when conditions are favorable for disease development. A second application (minimum interval of 14 days) may be made if needed. Early season leaf disease control/suppression: apply 2.0 to 4.0 fl oz per acre of Stratego YLD Fungicide for control of early season tan spot, Septoria, Stagonospora and powdery mildew and suppression of rusts. May be applied by ground, air or chemigation. Do not apply more than two applications per season. See label for grazing restrictions. Do not apply after Feekes growth stage 10.5 (full head emergence). Do not apply within 35 days of harvest.
TEBU 3.6F AmTide LLC	tebuconazole	40.53%	4.0 fl oz per acre	For leaf, stem and stripe rusts (*Puccinia* spp.), suppression of head blight or scab (*Fusarium* spp.). Rusts: Apply at the earliest sign of rust pustules on foliage. Fusarium head blight: Optimal timing of TEBU 3.6F for Fusarium head blight suppression is the beginning of flowering on main stem heads (Feekes 10.51). For optimum disease control, the lowest recommended rate of a spray surfactant should be tank-mixed with TEBU 3.6F. Apply TEBU 3.6F in a minimum of 10 gallons of spray solution per acre by ground or in a minimum of 5 gallons of spray solution by air. Straw may be fed or used for bedding. Do not allow livestock to graze or feed green forage to livestock prior to 6 days after treatment with TEBU 3.6F. A maximum of 4.0 fl oz may be applied per acre per crop season. Restricted-entry interval (REI) is 12 hours. Preharvest interval (PHI) is 30 days.

Foliar fungicides labeled for use on winter wheat - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
Tebuzol 3.6F Fungicide United Phosphorus, Inc.	tebuconazole	38.70%	2.0 to 4.0 fl oz per acre	For leaf, stem and stripe rusts (*Puccinia* spp.), suppression of head blight or scab (*Fusarium* spp.), Septoria glume blotch (*Stagonospora nordorum*) and powdery mildew use 4.0 fl oz per acre rate. For tan spot and Septoria leaf spot use 2.0 to 4.0 fl oz per acre rate. Wheat fields should be observed closely for early disease symptoms, particularly when susceptible varieties are planted and/or under prolonged conditions favorable for disease development. Rusts: apply Tebuzol 3.6F at the earliest sign of rust pustules on foliage. Fusarium head blight: optimal timing of Tebuzol 3.6F for Fusarium head blight suppression is the beginning of flowering on the main stem heads (Feekes 10.51). For control of Septoria glume blotch, apply what at least 75% of wheat heads on the main stem are fully emerged to when 50% of the heads on the main stem are in flower. A maximum of 4.0 fl oz of Tebuzol 3.6F may be applied per acre per crop season. Straw may be fed or used for bedding. Do not allow livestock to graze or feed green forage to livestock prior to 6 days after treatment. Restricted-entry interval (REI) is 12 hours. Do not apply within 30 days of harvest (PHI = 30 days).
Tilt Syngenta	propiconazole	41.80%	2.0 to 4.0 fl oz per acre	For early-season suppression of powdery mildew, Septoria leaf blight, Stagonospora glume blotch and tan spot: Apply 2.0 to 4.0 fl oz per acre. Apply in the spring. Follow up with a second application up to Feekes growth stage 10.5 for season-long control. For control of leaf diseases including rust, powdery mildew, Septoria leaf blight, Stagonospora glume blotch and tan spot: apply 4.0 fl oz per acre. Protecting the flag leaf is important for maximizing the potential yield. Highest yields are normally obtained when Tilt is applied when the flag leaf is 50% to fully emerged. Applications may be made no closer than a 14-day interval. The use of oil-base adjuvant may improve the spray coverage and canopy penetration. Foot rot: Apply 4.0 fl oz per acre. Apply Tilt plus half rates of other EPA registered fungicides such as thiophanate-methyl. Apply at tillering, but before elongation has occurred. Fusarium head blight suppression: 4.0 fl oz per acre. Apply Tilt at approximately 50% flowering. Addition of a penetrating type adjuvant may increase Fusarium head blight suppression. Do not apply more than 8.0 fl oz per acre per season of Tilt. Do not apply more than 4.0 fl oz per acre per season of Tilt if forage or hay will be harvested. Do not apply within 30 days of harvest for forage or hay. Do not apply after Feekes 10.5 in wheat.
Toledo Rotam North America, Inc.	tebuconazole	38.70%	4.0 fl oz per acre	For leaf, stem and stripe rusts and suppression only of head blight or scab (*Fusarium* spp.). Wheat fields should be observed closely for early disease symptoms, particularly when susceptible varieties are planted and/or under prolonged conditions favorable for disease development. Rusts: Apply Toledo at the earliest sign of rust pustules on foliage. Fusarium head blight: Optimum timing of Toledo for Fusarium head blight suppression is the beginning of flowering on the main stem heads (Feekes 10.5). For optimum disease control, the lowest specified rate of a spray surfactant should be tank mixed with Toledo. Toledo must have two to four hours of drying time on plant foliage for the active ingredient to move systemically into plant tissue before rain or irrigation occurs. After this period of time Toledo will be resistant to weathering. A maximum of 4.0 fl oz of Toledo may be applied per acre per season. Do not allow livestock to graze or feed green forage to livestock prior to 6 days after treatment with Toledo. Straw may be fed or used for bedding. Do not apply within 30 days of harvest.

Foliar fungicides labeled for use on winter wheat - *continued*

Trade name Company	Common chemical name	% active ingredient	Rate	Additional label information
TwinLine BASF	pyraclostrobin metconazole	12.00% 7.40%	7.0 to 9.0 fl oz per acre	Target diseases: black point, powdery mildew, rust, Septoria leaf and glume blotch and tan spot. TwinLine is not labeled for the suppression of Fusarium head scab. For optimum disease control, begin applications of TwinLine before disease development. To maximize yields in cereals, it is important to protect the flag leaf. For diseases other than head scab, apply TwinLine immediately after flag leaf emergence for optimum results. Do not apply after Feekes growth stage 10.5 Rates up to 9.0 fl oz per acre of TwinLine may be used for severe disease pressure. The minimum retreatment interval (RTI) is 6 to 8 days after the first application. Use the higher rate and shorter interval when disease pressure is high. Resistance management: To limit the potential for development of resistance, do not make more than two applications of TwinLine per season. Apply no later than the beginning of flowering (Feekes 10.5 or Zadok's 59).

Root, crown and wilt diseases of winter wheat

Several soilborne fungi can cause root and crown diseases of wheat. Affected plants may be stunted or less vigorous than healthy plants. Plants may yellow, wilt and die prematurely. Dead plants may have a bleached or white appearance. When affected plants are dug up, root systems may be poor with roots and crown tissues discolored and deteriorated.

Cephalosporium stripe had not been a significant problem on wheat in most of Missouri. With recent wet seasons, shorter rotations between wheat crops, and reduced tillage, this disease has become more common in the northern part of the state. Foliage symptoms are most evident during jointing and heading. Light green to yellow-green longitudinal stripes develop on the leaves of infected plants. The stripes run parallel to the leaf midrib and may extend the entire length of the plant. Older lesions are predominantly yellow or even brown. Severely infected plants may be stunted, produce few tillers and die prematurely. The fungus that causes this disease, *Cephalosporium gramineum*, persists in association with wheat residues and may also be soilborne. Fungicides are not effective in controlling Cephalosporium stripe, and resistant varieties are not available for Missouri.

Management options for cephalosporium stripe

- Crop rotation to corn or legumes for at least two years.
- Residue management.
- Proper fertility.
- Proper weed control.

Take-all is one of the more common root and crown rot diseases of wheat in Missouri. The fungus that causes this disease may infect seedlings in the fall. Symptoms are usually most evident after heading as white heads on wheat plants. Infected plants are also stunted, slightly yellow, have few tillers and ripen prematurely. A shiny, black discoloration of the lower stem and crown may be evident if the lowest leaf sheath is scraped off with a knife or fingernail.

Take-all of wheat is caused by the fungus *Gaeumannomyces graminis* var. *tritici* This fungus survives in infected host plants (wheat, barley, rye and weed grasses such as smooth bromegrass, quackgrass and bentgrass) and in infested host debris. Infection occurs when the fungus penetrates the young roots of a living host plant. Infection can occur throughout the growing season but is more severe when the temperature is between 54 and 64 degrees F. Because the take-all fungus is more active in wet soils, the disease is typically most severe in wet areas or years or in irrigated fields. Root infections in the fall and early spring are most likely to progress to the crown and foot of the plant. Hot, dry weather after heading increases the water stress on plants infected with take-all and may lead to the sudden development of white heads on plants that were actually infected earlier in the season or the previous fall.

Take-all is favored by continuous cropping of wheat. It is also more severe in lighter, alkaline, infertile and poorly drained soils. Plant nutrients offer increased resistance to take-all and a greater capacity to tolerate infections by producing more roots. It is important to maintain good levels of available nitrogen, phosphorus and potassium. Soil pH also affects the development of this disease. Disease damage is usually worse as soil pH approaches 7.0.

Management options for take-all

- Plant good-quality seed of adapted, disease-resistant varieties.
- Plant in well-drained sites under good seedbed conditions.
- Rotate with non-host crops for one to three years.
- Control weed grass hosts and volunteer wheat.
- Use seed treatment fungicides. See the preceding table of seed treatment fungicides labeled for use on winter wheat.
- Maintain good plant vigor with adequate fertility.

Head diseases of winter wheat

Diseases such as smuts, bunts and scab affect primarily the head of the wheat plant. Smut and bunt diseases such as stinking smut or loose smut tend to replace the normal kernels in the head with galls that contain masses of powdery black spores. The scab fungus can colonize heads, producing kernels that are shrunken, shriveled and discolored.

Loose smut is obvious as heads emerge from the boot. All portions of the head except the rachis are converted to masses of dusty black spores. The fungus that causes loose smut, *Ustilago tritici*, survives within the embryo of wheat

seeds; therefore planting disease-free seed and using systemic fungicide seed treatments are important management tools. Stinking smut (also called covered smut or common bunt) is not as obvious as loose smut. The kernels are replaced with smut galls, but the pericarp covering the smut gall remains intact masking the smut gall. At harvest the pericarps are broken releasing clouds of dark spores. Grain contaminated with stinking smut has a strong fishy odor and a darkened appearance. The fungus that causes stinking smut can survive on wheat seed and in the soil. Disease development is favored by cool, wet conditions.

Management options for smut and bunt diseases

- Plant disease-free seed.
- Use a systemic fungicide seed treatment. See the preceding table of seed treatment fungicides labeled for use on winter wheat.

Scab or Fusarium head blight of wheat is characterized by premature bleaching of a portion of the head or the entire head. Superficial mold growth, usually pink or orange in color, may be evident at the base of the diseased spikelets. Bleached spikelets are usually sterile or contain shriveled or discolored seed.

Scab is caused by the fungus *Fusarium graminearum*. This fungus overwinters on host residues such as wheat stubble, corn stalks and grass residues. Wind currents carry spores to wheat heads from the residues on which they have survived. If environmental conditions are favorable, i.e., warm and moist, the spores germinate and invade flower parts, glumes and other portions of the spike. Scab infection occurs when the wheat crop is in the flowering to early grain fill stages. Infection is dependent on environmental conditions while wheat is in susceptible stages of growth. Moderate temperatures in the range of 77 to 86 degrees F, frequent rain, overcast days, high humidity and prolonged dews favor infection and development of the scab fungus.

An additional concern with wheat scab is the possibility of mycotoxin production in the infected grain. Mycotoxins are naturally produced chemicals that in small amounts may be deleterious to animal or human health. The fungus that causes wheat scab may produce several different mycotoxins, including vomitoxin (deoxynivalenol or DON) and zearalenone. This is a primary concern where grain is fed to nonruminant animals. Ruminants are fairly tolerant of these two mycotoxins. Swine and poultry may refuse to eat grain containing high levels of these mycotoxins. In cases where mycotoxin problems are suspected, a sample should be submitted to a qualified laboratory for mycotoxin analysis.

Selecting varieties with tolerance or resistance to scab and planting disease-free seed are important management options to reduce the potential for scab or Fusarium head blight. Since corn is a host of *Fusarium graminearum*, planting wheat into corn residue can increase the risk of scab developing in the wheat crop. Rotating to a crop other than corn or small grains or managing corn residues should reduce this risk. Recently several of the wheat foliar fungicides have had label expansions to include the suppression of Fusarium head blight or scab. Typically these fungicides are applied at the beginning of flowering (Feekes growth stage 10.51) on main stem heads or Feekes growth stage 10.51. It is important to understand that the labels state suppression, not control, of scab or Fusarium head blight. There are also several fungicide labels that specifically state that those products are not effective against scab or Fusarium head blight.

Management options for wheat scab

- Plant adapted varieties with tolerance to scab.
- Rotate to nonhost crops (corn is also a host, so rotation should be to crops other than small grains or corn).
- Manage residues.
- Plant disease-free seed. (If planting seed from a field that had scab, clean seed thoroughly before planting, have a germination test done on the lot, and use a fungicide seed treatment to minimize seedling blight problems caused by seedborne *Fusarium*).
- If conditions are favorable for the development of scab, consider applying one of the foliar fungicides that may aid in the suppression of this disease. See preceding table of foliar fungicides labeled for use on winter wheat.

Fungicide efficacy for control of wheat diseases

The North Central Regional Committee on Management of Small Grain Diseases (NCERA-184) has developed the following information on fungicide efficacy for control of certain foliar diseases of wheat for use by the grain production industry in the United States. Efficacy ratings for each fungicide listed in the table were determined by field testing the materials over multiple years and locations by the members of the committee. Efficacy is based on proper application timing to achieve optimum effectiveness of the fungicide as determined by labeled instructions and overall level of disease in the field at the time of application. Differences in efficacy among fungicide products were determined by direct comparisons among products in field tests and are based on a single application of the labeled rate as listed in the table. Table includes most widely marketed products, and is not intended to be a list of all labeled products.

Fungicide Efficacy for Control of Wheat Diseases (Revised 4-17-12)

Efficacy of fungicides for wheat disease control based on appropriate application timing

Fungicide(s)				Powdery mildew	Stagonospora leaf/glume blotch	Septoria leaf blotch	Tan spot	Stripe rust	Leaf rust	Stem rust	Head scab	Harvest restriction
Class	Active ingredient	Product	Rate/A (fl. oz)									
Strobilurin	Fluoxastrobin 40.3%	Evito 480 SC	2.0 – 4.0	G	--[3]	--[3]	VG	--[3]	VG	--[3]	NL	40 days
	Pyraclostrobin 23.6%	Headline SC	6.0 - 9.0	G	VG	VG	E	E[2]	E	G	NL	Feekes 10.5
Triazole	Metconazole 8.6%	Caramba 0.75 SL	10.0 - 17.0	VG	VG	--[3]	VG	E	E	E	G	30 days
	Propiconazole 41.8%	Tilt 3.6 EC[4]	4.0	VG	VG	VG	VG	VG	VG	VG	P	Feekes 10.5
	Prothioconazole 41%	Proline 480 SC	5.0 - 5.7	--[3]	VG	VG	VG	--[3]	VG	VG	G	30 days
	Tebuconazole 38.7%	Folicur 3.6 F[4]	4.0	G	VG	VG	VG	E	E	E	F	30 days
	Prothioconazole19% Tebuconazole 19%	Prosaro 421 SC	6.5 - 8.2	G	VG	VG	VG	E	E	E	G	30 days
Mixed mode of action	Metconazole 7.4% Pyraclostrobin 12%	TwinLine 1.75 EC	7.0 – 9.0	G	VG	VG	E	E	E	VG	NL	Feekes 10.5 and 30 days
	Propiconazole 11.7% Azoxystrobin 7.0%	Quilt 200 SC	14.0	VG	VG	VG	VG	E	E	VG	NL	Feekes 10.5
	Propiconazole 11.7% Azoxystrobin 13.5%	Quilt Xcel 2.2 SE	10.5 - 14.0	VG	VG	VG	VG	E	E	VG	NL	Feekes 10.5
	Propiconazole 11.4% Trifloxystrobin 11.4%	Stratego 250 EC	10.0	G	VG	VG	VG	VG	VG	VG	NL	35 days
	Prothioconazole 10.8% Trifloxystrobin 32.3%	Stratego YLD	4.0	G	VG	VG	VG	VG	E	VG	NL	35 days
	Tebuconazole 22.6% Trifloxystrobin 22.6%	Absolute 500 SC	5.0	G	VG	VG	VG	VG	E	VG	NL	35 days

Notes:

[1] Efficacy categories: NL=Not Labeled and Not Recommended; P=Poor; F=Fair; G=Good; VG=Very Good; E=Excellent.

[2] Efficacy may be significantly reduced if solo strobilurin products are applied after stripe rust infection has occurred

[3] Insufficient data to make statement about efficacy of this product

[4] Multiple generic products containing the active ingredients propiconazole and tebuconazole may also be labeled in some states. Products including tebuconazole incude: Embrace, Monsoon, Muscle 3.6 F, Onset, Orius 3.6 F, Tebucon 3.6 F, Tebustar 3.6 F, Tebuzol 3.6 F, Tegrol and Toledo. Products containing propiconazole include: Bumper 41.8 EC, Fitness, Propiconazole E-AG, and PropiMax 3.6 EC.

This information is provided only as a guide. It is the responsibility of the pesticide applicator by law to read and follow all current label directions. No endorsement is intended for products listed, nor is criticism meant for products not listed. Members or participants in the NCERA-184 committee assume no liability resulting from the use of these products.

Insect management for field corn

Insect pests can cause substantial damage to field corn throughout the growing season, but especially during early stages of plant growth. Insect problems are best managed through the use of integrated pest management (IPM) programs where all viable control strategies are considered and appropriate strategies are selected for use against specific insect pests. Control strategies used in an IPM program may include chemical, cultural, mechanical, biological and genetic options. It is essential that proper identification of target insects and knowledge about pest biologies be considered when making management decisions.

In recent years additions to available management strategies for insect control in field corn include the introductions of (1) commercially applied seed treatments, (2) transgenic insect-resistant corn hybrids, (3) nontraditional types of insecticides, and (4) formulations that contain two or more complementary insecticides.

Several different commercially applied seed treatments are labeled for field corn and are included within the recommendations list for each insect. Benefits derived from seed treatments include general control or suppression of several seedling corn pests, easy handling and reduced pesticide exposure to users.

Transgenic insect-resistant corn hybrids continue to be introduced for control of insects that consistently cause excessive economic losses and are often difficult to control with traditional management strategies. See Table 1 for a list of registered transgenic products and their traits currently labeled for field corn. Be sure to follow specific Bt corn refuge requirements and resistance management protocols for transgenic corn hybrids. Following these requirements and protocols is essential to prevent the development of insect resistance for these control strategies.

Scouting and proper insect identification are still important components in any insect pest management program. Although seed treatments and Bt transgenic hybrids are effective at controlling many insect pests of field corn, there are other insects they only suppress or do not target. To protect against economic loss from insects not controlled by these management strategies, producers are encouraged to scout crop fields often throughout the growing season. Monitoring and proper pest identification are essential activities of all integrated pest management programs.

Corn, Table 1. Transgenic corn hybrids and Bt traits - 2013

Product trade name	Bt protein	Insects controlled (**boldface**) *or suppressed (italics)*		Refuge (%)	Refuge location	Herbicide tolerance
		Above ground: lepidopterous moths and caterpillars	Below ground: beetles			
Agrisure CB/LL	Cry1Ab	**ECB, SWCB,** *CEW, FAW, SB*		20%	1/2 mile	LL
Agrisure GT/CB/LL	Cry1Ab	**ECB, SWCB, BCW,** *CEW, FAW, SB*		20%	1/2 Mile	GT, LL
Agrisure RW	mCry3A		**CRW**	20%	adjacent	
Agrisure GT/RW	mCry3A		**CRW**	20%	adjacent	GT
Agrisure CB/LL/RW	Cry1Ab mCry3A	**ECB, SWCB,** *CEW, FAW, SB*	**CRW**	20%	adjacent	LL
Agrisure 3000GT	Cry1Ab mCry3A	**ECB, SWCB,** *CEW, FAW, SB*	**CRW**	20%	adjacent	GT, LL
Agrisure Viptera 3110	Cry1Ab Vip3A	**ECB, SWCB, BCW,** **CEW, FAW, SB, WBC**		20%	1/2 mile	GT, LL
Agrisure Viptera 3111	Cry1Ab mCry3A Vip3A	**ECB, SWCB, BCW,** **CEW, FAW, SB, WBC**	**CRW**	20%	adjacent	GT, LL
Agrisure Viptera 3122 Refuge Renew	Cry1Ab Cry1F mCry3A Cry34/35Ab1	**ECB, SWCB, BCW,** **FAW, WBC,** *CEW, SB*	**CRW**	5% in bag		GT
Agrisure Viptera 3220	Cry1Ab Cry1F Vip3A	**ECB, SWCB, BCW,** **FAW, WBC, SB**	**CRW**	5% in bag		GT
Agrisure Artesian 4011	Cry1Ab mCry3A	**ECB, SWCB,** *CEW, FAW, SB*	**CRW**	20%	adjacent	GT, LL
Herculex I (H1X)	Cry1F	**ECB, SWCB, BCW,** **FAW, WBC** *CEW, SB*		20%	1/2 mile	LL RR2 (some)
Herculex RW (HXRW)	Cry34/35Ab1		**CRW**	20%	adjacent	LL RR2 (some)
Herculex Extra (HXX)	Cry1F Cry34/35Ab1	**ECB, SWCB, BCW,** **FAW, WBC** *CEW, SB*	**CRW**	20%	adjacent	LL RR2 (some)

Abbreviations: ***Insects:*** ECB = European corn borer; SWCB = southwestern corn borer; BCW = black cutworm; CEW = corn earworm; FAW = fall armyworm; SB = stalk borer; WBC = western bean cutworm. ***Herbicide traits:*** GT = glyphosate tolerant; LL = Liberty Link / glufosinate tolerant; RR2 = Roundup Ready / glyphosate tolerant. Be sure to follow specific refuge restrictions that apply to these transgenic hybrids.

