

# AGRICULTURAL GUIDE

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Conservation tillage

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## No-till planting systems

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In no-tillage planting systems, a planting is made directly into an essentially unprepared seedbed. Evaluate the economical and practical feasibility if you consider a no-till planting system. You won't always completely eliminate tillage, and your management ability and experience often determine the economic reward.

### Advantages

No-till planting systems: 1) reduce erosion; 2) conserve moisture; 3) reduce the size of tractor power and the need for tillage equipment; 4) use less labor; 5) require fewer days for planting crops; 6) use less liquid fuel; 7) increase soil organic matter and tilth; 8) reduce crusting; 9) provide firmer soil conditions at harvest; and 10) reduce soil temperatures.

### Disadvantages

No-till planting systems: 1) rely on herbicides for weed control; 2) require a no-till planter or planter modification; 3) may mean delayed planting because of lower spring soil temperatures and greater moisture under heavy residue; 4) may cause soil compaction in upper soil zone; and 5) may cause different, greater, or more frequent insect, disease, and weed problems than those typical in conventional tillage crop production.

If you understand the constraints, often you can eliminate or reduce them through the wise use and adaptation of tillage and cropping practices to the farming conditions.

This guide sheet explains and outlines practices for more profitable no-till crop production.

### Field selection

You'll find that not all fields or even the same fields

every year should be planted using no-till. Only use no-till planting systems on fields with weeds that can be economically controlled with existing herbicides. For early planting, fields with good drainage are best. A corn-soybean rotation may allow for warmer soils for the following crop. Hilly land, and steep or long sloping fields, benefit the most from the erosion control provided by a no-till system. Monitor fields to determine potential disease and insect problems. Build up fertility (lime and fertilizer nutrients) to medium or higher levels before committing a field to a no-till system. Periodic tillage may be useful to improve soil fertility distribution, close ruts, reduce soil compaction, and reduce certain pest problems which may have resulted from the lack of tillage.

### Residue (or cover crop) management

The objective of residue management is to leave enough residue in place to control erosion but still allow for adequate stand establishment. The more residue that remains, the better is the erosion control. Sixty to 70 percent ground cover is generally required to control erosion effectively and to conserve moisture. Greater or lesser amounts may be needed depending on steepness of slope, length of slope, residue and soil type. Residues along with cover crops, grass waterways, terraces, strip or contour cropping helps control erosion even more.

Under heavy surface residues, soils may remain cool and wet in the spring. Residues may also interfere with proper planter function. Plant fields with heavy residues last to allow soils to warm. Residue cutting and moving devices (extra coulters, V-set disks, trash whippers, tines) can be used if residues inhibit proper planter function.

Cover crops and sod can effectively dry out the

soil in the spring, and they provide a good mulch. When planting in cover crops or sod, the vegetation can be:

- killed with contact or translocated herbicides one to two weeks before planting, if soils have been dry up to that point;
- killed at planting, if soils have been wet; or
- grazed or removed for forage one to two weeks before planting. (This practice allows adequate regrowth for use of a burn-down herbicide.) Grazing or removing the vegetation is particularly beneficial where it's heavy and rodents may be a problem. For adequate kill when you're using contact herbicides, time the killing of the cover crop according to its growth stage.

When doublecropping soybeans or other crops after wheat, leave a 6- to 12-inch stubble. Chop the straw if possible, and distribute it evenly across the surface. Burning can destroy the mulching effect of the straw. Also, the carbon from the burn may bind itself to some herbicides.

## Fertility

Where practical, test the soil in fields destined for no-till systems while they are under conventional tillage. Bring them up then to medium or higher test levels. Incorporate fertilizer and lime uniformly into the soil, if they are needed. If you fertilize uniformly to medium or higher test levels before starting your no-till system, you can maintain crop production with topdress lime and fertilizer applications.

The pH in the top few inches of the soil may decrease in a no-till field when nitrogen fertilizers are applied to the surface. This acidified layer limits root growth, nutrient availability, and herbicide activity. Frequent applications of small amounts of lime will correct the problem.

Take soil test samples for pH in the upper 2 inches to determine when surface acidity problems exist. Use standard 6- to 7-inch soil samples for nutrient requirements. If only the surface 2 or 3 inches of soil requires lime, apply only one-half of the lime recommendation that's given on a soil test report for the surface soil sample.

Avoid over-liming or liming just before planting, particularly if you're using triazine herbicides. High lime (pH) increases the activity of these herbicides, and that can cause crop injury.