Table 1 was developed using information derived from specific pesticide labels, the 2013 "Master list of Bt traits with target pests and refuge requirements for Midwest corn" by Dr. Chris DiFonzo, Michigan State University, and Dr. Eileen Cullen, University of Wisconsin - Madison, and personal communications with Dr. Bruce Hibbard (USDA-ARS Corn Insects Project, Columbia, Mo.).

Product trade name	Bt protein	Insects controlled (boldface) *or suppressed (italics)* — Above ground: lepidopterous moths and caterpillars	Below ground: beetles	Refuge (%)	Refuge location	Herbicide tolerance
Optimum AcreMax	Cry1F Cry1Ab	**ECB, SWCB, BCW, FAW, WBC** *CEW, SB*		5% in bag		RR2
Optimum AcreMax 1 (AM1)	Cry1F Cry34/35Ab1	**ECB, SWCB, BCW, FAW, WBC** *CEW, SB*	**CRW**	10% in bag (CRW)		LL, RR2
Optimum AcreMax RW	Cry34/35Ab1		**CRW**	10% in bag		RR2
Optimum AcreMax Xtra	Cry1F Cry1Ab Cry34/35Ab1	**ECB, SWCB, BCW, FAW, WBC** *CEW, SB*	**CRW**	10% in bag		RR2
Optimum AcreMax Xtreme	Cry1F Cry1Ab mCRY3A Cry34/35Ab1	**ECB, SWCB, BCW, FAW, WBC** *CEW, SB*	**CRW**	5% in bag		RR2
Optimum Intrasect	Cry1F Cry1Ab	**ECB, SWCB, BCW, FAW, WBC** *CEW, SB*		5%	1/2 mile	LL, RR2
Optimum Intrasect Xtra	Cry1F Cry1Ab Cry34/35Ab1	**ECB, SWCB, BCW, FAW, WBC** *CEW, SB*	**CRW**	20%	adjacent	LL, RR2
Optimum Intersect Xtreme	Cry1F Cry1Ab mCry3A Cry34/35Ab1	**ECB, SWCB, BCW, FAW, WBC** *CEW, SB*	**CRW**	5%	adjacent	LL, RR2
Optimum Trisect	Cry1F mCry3A	**ECB, SWCB, BCW, FAW, WBC** *CEW, SB*	**CRW**	20%	adjacent	LL, RR2
YGCB	Cry1Ab	**ECB, SWCB,** *CEW, FAW, SB*		20%	1/2 mile	RR2 (some)
YGRW	Cry3Bb1		**CRW**	20%	adjacent	RR2 (some)
YieldGard Plus	Cry1Ab Cry3Bb1	**ECB, SWCB,** *CEW, FAW, SB*	**CRW**	20%	adjacent	RR2 (some)
YieldGard VTRW	Cry3Bb1		**CRW**	20%	adjacent	RR2
YieldGard VT Triple	Cry1Ab Cry3Bb1	**ECB, SWCB,** *CEW, FAW, SB*	**CRW**	20%	adjacent	RR2
Genuity VT Double Pro (VT2P)	Cry1A.105 Cry2Ab2	**ECB, SWCB, CEW, FAW**		5%	1/2 mile	RR2
Genuity VT Triple Pro VT2P	Cry1A.105 Cry2Ab2 Cry3Bb1	**ECB, SWCB, CEW, FAW**	**CRW**	20%	adjacent	RR2
SmartStax (DOW) or Genuity SmartStax (Monsanto)	Cry1A.105 Cry2Ab2 Cry1F Cry3Bb1 Cry34/35Ab1	**ECB, SWCB, BCW, FAW, WBC** *SB*	**CRW**	5%	adjacent	LL, RR2
Genuity SmartStax RIB Complete (Monsanto)	Cry1A.105 Cry2Ab2 Cry1F Cry3Bb1 Cry34/35Ab1	**ECB, SWCB, BCW, FAW, WBC** *SB*	**CRW**	5% in bag		LL, RR2
Genuity VT Double Pro Complete	Cry1A.105 Cry2Ab2	**ECB, SWCB, CEW, FAW**		5% in bag		RR2
REFUGE ADVANCED powered by SmartStax (Dow)	Cry1A.105 Cry2Ab2 Cry1F Cry3Bb1 Cry34/35Ab1	**ECB, SWCB, BCW, FAW, WBC** *SB*	**CRW**	5% in bag		LL, RR2

Comments: Management of several insect pests of corn may be accomplished by using corn hybrids that have been genetically engineered to produce *Bacillus thuringiensis* (Bt) and certain insect toxins. Bt hybrid events and their toxins target specific insect pests. Be sure to match these hybrids to pests requiring control. Follow all refuge requirements associatied with these Bt hybids.

Abbreviations: ***Insects:*** ECB = European corn borer; SWCB = southwestern corn borer; BCW = black cutworm; CEW = corn earworm; FAW = fall armyworm; SB = stalk borer; WBC = western bean cutworm. ***Herbicide traits:*** GT = glyphosate tolerant; LL = Liberty Link / glufosinate tolerant; RR2 = Roundup Ready / glyphosate tolerant. Be sure to follow specific refuge restrictions that apply to these transgenic hybrids.

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Insecticides for field corn

Insect	Insecticides: Common name	Insecticides: Trade name	Amount of product per acre	Placement	REI (hours)	Preharvest interval (days)
Armyworm, "True" Mythimnaunipuncta, formerly *Pseudaletia unipuncta* (Haworth) **Comments:** Treat seedling corn when 25% or more of plants are being damaged and one or more 0.75 inch long or shorter larvae are present per damaged plant. On more mature corn, control is justified after pollen shed if leaves above the ear zone are being consumed by larvae. Optimal control by Tracer is best achieved when the insecticide is applied at peak egg hatch or when larvae are small.	permethrin	*Ambush 25 WP	6.4 to 12.8 fl oz	foliage	12	30 (grain or stover), 0 (forage)
	permethrin	*Ambush Insecticide (2EC)	6.4 to 12.8 fl oz	foliage	12	30 (grain or stover), 0 (forage)
	permethrin	*multiple products	see specific label	foliage	12	see specific label
	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	foliage	12	21 (grain)
	cyfluthrin	*Baythroid XL (1st & 2nd instars only)	1.6 to 2.8 fl oz	foliage	12	21 (grain or fodder) 0 (green forage)
	flubendiamide	*Belt SC	2.0 to 3.0 fl oz	foliage	12	1 (green forage and silage) 28 (grain or stover)
	lambda-cyhalothrin + chlorantraniliprole	*Besiege	6.0 to 9.0 fl oz	foliage	24	21(grain or fodder)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	30 (grain, fodder, graze)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	11 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	gamma-cyhalothrin	*Declare	1.02 to 1.54 fl oz	foliage	24	21(harvest)
	deltamethrin	*Delta Gold 1.5EC	1.5 to 1.9 fl oz	foliage	12	21 (grain, fodder) 12 (cut forage or graze)
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	foliage	12	30 (grain, stover, graze) 60 (forage)
	methoxyfenozide	Intrepid 2F	4.0 to 8.0 fl oz	foliage	4	21 (grain)
	methomyl	*Lannate SP	1/4 to 1/2 lb	foliage	48	0 (ears), 3 (forage), 21 (fodder)
	methomyl	*Lannate LV	3/4 to 1 1/2 pt	foliage	48	0 (ears), 3 (forage), 21 (fodder)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	21 (grain, ears ,forage, fodder)
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	foliage	24	21 (grain, ears, forage, fodder)
	zeta-cypermethrin	*Mustang Maxx	3.2 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	zeta-cypermethrin	*Mustang Max	3.2 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	chlorpyrifos	*Nufos 4E	1 to 2 pt	foliage	24	21 (grain or ears)
	microencapsulated methyl parathion	*Penncap-M	2 to 3 pt	foliage	48	12 (grain, forage, graze)
	permethrin	*Pounce 3.2EC	4 to 6 fl oz/A	foliage	12	30 (grain or stover), 0 (forage)
	carbaryl	Sevin 4F	2 to 4 pt	foliage	12	48 (grain or fodder) 14 (harvest or graze forage)
	carbaryl	Seven XLR Plus	2 to 4 pt	foliage	12	48 (grain or fodder) 14 (harvest or graze forage)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	30 (grain, stover) 60 (forage)
	cyfluthrin	*Tombstone Helios	1.6 to 2.8 fl oz	foliage	12	21 (grain or fodder), 0 (forage)
	spinosad	Tracer 4SC	1.0 to 3.0 fl oz	foliage	1	28 (grain), 3 (fodder or forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.5 to 10.3 fl oz	foliage	12	30(grain) 60(forage)
	lambda-cyhalothrin	*Warrior II	1.28 to 1.92 fl oz	foliage	24	21 (grain), 1 (graze, forage) 21 (treated feed or fodder)

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Insecticides for field corn - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Amount of product per acre	Placement	REI (hours)	Preharvest interval (days)
Billbugs *Sphenophorus maidis* (Chittenden) Primarily maize billbug plus claycolored and southern corn billbug species damage corn in Missouri. **Comments:** No specific thresholds are available, but a general rule is that the economic threshold is reached when 5% or more of plants are damaged in an acceptable stand and billbugs are present in the field. Insecticide sprays are most effective if applied at rate of 20 to 40 gallons per acre of formulated material directed over the row on corn less than 6-inches tall or directed at plants for taller corn seedlings. Billbug infestations generally associated with bottomland fields supporting infestations of yellow nutsedge. Use of Accent or Beacon herbicides following Counter 15G applications may cause severe crop damage.	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	32 to 42 fl oz (see label)	foliage	24	21 (grain) 14 (graze or silage harvest)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	38 to 42 fl oz	spray base of plants	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos	*Lorsban Advanced	2 pt	spray at base of plants	24	21 (grain,ears,forage,fodder)
	chlorpyrifos	*Lorsban	2 pt	spray at base of plants	24	21 (grain,ears,forage,fodder)
	chlorpyrifos	*Nufos 4E	2 pt	spray at base of plants	24	21 (grain or ears)
	Preplant, at-plant, preemergence applications					
	chlorpyrifos	*Lorsban 15G	8 to 16 oz/1000 ft row	broadcast or 7-inch band over row	24	
	tefluthrin	*Force CS	0.46 to 0.57 (pest suppression)	T-band, In-furrow. See specific label.	12	
	tefluthrin	*Force 3G	5 oz/1000 ft row (pest suppression)	7-inch T-band over row. See specific label.	0	
	terbufos	*Counter 15G	8 oz/1000 ft row	7-inch band or in-furrow. See specific label.	48	
	Seed treatments					
	thiamethoxam	Avicta Complete-Corn	1.250 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser 5FS (250)	0.250 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser Extreme 250	0.250 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser Extreme 1250	1.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 250	0.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 500	0.500 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 600 (250)	0.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 600 (1250)	1.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 1250	1.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho/Votivo	0.500 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 1250/ Votivo	1.250 mg ai/kernel	commercial on seed		

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Insecticides for field corn - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Amount of product per acre	Placement	REI (hours)	Preharvest interval (days)
Black cutworm *Agrotis ipsilon* (Hufnagel) and other cutworms species **Comments:** Apply as postemergent rescue treatment when 1–2% or more of plants are cut below ground or 2–3% or more of plants have been cut above ground and larvae are present. Corn planted late into fields supporting winter annual weeds such as henbit and chickweed is at greatest risk.	permethrin	*Ambush 25WP	6.4 to 12.8 fl oz	foliage	12	30 (grain or stover), 0 (forage)
	permethrin	*Ambush Insecticide (2EC)	6.4 to 12.8 fl oz	foliage	12	30 (grain or stover), 0 (forage)
	permethrin	*multiple products	see specific labels	foliage	12	see specific label
	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	foliage	12	21 (grain)
	cyfluthrin	*Baythroid XL	0.8 to 1.6 fl oz	foliage	12	21 (grain or fodder) 0 (green forage)
	flubendiamide	*Belt SC	2.0 to 3.0 fl oz	foliage	12	1 (green forage and silage) 28 (grain or stover)
	lambda-cyhalothrin + chlorantraniliprole	*Besiege	5.0 to 9.0 fl oz	foliage	24	21(grain or fodder)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	30 (grain, fodder, graze)
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	11 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest) 12 (cut forage or graze)
	gamma-cyhalothrin bifenthrin	*Declare	0.77 to 1.28 fl oz	foliage	24	21(harvest) 60 (forage)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	21 (grain, ears, forage, fodder)
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	foliage	24	21 (grain,ears,forage,fodder)
	zeta-cypermethrin	*Mustang Maxx	1.28 to 2.8 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	zeta-cypermethrin	*Mustang Max	1.28 to 2.8 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	chlorpyrifos	*Nufos 4E	1 to 2 pt	foliage	24	21 (grain or ears)
	microencapsulated methyl parathion	*Penncap-M	4 pt	foliage	48	12 (grain, forage, graze)
	permethrin	*Pounce 3.2EC	4 to 6 fl oz/A	foliage	12	30 (grain or stover), 0 (forage)
	carbaryl	Sevin 4F	4 pt	foliage	12	48 (grain or fodder) 14 (harvest or graze forage)
	carbaryl	Seven XLR Plus	4 pt	foliage	12	48 (grain or fodder) 14 (harvest or graze forage)
	chlorpyrifos + bifenthrin	*Stallion	3.75 to 11.75 fl oz	foliage	24	30 (grain, stover) 60 (forage)
	cyfluthrin	Tombstone Helios	0.8 to 1.6 fl oz	foliage	12	21 (grain or fodder), 0 (forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	3.5 to 10.3 fl oz	foliage	12	30(grain) 60(forage)
	lambda-cyhalothrin	*Warrior II	0.96 to 1.6 fl oz	foliage	24	21 (grain), 1 (graze, forage) 21 (treated feed or fodder)
	Nonfoliar insecticide applications					
	permethrin	*Ambush Insecticide 2EC	0.5 fl oz/1000 ft row	In-furrow, T-band, see label	12	30 (grain or stover), 0 (forage)
	permethrin	*Ambush Insecticide 2EC	6.4 to 12.8 fl oz	Preplant, pre-emergence. See specific label	12	30 (grain or stover), 0 (forage)
	bifenthrin	*Brigade 2EC	0.15 to 0.30 fl oz/1000 ft row	7 inch T-band	12	30 (grain, grazing, feed)
	bifenthrin	*Brigade 2EC	2.56 fl oz	preemergence	12	30 (grain, fodder, graze)
	bifenthrin	*Brigade 2EC	3 to 4 fl oz	preplant incorporate	12	30 (grain, fodder, graze)

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Insecticides for field corn - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Amount of product per acre	Placement	REI (hours)	Preharvest interval (days)
Black cutworm - *continued*	bifenthrin	*Capture LFR	3.4 to 6.8 fl oz	At-plant broadcast, 5-7 inch. T-band or in-furrow	12	30 (grain or stover), 60 (forage) 30 (graze or feed)
	bifenthrin	*Capture LFR	4 to 5.3 fl oz 3.4 fl oz	preplant incorporate preemergence	12	30 (grain or stover), 60 (forage) 30 (graze or feed)
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	16 to 38 fl oz/A	At plant, T-band	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 38 fl oz	At-plant, T-band	24	21 (grain or ears) 14 (graze or silage harvest)
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	At plant broadcast or 5-7 inch T-band on soil surface	12	30 (grain, stover, graze) 60 (forage)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	Preplant, At-plant, post-emergence. See label.	24	21 (grain, ears, forage, fodder)
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	Preplant, At-plant, post-emergence. See label.	24	21 (grain, ears, forage, fodder)
	zeta-cypermethrin	*Mustang Maxx	0.16 fl oz/1000 ft row	At-plant, T-band	12	30 (grain, stover) 60 (forage)
	zeta-cypermethrin	*Mustang Max	0.16 fl oz/1000 ft row	At-plant, T-band	12	30 (grain, stover) 60 (forage)
	chlorpyrifos	*Nufos 4E	1 to 2 pt	Preplant, at-plant, pre-emergence	24	21 (grain or ears)
	permethrin	*Pounce 3.2EC	6 fl oz/1000 ft row	At Plant, in-furrow or t-band		
	permethrin	*Pounce 3.2EC	4 to 6 fl oz/A (30 inch row spacing)	Pre, in- furrow or t-band (30 inch row spacing)		
	chlorpyrifos + bifenthrin	*Stallion	0.68 fl oz/1000 ft row (30 inch row spacing)	Pre-emerge, PPI, In-furrow, band, t-band	24	30 (grain, stover) 60 (forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	0.64 fl oz/1000 ft row	5-7 inch T-band on open row	12	30(grain) 60(forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	6.25 fl oz/A	pre-plant incorporate	12	30(grain) 60(forage)
	Seed treatments					
	thiamethoxam	Avicta Complete-Corn	1.250 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser 5FS (250)	0.250 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser Extreme 250	0.250 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser Extreme 1250	1.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 250	0.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 500	0.500 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 600 (250)	0.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 600 (1250)	1.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 1250	1.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho/Votivo	0.500 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 1250/ Votivo	1.250 mg ai/kernel	commercial on seed		

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Insecticides for field corn - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Amount of product per acre	Placement	REI (hours)	Preharvest interval (days)
Chinch bug *Blissus leucopterus* (Say) **Comments:** Use ground equipment to treat border rows when insects begin migration from small grains or native grass stands to field corn. Risk of economic infestations is greatest in corn or sorghum (milo) planted into wheat stubble or native grass stands. Considered an occasional pest in Missouri, chinch bug adults and nymphs may move to field corn or grain sorghum (milo) fields in early summer after wheat plants dry. A majority of feeding by this pest occurs when plant juices are sucked from plant roots and lower stem tissues. Feeding damage to field corn often is expressed as wilted plants which may or may not survive, but produce reduced yields. Chinch bug infestations typically begin on plants located along field margins and move inward as pest infestations increase. Foliar sprays should be formulated in a minimum of 10 gallons of water per acre and spray be directed at the base of plants.	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	foliage	12	21 (grain)
	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage	12	21 (grain or fodder) 0 (green forage)
	lambda-cyhalothrin + chlorantraniliprole	*Besiege	9.0 fl oz	foliage	24	21(grain or fodder)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	30 (grain, fodder, graze)
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	16 to 38 fl oz	broadcast over row or base of plant (see label)	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	19 to 38 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	gamma-cyhalothrin bifenthrin	*Declare	1.54 fl oz	foliage	24	21(harvest) 60 (forage)
	deltamethrin	*Delta Gold 1.5EC	1.5 to 1.9 fl oz	foliage	12	21 (grain, fodder) 12 (cut forage or graze)
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	foliage	12	30 (grain, stover, graze) 60 (forage)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	21 (grain,ears,forage,fodder)
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	foliage	24	21 (grain,ears,forage,fodder)
	zeta-cypermethrin	*Mustang Maxx	3.2 to 4.0 fl oz	spray larvae when migrating broadcast on foliage	12	30 (grain, stover) 60 (forage)
	zeta-cypermethrin	*Mustang Max	3.2 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	chlorpyrifos	*Nufos 4E	1 to 2 pt	foliage	24	21 (grain or ears)
	carbaryl	Sevin 4F	2 to 4 pt	foliage	12	48 (grain or fodder) 14 (harvest or graze forage)
	carbaryl	Seven XLR Plus	2 to 4 pt	broadcast toward stalk	12	48 (grain or fodder) 14 (harvest or graze forage)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	spray larvae when migrating broadcast on foliage	24	30 (grain, stover) 60 (forage)
	cyfluthrin	*Tombstone Helios	1.6 to 2.8 fl oz	foliage	12	21 (grain or fodder), 0 (forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.5 to 10.3 fl oz	foliage	12	30(grain) 60(forage)
	lambda-cyhalothrin	*Warrior II	1.92 fl oz	foliage	24	21 (grain), 1 (graze, forage) 21 (treated feed or fodder)
	Seed treatments					
	thiamethoxam	Avicta Complete-Corn	1.250 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser 5FS (250)	0.250 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser Extreme 250	0.250 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser Extreme 1250	1.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 250	0.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 500	0.500 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 600 (250)	0.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 600 (1250)	1.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 1250	1.250 mg ai/kernel	commercial on seed		

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Insecticides for field corn - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Amount of product per acre	Placement	REI (hours)	Preharvest interval (days)
Chinch bug - *continued*	clothianidin	Poncho/Votivo	0.500 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 1250/ Votivo	1.250 mg ai/kernel	commercial on seed		
Corn earworm *Helicoverpa (=Heliothis) zea* (Boddie) **Comments:** Timing of insecticide applications are critical if optimal control of larvae is to be achieved before larvae enter ear tips. Best results are achieved when sprays are directed toward ear zone. Optimal control from Success or Tracer is best achieved when the insecticide is applied at peak egg hatch or when larvae are small.	permethrin	*Ambush 25WP	6.4 to 12.8 fl oz	foliage	12	30 (grain or stover), 0 (forage)
	permethrin	*Ambush Insecticide (2EC)	6.4 to 12.8 fl oz	foliage	12	30 (grain or stover), 0 (forage)
	permethrin	*multiple products	see specific label	foliage	12	see specific label
	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	foliage	12	21 (grain)
	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage	12	21 (grain or fodder) 0 (green forage)
	flubendiamide	*Belt SC	2.0 to 3.0 fl oz	foliage	12	1 (green forage and silage) 28 (grain or stover)
	lambda-cyhalothrin + chlorantraniliprole	*Besiege	5.0 to 9.0 fl oz	on foliage prior to larvae boring into plant stalk or ear	24	21(grain or fodder)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	30 (grain, fodder, graze)
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	16 to 38 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	19 to 38 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	gamma-cyhalothrin bifenthrin	*Declare	0.77 to 1.28 fl oz	foliage	24	21(harvest) 60 (forage)
	deltamethrin	*Delta Gold 1.5EC	1.5 to 1.9 fl oz	foliage	12	21 (grain, fodder) 12 (cut forage or graze)
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz		12	30 (grain, stover, graze) 60 (forage)
	methomyl	*Lannate SP	1/4 to 1/2 lb	foliage (ovicide/ larvacide)	48	0 (ears), 3 (forage), 21 (fodder)
	methomyl	*Lannate LV	3/4 to 1.5 pt	foliage (ovicide/ larvacide)	48	0 (ears), 3 (forage), 21 (fodder)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	21 (grain,ears,forage,fodder)
	chlorpyrifos	*Lorsban 4E	1.5 to 2 pt	foliage	24	21 (grain,ears,forage,fodder)
	zeta-cypermethrin	*Mustang Maxx	1.76 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	zeta-cypermethrin	*Mustang Max	1.76 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	chlorpyrifos	*Nufos 4E	1.5 to 2 pt	foliage	24	21 (grain or ears)
	permethrin	*Pounce 3.2EC	4 to 6 fl oz/A	foliage	12	30 (grain or stover), 0 (forage)
	carbaryl	Sevin 4F	2 to 4 pt	foliage	12	48 (grain or fodder) 14 (harvest or graze forage)
	carbaryl	Seven XLR Plus	2 to 4 pt	foliage	12	48 (grain or fodder) 14 (harvest or graze forage)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	on foliage prior to larvae boring into plant stalk or ear	24	30 (grain, stover) 60 (forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.5 to 10.3 fl oz	foliage	12	30(grain, graze) 60(forage)
	cyfluthrin	*Tombstone Helios	1.6 to 2.8 fl oz	foliage	12	21 (grain or fodder), 0 (forage)
	spinosad	Tracer 4SC	2.0 to 3.0 fl oz	foliage	1	28 (grain), 3 (fodder or forage)
	lambda-cyhalothrin	*Warrior II	0.96 to 1.6 fl oz	foliage	24	21 (grain), 1 (graze, forage) 21 (treated feed or fodder)

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Insecticides for field corn - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Amount of product per acre	Placement	REI (hours)	Preharvest interval (days)
Corn earworm - *continued*	**Seed treatments**					
	thiamethoxam	Avicta Complete-Corn	1.25 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser Extreme 1250	1.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 1250	1.250 mg ai/kernel	commercial on seed		
Corn leaf aphids *Rhopalosiphum maidis* (Fitch) **Comments:** This pest rarely requires treatment unless severe drought conditions persist. Under drought stress, apply insecticide during late whorl to early tassel when 50% or more of plants support 50 to 400 aphids per plant. If crop is not under drought stress, aphids in excess of 400 per plant are required for treatment to be justified. Do not apply dimethoate during corn pollen-shed.	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	foliage	12	21 (grain)
	lambda-cyhalothrin + chlorantraniliprole	*Besiege	6 to 9 fl oz	foliage	24	21(grain or fodder)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	30 (grain, fodder, graze)
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	11 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	deltamethrin	*Delta Gold 1.5EC	1.5 to 1.9 fl oz (suppression only)	foliage	12	21 (grain, fodder) 12 (cut forage or graze)
	dimethoate	Dimethoate 4E	2/3 - 1 pt	foliage	48	28 (grain) 14 (forage)
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	foliage	12	30 (grain, stover, graze) 60 (forage)
	methomyl	*Lannate SP	1/4 to 1/2 lb	foliage	48	0 (ears), 3 (forage), 21 (fodder)
	methomyl	*Lannate LV	3/4 to 1.5 pt	foliage	48	0 (ears), 3 (forage), 21 (fodder)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	21 (grain,ears,forage,fodder)
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	foliage	24	21 (grain,ears,forage,fodder)
	zeta-cypermethrin	*Mustang Maxx	1.76 to 4.0 fl oz control variable by species	foliage	12	30 (grain, stover) 60 (forage)
	zeta-cypermethrin	*Mustang Max	2.72 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	chlorpyrifos	*Nufos 4E	1 to 2 pt	foliage	24	21 (grain or ears)
	microencapsulated methyl parathion	*Penncap-M	2 to 3 pt	foliage	48	12 (grain, forage, graze)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz control variable by species	foliage	24	30 (grain, stover) 60 (forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.5 to 10.3 fl oz	foliage	12	30(grain, graze) 60(forage)
	lambda-cyhalothrin	*Warrior II	1.28 to 1.92 fl oz (suppresion only)	foliage	24	21 (grain), 1 (graze, forage) 21 (treated feed or fodder)
Corn rootworm adults - Western corn rootworm *Diabrotica virgifera virgifera* and **Northern corn rootworm** *Diabrotica barberi* **Comments:** Beetles may reduce pollination by early silk clipping. Treatment is justified if pollination is not complete, silks are being clipped, and there are five or more beetles present per plant.	permethrin	*Ambush 25WP	6.4 to 12.8 fl oz	foliage	12	30 (grain or stover), 0 (forage)
	permethrin	*Ambush Insecticide (2EC)	6.4 to 12.8 fl oz	foliage	12	30 (grain or stover), 0 (forage)
	permethrin	*multiple products	see specific label	foliage	12	see specific label
	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	foliage	12	21 (grain)
	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage	12	21 (grain or fodder) 0 (green forage)
	lambda-cyhalothrin + chlorantraniliprole	*Besiege	6 to 9 fl oz	foliage	24	21(grain or fodder)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	30 (grain, fodder, graze)
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	11 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	gamma-cyhalothrin	*Declare	1.02 to 1.54 fl oz	foliage	24	21(harvest)
	deltamethrin	*Delta Gold 1.5EC	1.5 to 1.9 fl oz	foliage	12	21 (grain, fodder) 12 (cut forage or graze)

Note: See Table 1 for listing of (Bt) trangenic traits.
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Insecticides for field corn - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Amount of product per acre	Placement	REI (hours)	Preharvest interval (days)
Corn rootworm adults - *continued*	dimethoate	Dimethoate 4E	2/3 - 1 pt	foliage	48	28 (grain) 14 (forage)
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	foliage	12	30 (grain, stover, graze) 60 (forage)
	methomyl	*Lannate SP	1/4 to 1/2 lb	foliage	48	0 (ears), 3 (forage), 21 (fodder)
	methomyl	*Lannate LV	3/4 to 1.5 pt	foliage	48	0 (ears), 3 (forage), 21 (fodder)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	21 (grain, ears, forage, fodder)
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	foliage	24	21 (grain,ears,forage,fodder)
	zeta-cypermethrin	*Mustang Maxx	2.72 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	zeta-cypermethrin	*Mustang Max	2.72 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	chlorpyrifos	*Nufos 4E	1 to 2 pt	foliage	24	21 (grain or ears)
	microencapsulated methyl parathion	*Penncap-M	1 to 2 pt	foliage	48	12 (grain, forage, graze)
	permethrin	*Pounce 3.2EC	4 to 8 fl oz/A	foliage	12	30 (grain or stover), 0 (forage)
	carbaryl	Sevin 4F	2 to 4 pt	foliage	12	48 (grain or fodder) 14 (harvest or graze forage)
	carbaryl	Seven XLR Plus	2 to 4 pt	foliage	12	48 (grain or fodder) 14 (harvest or graze forage)
	chlorpyrifos + bifenthrin	*Stallion	3.75 to 11.75 fl oz	foliage	24	30 (grain, stover) 60 (forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.5 to 10.3 fl oz	foliage	12	30(grain) 60(forage)
	cyfluthrin	*Tombstone Helios	1.6 to 2.8 fl oz	foliage	12	21 (grain or fodder), 0 (forage)
	lambda-cyhalothrin	*Warrior II	1.28 to 1.92 fl oz	foliage	24	21 (grain), 1 (graze, forage) 21 (treated feed or fodder)
Corn rootworm larvae - Western corn rootworm *Diabrotica virgifera virgifera,* and **Northern corn rootworm** *Diabrotica barberi* **Comments:** Continuous corn or fields with recent corn rootworm problems most at risk.	**Nonfoliar insecticide applications**					
	cyfluthrin	*Aztec 2.1G	6.7 oz/1000 ft row	7-inch band, t-band, or in furrow	48	
	cyfluthrin	*Aztec 4.67 (Smartbox)	3 oz/1000 ft row	Band, furrow with incorporation (for smartbox use)	48	
	bifenthrin	*Brigade 2EC	0.15 to 0.30 fl oz/1000 ft row	7 inch T-band	12	
	bifenthrin	*Brigade 2EC	2.56 fl oz	preemergence	12	
	bifenthrin	*Brigade 2EC	3 to 4 fl oz	preplant incorporate	12	
	bifenthrin	*Capture LFR	3.4 to 6.8 fl oz	At-plant broadcast, 5-7 inch T-band or in-furrow	12	
	bifenthrin	*Capture LFR	4 to 5.3 fl oz 3.4 fl oz	preplant incorporate preemergence	12 12	
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 38 fl oz	At-plant, band, see specific labels	24	
	terbufos	*Counter 15G (Lock'nLoad system) *Counter 15G (Smartbox)	6 to 8 oz/1000 ft row 6 to 8 oz/1000 ft row	band, furrow,	48 48	
	tefluthrin	*Force CS	0.46 to 0.57	band, furrow, see specific label	12	
	tefluthrin	*Force 3G	4 to 5 oz/1000 ft row	7-inch T-band over row, see specific label	0	

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Insecticides for field corn - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Amount of product per acre	Placement	REI (hours)	Preharvest interval (days)
Corn rootworm larvae - *continued*	tefluthrin	*Force 3g (Smartbox)	4 to 5 oz/1000 ft row	band, furrow	0	
	tefluthrin	*Force CS	0.46 to 0.57 oz/1000 ft row	Band, furrow	12	
	chlorethoxyfos	*Fortress 2.5G	7.5 to 9.0 0z/1000 ft row	band, furrow See label	48	
	chlorethoxyfos	*Fortress 5G (Smartbox)	3.0 to 4.5 oz/1000 ft row	band, furrow See label	72	
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	At-plant broadcast or 5-7 inch T-band on soil surface	12	
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	Soil broadcast at-plant or soil cultivation post-emerge	24	
	chlorpyrifos	*Lorsban 4E	2 pt	Soil broadcast at plant or soil cultivation post-emerge	24	
	chlorpyrifos	*Lorsban 15G	8 oz/1000 ft row	At-plant in-furrow or band	24	
	chlorpyfifos	*Lorsban 15G	8 oz/1000 ft row	Spray soil at base of plant at cultivation	24	
	chlorpyrifos	*Nufos 4E	1 to 2 pt	Soil broadcast at-plant or soil cultivation post-emerge	24	
	chlorpyrifos	*Nufos 15G		At-plant in-furrow or band	24	
	chlorethoxyfos + bifenthrin	Smart Choice 5G	3.0 to 3.5 oz/1000 ft row	in- furrow at planting	48	30(harvest, fooder, graze)
	Seed treatments					
	thiamethoxam	Avicta Complete-Corn	1.250 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser Extreme 1250	1.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 600 (1250)	1.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 1250	1.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 1250/ Votivo	1.250 mg ai/kernel	commercial on seed		

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Insecticides for field corn - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Amount of product per acre	Placement	REI (hours)	Preharvest interval (days)
European corn borer, 1st gen *Ostrinia nubilalis* (Hübner) **Comments:** Treat corn for first-generation ECB larvae when 50% of the plants show leaf feeding and live larvae are present. Sprays applied by ground equipment should be directed over the row to increase insecticide performance. Granular formulations applied by air generally perform better than spray formulations applied by air. Optimal control from Tracer is best achieved when the insecticide is applied at peak egg hatch. Larval control from most insecticides is best achieved before larvae burrow into plants.	permethrin	*Ambush 25WP	6.4 to 12.8 fl oz	foliage	12	30 (grain or stover), 0 (forage)
	permethrin	*Ambush Insecticide (2EC)	6.4 to 12.8 fl oz	foliage	12	30 (grain or stover), 0 (forage)
	permethrin	*multiple products	see specific label	foliage	12	see specific label
	esfenvalerate	*Asana XL	7.8 to 9.6 fl oz	foliage	12	21 (grain)
	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage (for 1st & 2nd instars only)	12	21 (grain or fodder) 0 (green forage)
	flubendiamide	*Belt SC	2.0 to 3.0 fl oz	foliage	12	1 (green forage and silage) 28 (grain or stover)
	lambda-cyhalothrin + chlorantraniliprole	*Besiege	6 to 9 fl oz	broadcast on foliage (before larvae bore into stalk)	24	21(grain or fodder)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	30 (grain, fodder, graze)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	19 to 38 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	11 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	gamma-cyhalothrin	*Declare	1.02 to 1.54 fl oz	foliage	24	21(harvest)
	deltamethrin	*Delta Gold 1.5EC	1.5 to 1.9 fl oz	foliage	12	21 (grain, fodder) 12 (cut forage or graze)
European corn borer, 2nd gen **Comments:** For second-generation ECB larvae, treat when 50% of plants have egg masses and/or larvae on the first leaf above and below the ear. Optimal control from Success or Tracer is best achieved when the insecticide is applied at peak egg hatch or when larvae are small.	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	foliage	12	30 (grain, stover, graze) 60 (forage)
	methoxyfenozide	Intrepid 2F	4.0 to 8.0 fl oz	over whorl	4	21 (grain)
	methomyl	*Lannate SP	1/4 to 1/2 lb	ears	48	0 (ears), 3 (forage), 21 (fodder)
	methomyl	*Lannate LV	3/4 to 1.5 pt	ears	48	0 (ears), 3 (forage), 21 (fodder)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	over whorls	24	21 (grain, ears ,forage, fodder)
	chlorpyrifos	*Lorsban 4E	1 1/2 to 2 pt	over whorls	24	21 (grain, ears, forage, fodder)
	chlorpyrifos	*Lorsban 15G	5 to 6.5 lb aerial application	over whorls - aerial	24	21 (grain or ears)
	zeta-cypermethrin	*Mustang Max	2.72 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	zeta-cypermethrin	*Mustang Maxx	2.72 to 4.0 fl oz	broadcst on foliage	12	30 (grain, stover) 60 (forage)
	chlorpyrifos	*Nufos 4E	1 to 2 pt	over whorls	24	21 (grain or ears)
	chlorpyrifos	*Nufos 15G	5 to 6.5 lb aerial application	over whorls - aerial	24	21 (grain or ears)
	microencapsulated methyl parathion	*Penncap-M	2 pt ground, 3 pt aerial 3 to 4 pt broadcast	over whorls over whorls & foliage	48	12 (grain, forage, graze)
	permethrin	*Pounce 3.2EC	4 to 8 fl oz/A	foliage	12	30 (grain or stover), 0 (forage)
	carbaryl	Sevin 4F	3 to 4 pt	foliage	12	48 (grain or fodder) 14 (harvest or graze forage)
	carbaryl	Seven XLR Plus	3 to 4 pt	foliage	12	48 (grain or fodder) 14 (harvest or graze forage)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	broadcast on foliage (before larvae bore into stalk)	24	30 (grain, stover) 60 (forage)
	cyfluthrin	*Tombstone Helios	1.6 to 2.8 fl oz	foliage	12	21 (grain or fodder), 0 (forage)
	spinosad	Tracer 4SC	1.0 to 3.0 fl oz	foliage, over whorls	1	28 (grain), 3 (fodder or forage)

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Insecticides for field corn - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Amount of product per acre	Placement	REI (hours)	Preharvest interval (days)
European corn borer, - *continued*	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.5 to 10.3 fl oz	foliage	12	30(grain, graze) 60(forage)
	lambda-cyhalothrin	*Warrior II	1.28 to 1.92 fl oz	foliage	24	21 (grain), 1 (graze, forage) 21 (treated feed or fodder)
	Bacillus thuringiensis					
	Bt formulations:	Agree, Biobit, Condor, Delivery, Lepinox, Javelin, Xentari, others.	see specific labels	Broadcast		
Fall armyworm *Spodoptera frugiperda* J.E. Smith **Comments:** Treat when 75% or more of plants have whorl damage and larvae are present in whorls. Ground applied sprays directed over the row are recommended for best control of this pest in whorls. Control of this pest in ear tips is difficult to achieve. Optimal control from Success or Tracer is best achieved when the insecticide is applied at peak egg hatch or when larvae are small.	permethrin	*Ambush 25WP	6.4 to 12.8 fl oz	foliage	12	30 (grain or stover), 0 (forage)
	permethrin	*Ambush Insecticide (2EC)	6.4 to 12.8 fl oz	foliage	12	30 (grain or stover), 0 (forage)
	cyfluthrin	*Baythroid XL (1st and 2nd instars only)	2.8 fl oz	foliage (for 1st & 2nd instars only)	12	21 (grain or fodder) 0 (green forage)
	flubendiamide	*Belt SC	2.0 to 3.0 fl oz	foliage	12	1 (green forage and silage) 28 (grain or stover)
	lambda-cyhalothrin + chlorantraniliprole	*Besiege	6.0 to 9.0 fl oz	foliage	24	21(grain or fodder)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	30 (grain, fodder, graze)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	11 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	gamma-cyhalothrin	*Declare	1.02 to 1.54 fl oz	foliage	24	21(harvest)
	deltamethrin	*Delta Gold 1.5EC	1.5 to 1.9 fl oz	foliage	12	21 (grain, fodder) 12 (cut forage or graze)
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	foliage	12	30 (grain, stover, graze) 60 (forage)
	methomyl	*Lannate SP	1/4 to 1/2 lb	foliage	48	0 (ears), 3 (forage), 21 (fodder)
	methomyl	*Lannate LV	3/4 to 1.5 pt	foliage	48	0 (ears), 3 (forage), 21 (fodder)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	21 (grain, ears ,forage, fodder)
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	foliage	24	21 (grain, ears, forage, fodder)
	zeta-cypermethrin	*Mustang Max	3.2 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	zeta-cypermethrin	*Mustang Maxx	3.2 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	chlorpyrifos	*Nufos 4E	1 to 2 pt	foliage	24	21 (grain or ears)
	carbaryl	Sevin 4F	2 to 4 pt	foliage	12	48 (grain or fodder) 14 (harvest or graze forage)
	carbaryl	Seven XLR Plus	2 to 4 pt	foliage	12	48 (grain or fodder) 14 (harvest or graze forage)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	30 (grain, stover) 60 (forage)
	cyfluthrin	*Tombstone Helios	2.8 fl oz	foliage	12	21 (grain or fodder), 0 (forage)
	spinosad	Tracer 4SC	1.0 to 3.0 fl oz	foliage	1	28 (grain), 3 (fodder or forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.5 to 10.3 fl oz	foliage	12	30(grain) 60(forage)
	lambda-cyhalothrin	*Warrior II	1.28 to 1.92 fl oz	foliage	24	21 (grain), 1 (graze, forage) 21 (treated feed or fodder)