In no-till cropping systems, more nitrogen is lost when it's applied to the surface than when it's incorporated or injected into the soil. Also, more nitrogen is lost easier from dry urea than from a 28-percent solution or from ammonium nitrate. On no-till fields, you can inject liquid nitrogen or anhydrous ammonia into the soil, using coulters in front of the injector knives. When you are injecting the nitrogen 4 to 8 inches below the soil surface, use the same rates

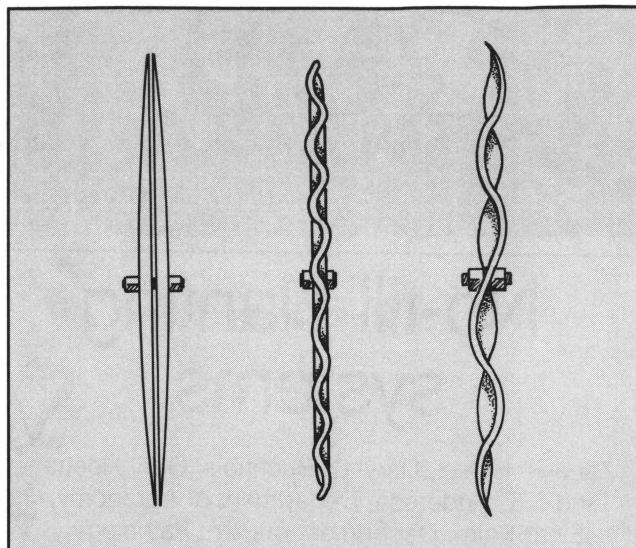


Figure 1. Coulters types: (from left) smooth, ripple or narrow fluted, and wide fluted.

you would use for conventional tillage. If you must apply nitrogen to the surface, increase the recommended rates for conventional tillage by 15 percent.

Take soil test samples for phosphate and potash the standard 6- to 7-inch depth on no-till fields, even though you'll be making applications continuously on the surface. Since there's more moisture under the residue, the roots will feed on surface-applied phosphate and potash. Row applications are beneficial if soil test levels are low. The rates recommended by the soil test report are the same for no-till as for conventional tillage.

## Stand establishment

The requirements for a good stand in a no-till field are the same as for conventional plantings. An acceptable stand requires:

- uniform seed placement at the desired depth;
- uniform planting of high quality seed for the desired population;
- good seed-to-soil contact; and
- adequate moisture and temperature for germination.

In no-till fields, these desired planting characteristics require added field and machinery management.

### Machinery management

Most no-till planters on the market today work well under good soil and residue conditions. However, most will need some adjustments and even modifications when working in heavy residues, compacted or wet soils, on sod fields, or in other difficult situations.

● **Coulters.** Most no-till fields have a certain amount of residue which normally must be cut or moved slightly to allow the seed opener and press