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Insecticides for field corn - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Amount of product per acre	Placement	REI (hours)	Preharvest interval (days)
Corn flea beetle *Chaetocnema pulicaria* and flea beetle complex, including the **Red headed flea beetle,** *Systena frontalis* **Comments:** For corn flea beetle treat when five or more beetles per plant are present or when seedling plants are being severely damaged or killed and beetles are present. For red headed flea beetles clipping silks, treat when pollination is less than 50 complete, silks are cut to less than 1/2 inch in length, and numerous beetles are present.	permethrin	*Ambush 25WP	6.4 to 12.8 fl oz	foliage	12	30 (grain or stover), 0 (forage)
	permethrin	*Ambush Insecticide (2EC)	6.4 to 12.8 fl oz	foliage	12	30 (grain or stover), 0 (forage)
	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	foliage	12	21 (grain)
	cyfluthrin	*Baythroid XL	0.8 to 1.6 fl oz	foliage	12	21 (grain or fodder) 0 (green forage)
	lambda-cyhalothrin + chlorantraniliprole	*Besiege	6.0 to 9.0 fl oz	foliage	24	21(grain or fodder)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	30 (grain, fodder, graze)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt Advanced	13 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	gamma-cyhalothrin	*Declare	1.02 to 1.54 fl oz	foliage	24	21(harvest)
	deltamethrin	*Delta Gold 1.5EC	1.0 to 1.5 fl oz	foliage	12	21 (grain, fodder) 12 (cut forage or graze)
	zeta-cypermethrin + bifenthrin	*Hero	2.6 to 6.1 fl oz	foliage	12	30 (grain, stover, graze) 60 (forage)
	methomyl	*Lannate SP	1/4 to 1/2 lb	foliage	48	0 (ears), 3 (forage), 21 (fodder)
	methomyl	*Lannate LV	3/4 to 1.5 pt	foliage	48	0 (ears), 3 (forage), 21 (fodder)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	21 (grain, ears ,forage, fodder)
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	foliage	24	21 (grain, ears, forage, fodder)
	zeta-cypermethrin	*Mustang Max	2.72 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	zeta-cypermethrin	*Mustang Maxx	2.72 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	chlorpyrifos	*Nufos 4E	1 to 2 pt	foliage	24	21 (grain or ears)
	microencapsulated methyl parathion	*Penncap-M	2 to 3 pt	foliage	48	12 (grain, forage, graze)
	carbaryl	Sevin 4F	2 to 4 pt	foliage	12	48 (grain or fodder) 14 (harvest or graze forage)
	carbaryl	Seven XLR Plus	2 to 4 pt	foliage	12	48 (grain or fodder) 14 (harvest or graze forage)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	30 (grain, stover) 60 (forage)
	cyfluthrin	*Tombstone Helios	0.8 to 1.6 fl oz	foliage	12	21 (grain or fodder), 0 (forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	3.5 to 10.3 fl oz	foliage	12	30(grain) 60(forage)
	lambda-cyhalothrin	*Warrior II	1.28 to 1.92 fl oz	foliage	24	21 (grain), 1 (graze, forage) 21 (treated feed or fodder)
	Seed treatments (for corn flea beetle only):					
	thiamethoxam	Avicta Complete-Corn	1.250 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser 5FS (250)	0.250 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser Extreme 250	0.250 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser Extreme 1250	1.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 600 (250)	0.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 1250	1.250 mg ai/kernel	commercial on seed		

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Insecticides for field corn - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Amount of product per acre	Placement	REI (hours)	Preharvest interval (days)
Corn flea beetle, - *continued*	clothianidin	Poncho/Votivo	0.500 mg ai/kernel	commercial on seed		
	tefluthrin	Proshield with Force ST	see label	commercial on seed		
Grasshopper complex **Comments:** Control grasshoppers when they are small by applying spot treatments to hatching sites in field borders and grass waterways. Treatment is justified in corn field when seven or more grasshoppers per square yard are present and filiage is being severely damaged. After pollen shed, control may be necessary if grasshoppers are damaging foliage above ear zone. Dimethoate should not be applied to corn during pollen-shed.	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	foliage	12	21 (grain)
	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage	12	21 (grain or fodder) 0 (green forage)
	lambda-cyhalothrin + chlorantraniliprole	*Besiege	6.0 to 9.0 fl oz	foliage	24	21(grain or fodder)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	30 (grain, fodder, graze)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	7 to 13 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt Advanced	6 to 13 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	gamma-cyhalothrin	*Declare	1.02 to 1.54 fl oz	foliage	24	21(harvest)
	deltamethrin	*Delta Gold 1.5EC	1.0 to 1.5 fl oz	foliage	12	21 (grain, fodder) 12 (cut forage or graze)
	dimethoate	Dimethoate 4E	1 pt	foliage	48	28 (grain) 14 (forage)
	zeta-cypermethrin + bifenthrin	*Hero	2.6 to 6.1 fl oz	foliage	12	30 (grain, stover, graze) 60 (forage)
	chlorpyrifos	*Lorsban Advanced	1/2 to 1 pt	foliage	24	21 (grain, ears ,forage, fodder)
	chlorpyrifos	*Lorsban 4E	1/2 to 1 pt	foliage	24	21 (grain, ears, forage, fodder)
	zeta-cypermethrin	*Mustang Max	2.72 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	zeta-cypermethrin	*Mustang Maxx	2.72 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	chlorpyrifos	*Nufos 4E	1/2 to 1 pt	foliage	24	21 (grain or ears)
	microencapsulated methyl parathion	*Penncap-M	2 to 3 pt	foliage	48	12 (grain, forage, graze)
	carbaryl	Seven XLR Plus	1 to 3 pt	foliage	12	48 (grain or fodder) 14 (harvest or graze forage)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	30 (grain, stover) 60 (forage)
	cyfluthrin	*Tombstone Helios	2.1 to 2.8 fl oz	foliage	12	21 (grain or fodder), 0 (forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.5 to 10.3 fl oz	foliage	12	30(grain) 60(forage)
	lambda-cyhalothrin	*Warrior II	1.28 to 1.92 fl oz	foliage	24	21 (grain), 1 (graze, forage) 21 (treated feed or fodder)

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Insecticides for field corn - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Amount of product per acre	Placement	REI (hours)	Preharvest interval (days)
Japanese beetle adults *Popillia japonica* Newman **Comments:** Treatment of Japanese beetle is justified if 3 or more beetles are present on green silk, silks are eaten to 1/2 inch or less in length, and pollination is less that 50% complete.	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	foliage	12	21 (grain)
	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage	12	21 (grain or fodder) 0 (green forage)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	30 (grain, fodder, graze)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	38 to 42 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	deltamethrin	*Delta Gold 1.5EC	1.5 to 1.9 fl oz	foliage	12	21 (grain, fodder) 12 (cut forage or graze)
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	foliage	12	30 (grain, stover, graze) 60 (forage)
	zeta-cypermethrin	*Mustang Max	2.72 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	microencapsulated methyl parathion	*Penncap-M	2 to 3 pt	foliage	48	12 (grain, forage, graze)
	carbaryl	Sevin 4F	2 to 4 pt	foliage	12	48 (grain or fodder) 14 (harvest or graze forage)
	cyfluthrin	*Tombstone Helios	1.6 to 2.8 fl oz	foliage	12	21 (grain or fodder), 0 (forage)
	lambda-cyhalothrin	*Warrior II	1.28 to 1.92 fl oz	foliage	24	21 (grain), 1 (graze, forage) 21 (treated feed or fodder)
Seedcorn maggot *Delia platura* (Meigen) **Seedcorn beetle** *Stenolophus lecontei* **Slender seedcorn beetle** *Clivinia impressitrons* LeConte **Comments:** Fields most at risk from seedcorn maggot are those with soils high in organic matter content, have received heavy applications of animal manures before planting or where a green cover crop or sod has recently been turned under the soil surface to decompose. Most soil insecticides used at planting or as seed treatments will provide protection from this pest.	cyfluthrin	*Aztec 2.1G	6.7 oz/1000 ft row	7-inch band, t-band, or in furrow	48	
	cyfluthrin	*Aztec 4.67 (for smartbox use)	3 oz/1000 ft row	T-band, furrow with incorporation	48	
	beta-cyfluthrin	*Baythroid XL	0.12 to 0.16 oz/1000 ft row (30-inch row spacing)	In-furrow at planting (apply w water or fertilizer)	12	21 (grain or fodder) 0 (green forage)
	bifenthrin	*Brigade 2EC	0.15 to 0.30 fl oz/1000 ft row with 30-inch row spacing	In-furrow at planting (apply w water or fertilizer)	12	30 (grain, fodder, graze)
	bifenthrin	*Capture LFR	0.2 to 0.39 fl oz/1000 ft row	Band or furrow at planting (LFR applied with fertilizer)	12	30 (grain or stover), 60 (forage) 30 (graze or feed)
	terbufos	*Counter 15G	6 to 8 oz/1000 ft row	Band or furrow at planting	48	
	tefluthrin	*Force 3G	4 to 5 oz/1000 ft ror	Band or furrow at planting	0	
	tefluthrin	*Force CS	0.46 to 0.57 fl oz/1000 ft row	Band or furrow at planting	12	
	chlorethoxyfos	*Fortress 2.5G	6.0 to 7.5 oz/1000 ft row	in-furrow at planting, band	48	
	chlorpyrifos	*Lorsban 15G	8 oz/1000 ft row	Band or furrow at planting	24	
	cholpyrifos	*Nufos 15G	8 oz/1000 ft row	Band or furrow at planting	24	
	chlorethoxyfos + bifenthrin	Smart Choice 5G	3.0 to 3.5 oz/1000 ft row	in- furrow at planting	48	30 (harvest, fooder, graze)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	0.64 fl oz/1000 ft row	band	12	30 (grain, fodder, graze)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	6.25 fl oz/A	pre-plant incorporate	12	30 (grain) 60(forage)

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Insecticides for field corn - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Amount of product per acre	Placement	REI (hours)	Preharvest interval (days)
Seedcorn maggot, - *continued*	**Seed treatments:**					
	thiamethoxam	Cruiser 5FS (250)	0.250 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser Extreme 250	0.250 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser Extreme 1250	1.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 600 (250)	0.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 1250	1.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho/Votivo	0.500 mg ai/kernel	commercial on seed		
	permethrin	Kernel Guard Supreme	1.5 oz/42 lbs of seed	planter box or hopper		
Southern corn leaf beetle *Cyphus denticollis* **Comments:** No economic thresholds have been established at this time. Treatment is justified if adults are present and causing significant damage through foliage or stem feeding.	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	broadcast	12	21 (grain or fodder) 0 (green forage)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	broadcast	12	30 (grain, fodder, graze)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt Advanced	11 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 26 fl oz	broadcast	24	21 (grain or ears) 14 (graze or silage harvest)
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	broadcast	12	30 (grain, stover, graze) 60 (forage)
	chlorpyrifos	*Lorsban Advanced	1/2 to 1 pt	foliage	24	21 (grain, ears ,forage, fodder)
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	broadcast	24	21 (grain, ears ,forage, fodder)
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	Broadcast	24	21 (grain, ears ,forage, fodder)
	zeta-cypermethrin	*Mustang Maxx	2.72 to 4.0 fl oz	Broadcast	12	30 (grain, stover) 60 (forage)
	zeta-cypermethrin	*Mustang Max	2.72 to 4.0 fl oz	broadcast	12	30 (grain, stover) 60 (forage)
	chlorpyrifos	*Nufos 4E	1 to 2 pt	broadcast	24	21 (grain or ears)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	30 (grain, stover) 60 (forage)
	cyfluthrin	*Tombstone Helios	1.6 to 2.8 fl oz	foliage	12	21 (grain or fodder), 0 (forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.5 to 10.3 fl oz	foliage	12	30(grain) 60(forage)
Southwestern corn borer 2nd generation **Comments:** Apply control at peak second generation oviposition or when 25% of plants have eggs and live larvae present. Optimal control from Success or Tracer is best achieved when the insecticide is applied at peak egg hatch or when larvae are small.	permethrin	*Ambush 25WP	6.4 to 12.8 fl oz	foliage	12	30 (grain or stover), 0 (forage)
	permethrin	*Ambush Insecticide (2EC)	6.4 to 12.8 fl oz	foliage	12	30 (grain or stover), 0 (forage)
	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	foliage	12	21 (grain)
	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage (for 1st & 2nd instars only)	12	21 (grain or fodder) 0 (green forage)
	lambda-cyhalothrin + chlorantraniliprole	*Besiege	6.0 to 9.0 fl oz	foliage	24	21(grain or fodder)
	flubendiamide	*Belt SC	2.0 to 3.0 fl oz	foliage	12	1 (green forage and silage) 28 (grain or stover)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	30 (grain, fodder, graze)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	19 to 38 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	16 to 38 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)

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Insecticides for field corn - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Amount of product per acre	Placement	REI (hours)	Preharvest interval (days)
Southwestern corn borer - *continued*	deltamethrin	*Delta Gold 1.5EC	1.5 to 1.9 fl oz	foliage	12	21 (grain, fodder) 12 (cut forage or graze)
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	foliage	12	30 (grain, stover, graze) 60 (forage)
	methoxyfenozide	Intrepid 2F	4.0 to 8.0 fl oz	foliage	4	21 (grain)
	chlorpyrifos	*Lorsban Advanced	1 1/2 to 2 pt	over whorls	24	21 (grain, ears ,forage, fodder)
	chlorpyrifos	*Lorsban 4E	1 1/2 to 2 pt	over whorls	24	21 (grain, ears, forage, fodder)
	chlorpyrifos	*Lorsban 15G	6.5 lb aerial application	over whorls - aerial	24	21 (grain or ears)
	zeta-cypermethrin	*Mustang Max	2.72 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	zeta-cypermethrin	*Mustang Maxx	2.72 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	chlorpyrifos	*Nufos 4E	1 1/2 to 2 pt	over whorls	24	21 (grain or ears)
	chlorpyrifos	*Nufos 15G	6.5 lb aerial application	over whorls - aerial	24	21 (grain or ears)
	microencapsulated methyl parathion	*Penncap-M	2 pt ground, 3 pt aerial 2 to 4 pt broadcast	over whorls over whorls & foliage	48	12 (grain, forage, graze)
	carbaryl	Sevin 4F	2 to 4 pt	foliage	12	48 (grain or fodder) 14 (harvest or graze forage)
	carbaryl	Seven XLR Plus	2 to 4 pt	foliage	12	48 (grain or fodder) 14 (harvest or graze forage)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	30 (grain, stover) 60 (forage)
	cyfluthrin	*Tombstone Helios	1.6 to 2.8 fl oz	foliage	12	21 (grain or fodder), 0 (forage)
	spinosad	Tracer 4SC	2.0 to 3.0 fl oz	foliage , over whorls	1	28 (grain), 3 (fodder or forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.5 to 10.3 fl oz	foliage	12	30(grain) 60(forage)
	lambda-cyhalothrin	*Warrior II	1.28 to 1.92 fl oz	foliage	24	21 (grain), 1 (graze, forage) 21 (treated feed or fodder)
	Bacillus thuringiensis					
	Bt formulations:	Agree, Biobit, Condor, Delivery, Dipel, Lepinox, Javelin, Xentari & others.	see specific labels	broadcast		
Stalk borer *Papaipema nebris* Guenee **Comments:** Apply postemergence sprays when young larvae are moving from weed hosts to corn.	permethrin	*Ambush 25WP	6.4 to 12.8 fl oz	foliage	12	30 (grain or stover), 0 (forage)
	permethrin	*Ambush Insecticide (2EC)	6.4 to 12.8 fl oz	foliage	12	30 (grain or stover), 0 (forage)
	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	foliage	12	21 (grain)
	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage	12	21 (grain or fodder) 0 (green forage)
	lambda-cyhalothrin + chlorantraniliprole	*Besiege	6.0 to 9.0 fl oz	foliage	24	21(grain or fodder)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	30 (grain, fodder, graze)
	bifenthrin	*Capture LFR	3.4 to 6.8 fl oz	At plant broadcast	12	
	bifenthrin	*Capture LFR	0.2 to 0.39 fl oz/ 1000 ft row	At plant band, in furrow		
	bifenthrin	*Capture LFR	3.4 fl oz	preemerge broadcast		
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	16 to 38 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)

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Insecticides for field corn - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Amount of product per acre	Placement	REI (hours)	Preharvest interval (days)
Stalk borer - *continued*	chlorpyrifos + gamma-cyhalothrin	*Cobalt	38 to 42 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	16 to 38 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	gamma-cyhalothrin	*Declare	1.02 to 1.54 fl oz	foliage	24	21(harvest)
	deltamethrin	*Delta Gold 1.5EC	1.5 to 1.9 fl oz	foliage	12	21 (grain, fodder) 12 (cut forage or graze)
	zeta-cypermethrin + bifenthrin	*Hero	2.6 to 6.1 fl oz	foliage	12	30 (grain, stover, graze) 60 (forage)
	chlorpyrifos	*Lorsban Advanced	2 pt	foliage	24	21 (grain, ears ,forage, fodder)
	chlorpyrifos	*Lorsban 4E	2 pt	foliage	24	21 (grain, ears, forage, fodder)
	zeta-cypermethrin	*Mustang Max	2.72 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	zeta-cypermethrin	*Mustang Maxx	2.72 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	chlorpyrifos	*Nufos 4E	2 pt	foliage	24	21 (grain or ears)
	permethrin	*Pounce 3.2EC	4 to 6 fl oz/A	foliage	12	30 (grain or stover), 0(forage)
	permethrin	*Pounce 3.2EC	4 to 6 fl oz/A	pre-plant incorporate, preemerge, at plant	12	30 (grain or stover), 0(forage)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	30 (grain, stover) 60(forage)
	cyfluthrin	*Tombstone Helios	1.6 to 2.8 fl oz	foliage	12	21 (grain or fodder), 0(forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	3.5 to 10.3 fl oz	foliage	12	30 (grain) 60 (forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	6.25 fl oz/A	pre-lant incorporate	12	30 (grain) 60 (forage)
	lambda-cyhalothrin	*Warrior II	1.28 to 1.92 fl oz	foliage	24	21 (grain), 1 (graze, forage) 21 (treated feed or fodder)
Stink bugs **Comments:** Apply as postemergence rescue treatment. Stink bug problems in field corn often occur initially in border rows located adjacent to areas supporting woody shrubs and trees. Corn seedlings most at risk of stink bug damage during two weeks following emergence and later in the season during early development of corn ears. No economic thresholds exist for stink bugs found on corn, but thresholds of 2-3% of seedling plants damaged are appropriate. Stink bugs often feed during early morning and can often be found on plant stems near to the soil surface.	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage	12	21 (grain or fodder) 0 (green forage)
	lambda-cyhalothrin + chlorantraniliprole	*Besiege	6.0 to 9.0 fl oz	broadcast on foliage	24	21(grain or fodder)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	30 (grain, fodder, graze)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	19 to 38 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	16 to 38 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	gamma-cyhalothrin	*Declare	1.02 to 1.54 fl oz	foliage	24	21(harvest)
	deltamethrin	*Delta Gold 1.5EC	1.5 to 1.9 fl oz	foliage	12	21 (grain, fodder) 12 (cut forage or graze)
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	foliage	12	30 (grain, stover, graze) 60 (forage)
	zeta-cypermethrin	*Mustang Max	2.72 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	zeta-cypermethrin	*Mustang Maxx	2.72 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	microencapsulated methyl parathion	*Penncap-M	1 to 3 pt	foliage	48	12 (grain, forage, graze)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	broadcast on foliage	24	30 (grain, stover) 60 (forage)

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Insecticides for field corn - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Amount of product per acre	Placement	REI (hours)	Preharvest interval (days)
Stinkbugs - *continued*	cyfluthrin	*Tombstone Helios	1.6 to 2.8 fl oz	foliage	12	21 (grain or fodder), 0 (forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.5 to 10.3 fl oz	broadcast on foliage	12	30(grain) 60(forage)
	lambda-cyhalothrin	*Warrior II	1.28 to 1.92 fl oz	foliage	24	21 (grain), 1 (graze, forage) 21 (treated feed or fodder)
Twospotted spider mites *Tetranychus urticae* Koch **Comments:** Treatment is justified if high mite numbers are causing yellowing or browning of lower plant leaves before dent growth stage of field corn. Do not apply dimethoate during pollen-shed.	bifenthrin	*Brigade 2EC	5.12 to 6.4 fl oz	foliage	12	30 (grain, fodder, graze)
	propargite	*Comite	32 to 48 fl oz	foliage	312	30(harvest, grazing, silage)
	dimethoate	Dimethoate 4EC	2/3 to 1 pt	broadcast	48	28 (grain) 14 (forage)
	zeta-cypermethrin + bifenthrin	*Hero	10.3 fl oz	broadcast	12	30 (grain, stover, graze) 60 (forage)
Webworms **Comments:** Many webworm species readily feed on grass and occasionally become pests of field corn. Sod webworm is an occasional pest of seedling field corn. Larvae often feed at the base of seedling plants where they typically damage roots and plant stems. Heavy infestations of this pest may result in ragged plant foliage, twisted plants, and destruction of the plant growing point. Corn fields most at risk include those planted into sod or grass pastures. Other species of webworm occasionally attack the foliage of seedling corn plants where they spin webbing and feed on leaf tissue. Economic thresholds are lacking for most webworm species, but producers often treat when webworm damage is severe and live larvae present. Some seed treatments may help control this pest group, although trial data is lacking. See specific insecticide labels for proper insecticide placement and management of webworms in corn.	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage	12	21 (grain or fodder) 0 (green forage)
	lambda-cyhalothrin + chlorantraniliprole	*Besiege	6.0 to 9.0 fl oz	foliage	24	21(grain or fodder)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	30 (grain, fodder, graze)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	11 to 26 fl oz	broadcast on foliageor soil surface, light	24	21 (grain or ears) 14 (graze or silage harvest)
	gamma-cyhalothrin	*Declare	1.02 to 1.54 fl oz	foliage	24	21(harvest)
	deltamethrin	*Delta Gold 1.5EC	1.5 to 1.9 fl oz	foliage	12	21 (grain, fodder) 12 (cut forage or graze)
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	foliage	12	30 (grain, stover, graze) 60 (forage)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	21 (grain, ears ,forage, fodder)
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	foliage	24	21 (grain, ears, forage, fodder)
	zeta-cypermethrin	*Mustang Maxx	2.72 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	zeta-cypermethrin	*Mustang Max	2.72 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	chlorpyrifos	*Nufos 4E	1 to 2 pt	foliage	24	21 (grain or ears)
	permethrin	*Pounce 3.2EC	4 to 6 fl oz/A	foliage	12	30 (grain or stover), 0 (forage)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	30 (grain, stover) 60 (forage)
	cyfluthrin	*Tombstone Helios	1.6 to 2.8 fl oz	foliage	12	21 (grain or fodder), 0 (forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.5 to 10.3 fl oz	foliage	12	30(grain) 60(forage)
	lambda-cyhalothrin	*Warrior II	1.28 to 1.92 fl oz	foliage	24	21 (grain), 1 (graze, forage) 21 (treated feed or fodder)

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Insecticides for field corn - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Amount of product per acre	Placement	REI (hours)	Preharvest interval (days)
Western bean cutworm **Comments:** Scout from first tassel until silks brown. Scout for round, white eggs in groups of a few to 200 located on upper surface of leaves above ear zone. Pale larvae have light-brown stripe running the length of back. Treat when 95% of corn is tasseled and contains 8% or more of plants with eggs or larvae present. Control is difficult once larvae enter corn ears. Optimal control from Success or Tracer is best achieved when the insecticide is applied at peak egg hatch or when larvae are small.	permethrin	*Ambush Insecticide (2EC)	3.2 to 6.4 fl oz	foliage	12	30 (grain or stover), 0 (forage)
	esfenvalerate	*Asana XL	2.9 to 5.8 fl oz	foliage	12	21 (grain)
	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage	12	21 (grain or fodder) 0 (green forage)
	flubendiamide	*Belt SC	2.0 to 3.0 fl oz	foliage	12	1 (green forage and silage) 28 (grain or stover)
	lambda-cyhalothrin + chlorantraniliprole	*Besiege	5.0 to 9.0 fl oz	foliage	24	21(grain or fodder)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	30 (grain, fodder, graze)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	11 to 26 fl oz	5 to 6-band or in furrow	24	21 (grain or ears) 14 (graze or silage harvest)
	gamma-cyhalothrin	*Declare	0.77 to 1.28 fl oz	foliage	24	21(harvest)
	zeta-cypermethrin + bifenthrin	*Hero	2.6 to 6.1 fl oz	foliage	12	30 (grain, stover, graze) 60 (forage)
	methoxyfenozide	Intrepid 2F	4.0 to 8.0 fl oz	foliage	4	21 (grain)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	21 (grain, ears ,forage, fodder)
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	foliage	24	21 (grain, ears, forage, fodder)
	zeta-cypermethrin	*Mustang Max	1.76 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	zeta-cypermethrin	*Mustang Maxx	1.76 to 4.0 fl oz	foliage	12	30 (grain, stover) 60 (forage)
	chlorpyrifos	*Nufos 4E	1 to 2 pt	foliage	24	21 (grain or ears)
	microencapsulated methyl parathion	*Penncap-M	2 to 4 pt	foliage	48	12 (grain, forage, graze)
	permethrin	*Pounce 3.2EC	2 to 4 fl oz/A	foliage	12	30 (grain or stover), 0 (forage)
	carbaryl	Sevin 4F	4 pt	foliage	12	48 (grain or fodder) 14 (harvest or graze forage)
	carbaryl	Seven XLR Plus	2 to 4 pt	foliage	12	48 (grain or fodder) 14 (harvest or graze forage)
	chlorpyrifos + bifenthrin	*Stallion	5.0 to 11.75 fl oz	broadcast on foliage	24	30 (grain, stover) 60 (forage)
	spinosad	Tracer 4SC	2 to 3 fl oz	foliage	1	28 (grain), 3 (fodder or forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.5 to 10.3 fl oz	broadcast on foliage	12	30(grain) 60(forage)
	lambda-cyhalothrin	*Warrior II	0.96 to 1.6 fl oz	foliage	24	21 (grain), 1 (graze, forage) 21 (treated feed or fodder)
White grubs **Comments:** Corn planted into pastures, grasslands, weedy fields and river bottom fields bordered by willows, sycamore, cottonwood and other wetland trees may be at greater risk of grub damage. hatch or when larvae are small.	cyfluthrin	*Aztec 2.1G	6.7 oz/1000 ft row	7-inch band, t-band, or in furrow	48	
	cyfluthrin	*Aztec 4.67 (Smartbox)	3 oz/1000 ft row	Band, furrow incorporation (for smartbox use)	48	
	bifenthrin	*Brigade 2EC	3 to 4 fl oz	preplant incorporate	12	
	bifenthrin	*Brigade 2EC	0.15 to 0.3 fl oz/1000 ft row	Band, furrow	12	
	bifenthrin	*Capture LFR	3.4 to 6.8 fl oz 0.2 to 0.39 fl oz/1000 ft row 4 to 5.3 fl oz	At-plant broadcast T-band or in-furrow preplant incorporate	12 12 12	
	terbufos	*Counter 15G	8 oz/1000 ft row	7-inch band or in-furrow	48	

Note: See Table 1 for listing of (Bt) trangenic traits.
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Insecticides for field corn - *continued*

Insect	Insecticides		Amount of product per acre	Placement	REI (hours)	Preharvest interval (days)
	Common name	Trade name				
White grubs - *continued*	chlorpyrifos + gamma-cyhalothrin	*Cobalt	2.87 fl oz/1000 ft row	Band incorporate, see label	24	
	tefluthrin	*Force 3G	4 to 5 oz/1000 ft row	At-plant in-furrow	0	
	tefluthrin	*Force CS	0.46 to 0.57 oz/1000 sq ft	At-plant in-furrow	12	
	chlorethoxyfos	*Fortress 2.5G	6.0 to 7.5 oz/1000 ft row	At-plant in-furrow	48	
	chlorethoxyfos	*Fortress 5G	3 to 3.75 oz/1000 ft row	Furrow (for smartbox use)	48	
	chlorpyrifos	*Lorsban 15G	8.0 oz/1000 ft row	Band, in-furrow	24	
	chlorpyrifos	*Nufos 15G	8 to 16 oz/1000 ft row	Band, in-furrow	24	
	chlorethoxyfos + bifenthrin	Smart Choice 5G	3.0 to 3.5 oz/1000 ft row	in- furrow at planting	48	
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	6.25 fl oz/A	pre-plant incorporate	12	
	spinosad	*Tombstone Helios	0.14 to 0.16 fl oz/1000 ft row	Furrow or fertilizer at-plant	12	
	lambda-cyhalothrin	*Warrior II with Zeon	0.33 fl oz/1000 ft row	At-plant band or in-furrow	24	
	Seed treatments:					
	thiamethoxam	Avicta Complete-Corn	1.250 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser 5FS (250)	0.250 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser Extreme 250	0.250 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser Extreme 1250	1.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 250	0.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 500	0.500 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 600 (250)	0.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 600 (1250)	1.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 1250	1.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho/Votivo	0.500 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 1250/ Votivo	1.250 mg ai/kernel	commercial on seed		

Note: See Table 1 for listing of (Bt) trangenic traits.
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Insecticides for field corn - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Amount of product per acre	Placement	REI (hours)	Preharvest interval (days)
Wireworm	cyfluthrin	*Aztec 4.67	3 oz/1000 ft row	Band, furrow incorporation	48	
Comments: Treatment is justified if field has chronic history of wireworm problems or if the number of wireworm larvae collected from solar bait stations exceed the economic threshold (average of one or more per trap).	bifenthrin	*Brigade 2EC	3 to 4 fl oz	preplant incorporate	12	30 (grain, fodder, graze)
	bifenthrin	*Brigade 2EC	0.15 to 0.3 fl oz/1000 ft row	Band, furrow	12	
	bifenthrin	*Capture LFR	3.4 to 6.8 fl oz	At plant broadcast	12	
		*Capture LFR	0.2 to 0.39 fl oz/ 1000 ft row	T-band or in furrow	12	
		*Capture LFR	4 to 5.3 fl oz	pre-plant incorporate	12	
	terbufos	*Counter 15G	8 oz/1000 ft row	7-inch band or in-furrow	48	
	tefluthrin	*Force 3G	4 to 5 oz/1000 ft row	At-plant in-furrow	0	
	tefluthrin	*Force CS	0.46 to 0.57 oz/1000 sq ft	At-plant in-furrow	12	
	chlorethoxyfos	*Fortress 2.5G	6.0 to 7.5 oz/1000 ft row	At-plant in-furrow	48	
	chlorethoxyfos	*Fortress 5G	3 to 3.75 oz/1000 ft row	Furrow (for smartbox use)	48	
	chlorpyrifos	*Lorsban 15G	8.0 oz/1000 ft row	At-plant in-furrow	24	
	chlorpyrifos	*Nufos 15G	8 to 16 oz/1000 ft row	At-plant in-furrow	24	
	spinosad	*Tombstone Helios	0.14 to 0.16 fl oz/1000 ft row	Furrow or fertilizer at-plant	12	
	lambda-cyhalothrin	*Warrior II with Zeon	0.33 fl oz/1000 ft row	At-plant band or in-furrow	24	
	Seed treatments:					
	thiamethoxam	Avicta Complete-Corn	1.250 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser 5FS (250)	0.250 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser Extreme 250	0.250 mg ai/kernel	commercial on seed		
	thiamethoxam	Cruiser Extreme 1250	1.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 250	0.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 500	0.500 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 600 (250)	0.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 600 (1250)	1.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 1250	1.250 mg ai/kernel	commercial on seed		
	clothianidin	Poncho/Votivo	0.500 mg ai/kernel	commercial on seed		
	clothianidin	Poncho 1250/ Votivo	1.250 mg ai/kernel	commercial on seed		

Note: See Table 1 for listing of (Bt) trangenic traits.
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Insect management for grain sorghum (milo)

Several insect pests of field corn, along with the greenbug, sorghum midge and sorghum webworm, may cause severe damage to grain sorghum. Management of these insect pests is best achieved through the use of an integrated pest management (IPM) program. In such a program, all available management strategies are reviewed, and appropriate ones are selected and implemented depending on the specific target insect. Control strategies may consist of cultural, mechanical, biological or chemical options. An individual control strategy or a combination of several control strategies may be used to achieve effective pest control. Proper identification of pest species and knowledge of pest biologies are essential when making management decisions.

Insecticides for grain sorghum

Foliar sprays

Insect	Insecticides: Common name	Insecticides: Trade name	Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
Chinch bug *Blissus leucopterus* (Say) **Comments:** Use ground equipment to treat border rows when insects begin migration from small grains or native grass stands to grain sorghum (milo). Risk of economic infestations is greatest in corn or grain sorghum (milo) planted into wheat stubble or native grass stands. Considered an occasional pest in Missouri, chinch bug adults and nymphs move to field corn or grain sorghum (milo) fields in early summer after wheat plants dry. A majority of feeding by this pest occurs when plant juices are sucked from plant roots.	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	spray toward base of plants	12	21 (grain)
	cyfluthrin	*Baythroid XL	2.0 to 2.8 fl oz	spray toward base of plants	12	14 (grain or graze)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 38 fl oz	spray toward base of plants	24	30 (grain, forage, fodder, hay, or silage up to 26 fl oz rate, or 60 days above 26 fl oz rate)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt Advanced	13 to 38 fl oz	spray toward base of plants	24	30 (grain, forage, fodder, hay, or silage up to 26 fl oz rate, or 60 days above 26 fl oz rate)
	gamma-cyfluthrin	*Declare/Prolex	1.54 fl oz	spray toward base of plants	24	30 (grain)
	deltamethrin	*Delta Gold 1.5EC	1.3 to 1.9 fl oz	spray toward base of plants	12	14 (grain, cut or graze forage)
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	spray toward base of plants	24	30 (grain, forage, fodder, hay, or silage up to 1 pt rate, or 60 days above 1 pt rate).
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	spray toward base of plants	24	30 (grain, forage, fodder, hay, or silage up to 1 pt rate, or 60 days above 1 pt rate).
	zeta-cypermethrin	*Mustang Max	3.2 to 4.0 fl oz	spray toward base of plants	12	30 (grain, stover) 45 (forage)
	zeta-cypermethrin	*Mustang Maxx	3.2 to 4.0 fl oz	spray toward base of plants	12	30 (grain, stover) 45 (forage)
	chlorpyrifos	*Nufos 4E	1 to 2 pt	spray toward base of plants	24	30 (grain, forage, fodder, hay, or silage up to 1 pt rate, or 60 days above 1 pt rate).
	carbaryl	Sevin 80S	1.25 to 2.5 lb	spray toward base of plants	12	21 (grain or fodder) 14 (harvest or graze forage)
	carbaryl	Seven XLR Plus	2 to 3 pt	foliage	12	14 (grain or straw)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	30 (grain, stover) 45 (forage)
	cyfluthrin	*Tombstone Helios	2.0 to 2.8 fl oz		12	14 (harvest or graze forage)
	lambda-cyhalothrin	*Warrior II	1.28 to1.92 fl oz	grain head, foliage	24	30 (grain), 7 (graze) 30 (straw fed to livestock)
	Seed treatments					
	thiamethoxam	Cruiser 5FS	5.1 fl oz/100 lb. of seed	commercial on seed	12	
	imadacloprid	Gaucho 5FS	6.4 fl oz/100 lb of seed	commercial on seed	12	
	imadacloprid	Gaucho 600	6.4 fl oz/100 lb of seed	commercial on seed	12	
	clothianidin	Poncho 600	5.1 to 6.4 fl oz/100 lbs seed	commercial on seed	12	
	clothianidin	NipSit Inside 5F	5.1 to 6.4 fl oz/100 lbs seed	commercial on seed	12	
	Note: All seed treatments listed provide early season suppression for chinch bugs.					

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Insecticides for grain sorghum - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
Corn earworm (sorghum headworm) *Helicoverpa (=Heliothis) zea* (Boddie) **Comments:** Treat when larvae average two or more worms per head.	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	grain head, foliage	12	21 (grain)
	cyfluthrin	*Baythroid XL	1.3 to 2.8 fl oz	grain head, foliage	12	14 (grain or graze)
	flubendiamide	*Belt SC	2.0 to 4.0 fl oz	broadcast on foliage	12	3 (forage) 14 (grain or stover)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	19 to 38 fl oz	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage up to 26 fl oz rate, or 60 days above 26 fl oz rate)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt Advanced	19 to 38 fl oz	spray toward base of plants	24	30 (grain, forage, fodder, hay, or silage up to 26 fl oz rate, or
	gamma-cyfluthrin	*Declare/Prolex	1.02 to 1.54 fl oz	grain head, foliage	24	30 (grain)
	deltamethrin	*Delta Gold 1.5EC	1.3 to 1.9 fl oz	grain head, foliage	12	14 (grain, cut or graze forage)
	methomyl	*Lannate SP	1/4 to 1/2 lb	grain head, foliage	48	14 (feeding or cutting for hay)
	methomyl	*Lannate LV	3/4 to 1 1/2 pt	grain head, foliage	48	14 (feeding or cutting for hay)
	chlorpyrifos	*Lorsban Advanced	2 pt	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage up to 1 pt rate, or 60 days above 1 pt rate).
	chlorpyrifos	*Lorsban 4E	2 pt	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage up to 1 pt rate, or 60 days above 1 pt rate).
	zeta-cypermethrin	*Mustang Max	1.76 to 4.0 fl oz	grain head, foliage	12	30 (grain, stover) 45 (forage)
	zeta-cypermethrin	*Mustang Maxx	1.76 to 4.0 fl oz	grain head, foliage	12	30 (grain, stover) 45 (forage)
	chlorpyrifos	*Nufos 4E	2 pt	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage up to 1 pt rate, or 60 days above 1 pt rate).
	carbaryl	Sevin 80S	1 1/4 to 2 1/2 lb	grain head, foliage	12	21 (grain or fodder) 14 (harvest or graze forage)
	carbaryl	Sevin XLR Plus	2 to 3 pts	grain head, foliage	12	21 (grain or fodder) 14 (harvest or graze forage)
	chlorpyrifos + bifenthrin	*Stallion	5.0 to 11.75 fl oz	foliage	24	30 (grain, stover) 45 (forage)
	cyfluthrin	*Tombstone Helios	1.3 to 2.8 fl oz	grain head, foliage	12	14 (harvest or graze forage)
	spinosad	Tracer 4SC	2.0 to 3.0 fl oz	foliage	1	28 (grain), 3 (fodder or forage)
	lambda-cyhalothrin	*Warrior II	1.28 to1.92 fl oz	grain head, foliage	24	30 (grain), 7 (graze) 30 (straw fed to livestock)
Corn leaf aphids *Rhopalosiphum maidis* (Fitch) **Comments:** This pest rarely requires treatment unless severe drought conditions persist.	chlorpyrifos + gamma-cyhalothrin	*Cobalt Advanced	7 to 13 fl oz	foliage, over row	24	21 (grain or ears) 14 (graze or silage haravest)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	7 to 13 fl oz	foliage, over row	24	21 (grain or ears)
	dimethoate	Dimethoate 4E	1/2 to 1 pt	foliage, over row	48	28 (grain) 14 (forage)
	chlorpyrifos	*Lorsban 4E	1/2 to 1 pt	foliage, over row	24	30 (grain, forage, fodder, hay, or silage)
	chlorpyrifos	*Lorsban Advanced	1/2 to 1 pt	foliage, over row	24	30 (grain, forage, fodder, hay, or silage)
	zeta-cypermethrin	*Mustang Max	3.2 to 4.0 fl oz	foliage, over row	12	30 (grain, stover) 45 (forage)
	zeta-cypermethrin	*Mustang Maxx	3.2 to 4.0 fl oz	foliage, over row	12	30 (grain, stover) 45 (forage)
	chlorpyrifos	*Nufos 4E	1/2 to 1 pt	foliage, over row	24	30 (grain, forage, fodder, hay, or silage)

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Insecticides for grain sorghum - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
Cutworm spp. **Comments:** Apply postemergence rescue treatment when 2–4% or more of plants are cut and larvae are	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	grain head, foliage	12	21 (grain)
	cyfluthrin	*Baythroid XL	1 to 1.3 fl oz	grain head, foliage	12	14 (grain or graze)
	flubendiamide	*Belt SC	2.0 to 4.0 fl oz	broadcast on foliage	12	3 (forage) 14 (grain or stover)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt Advanced	7 to 13 fl oz	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	7 to 13 fl oz	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage)
	gamma-cyfluthrin	*Declare/Prolex	0.77 to 1.02 fl oz	grain head, foliage	24	30 (grain)
	deltamethrin	*Delta Gold 1.5EC	1 to 1.5 fl oz	grain head, foliage	12	14 (grain, cut or graze forage)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage up to 1 pt rate, or 60 days above 1 pt rate).
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage up to 1 pt rate, or 60 days above 1 pt rate).
	zeta-cypermethrin	*Mustang Max	1.28 to 4.0 fl oz	grain head, foliage	12	30 (grain, stover) 45 (forage)
	zeta-cypermethrin	*Mustang Maxx	1.28 to 4.0 fl oz	grain head, foliage	12	30 (grain, stover) 45 (forage)
	chlorpyrifos	*Nufos 4E	1 to 2 pt	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage up to 1 pt rate, or 60 days above 1 pt rate).
	carbaryl	Sevin 80S	2.5 lb	grain head, foliage	12	21 (grain or fodder)
	carbaryl	Sevin XLR Plus	4 pts	grain head, foliage	12	21 (grain or fodder) 14 (harvest or graze forage)
	chlorpyrifos + bifenthrin	*Stallion	3.75 to 11.75 fl oz	foliage	24	30 (grain, stover) 45 (forage)
	cyfluthrin	*Tombstone Helios	1 to1.3 fl oz	grain head, foliage	12	14 (harvest or graze forage)
	lambda-cyhalothrin	*Warrior II	0.96 to 1.28 fl oz	grain head, foliage	24	30 (grain), 7 (graze) 30 (straw fed to livestock)
Fall armyworm *Spodoptera frugiperda* J.E. Smith **Comments:** Treat when larvae average two or more larvae per head. Leaf and whorl damage rarely economic in Missouri.	cyfluthrin	*Baythroid XL	1.3 to 2.8 fl oz 1st & 2nd instars only	grain head, over row	12	14 (grain or graze)
	flubendiamide	*Belt SC	2.0 to 4.0 fl oz	broadcast on foliage	12	3 (forage) 14 (grain or stover)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt Advanced	13 to 38 fl oz	spray toward base of plants	24	30 (grain, forage, fodder, hay, or silage up to 26 fl oz rate, or 60 days above 26 fl oz rate)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 38 fl oz	grain head, over row	24	30 (grain, forage, fodder, hay, or silage)
	gamma-cyfluthrin	*Declare/Prolex	1.02 to 1.54 fl oz	grain head, foliage	24	30 (grain)
	methomyl	*Lannate SP	1/4 to 3/8 lb	grain head, foliage	48	14 (feeding or cutting for hay)
	methomyl	*Lannate LV	3/4 to 1.5 pt	grain head, foliage	48	14 (feeding or cutting for hay)
	zeta-cypermethrin	*Mustang Max	1.76 to 4.0 fl oz	grain head, foliage	12	30 (grain, stover) 45 (forage)
	zeta-cypermethrin	*Mustang Maxx	1.76 to 4.0 fl oz	spray toward base of plants	12	30 (grain, stover) 45 (forage)
	carbaryl	Sevin 80S	1.25 to 2.5 lb	grain head, foliage	12	21 (grain or fodder) 14 (harvest or graze forage)
	carbaryl	Sevin XLR Plus	2 to 4 pts	grain head, foliage	12	21 (grain or fodder) 14 (harvest or graze forage)