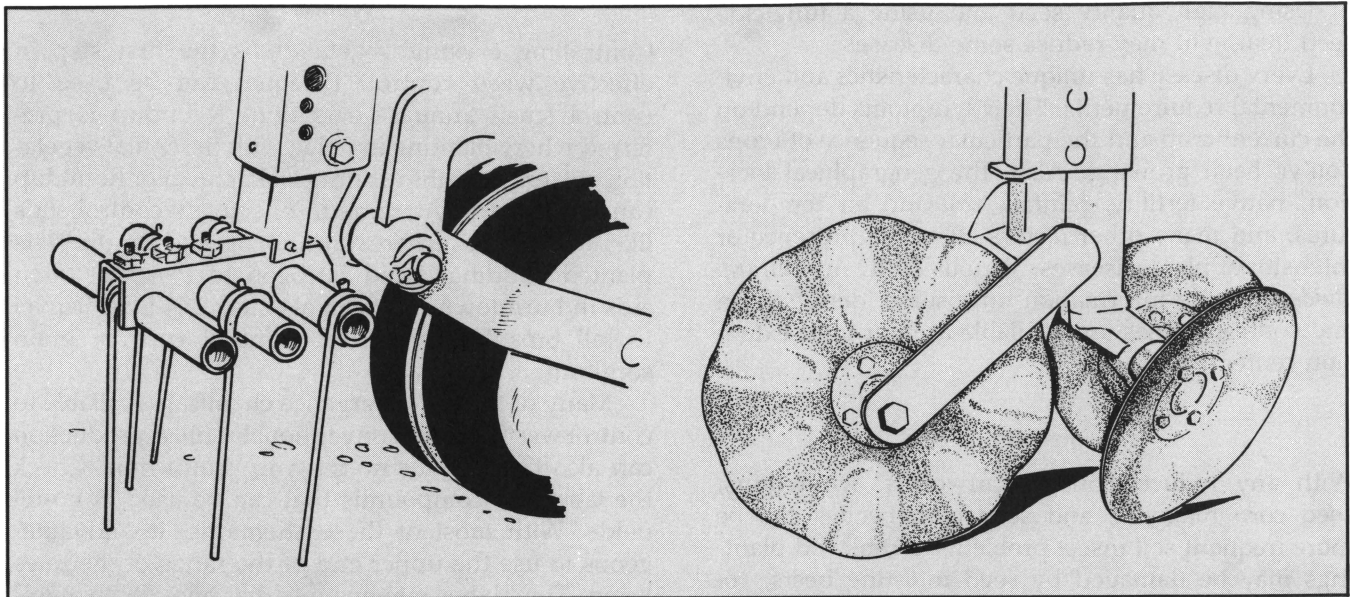


Figure 2. Residue moving devices: rake tines (left) and V-shaped discs.

wheel to function properly. Coulters placed in front of the seed openers cut through these residues. One of three basic coulters is typically used: smooth, ripple or narrow (1 inch) fluted, or wide (2 inch) fluted. Figure 1 shows diagrams of all three.

Smooth coulters are best when used with planters seeding forages or small grains or for cutting residues ahead of some other soil opening or moving device.

Wide, fluted coulters till a sizable slot, which allows the seed opener and press wheels to operate in conditions somewhat similar to conventionally tilled soil. However, these wide coulters have some disadvantages. If soils are wet, hard, or sod bound, or if the planter speed is too fast, the coulters often throw the soil away from the slot. This results in poor depth control and little soil for good seed-to-soil contact. In hard soil, these coulters often need additional weight to get them into the soil.

The narrow, fluted or ripple coulters are generally the preferred type for variable conditions. They throw less soil from the slot than wide, fluted coulters. Still, they open a slot wide enough to let the trailing planting units perform adequately.

A few new planters do not use coulters, but rather heavy duty offset disc seed openers. Experience is limited on their use, but they appear to function very well under good soil conditions.

When contour farming, coulters placement in relation to the seed opener is important. If you place coulters more than 1 to 2 feet in front of seed openers, the openers may not stay in the slot when planting on the contour. If you place coulters closer than 4 to 6 inches to the seed opener, trash or rocks may jam between the coulters and the seed openers.

To some extent, the depth of coulters penetration determines the seeding depth. It's most important to

adjust the coulters and seed opener for a uniformly desired seed depth. As a guideline, set the coulters at  $\frac{1}{4}$  to  $\frac{1}{2}$  inch deeper than the intended seeding depth. Although this setting may not result in the desired seed placement, it's a starting point. Make slight adjustments up or down to achieve the desired planting depth into firm soil.

● **Residue moving devices.** Heavy or wet residue often keeps planters from functioning properly. Instead of cutting the residue, the coulters may just push it into the slot. Even if it is cut, heavy residue may bind in the planter units or cause seed units not to plant at uniform depths. Several devices have been developed to solve these problems. Some planters have two coulters. The first, a smooth coulters, which normally cuts through residue best, is placed in front of a second, fluted or rippled coulters. The first cuts the residue, and the second forms the slot. Another method is to place two coulters side by side or place them at a slight angle.

Recently, two other devices have been developed to move the residue (see figure 2). Rake tines drag along the soil surface, creating a vibrating action, which keeps short light residue (chopped wheat straw) out of the coulters' or seed opener's path. But in long heavy residue (such as corn stalks), this device may actually drag the residue.

Two discs, set in a "V" shape and placed in front of the coulters, will cut some residue and move it to the side. You could also use these devices in front of the seed opener to create a smooth soil surface on trashy or rough soil. Sometimes, large cultivator sweeps are used for the same purpose or in no-till ridge planting.