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Insecticides for grain sorghum - *continued*

Insect	Insecticides		Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
	Common name	Trade name				
Fall armyworm - *continued*	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	30 (grain, stover) 45 (forage)
	cyfluthrin	*Tombstone Helios	1 to1.3 fl oz 1st & 2nd instars only	grain head, foliage	12	14 (harvest or graze forage)
	lambda-cyhalothrin	*Warrior II	1.28 to 1.92 fl oz	grain head, foliage	24	30 (grain), 7 (graze) 30 (straw fed to livestock)
Grasshopper spp.	cyfluthrin	*Baythroid XL	2 to 2.8 fl oz	grain head, foliage	12	14 (grain or graze)
Comments: Control grasshoppers when they are small by applying spot treatments to hatching sites in field borders and grass waterways. Treatment in field is justified when seven or more grasshoppers per square yard are present.	chlorpyrifos + gamma-cyhalothrin	*Cobalt	7 to 13 fl oz	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt Advanced	7 to 13 fl oz	spray toward base of plants	24	30 (grain, forage, fodder, hay, or silage up to 26 fl oz rate, or 60 days above 26 fl oz rate)
	gamma-cyfluthrin	*Declare/Prolex	1.02 to 1.54 fl oz	grain head, foliage	24	30 (grain)
	deltamethrin	*Delta Gold 1.5EC	1 to 1.5 fl oz	grain head, foliage	12	14 (grain, cut or graze forage)
	dimethoate	Dimethoate 4E	1/2 to 1 pt	grain head, foliage	48	28 (grain) 14 (forage)
	chlorpyrifos	*Lorsban Advanced	1/2 to 1 pt	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage)
	chlorpyrifos	*Lorsban 4E	1/2 to 1 pt	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage)
	zeta-cypermethrin	*Mustang Max	3.2 to 4.0 fl oz	grain head, foliage	12	30 (grain, stover) 45 (forage)
	zeta-cypermethrin	*Mustang Maxx	3.2 to 4.0 fl oz	grain head, foliage	12	30 (grain, stover) 45 (forage)
	chlorpyrifos	*Nufos 4E	1/2 to 1 pt	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	30 (grain, stover) 45 (forage)
	cyfluthrin	*Tombstone Helios	2 to 2.8 fl oz	grain head, foliage	12	14 (harvest or graze forage)
	lambda-cyhalothrin	*Warrior II	1.28 to 1.92 fl oz	grain head, foliage	24	30 (grain), 7 (graze) 30 (straw fed to livestock)
Greenbug *Schizaphis graminum* Rondani **Comments:** Treat seedling plants when an average of 10 or more aphids are present per plant or if greenbug feeding caused the death of three or more fully expanded leaves before hard-dough stage.	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 38 fl oz	foliage, over row	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt Advanced	13 to 38 fl oz	spray toward base of plants	24	30 (grain, forage, fodder, hay, or silage up to 26 fl oz rate, or 60 days above 26 fl oz rate)
	dimethoate	Dimethoate 4E	1/2 to 1 pt	foliage, over row	48	28 (grain) 14 (forage)
	chlorpyrifos	*Lorsban 4E	1/2 to 1 pt	foliage, over row	24	30 (grain, forage, fodder, hay, or silage)
	chlorpyrifos	*Lorsban Advanced	1/2 to 1 pt	foliage, over row	24	30 (grain, forage, fodder, hay, or silage)
	chlorpyrifos	*Nufos 4E	1/2 to 1 pt	foliage, over row	24	30 (grain, forage, fodder, hay, or silage)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	30 (grain, stover) 45 (forage)

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Insecticides for grain sorghum - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
Sorghum midge *Contarinia sorghicola* **Comments:** Apply during bloom when 50% of heads are in bloom and adult midges average one of more per sorghum head. The sorghum midge may cause significant damage and yield loss of grain sorghum.	esfenvalerate	*Asana XL	2.9 to 5.8 fl oz	grain head, foliage	12	21 (grain)
	cyfluthrin	*Baythroid XL	1 to 1.3 fl oz	grain head, foliage	12	14 (grain or graze)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	7 to 13 fl oz	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt Advanced	7 to 13 fl oz	spray toward base of plants	24	30 (grain, forage, fodder, hay, or silage up to 26 fl oz rate, or 60 days above 26 fl oz rate)
	gamma-cyfluthrin	*Declare/Prolex	0.77 to 1.02 fl oz	grain head, foliage	24	30 (grain)
	deltamethrin	*Delta Gold 1.5EC	1.3 to 1.9 fl oz	grain head, foliage	12	14 (grain, cut or graze forage)
	dimethoate	Dimethoate 4E	1/4 to 1/2 pt	foliage, over row	48	28 (grain) 14 (forage)
	methomyl	*Lannate SP	1/4 to 1/2 lb	grain head, foliage	48	14 (feeding or cutting for hay)
	methomyl	*Lannate LV	3/4 to 1.5 pt	grain head, foliage	48	14 (feeding or cutting for hay)
	chlorpyrifos	*Lorsban Advanced	1/2 pt	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage up to 1 pt rate, or 60 days above 1 pt rate).
	chlorpyrifos	*Lorsban 4E	1/2 pt	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage up to 1 pt rate, or 60 days above 1 pt rate).
	zeta-cypermethrin	*Mustang Max	1.28 to 4.0 fl oz	grain head, foliage	12	30 (grain, stover) 45 (forage)
	zeta-cypermethrin	*Mustang Maxx	1.28 to 4.0 fl oz	grain head, foliage	12	30 (grain, stover) 45 (forage)
	chlorpyrifos	*Nufos 4E	1/2 pt	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage up to 1 pt rate, or 60 days above 1 pt rate).
	chlorpyrifos + bifenthrin	*Stallion	3.75 to 11.75 fl oz	foliage	24	30 (grain, stover) 45 (forage)
	cyfluthrin	*Tombstone Helios	1 to 1.3 fl oz	grain head, foliage	12	14 (harvest or graze forage)
	lambda-cyhalothrin	*Warrior II	0.96 to 1.28 fl oz	grain head, foliage	24	30 (grain), 7 (graze) 30 (straw fed to livestock)
Sorghum webworm *Nola sorghiella* **Comments:** Treat when five or more larvae per head are present. The sorghum webworm is a major pest of sorghum, especially those varieties that have compact seedheads.	cyfluthrin	*Baythroid XL	1.3 to 2.8 fl oz	grain head, foliage	12	14 (grain or graze)
	flubendiamide	*Belt SC	2.0 to 4.0 fl oz	broadcast on foliage	12	3 (forage) 14 (grain or stover)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt Advanced	19 to 38 fl oz	spray toward base of plants	24	30 (grain, forage, fodder, hay, or silage up to 26 fl oz rate, or 60 days above 26 fl oz rate)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	19 to 38 fl oz	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage)
	gamma-cyfluthrin	*Declare/Prolex	1.02 to 1.54 fl oz	grain head, foliage	24	30 (grain)
	deltamethrin	*Delta Gold 1.5EC	1 to 1.5 fl oz	grain head, foliage	12	14 (grain, cut or graze forage)
	methomyl	*Lannate SP	1/2 lb	grain head, foliage	48	14 (feeding or cutting for hay)
	methomyl	*Lannate LV	1.5 pt	grain head, foliage	48	14 (feeding or cutting for hay)
	chlorpyrifos	*Lorsban Advanced	1 pt	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage up to 1 pt rate, or 60 days above 1 pt rate).
	chlorpyrifos	*Lorsban 4E	1 pt	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage up to 1 pt rate, or 60 days above 1 pt rate).
	zeta-cypermethrin	*Mustang Max	1.76 to 4.0 fl oz	grain head, foliage	12	30 (grain, stover) 45 (forage)
	zeta-cypermethrin	*Mustang Maxx	1.76 to 4.0 fl oz	grain head, foliage	12	30 (grain, stover) 45 (forage)

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Insecticides for grain sorghum - *continued*

Insect	Insecticides		Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
	Common name	Trade name				
Sorghum webworm - *continued*	chlorpyrifos	*Nufos 4E	1 pt	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage up to 1 pt rate, or 60 days above 1 pt rate).
	carbaryl	Sevin 80S	1.25 to 2.5 lb	grain head, foliage	12	21 (grain or fodder) 14 (harvest or graze forage)
	chlorpyrifos + bifenthrin	*Stallion	5.0 to 11.75 fl oz	foliage	24	30 (grain, stover) 45 (forage)
	cyfluthrin	*Tombstone Helios	1.3 to 2.8 fl oz	grain head, foliage	12	14 (harvest or graze forage)
	lambda-cyhalothrin	*Warrior II	1.28 to 1.92 fl oz	grain head, foliage	24	30 (grain), 7 (graze)
Yellow sugarcane aphid *Sipha flava* (Forbes) **Comments:** Treat seedling sorghum when an average of 5 to 10 or more aphids are present per plant.	chlorpyrifos + gamma-cyhalothrin	*Cobalt	7 to 13 fl oz	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt Advanced	7 to 13 fl oz	spray toward base of plants	24	30 (grain, forage, fodder, hay, or silage up to 26 fl oz rate, or 60 days above 26 fl oz rate)
	chlorpyrifos	*Lorsban Advanced	1/2 to 1 pt	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage up to 1 pt rate, or 60 days above 1 pt rate).
	chlorpyrifos	*Lorsban 4E	1/2 to 1 pt	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage up to 1 pt rate, or 60 days above 1 pt rate).
	zeta-cypermethrin	*Mustang Max	3.2 to 4.0 fl oz	grain head, foliage	12	30 (grain, stover) 45 (forage)
	zeta-cypermethrin	*Mustang Maxx	3.2 to 4.0 fl oz	grain head, foliage	12	30 (grain, stover) 45 (forage)
	chlorpyrifos	*Nufos 4E	1/2 to 1 pt	grain head, foliage	24	30 (grain, forage, fodder, hay, or silage up to 1 pt rate, or 60 days above 1 pt rate).
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	30 (grain, stover) 45 (forage)

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Insect management for soybean

In recent years the bean leaf beetle, Dectes stem borer, green cloverworm, Japanese beetle, southern corn rootworm, soybean aphid, soybean podworm, stink bugs, and webworms have all increased in importance as soybean insect pests in Missouri. These pests offer new management challenges to Missouri's soybean producers. Management of these insect pests is best achieved through the use of an integrated pest management (IPM) program. In such a program, all available management strategies are reviewed and appropriate ones selected and implemented depending on the specific target insect. Control strategies may consist of cultural, mechanical, biological or chemical options. An individual control strategy or a combination of several control strategies may be used to achieve effective pest control. Commercially applied insecticide seed treatments introduced for early-season pest insect management continue to gain in popularity. Proper identification of pest species and knowledge about pest biologies are essential when making management decisions.

Insecticides for soybean

Insect	Insecticides		Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
	Common name	Trade name				
Bean leaf beetle *Certoma trifurcata* (Forster) **Comments:** Treatment of seedling soybean is rarely needed, although foliage and pod feeding later in the growing season may cause substantial yield loss. If treatment of seedling soybean is needed, treat when five or more beetles are present per foot of row and one or more plants per foot of row are destroyed. Cold, dry growing conditions may lead to increased been leaf beetle problems on emerging and small seedling soybean. Before bloom treat when five or more beetles are present per foot of row and defoliation exceeds 30%. At growth stages from bloom to pod fill, treat when defoliation reaches 20% and beetles average 10 or more per foot of row for 30-inch rows or one to three beetles for 7-inch rows. During pod fill to beginning senecense, treat when 5%-10% of pods are damaged, plants are still green, and beetles are numerous in the field.	permethrin	*Ambush Insecticide (2EC)	3.2 to 6.4 fl oz	foliage	12	60(harvest)
	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	clothianidin	*Belay	3.0 to 6.0 fl oz	foliage	12	21 (harvest)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	18 (grain)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	19 to 38 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	16 to 38 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	gamma-cyhalothrin	*Declare	0.77 to 1.28 fl oz	foliage	24	45 (harvest) Do not graze or feed livestock
	deltamethrin	*Delta Gold 1.5EC	1.5 to 1.9 fl oz	broadcast on foliage	12	21 (grain) Do not graze or feed livestock
	dimethoate	Dimethoate 4EC	1pt.	foliage	48	21 (grain) 5 (graze, hay)
	lambda-cyhalothrin + thiamethoxam	*Endigo ZC	4.0 to 4.5 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	zeta-cypermethrin + bifenthrin	*Hero	2.6 to 6.1 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	acetamiprid + bifenthrin	*Justice	2.5 to 3.0 fl oz	foliage	12	Do not graze or feed livestock
	methomyl	*Lannate SP *Lannate LV	1/4 to 3/8 lb 3/4 to 1 pt	foliage	48	14 (grain) 3 (forage) 12 (hay)
	imidacloprid + cyfluthrin	*Leverage 2.7	3.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	Imidacloprid + beta cyfluthrin	*Leverage 360	2.8 fl oz	foliage	12	45 (grain) 15 (hay, green forage)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Maxx	2.8 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Max	2.8 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	chlorpyrifos	*Nufos 4E	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	acephate	Orthene 97	3/4 to 1 lb	foliage	24	14 (grain) Do not graze or feed livestock
	microencapsulated methyl parathion	*Penncap-M	2 to 3 pt	foliage	96	20 (grain)
	permethrin	*Pounce 3.2EC	2 to 4 fl oz/A	foliage	12	60 (harvest)
	carbaryl	Sevin 4F	1 to 2 pt	foliage	12	21 (dry grain or hay) 14 (graze or forage)

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Insecticides for soybean - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
Bean leaf beetle - *continued*	carbaryl	Seven XLR Plus	1 to 2 pt	foliage	12	21 (harvest) 14 (harvest or graze forage)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	28 (grain) Do not graze or feed livestock
	cyfluthrin	*Tombstone Helios	1.6 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	3.5 to 4.8 fl oz	foliage	12	21(grain) Do not graze or feed livestock
	lambda-cyhalothrin	*Warrior II with Zeon	0.96 to 1.6 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	Seed treatments					
	thiamethoxam	Cruiser 5FS	0.756-0.1512 mg/ kernel	commercial on seed		
	imadacloprid	Gaucho 600	1.6-3.2 oz/100 lb seed	commercial on seed		
	clothianidin	NipsIt Inside	1.28 fl oz/100 lbs seed	commercial on seed		
Blister beetle *Epicata* spp. **Comments:** An occasional to rare pest on soybean. Treat when defoliation reaches 30% prebloom or 20% from bloom to pod fill.	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	clothianidin	*Belay	3.0 to 6.0 fl oz	foliage	12	21 (harvest)
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	11 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 26 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	gamma-cyhalothrin	*Declare	1.28 to 1.54 fl oz	foliage	24	45 (harvest) Do not graze or feed livestock
	lambda-cyhalothrin + thiamethoxam	*Endigo ZC	4.0 to 4.5 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Max	2.8 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Maxx	2.8 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	carbaryl	Sevin 4F	1 to 2 pt	foliage	12	21 (dry grain or hay) 14 (graze or forage)
	chlorpyrifos + bifenthrin	*Stallion	5.0 to 11.75 fl oz	foliage	24	28 (grain) Do not graze or feed livestock
	cyfluthrin	*Tombstone Helios	1.6 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.8 fl oz	foliage	12	21(grain) Do not graze or feed livestock
	lambda-cyhalothrin	*Warrior II with Zeon	1.60 to 1.92 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
Corn earworm / soybean pod worm *Helicoverpa zea* (Boddie) **Comments:** Treat when defoliation reaches 30% prebloom or 20% from bloom to pod fill or when larval numbers exceed one per foot of row and 5% or more of pods are damaged. Heavy populations may cause excessive defoliation and pod loss.	permethrin	*Ambush Insecticide (2EC)	6.4 to 12.8 fl oz	foliage	12	60(harvest)
	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	18 (grain)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	19 to 38 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	16 to 38 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	gamma-cyhalothrin	*Declare	0.77 to 1.28 fl oz	foliage	24	45 (harvest) Do not graze or feed livestock
	lambda-cyhalothrin + thiamethoxam	*Endigo ZC	2.5 to 3.5 fl oz	foliage	24	30 (grain) Do not graze or feed livestock

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Insecticides for soybean - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
Corn earworm - *continued*	zeta-cypermethrin + bifenthrin	*Hero	2.6 to 6.1 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	methomyl	*Lannate SP *Lannate LV	1/4 to 1/2 lb 3/4 to 1 1/2 pt	foliage	48	14 (grain) 3 (forage) 12 (hay)
	Imidacloprid + cyfluthrin	*Leverage 2.7	3.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	Imidacloprid + beta cyfluthrin	*Leverage 360	2.8 fl oz	foliage	12	45 (grain) 15 (hay, green forage)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Maxx	2.8 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Max	2.8 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	chlorpyrifos	*Nufos 4E	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	permethrin	*Pounce 3.2EC	4 to 8 fl oz/A	foliage	12	60 (harvest)
	carbaryl	Sevin 4F	1 to 3 pt	foliage	12	21 (dry grain or hay) 14 (graze or forage)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	28 (grain) Do not graze or feed livestock
	cyfluthrin	*Tombstone Helios	1.6 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	spinosad	Tracer Naturalyte	1.5 to 2 fl oz	foliage	4	28 (grain) Do not graze or feed livestock
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.8 fl oz	foliage	12	21(grain) Do not graze or feed livestock
	lambda-cyhalothrin	*Warrior II with Zeon	0.96 to1.60 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
Cutworm Complex **Comments:** Scout emerging plants and treat if cutting reaches or exceeds 20% and cutworms are present.	permethrin	*Ambush Insecticide (2EC)	3.2 to 6.4 fl oz	foliage	12	60(harvest) Do not graze or feed livestock
	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	flubendiamide	*Belt SC	2.0 to 3.0 fl oz	foliage	12	14 (grain) 3 (forage and hay)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	18 (grain)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 26 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	11 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	gamma-cyhalothrin	*Declare	0.77 to 1.28 fl oz	foliage	24	45 (harvest) Do not graze or feed livestock
	lambda-cyhalothrin + thiamethoxam	*Endigo ZC	3.5 to 4.0 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	zeta-cypermethrin + bifenthrin	*Hero	2.6 to 6.1 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	Imidacloprid + beta cyfluthrin	*Leverage 360	2.8 fl oz	foliage	12	45 (grain) 15 (hay, green forage)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Maxx	1.28 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Max	1.28 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock

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Insecticides for soybean - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
Cutworm - *continued*	chlorpyrifos	*Nufos 4E	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	permethrin	*Pounce 3.2EC	2 to 4 fl oz/A	foliage	12	60 (harvest)
	chlorpyrifos + bifenthrin	*Stallion	3.75 to 11.75 fl oz	foliage	24	28 (grain) Do not graze or feed livestock
	cyfluthrin	*Tombstone Helios	0.8 to 1.6 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	3.5 to 4.8 fl oz	foliage	12	21(grain) Do not graze or feed livestock
	lambda-cyhalothrin	*Warrior II with Zeon	0.96 to1.60 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
Fall armyworm **Comments:** Fall armyworm larval numbers have increased in soybean for the past several years. Larvae are foliage feeders causing minor damage in most years. A rescue insecticide application may become necessary if numbers of other defoliating caterpillars are also elevated during soybean pod fill.	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	flubendiamide	*Belt SC	2.0 to 3.0 fl oz	foliage	12	14 (grain) 3 (forage and hay)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	18 (grain)
	gamma-cyhalothrin	*Declare	1.28 to 1.54 fl oz	foliage	24	45 (harvest) Do not graze or feed livestock
	lambda-cyhalothrin + thiamethoxam	*Endigo ZC	4.0 to 4.5 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	methomyl	*Lannate SP *Lannate LV	3/8 to 1/2 lb 1 to 1.5 pt	foliage	48	14 (grain) 3 (forage) 12 (hay)
	Imidacloprid + beta cyfluthrin	*Leverage 360 (1st & 2nd instars only)	2.8 fl oz	foliage	12	45 (grain) 15 (hay, green forage)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Maxx	3.2 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Max	3.2 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	chlorpyrifos	*Nufos 4E	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	28 (grain) Do not graze or feed livestock
	spinosad	Tracer Naturalyte	1.5 to 2 fl oz	foliage	4	28 (grain) Do not graze or feed livestock
	cyfluthrin	*Tombstone Helios	1.60 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	lambda-cyhalothrin	*Warrior II with Zeon	1.60 to 1.92 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
Grasshopper Complex **Comments:** Treat when defoliation reaches 30% before bloom, 20% bloom to pod fill, or when 5% to 10% of pods are damaged and hoppers are present. Treat when grasshoppers are small for optimal control.	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	cyfluthrin	*Baythroid XL	2.0 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	18 (grain)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	7 to 13 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	6 to 13 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	gamma-cyhalothrin	*Declare	1.28 to 1.54 fl oz	foliage	24	45 (harvest) Do not graze or feed livestock
	deltamethrin	*Delta Gold 1.5EC	1.5 to 1.9 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	dimethoate	Dimethoate 4EC	1 pt	foliage	48	21 (grain)