● **Seed openers.** At least three types of seed openers are available on planters: disc (single or

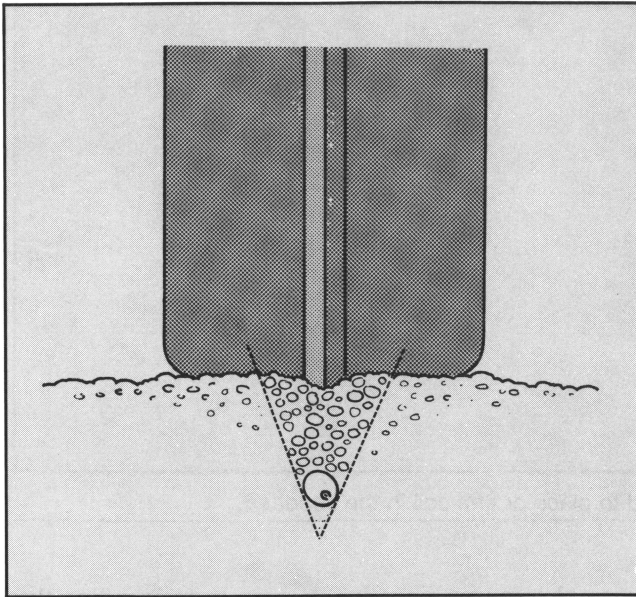


Figure 3. Wide, flat, press wheels ride on the ridges, so they don't allow for good soil compaction around the seed.

double), shank (hoe), or slot (runner). By far, the most popular is the double disc. Double disc openers move through the soil easier and drag less residue than the hoe or runner. Shank and slot seed openers work well in fields where residue is not excessive.

● **Depth control mechanisms.** For uniform planting on uneven fields, each row unit should operate independently of the others. Most planters control the depth of the seed openers from depth (gauge) wheels or bands on the seed openers or from a linkage to the press wheel. Unless gauge wheels are independent of the seed opener (normally double discs), planting over the top of old crop rows (but not in the centers of the rows because of hard soil there) or over other obstructions can cause depth variation. Solve this problem by staying off the old crop rows or by using V-shaped discs or sweeps in front of the seed openers. You won't normally have these problems with depth control from narrow press wheels. However, seed depth may vary on uneven land because the press wheels control depth at some distance from the seed opener.

● **Press wheels.** No-till stand establishment, especially in dry weather, may fail because of difficulty in covering the seed with soil. So lack of moisture, rodents eating the seed, or herbicide injury may result in a poor or variable plant population. To cover the seed firmly, use press wheels or other devices and adjust them properly. Not all press wheels that work effectively in conventionally tilled seedbeds work in no-till conditions. Wide (3 inches or more), relatively flat-shaped press wheels often do not cover the seed unless the soil is loose (see figure 3). These wide

press wheels run on the hard soil or sod that has not been loosened. Using a small dolly wheel in the furrow just behind the seed opener or using scrapers or small covering discs between the opener and press wheel can cover and firm the soil in the seedbed (see figure 4).

In some conditions in no-till fields, the popular V or slanted, narrow, press wheels close the top of the slot, but they fail to firm the soil around the seed (see figure 5). This usually happens on wet, hard, or sod-bound soil where the narrow coulters did not loosen soil to be pressed in the slot. Using a wider coulters, adding weight (or spring down-pressure), or using narrower, heavier (cast iron), press wheels may solve the problem. Offset or single, slanted press wheels may also work.

Some press wheels, like the single, slanted or the small dolly wheel, may give good seed-to-soil contact but may leave the seed poorly covered in wet soil. Scrapers or small covering discs can help.

Despite the type of press wheels used, variable conditions will limit their effectiveness. Instead of changing press wheels or adding other devices, simply adding weight (for example, 400 pounds per row) or spring down-pressure or driving slower may solve many problems.

● **Speed.** Traveling too fast often causes one or more of the planter parts to work poorly, and this results in poor depth control or insufficient seed-to-soil contact. Planter seeding rates may also be affected. A no-till planter can rarely be driven faster than 5 mph and still plant effectively. Most often, 3 to 4 mph should be the maximum. Or, in reality, the maximum speed depends on field conditions and the requirements for stand establishment.

Some of these recommendations for machinery management may or may not be useful to you. You should, however, use whatever practices you can to make your planter create the desired characteristics for good stand establishment.

#### Field considerations at planting time

In the spring, untilled or residue-covered soils often dry and warm up more slowly. Check soil temperatures at the 4-inch depth (at 8 a.m.) before planting. Make no assumptions about soil temperature; check it. The minimum temperature for planting corn is 50 degrees F, for soybeans 55 degrees F, and for grain sorghum 60 degrees F. Forages and small grains can be planted in cooler soils. To allow no-till acres time to dry and warm up, plant your conventionally tilled acres first, if possible. Planting shallower than normal (1½" with corn, 1" with soybeans) will be helpful in cool, moist soils. Certain rotations may provide for lighter residues and permit soils to warm up for early crops.