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Insecticides for soybean - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
Grasshopper - *continued*	lambda-cyhalothrin + thiamethoxam	*Endigo ZC	4.0 to 4.5 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	zeta-cypermethrin + bifenthrin	*Hero	2.6 to 6.1 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	imidacloprid + cyfluthrin	*Leverage 2.7	3.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	Imidacloprid + beta cyfluthrin	*Leverage 360	2.8 fl oz	foliage	12	45 (grain) 15 (hay, green forage)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	chlorpyrifos	*Lorsban 4E	1/2 to 1 pt	foliage	24	28 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Maxx	3.2 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Max	3.2 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	chlorpyrifos	*Nufos 4E	1/2 to 1 pt	foliage	24	28 (grain) Do not graze or feed livestock
	acephate	Orthene 97	1/4 to 1/2 lb	foliage	24	14 (grain) Do not graze or feed livestock
	microencapsulated methyl parathion	*Penncap-M	2 to 3 pt	foliage	96	20 (grain)
	chlorpyrifos + bifenthrin	*Stallion	5.0 to 11.75 fl oz	foliage	24	28 (grain) Do not graze or feed livestock
	cyfluthrin	*Tombstone Helios	2.0 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.8 fl oz	foliage	12	21(grain) Do not graze or feed livestock
	lambda-cyhalothrin	*Warrior II with Zeon	1.60 to 1.92 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
Green cloverworm *Hypena scabra* (Fabricius) **Comments:** Treat when defoliation reaches 20% or more during bloom, pod set, or pod fill and 10 to 15 or more half grown or larger larvae are present per foot of row.	permethrin	*Ambush Insecticide (2EC)	3.2 to 6.4 fl oz	foliage	12	60(harvest)
	esfenvalerate	*Asana XL	2.9 to 5.8 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	cyfluthrin	*Baythroid XL	0.8 to 1.6 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	18 (grain)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	7 to 13 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	6 to 13 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	gamma-cyhalothrin	*Declare	0.77 to 1.28 fl oz	foliage	24	45 (harvest) Do not graze or feed livestock
	deltamethrin	*Delta Gold 1.5EC	1.5 to 1.9 fl oz	broadcast on foliage	12	21 (grain) Do not graze or feed livestock
	lambda-cyhalothrin + thiamethoxam	*Endigo ZC	3.5 to 4.0 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	zeta-cypermethrin + bifenthrin	*Hero	2.6 to 6.1 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	methomyl	*Lannate SP *Lannate LV	1/4 to 1/2 lb 3/4 to 1.5 pt	foliage	48	14 (grain) 3 (forage) 12 (hay)
	imidacloprid + cyfluthrin	*Leverage 2.7	3.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	chlorpyrifos	*Lorsban Advanced	1/2 to 1 pt	foliage	24	28 (grain) Do not graze or feed livestock
	chlorpyrifos	*Lorsban 4E	1/2 to 1 pt	foliage	24	28 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Maxx	2.8 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Max	2.8 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock

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Insecticides for soybean - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
Green cloverworm - *continued*	chlorpyrifos	*Nufos 4E	1/2 to 1 pt	foliage	24	28 (grain) Do not graze or feed livestock
	acephate	Orthene 97	3/4 to 1 lb	foliage	24	14 (grain) Do not graze or feed livestock
	microencapsulated methyl parathion	*Penncap-M	2 to 3 pt	foliage	96	20 (grain)
	permethrin	*Pounce 3.2EC	2 to 4 fl oz/A	foliage	12	60 (harvest)
	carbaryl	Sevin 4F	2 to 3 pt	foliage	12	21 (dry grain or hay) 14 (graze or forage)
	carbaryl	Seven XLR Plus	1 to 2 pt	foliage	12	21 (harvest)
	chlorpyrifos + bifenthrin	*Stallion	5.0 to 11.75 fl oz	foliage	24	28 (grain) Do not graze or feed livestock
	spinosad	Tracer Naturalyte	1 to 2 fl oz	foliage	4	28 (grain) Do not graze or feed livestock
	cyfluthrin	*Tombstone Helios	0.8 to 1.6 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	3.5 to 4.8 fl oz	foliage	12	21(grain) Do not graze or feed livestock
	lambda-cyhalothrin	*Warrior II with Zeon	0.96 to1.60 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
Japanese beetle adults *Popillia japonica* Newman **Comments:** Treat when defoliation reaches or exceeds 30% before bloom and 20% between bloom and pod fill. Adults often aggregate on host plant to feed.	permethrin	*Ambush Insecticide (2EC)	6.4 to 12.8 fl oz	foliage	12	60(harvest)
	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	clothianidin	*Belay	3.0 to 6.0 fl oz	foliage	12	21 (harvest)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	18 (grain)
	gamma-cyhalothrin	*Declare	1.28 to 1.54 fl oz	foliage	24	45 (harvest) Do not graze or feed livestock
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	19 to 38 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	16 to 38 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	lambda-cyhalothrin + thiamethoxam	*Endigo ZC	4.0 to 4.5 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	imidacloprid + cyfluthrin	*Leverage 2.7	3.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	Imidacloprid + beta cyfluthrin	*Leverage 360	2.8 fl oz	foliage	12	45 (grain) 15 (hay, green forage)
	zeta-cypermethrin	*Mustang Maxx	2.8 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Max	2.8 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	microencapsulated methyl parathion	*Penncap-M	2 to 3 pt	foliage	96	20 (grain)
	permethrin	*Pounce 3.2EC	2 to 4 fl oz	foliage	12	60 (harvest)
	carbaryl	Sevin 4F	1 to 2 pt	foliage	12	21 (dry grain or hay) 14 (graze or forage)
	carbaryl	Seven XLR Plus	1 to 2 pt	foliage	12	21 (harvest) 14 (harvest or graze forage)
	chlorpyrifos + bifenthrin	*Stallion	5.0 to 11.75 fl oz	foliage	24	28 (grain) Do not graze or feed livestock
	cyfluthrin	*Tombstone Helios	0.8 to 1.6 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.8 fl oz	foliage	12	21(grain) Do not graze or feed livestock

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Insecticides for soybean - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
Japanese beetle - *continued*	lambda-cyhalothrin	*Warrior II with Zeon	1.60 to 1.92 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
Mexican bean beetle *Epilachna varivestis* Mulsant **Comments:** Treat when defoliation reaches 30% before bloom and 20% between bloom and pod fill. Although Mexican bean beetles can be found in Missouri, they rarely reach economic levels.	permethrin	*Ambush Insecticide (2EC)	3.2 to 6.4 fl oz	foliage	12	60(harvest)
	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	18 (grain)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	19 to 38 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	gamma-cyhalothrin	*Declare	0.77 to 1.28 fl oz	foliage	24	45 (harvest) Do not graze or feed livestock
	dimethoate	Dimethoate 4EC	1 pt	foliage	48	21 (grain)
	lambda-cyhalothrin + thiamethoxam	*Endigo ZC	3.5 to 4.0 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	methomyl	*Lannate SP *Lannate LV	1/4 to 1/2 lb 3/4 to 1.5 pt	foliage	48	14 (grain) 3 (forage) 12 (hay)
	imidacloprid + cyfluthrin	*Leverage 2.7	3.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	Imidacloprid + beta cyfluthrin	*Leverage 360	2.8 fl oz	foliage	12	45 (grain) 15 (hay, green forage)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Maxx	2.8 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Max	2.8 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	chlorpyrifos	*Nufos 4E	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	acephate	Orthene 97	3/4 to 1 lb	foliage	24	14 (grain) Do not graze or feed livestock
	microencapsulated methyl parathion	*Penncap-M	2 to 3 pt	foliage	96	20 (grain)
	permethrin	*Pounce 3.2EC	2 to 4 fl oz/A	foliage	12	60 (harvest)
	carbaryl	Sevin 4F	1 to 2 pt	foliage	12	21 (dry grain or hay) 14 (graze or forage)
	chlorpyrifos + bifenthrin	*Stallion	5.0 to 11.75 fl oz	foliage	24	28 (grain) Do not graze or feed livestock
	cyfluthrin	*Tombstone Helios	1.6 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.8 fl oz	foliage	12	21(grain) Do not graze or feed livestock
	lambda-cyhalothrin	*Warrior II with Zeon	0.96 to1.60 fl oz	foliage	24	30 (grain) Do not graze or feed livestock

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Insecticides for soybean - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
Potato leafhopper *Empoasca fabae* (Harris) **Comments:** Treat when potato leafhopper numbers (adults + nymphs) average six or more perplant at bloom, or 13 or more per plant at seed set and edges of leaves appear wrinkled and burned. Soybeans with none or few hairs on stem and leaflet surfaces are at greater risk of damage from this pest than soybean leaflets with numerous hairs or pubescence present. The hairs physically hold leafhoppers away from plant surfaces preventing these insects from probing inside plant tissues where they suck up plant juices with their piercing-sucking mouthparts.	permethrin	*Ambush Insecticide (2EC)	3.2 to 6.4 fl oz	foliage	12	60(harvest)
	esfenvalerate	*Asana XL	2.9 to 5.8 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	cyfluthrin	*Baythroid XL	0.8 to 1.6 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	clothianidin	*Belay	3.0 to 6.0 fl oz	foliage	12	21 (harvest)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	18 (grain)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	19 to 38 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	16 to 38 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	gamma-cyhalothrin	*Declare	0.77 to 1.28 fl oz	foliage	24	45 (harvest) Do not graze or feed livestock
	dimethoate	Dimethoate 4EC	1 pt	foliage	48	21 (grain)
	lambda-cyhalothrin + thiamethoxam	*Endigo ZC	3.5 to 4.0 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	acetamiprid + bifenthrin	*Justice	2.5 to 3.0 fl oz	foliage	12	Do not graze or feed livestock
	methomyl	*Lannate SP *Lannate LV	1/4 to 1/2 lb 3/4 to 1.5 pt	foliage	48	14 (grain) 3 (forage) 12 (hay)
	imidacloprid + cyfluthrin	*Leverage 2.7	3.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	Imidacloprid + beta cyfluthrin	*Leverage 360	2.8 fl oz	foliage	12	45 (grain) 15 (hay, green forage)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Maxx	2.8 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Max	2.8 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	chlorpyrifos	*Nufos 4E	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	acephate	Orthene 97	3/4 to 1 lb	foliage	24	14 (grain)
	microencapsulated methyl parathion	*Penncap-M	2 to 3 pt	foliage	96	20 (grain)
	permethrin	*Pounce 3.2EC	2 to 4 fl oz/A	foliage	12	60 (harvest)
	chlorpyrifos + bifenthrin	*Stallion	5.0 to 11.75 fl oz	foliage	24	28 (grain) Do not graze or feed livestock
	cyfluthrin	*Tombstone Helios	1.6 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	lambda-cyhalothrin	*Warrior II with Zeon	0.96 to1.60 fl oz	foliage	24	30 (grain) Do not graze or feed livestock

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Insecticides for soybean - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
Soybean aphid *Aphis glycines* Matsamura **Comments:** Treat when 250 or more aphids are present per plant when soybean plants are in the R1 through R5 growth stages. Larger yield responses will be realized when the insecticide is applied closer to the R1 stage of growth as compared to later growth stages. In Missouri, beneficial insects are very important and can often control light to moderate soybean aphid infestations if give an opportunity to do so.	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	cyfluthrin	*Baythroid XL	2.0 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	clothianidin	*Belay	3.0 to 6.0 fl oz	foliage	12	21 (harvest)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	18 (grain)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 26 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	chlorpyrifos + gamma-cyhalothrin	*Cobalt Advanced	11 to 26 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	gamma-cyhalothrin	*Declare	0.77 to 1.28 fl oz	foliage	24	45 (harvest) Do not graze or feed livestock
	deltamethrin	*Delta Gold 1.5EC	1.5 to 1.9 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	dimethoate	Dimethoate 4EC	1 pt	foliage	48	21 (grain)
	lambda-cyhalothrin + thiamethoxam	*Endigo ZC	3.5 to 4.0 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	zeta-cypermethrin + bifentrhrin	*Hero	4.0 to 10.3 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	acetamiprid + bifenthrin	*Justice	2.5 to 3.0 fl oz	foliage	12	Do not graze or feed livestock
	Imidacloprid + cyfluthrin	*Leverage 2.7	3.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	Imidacloprid + beta cyfluthrin	*Leverage 360	2.8 fl oz	foliage	12	45 (grain) 15 (hay, green forage)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Maxx	2.8 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Max	2.8 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	chlorpyrifos	*Nufos 4E	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	acephate	Orthene 97	3/4 to 1 lb	foliage	24	14 (grain)
	microencapsulated methyl parathion	*Penncap-M	1 to 3 pt	foliage	96	20 (grain)
	permethrin	*Pounce 3.2EC	4 to 8 fl oz/A	foliage	12	60 (harvest)
	chlorpyrifos + bifenthrin	*Stallion	5.0 to 11.75 fl oz	foliage	24	28 (grain) Do not graze or feed livestock
	cyfluthrin	*Tombstone Helios	2.0 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	3.5 to 4.8 fl oz	foliage	12	21(grain) Do not graze or feed livestock
	lambda-cyhalothrin	*Warrior II with Zeon	0.96 to1.60 fl oz	foliage	24	30 (grain) Do not graze or feed livestock

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Insecticides for soybean - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
Soybean looper *Pseudoplusia includens* (Walker) **Comments:** Treat when defoliation reaches 30% before bloom and 20% from bloom to pod fill. The soybean looper is the most common looper found in soybean, although at least four other looper species also may occur in Missouri soybean fields.	permethrin	*Ambush Insecticide (2EC)	6.4 to 12.8 fl oz	foliage	12	60(harvest)
	flubendiamide	*Belt SC	2.0 to 3.0 fl oz	foliage	12	14 (grain) 3 (forage and hay)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	18 (grain)
	gamma-cyhalothrin	*Declare	1.54 fl oz	foliage	24	45 (harvest) Do not graze or feed livestock
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	acetamiprid + bifenthrin	*Justice	3.0 to 5.0 fl oz	foliage	12	Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Maxx	3.2 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Max	3.2 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	acephate	Orthene 97	3/4 to 1 lb	foliage	24	14 (grain)
	microencapsulated methyl parathion	*Penncap-M	2 to 3 pt	foliage	96	20 (grain)
	permethrin	*Pounce 3.2EC	4 to 8 fl oz/A	foliage	12	60 (harvest)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	28 (grain) Do not graze or feed livestock
	cyfluthrin	*Tombstone Helios	2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	spinosid	Tracer Naturalyte	1 to 2 fl oz	foliage	4	28 (grain) Do not graze or feed livestock
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.8 fl oz	foliage	12	21(grain) Do not graze or feed livestock
	lambda-cyhalothrin	*Warrior II with Zeon	1.92 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
Spider mites *Tetranychus urticae* Koch **Comments:** Before pod set, treat when foliage yellowing reaches 20% and mites are present on plants. After pod set, treat when foliage yellowing reaches 10% and mites are present on plants. Spider mite infestations on soybean are often associated with drought conditions.	bifenthrin	*Brigade 2EC	5.12 to 6.4 fl oz	foliage	12	18 (grain)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 26 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	11 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	gamma-cyhalothrin	*Declare	1.54 fl oz	foliage	24	45 (harvest) Do not graze or feed livestock
	dimethoate	Dimethoate 4EC	1 pt	foliage	48	21 (grain)
	lambda-cyhalothrin + thiamethoxam	*Endigo ZC (suppresion only)	4.5 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	chlorpyrifos	*Lorsban Advanced	1/2 to 1 pt	foliage	24	28 (grain) Do not graze or feed livestock
	chlorpyrifos	*Lorsban 4E	1/2 to 1 pt	foliage	24	28 (grain) Do not graze or feed livestock
	chlorpyrifos	*Nufos 4E	1/2 to 1 pt	foliage	24	28 (grain) Do not graze or feed livestock
	lambda-cyhalothrin	*Warrior II with Zeon	1.92 fl oz	foliage	24	30 (grain) Do not graze or feed livestock

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Insecticides for soybean - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
Stink bug complex Green stink bug *Acrosternum hilare* (Say) **Comments:** Treat when adult stink bugs or large nymphs average one or more per foot of row during pod fill. In Missouri, "delayed senescence" of soybean has been attributed to heavy feeding by green stink bug during soybean reproductive growth stages.	esfenvalerate	*Asana XL	5.8 to 9.6 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	clothianidin	*Belay	3.0 to 6.0 fl oz	foliage	12	21 (harvest)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	18 (grain)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	19 to 38 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	16 to 38 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	gamma-cyhalothrin	*Declare	1.28 to 1.54 fl oz	foliage	24	45 (harvest) Do not graze or feed livestock
	deltamethrin	*Delta Gold 1.5EC	1.5 to 1.9 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	lambda-cyhalothrin + thiamethoxam	*Endigo ZC	4.0 to 4.5 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	imidacloprid + cyfluthrin	*Leverage 2.7	3.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	Imidacloprid + beta cyfluthrin	*Leverage 360	2.8 fl oz	foliage	12	45 (grain) 15 (hay, green forage)
	zeta-cypermethrin	*Mustang Maxx	3.2 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Max	3.2 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	acephate	Orthene 97	1/2 to 1 lb	foliage	24	14 (grain)
	microencapsulated methyl parathion	*Penncap-M	1 to 3 pt	foliage	96	20 (grain)
	carbaryl	Sevin 4F	2 to 3 pt	foliage	12	21 (dry grain or hay) 14 (graze or forage)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	28 (grain) Do not graze or feed livestock
	cyfluthrin	*Tombstone Helios	1.6 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.8 fl oz	foliage	12	21(grain) Do not graze or feed livestock
	lambda-cyhalothrin	*Warrior II with Zeon	1.60 to1.92 fl oz	foliage	24	30 (grain) Do not graze or feed livestock

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Insecticides for soybean - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
Thistle caterpillar *Vanessa cardui* **Comments:** Treat when defoliation reaches 30% before bloom and 20% from bloom to pod fill. Adult stage is the Painted Lady butterfly.	permethrin	*Ambush Insecticide (2EC)	3.2 to 6.4 fl oz	foliage	12	60(harvest)
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	11 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 26 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	gamma-cyhalothrin	*Declare	0.77 to 1.28 fl oz	foliage	24	45 (harvest) Do not graze or feed livestock
	lambda-cyhalothrin + thiamethoxam	*Endigo ZC	3.5 to 4.0 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	zeta-cypermethrin + bifenthrin	*Hero	2.6 to 6.1 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Maxx	1.28 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Max	1.28 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	chlorpyrifos	*Nufos 4E	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	permethrin	*Pounce 3.2EC	2 to 4 fl oz/A	foliage	12	60 (harvest)
	carbaryl	Sevin 4F	3 pt	foliage	12	21 (dry grain or hay) 14 (graze or forage)
	carbaryl	Sevin XLR Plus	3 pt	foliage	12	21 (harvest) 14 (harvest or graze forage)
	chlorpyrifos + bifenthrin	*Stallion	3.75 to 11.75 fl oz	foliage	24	28 (grain) Do not graze or feed livestock
	zeta-cypermethrin +	*Triple Crown	3.5 to 4.8 fl oz	foliage	12	21(grain)
	lambda-cyhalothrin	*Warrior II with Zeon	0.96 to1.60 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
Thrips complex Soybean thrips *Sericothrips variablilis* Beach **Comments:** Treat when serious injury and some mortality of seedling plants occur and thrips are present.	cyfluthrin	*Baythroid XL	0.8 to 1.6 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	18 (grain)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	19 to 38 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	16 to 38 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	lambda-cyhalothrin + thiamethoxam	*Endigo ZC	3.5 to 4.0 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	methomyl	*Lannate SP *Lannate LV	1/4 to 1/2 lb 3/4 to 1 1/2 pt	foliage	48	14 (grain) 3 (forage) 12 (hay)
	imidacloprid + cyfluthrin	*Leverage 2.7	3.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	Imidacloprid + beta cyfluthrin	*Leverage 360	2.8 fl oz	foliage	12	45 (grain) 15 (hay, green forage)
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Maxx	3.2 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Max	3.2 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	acephate	Orthene 97	1/4 to 1/2 lb	foliage	24	14 (grain)
	microencapsulated methyl parathion	*Penncap-M	2 to 3 pt	foliage	96	20 (grain)