It's not a good idea to plant no-till fields when it would be too wet for conventional planting. Howev-

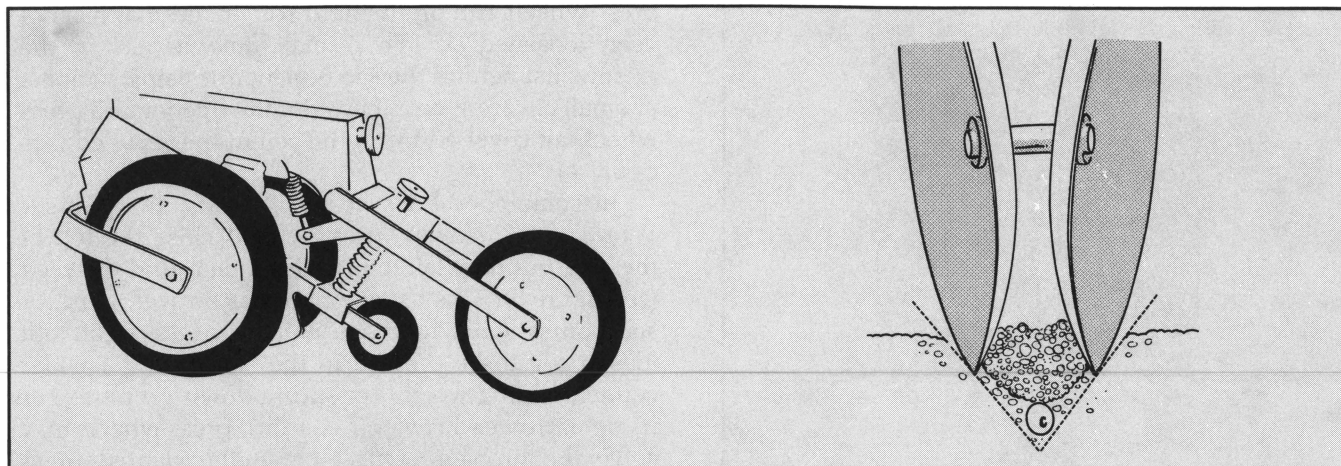


Figure 4. The small dolly wheel (left) or covering discs can be used to place or firm soil in the seedbed.

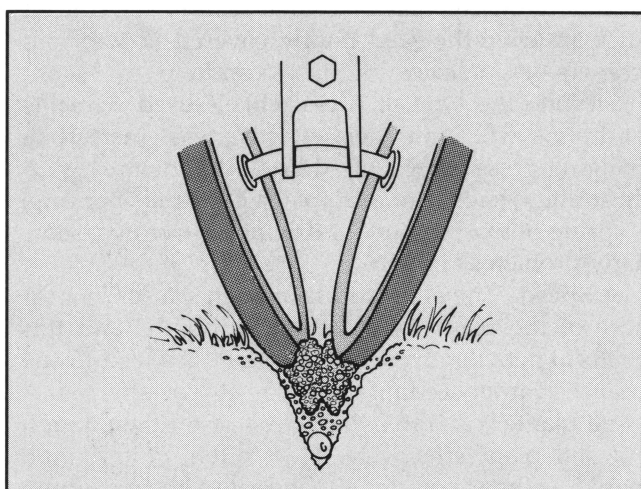


Figure 5. Under wet, hard, or sod-bound soils, the popular V-shaped wheels may not firm all the soil around the seeds.

er, after a light to moderate rain, no-till soils may be ready to plant several hours or even a day before conventionally tilled areas. How well the planter functions finally determines whether planting can proceed.

In fields with stress or variable conditions, high seed quality is a must. If you know that seed depth or seed-to-soil contact will be less than ideal, you may improve stands by increasing the seeding rate by 10 percent.

## Pest control

### Diseases

Disease-causing organisms survive in crop residues left on the soil surface or in volunteer plants. The probability of increased disease incidence in high residue crop production must be considered and monitored.

For a disease to occur, there must be a susceptible host, an aggressive pathogen or causal agent, and a

favorable environment for starting and spreading the infection. If one of these is missing, a disease will not develop. A disease can develop if a pathogen is present in the crop residues, a susceptible crop is planted, and the weather conditions are conducive to disease establishment.

A critical factor affecting the extent and severity of diseases is the survival of disease-causing organisms in crop residues. When a crop is grown continuously, certain fungi and bacteria increase and intensify in crop residues. For example, bacterial blight, anthracnose, brown spot, charcoal rot, downy mildew, pod and stem blight, purple seed strain, and others affecting soybeans become more serious in continuous soybeans and when residues are not covered. Thus, in all tillage systems, avoid growing one crop continuously.

High residue, no-till planting systems increase the potential for disease but not necessarily its occurrence. Covering disease-bearing residue by tilling speeds decay. Many organisms present in the decay process often work against the disease pathogens. Crop rotations also help to prevent disease pathogens from building up. For instance, you could alternate legumes (soybeans) with grasses (corn, sorghum, wheat).

Improved fertility and pH levels can also help reduce certain effects of disease. For example, low potassium in relation to the levels of other nutrients, especially nitrogen levels, can accentuate stalk rot disease in corn. This occurrence results in weakened stalks and increased lodging.

Cultivating or using herbicides may reduce some diseases or destroy the weed hosts of diseases. For example, destroying Johnsongrass can reduce Maize dwarf mosaic and Maize chlorotic dwarf of corn.

A shallow planting of soybeans often results in less damage from root rot diseases. Using green manure crops and other organic material may also beneficially reduce root rot diseases.

Using high quality seed and using a fungicide seed treatment may reduce some diseases.

Every disease has unique characteristics and environmental requirements. Their symptoms depend on the current crop and the particular sequence of crops you've been growing. Also, the geographical location, native fertility, rainfall, soil and air temperatures, and many other factors affect the presence or intensity of plant diseases. Various *UMC Agricultural Guides* provide information on disease identification and control; copies are available at your local extension center.

### Insects

With any reduced tillage, cutworms, wireworms, seed corn maggots, and seed corn beetles can be more frequent soil insect problems. No-till sod plantings may be damaged by seed infesting pests, rodents, and cutworms. Army worms cause damage when corn is 6 to 9 inches or more in height. European corn borers may increase in occurrence where stalks remain on the soil surface for several consecutive seasons.

There is no *one best* control measure for all situations for all soil insects. Scouting, or anticipating where insects might be a problem, is important. The value of seed treatment insecticides increases as the number of tillage operations decreases. Check labels for use of insecticides in no-till fields.

Insecticides normally should be placed in the furrow or incorporated in a band over the row. Apply insecticides according to the label. Either modify application equipment to work under no-till conditions, or choose insecticides that you can use properly with no-till practices.

For more information on controlling insect pests in reduced tillage cropping systems, consult *UMC Agricultural Guide 4906*, "Soil Insect Pest Control in Reduced Tillage Cropping Systems."

### Rodents

Mice, birds, and other pests can be problems in no-till production particularly in sods or heavy residue. Killing the vegetative cover early or harvesting part of the cover can reduce mouse damage. Mesurol is the only chemical currently labeled in Missouri to control mice and birds in no-till production.

### Weeds

Controlling existing vegetation is the first step in effective weed control. Paraquat can be used to control small annual vegetation. Roundup is preferred where planting in fields with perennial vegetation or large growths of annuals. Paraquat or Roundup can be added to Atrazine to effectively control sods like tall fescue where corn or grain sorghum is planted. Adding liquid nitrogen to Paraquat often aids in burndown. You can also use 2, 4-D or Banvel to kill broadleaf weeds in front of corn or grain sorghum.

Many of the pre-emergence chemicals available to control weeds under conventionally tilled production can also be used for no-till crop production. Check the labels for compounds that can be used in no-till fields. With most of these chemicals, it's advantageous to use the upper end of the range of the rates listed. The higher rate ensures that enough chemical is available to go through the residue and into the soil. Organic matter may also build upon the surface after several years. These fields may require higher chemical rates.

Postemergence chemicals are available to control most escaped grass or broadleaf weeds. Except in a double crop situation with heavy straw, these chemicals can be applied as you would on conventionally tilled soils.

Coverage is important, especially with contact herbicides. Increasing the pressure or gallonage may help. In all cases when using herbicides, **read the label** for information on proper application techniques. Herbicides are guaranteed to perform according to label directions. For more information, consult Guide 4905, "Herbicides for Conservation Tillage."

Weed control by mechanical cultivation is difficult in heavy crop residue. Rotary tillers and disk cultivators work in residue, but they bury much of the residue. Thus, they reduce the benefits of conservation and water infiltration. The rolling cultivator is an effective weed control tool which works well in low crop residue and will bury only a small portion of the residue. Coulters can be used to cut residue ahead of cultivators.

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