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Insecticides for soybean - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
Thrips - *continued*	carbaryl	Sevin 4F	2 pt	foliage	12	21 (dry grain or hay) 14 (graze or forage)
	carbaryl	Sevin XLR Plus	2 pt	foliage	12	21 (harvest) 14 (harvest or graze forage)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	28 (grain) Do not graze or feed livestock
	cyfluthrin	*Tombstone Helios	0.8 to 1.6 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.8 fl oz	foliage	12	21(grain) Do not graze or feed livestock
	lambda-cyhalothrin	*Warrior II with Zeon	0.96 to1.60 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
Webworm complex *Loxostege* spp. **Comments:** Treat when 10% to 12% of plants show heavy webbing on top leaflets or when defoliation reaches 30% before bloom or 20% from bloom to pod fill. Be sure that webworm larvae are still present in webbing mass when treating.	permethrin	*Ambush Insecticide (2EC)	6.4 to 12.8 fl oz	foliage	12	60(harvest)
	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	flubendiamide	*Belt SC	2.0 to 3.0 fl oz	foliage	12	14 (grain) 3 (forage and hay)
	bifenthrin	*Brigade 2EC	2.1 to 6.4 fl oz	foliage	12	18 (grain)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 26 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	11 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	gamma-cyhalothrin	*Declare	1.28 to 1.54 fl oz	foliage	24	45 (harvest) Do not graze or feed livestock
	lambda-cyhalothrin + thiamethoxam	*Endigo ZC	4.0 to 4.5 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Max	2.8 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Maxx	2.8 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	permethrin	*Pounce 3.2EC	4 to 8 fl oz/A	foliage	12	60 (harvest)
	carbaryl	Sevin 4F	2 to 3 pt	foliage	12	21 (dry grain or hay) 14 (graze or forage)
	carbaryl	Sevin XLR Plus	3 pt	foliage	12	21 (harvest) 14 (harvest or graze forage)
	cyfluthrin	*Tombstone Helios	1.6 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	lambda-cyhalothrin	*Warrior II with Zeon	1.6 to1.92 fl oz	foliage	24	30 (grain) Do not graze or feed livestock

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Insecticides for soybean - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
Woollybear caterpillar *Pyrrharctia isabella* **Comments:** Treat when defoliation reaches 30% before bloom and 20% from bloom to pod fill. The adult stage of this insect is the Isabella tiger moth.	esfenvalerate	*Asana XL	2.9 to 5.8 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	cyfluthrin	*Baythroid XL	1.6 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	flubendiamide	*Belt SC	2.0 to 3.0 fl oz	foliage	12	14 (grain) 3 (forage and hay)
	chlorpyrifos + lambda-cyhalothrin	*Cobalt Advanced	11 to 26 fl oz	foliage	24	21 (grain or ears) 14 (graze or silage harvest)
	chlorpyrifos + gamma-cyhalothrin	*Cobalt	13 to 26 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	gamma-cyhalothrin	*Declare	0.77 to 1.28 fl oz	foliage	24	45 (harvest) Do not graze or feed livestock
	lambda-cyhalothrin + thiamethoxam	*Endigo ZC	3.5 to 4.0 fl oz	foliage	24	30 (grain) Do not graze or feed livestock
	zeta-cypermethrin + bifenthrin	*Hero	4.0 to 10.3 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	chlorpyrifos	*Lorsban Advanced	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	chlorpyrifos	*Lorsban 4E	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Maxx	2.8 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	zeta-cypermethrin	*Mustang Max	2.8 to 4.0 fl oz	foliage	12	21 (grain) Do not graze or feed livestock
	chlorpyrifos	*Nufos 4E	1 to 2 pt	foliage	24	28 (grain) Do not graze or feed livestock
	permethrin	*Pounce 3.2EC	2 to 4 fl oz/A	foliage	12	60 (harvest)
	carbaryl	Sevin 4F	3 pt	foliage	12	21 (dry grain or hay) 14 (graze or forage)
	carbaryl	Sevin XLR Plus	3 pt	foliage	12	21 (harvest) 14 (harvest or graze forage)
	chlorpyrifos + bifenthrin	*Stallion	5.0 to 11.75 fl oz	foliage	24	28 (grain) Do not graze or feed livestock
	cyfluthrin	*Tombstone Helios	1.6 to 2.8 fl oz	foliage	12	45 (grain, feeding dry vines) 15 (green forage)
	zeta-cypermethrin + bifenthrin + imadacloprid	*Triple Crown	4.8 fl oz	foliage	12	21(grain) Do not graze or feed livestock
	lambda-cyhalothrin	*Warrior II with Zeon	0.96 to1.60 fl oz	foliage	24	30 (grain) Do not graze or feed livestock

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Insect management for wheat

Wheat acreage in Missouri is once again on the rise after several years in which the number of acres in wheat declined. This trend may continue as grain prices for wheat increase worldwide. Although wheat has few severe insect pests, one group of insects generating controversy is the aphid complex. This complex consists of greenbug, bird cherry-oat aphid, English grain aphid, corn leaf aphid, yellow sugarcane aphid and possibly others. Changes in wheat varieties, tillage practices, fertility levels, pest pressure and other factors all affect economic threshold numbers. Traditional economic thresholds developed for these pests now seem outdated with the adoption of "high performance wheat production systems." Recent research in Missouri suggests that aphid threshold levels may need to be more conservative to better protect loss of potential yield. An important goal in this state is to assess and modify economic thresholds for aphids and other wheat insect pests to better reflect Missouri field conditions.

Insecticides for wheat

Insect	Insecticides		Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
	Common name	Trade name				
Greenbug aphid *Schizaphis graminum* (Rodani)	cyfluthrin	*Baythroid XL	1.8 to 2.4 fl oz	foliage	12	30 (grain) 3 (grazing or forage)
Bird cherry-oat aphid *Rhopalosiphum padi* (L.)	dimethoate	Dimethoate 4EC	1 3/4 pt	foliage	48	35 (grain)
English grain aphid *Sitobion avenae* (Fabricius)	methomyl	*Lannate SP	1/4 to 1/2 lb	foliage	48	7 (grain) 10 (grazing or forage)
Corn leaf aphid *Rhopalosiphum* (Fitch)	zeta-cypermethrin	*Mustang Max	3.2 to 4.0 fl oz	foliage	12	14 (grain. forage, hay)
Yellow sugarcane aphid *Sipha flava* (Forbes)	zeta-cypermethrin	*Mustang Maxx	3.2 to 4.0 fl oz	foliage	12	14 (grain. forage, hay)
	microencapsulated methyl parathion	*Penncap-M	2 to 3 pt		48	15 (harvest or grazing)
	chlorpyrifos	*Nufos 4E	1/2 to 1 pt	foliage	24	28 (grain or straw) 14 (forage or hay)
	chlorpyrifos + bifenthrin	*Stallion	5.0 to 11.75 fl oz	foliage	24	28 (grain or straw) 14 (forage, hay)
	cyfluthrin	*Tombstone Helios	1.8 to 2.4 fl oz	foliage	12	30 (grain) 7 (grazing)
	lambda-cyhalothrin	*Warrior II with Zeon	1.28 to 1.92 fl oz	foliage	24	30 (grain, hay, straw)
	Seed treatments - Neonicotinoid compounds label for use in reducing aphid numbers and levels of barley yellow dwarf virus following emergence of seedling plants and development of 1 or 2 tillers.					
	imidacloprid	Gaucho	See product label	Commercially on seed		
	imidacloprid	Gaucho XT	3.4 fl oz/100 lbs. seed	Commercially on seed		
	imidacloprid	Gaucho 600	0.8 fl oz.100 lbs. seed	Commercially on seed		
	thiamethoxam	Cruiser	see product label	Commercially on seed		
	thiamethoxam	Cruiser 5FS	0.75 to 1.33 fl oz/100 lbs seed	Commercially on seed		
	thiamethoxam	CruiserMaxx Cereal	5.0 fl oz/100 lbs seed	Commercially on seed		

Comments:

Greenbug aphids tend to be occasional pests on winter wheat in Missouri. In most years greenbugs build throughout summer into fall, when they often feed on seedling wheat plants. Greenbugs may overwinter in wheat fields, but the predominant aphid found in Missouri wheat during winter is the bird cherry-oat aphid. Although low numbers of greenbugs are present during some winters, economic infestations are rarely found until spring. In spring, greenbugs may again migrate to Missouri fields from more southern locations. The greenbug aphid damages wheat in three ways including removal juices from plants using their piercing-sucking mouthparts, injection of a plant toxin during feeding, and transmission of the barley yellow dwarf virus to wheat plants if the aphids were previously infected. The traditional economic threshold at which treatment is justified requires 25 to 50 or more greenbug aphids present per linear foot of row. The greenbug is a vector of barley yellow dwarf virus with risk of infection highest on wheat seedling from fall plant emergence through late fall.

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Insecticides for wheat - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
Comments - *continued*						

Bird cherry-oat aphid has increased in importance in Missouri wheat during the past few years. This aphid is capable of overwintering in most wheat fields and often can be found in low numbers throughout the wheat growing seasons. Similar to greenbug, numbers of the bird cherry-oat aphid often build during summer into fall, during warm winter periods, and again in the spring. Bird cherry-oat aphids damage wheat by sucking plant juices and by the transmission of barley yellow-dwarf virusby previously infected aphids. A majority of feeding damage and transmission of barley yellow dwarfvirous typically occur wheat plants for the first 60 days following seedling emergence. Feeding and virus transmission may occur during other periods, but to a much lower level than present during the early wheat seedling stages of growth. Trials conducted in Missouri in past years suggest that both fall and spring reductions in bird cherry-oat aphid number result in higher wheat yields in most years. Based on these data, the economic threshold for bird cherry-oat aphids is to treat when 12 to 25 aphids or more are present per linear foot of row from the time of seedling emergence in the fall to heading during the following spring. Due to the increasing presence of barley yellow dwarf virus in Missouri in recent years and higher commodity value for wheat, the economic theshold may again need to be adjusted for bird cherry-oat aphid and other wheat aphids capable of vectoring barley yellow dwarf virus. Another factor to consider when determining economic thresholds for this aphid include the difficulty of estimating acurate numbers of bird dherry-oat aphids present in wheat fields. Three factors contribute to difficulty in finding this aphid when scouting wheat. They include the dark olive color of the aphid, its preference to live individually or in very small colonies on the plants, and a preference to feed and hide on lower leaves and plant stems near the soil surface. Estimates of scouting effeciency for the bird cherry-oat aphid on wheat suggest that approximately 50% of the aphids present in a specific area are found during normal scouting activities. The bird cherry-oat aphid is an efficient vector of barley yellow dwarf virus.The greenbug and bird cherry-oat aphids are the most important aphids found in Missouri wheat fields.

English grain aphid can be found in Missouri wheat where it occasionally damages wheat plants by removing plant juices and transmission of barley yellow dwarf virus. The English grain aphid is usually found in low numbers when present in Missouri wheat fields. The economic threshold for this aphid is to treat when populations of 100 or more aphids per tiller are present.

Corn leaf aphids and yellow sugarcane aphids rarely reach damaging levels due to heavy mortality of these aphids from biological control agents. Corn leaf aphids are capable of transmitting the barley yellow dwarf pathogen.

Insect	Insecticides: Common name	Insecticides: Trade name	Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
True armyworm *Pseudaletia unipuncta* (Haworth) **Comments:** **True armyworm** is an occasional severe pest of wheat and grass pastures. Treatment is justified when an average of 4 or more half-grown or larger worms per square foot are present during late spring and before more than 2% to 3% of heads are cut from stems. Scout at dusk, dawn, or at night as small larvae feed on foliage at night and remain in plant debris near ground during day. Optimal control from Success and Tracer insecticides is best achieved when they are applied at peak egg hatch or when larvae are small.	cyfluthrin	*Baythroid XL	1.8 to 2.4 fl oz	foliage 1st & 2nd instars only	12	30 (grain) 3 (grazing or forage)
	methomyl	*Lannate SP	1/4 to 1/2 lb	foliage	48	7 (grain) 10 (grazing or feeding)
	zeta-cypermethrin	*Mustang Max	1.76 to 4.0 fl oz	foliage	12	14 (grain. forage, hay)
	zeta-cypermethrin	*Mustang Maxx	1.76 to 4.0 fl oz	foliage	12	14 (grain. forage, hay)
	chlorpyrifos	*Nufos 4E	1 pt	foliage	24	28 (grain or straw) 14 (forage or hay)
	microencapsulated methyl parathion	*Penncap-M	2 to 3 pt	foliage	48	15 (harvest or graze)
	carbaryl	Sevin 80S	1 1/4 to 1 7/8 lb	foliage	12	21 (grain or straw) 7 (hay or forage)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	28 (grain or straw) 14 (forage, hay)
	spinosad	Tracer naturalyte	1.5 to 3.0 fl oz	foliage, timing important	4	21 (grain or straw) 14 (forage or hay)
	cyfluthrin	*Tombstone Helios	1.8 to 2.4 fl oz	foliage	12	30 (grain)
	lambda-cyhalothrin	*Warrior II with Zeon	1.28 to 1.92 fl oz	foliage	24	30 (grain or straw) 7 (hay or forage)

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Insecticides for wheat - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
Fall armyworm *Spodoptera frugiperda* (J. E. Smith) **Comments:** **Fall armyworm** is a rare pest in the fall of the year on early-planted wheat. Treat fields when 30% or more of plants show "window pane" feeding on foliage and plant stand is decreasing. Best to spray at night when larvae are actively feeding on foliage and air temperature remains above 55 degrees F. Optimal control from Success and Tracer insecticides is best achieved when they are applied at peak egg hatch or when larvae are small.	cyfluthrin	*Baythroid XL	1.8 to 2.4 fl oz	foliage 1st & 2nd instars only	12	30 (grain) 3 (grazing or forage)
	methomyl	*Lannate SP	1/4 to 1/2 lb	foliage	48	7 (grain) 10 (grazing or feeding)
	zeta-cypermethrin	*Mustang Max	1.76 to 4.0 fl oz	foliage	12	14 (grain. forage, hay)
	zeta-cypermethrin	*Mustang Maxx	1.76 to 4.0 fl oz	foliage	12	14 (grain. forage, hay)
	chlorpyrifos	*Nufos 4E	1 pt	foliage	24	28 (grain or straw) 14 (forage or hay)
	microencapsulated methyl parathion	*Penncap-M	2 to 3 pt	foliage	48	15 (harvest or graze)
	carbaryl	Sevin 80S	1 1/4 to 1 7/8 lb	foliage	12	21 (grain or straw) 7 (hay or forage)
	chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	foliage	24	28 (grain or straw) 14 (forage, hay)
	spinosad	Tracer Naturalyte	1.5 to 3.0 fl oz	foliage	4	21 (grain or straw) 14 (forage or hay)
	cyfluthrin	*Tombstone Helios	1.8 to 2.4 fl oz	foliage	12	30 (grain) 7 (grazing or forage)
	lambda-cyhalothrin	*Warrior II with Zeon	1.28 to 1.92 fl oz	foliage	24	30 (grain or straw)
Cereal leaf beetle *Oulema melanopus* **Comments:** **Cereal leaf beetle** is an occasional pest in years with dry springs. Treat when an average of one or more larvae are present per flag leaf or stem. Optimal control from Success and Tracer insecticides is best achieved when they are applied at peak egg hatch or when larvae are small.	cyfluthrin	*Baythroid XL	1.0 to 1.8 fl oz	foliage	12	30 (grain) 3 (grazing or forage)
	methomyl	*Lannate SP	1/4 to 1/2 lb	foliage	48	7 (grain) 7 (hay or forage)
	zeta-cypermethrin	*Mustang Max	1.76 to 4.0 fl oz	foliage	12	14 (grain, forage, hay)
	zeta-cypermethrin	*Mustang Maxx	1.76 to 4.0 fl oz	foliage	12	14 (grain. forage, hay)
	carbaryl	Sevin 80S	1.25 lb	foliage	12	21 (grain or straw) 7 (hay or forage)
	chlorpyrifos + bifenthrin	*Stallion	5.0 to 11.75 fl oz	foliage	24	28 (grain or straw) 14 (forage, hay)
	cyfluthrin	*Tombstone Helios	1.0 to 1.8 fl oz	foliage		30 (grain)
	spinosad	Tracer 4SC	1.0 to 3.0 fl oz	foliage	4	21 (grain or straw) 14 (forage or hay)
	lambda-cyhalothrin	*Warrior II with Zeon	1.28 to 1.92 fl oz	foliage	24	30 (grain or straw) 7 (hay or forage)
Grass sawfly *Pachynematus* sp. **Comments:** Occasional pest found on wheat heads where it may cut wheat heads, but rarely builds to levels requiring management with a pesticide.	cyfluthrin	*Baythroid XL	1.8 to 2.4 fl oz	foliage	12	30 (grain) 3 (grazing or forage)
	zeta-cypermethrin	*Mustang Max	3.2 to 4.0 fl oz	foliage	12	14 (grain. forage, hay)
	zeta-cypermethrin	*Mustang Maxx	3.2 to 4.0 fl oz	foliage	12	14 (grain. forage, hay)
	chlorpyrifos + bifenthrin	*Stallion	5.0 to 11.75 fl oz	foliage	24	28 (grain or straw) 14 (forage, hay)
	cyfluthrin	*Tombstone Helios	1.8 to 2.4 fl oz	foliage		30 (grain)
	lambda-cyhalothrin	*Warrior II with Zeon	1.6 to 1.92 fl oz	foliage	24	30 (grain or straw) 7 (hay or forage)

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Insecticides for wheat - *continued*

Insect	Insecticides: Common name	Insecticides: Trade name	Rate of formulated material per acre	Placement	REI (hours)	Preharvest interval (days)
Grasshoppers (numerous species) **Comments:** Treat when eight or more adults per square yard are present within crop. Barrier treatments in border areas may be required to prevent migration into the crop if more than 20 adults per square yard are present in field margins.	cyfluthrin	*Baythroid XL	1.8 to 2.4 fl oz	foliage	12	30 (grain) 3 (grazing or forage)
	dimethoate	Dimethoate 4EC	3/4 pt	foliage	48	35 (grain) 14 (grazing)
	zeta-cypermethrin	*Mustang Max	3.2 to 4.0 fl oz	foliage	12	14 (grain. forage, hay)
	microencapsulated methyl parathion	*Penncap-M	2 to 3 pt	foliage	48	15 (harvest or graze)
	chlorpyrifos + bifenthrin	*Stallion	5.0 to 11.75 fl oz	foliage	24	28 (grain or straw) 14 (forage, hay)
	cyfluthrin	*Tombstone Helios	1.8 to 2.4 fl oz	foliage		
	lambda-cyhalothrin	*Warrior II with Zeon	1.28 to 1.92 fl oz	foliage	24	30 (grain or straw) 7 (hay or forage)
Wheat curl mite *Aceria tosichella* Keifer	methyl parathion	Cheminova Methyl 4EC	0.5 to 1.5 pts	foliage	96	15 (harvest)

Wheat curl mite - ***Aceria tosichella*** **Keifer**

Comments: Control of this pest best achieved by alternative pest strategies. Alternative strategies may include destruction of volunteer grass and wheat plants approximately two weeks before planting,control grassy weeds in waterways and field borders, use resistant varieties if available. Insecticide applications usually not feasible for this pest.

Note: At this time no foliar rescue insecticide is labeled for control of wheat curl mite. To reduce numbers of wheat curl mite, the destruction of volunteer wheat before planting and use of resistant wheat varieties are recommended.

Winter grain mite *Penthaleeus major* (Duges)

Winter grain mite - *Penthaleeus major* (Duges)

Comments: Winter grain mite is a know pest of small grains and grasses. These mites possess black to dark brown bodies and red to reddish orange legs. The pest produces two generations annually in September/ October and March/April, and eggs survive the summer months by aestivation or slowed develoment. Mite populations are favored by cool temperatures being most active from 40 to 70 degrees F. Moist conditions also favor mite activity as mites move into the soil during hot or dry periods. Winter grain mites are an occasional problem in Missouri wheat during late winter periods when moist conditions and mild winter temperatures prevail.

White grub (numerous species)	**Seed treatments - Neonicotinoid compounds**					
	imidacloprid	Gaucho	See product label	Commercially on seed		
	thiamethoxam	Cruiser	see product label	Commercially on seed		

Comments: White grub in wheat often cause seedling damage during fall which results in stand loss and replacement by weed species. Damage is often observed as yellowing of seedling foliage and plant mortality when damage is severe. Grubs feed on roots, but some species will surface feed if wet conditions exist. If grubs are present before planting, consider either a soil incorporated insecticide or insecticide treated seed.

Wireworms (several species) **Comments:** Wireworm in wheat may cause seedling damage during fall and spring resultin in damaged plants and stand loss. Root and stem damage to wheat plants in fall may result in plant mortality. In spring plant roots may be fed upon by wireworm, but damage is rarely observed on large wheat plants.	**Seed treatments - Neonicotinoid compounds**					
	imidacloprid	Gaucho	See product label	Commercially on seed		
	imidacloprid	Gaucho XT	3.4 fl oz/100 lbs. seed	Commercially on seed		
	imidacloprid	Gaucho 600	0.8 fl oz.100 lbs. seed	Commercially on seed		
	thiamethoxam	Cruiser	see product label	Commercially on seed		
	thiamethoxam	Cruiser 5FS	0.75 to 1.33 fl oz/100 lbs seed	Commercially on seed		
	thiamethoxam	CruiserMaxx Cereal	5.0 fl oz/100 lbs seed	Commercially on seed		
	clothianidin	NipsIt SUITE Cereals	5.0 to 7.5 fl oz/100 lbs seed	Commercially on seed		

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UNIVERSITY OF MISSOURI Extension

■ *Issued in furtherance of the Cooperative Extension Work Acts of May 8 and June 30, 1914, in cooperation with the United States Department of Agriculture. Director, Cooperative Extension, University of Missouri, Columbia, MO 65211*
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M171 New 1/05, Revised 12/12/3C