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# Foliar Fungicides for Wheat

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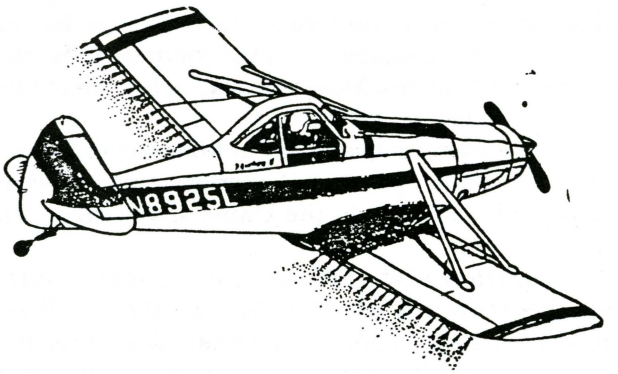


Wheat yields have been increasing in Missouri. Improved varieties, improved fertility management and the use of better crop land for wheat account for much of the increase.

Missouri farmers are showing considerable interest in intensive wheat management. In any given management program, a "high yield production package" must include:

- A high yielding wheat variety with relatively good resistance or tolerance to the major foliar diseases
- A balanced fertility program with emphasis on increased nitrogen applications–fall and spring (summer in some cases)
- Adequate seeding rates to obtain a good stand (1 1/2 to 2 bu/A should be adequate in most situations)
- Good weed control–optimum reduction of weed competition for fertility and water
- Appropriate insect control when needed (e.g. aphids, armyworms, grasshoppers, etc.)
- Growth regulators if needed, to prevent lodging.
- Foliar fungicide applications for reducing losses from leaf, stem and head diseases.

As Missouri farmers continue to pursue higher yields, potential for losses from diseases increases. Farmers need to consider the entire "high yield production package," not just a few of its components.

## Know the diseases

Diseases are a major hazard in wheat production, causing losses through reduced yields and quality of grain. Estimated annual wheat losses from diseases vary from 10 to 25 percent depending upon factors such as weather conditions, soil moisture, soil fertility, crop rotation, prevalence of fungal inoculum in the field or adjacent fields, prevailing winds, and susceptibility of particular varieties to various diseases.

Several leaf diseases of wheat frequently reduce yields. We can expect to see several fungus diseases of wheat: powdery mildew, Septoria leaf blotch, Septoria glume blotch, tan spot (yellow leaf spot), leaf rust, stripe rust (possibly), stem rust, Fusarium scab (mainly a head disease). Losses will vary from season to season. Control of these diseases can improve yields by 15 percent or more.

**Powdery mildew** is common in most wheat fields in the early part of the season under cool weather conditions. It is most abundant in parts of the field where growth is dense and the air is moist. Powdery mildew can become serious under high nitrogen fertility and thick stands. When weather becomes dry and hot, powdery mildew diminishes. If wet weather persists, powdery mildew can cause economic losses. Currently grown wheat varieties range from moderately resistant to susceptible.

**Septoria leaf blotch** is another common disease affecting wheat. The fungus that causes this Septoria disease survives on stubble and on the older leaves of the fall seeded crop. Septoria leaf blotch becomes most aggressive following the boot stage of wheat development. In any year when the leaf infections become serious on the upper leaves, especially the flag leaves, reductions in yield and quality can occur.

**Septoria glume blotch** is present on the leaves along with Septoria leaf blotch. The infections are hard to differentiate. Infections on the glumes come later with warmer weather. This Septoria disease appears to be more prevalent in southern Missouri fields, but can become widespread in certain years. Most wheat varieties are moderately susceptible.

**Tan spot** fungus survives on stubble and straw in the field. It, like Septoria, moves from lower leaves upward during the season. Most winter wheat varieties are moderately susceptible.

**Leaf rust** survives primarily in winter wheat growing regions of the Southern states. Spores blow north in the summer. In most years, leaf rust arrives too late to cause serious damage to Missouri wheat. But it is always a threat to susceptible wheat varieties, in both soft red and hard red winter wheats. Most wheat varieties are moderately resistant to moderately susceptible.

**Stem rust** also has been slow in coming into Missouri wheat in most years and therefore has not caused serious damage. We must continue to be alert to rust race changes. Most wheat varieties are moderately resistant to stem rust.

**Stripe rust** has been seen in Missouri in the past few years, but it appears to be serious only on certain susceptible varieties in the University Variety Trial program.

**Fusarium scab**, although not a leaf disease, becomes serious in wheat fields if weather conditions make possible infections of the heads during the time of anthesis (pollination). The epidemics of scab in Missouri in 1982, 1990 and 1991 proved to be very destructive. All wheat varieties are susceptible. Unfortunately, foliar fungicides have been only slightly effective against this disease. For further information see MU Guides: G4317, Scab of Wheat; G4319, Wheat Diseases in Missouri; and G4350, Leaf and Stem Disease of Wheat.

**Virus diseases** of wheat also can prevent maximized production. Several virus diseases are common to wheat. They include: Barley Yellow Dwarf (BYD), Soil-Borne Wheat Mosaic (SBWM), Wheat Yellow Mosaic (WYM), (also known as Wheat Spindle streak mosaic) and Wheat Streak Mosaic (WSM). Barley yellow dwarf is common to most wheat fields, and takes annual tolls. The soil-borne virus diseases are sporadic throughout certain wheat fields; losses are variable. Wheat streak mosaic can be devastating if extensive fall infections occur. See MU Guide G4318, "Virus Diseases of Wheat" for further information.

The foliar fungicides have no impact on the virus diseases, but the virus diseases can hurt yields, making the fungicides look ineffective.

Other root and lower stem diseases such as Take-all, Sharp eyespot and Strawbreaker as well as several nonparasitic disorders can harm wheat stands. This is true also of Hessian fly injury and other insect injury.

## Know the fungicides

Several protectant or systemic fungicides or combinations are effective in reducing disease potential. Some copper and sulfur fungicides are labeled for wheat, but they are not as effective as the organic materials.

The labeled foliar fungicides for wheat are:

- **Mancozeb** either 80 WP or Flowable– Dithane M-45 or F-45 (Rohm and Haas) or Manzate 200 DF (DuPont) or Penncozeb 80 WP or DF 75% (Atochem)–has been the standard protectant for many years. It is effective against Septoria leaf blotch, Septoria glume blotch, tan spot, and leaf rust, if applied before infection. It is not effective on powdery mildew. First application should be made at about Feeke's growth stages (GS) 9-10 (flag leaf emerged to late boot) and again 10 to 14 days later at about GS 10.3-10.5 (early head to flowering). Use 2 lb/A product of the WP or DF formulations. Begin when diseases threaten or at tillering to jointing stage. The maximum per year is 3 applications. Do not apply within 26 days of harvest.
- **Triadimefon** (Bayleton 50 WP or 50 DF) (Mobay) is a systemic "sterol inhibitor" fungicide that is very effective in control of powdery mildew and leaf rust. It is fair on Septoria diseases and tan spot (not registered for tan spot). Optimum first application should be made at about GS 10.0-10.3 (late boot to early head) Use 2-4 oz product per acre. Label allows for up to 16 oz/A; do not apply within 21 days of harvest. In most years, one application may be adequate, but a second application can be used if weather conditions favor disease development.
- **Triadimefon** (Bayleton) **plus mancozeb**. This combination–Bayleton 2 oz/A + mancozeb 1.5 lb/A (product)–provides a broad spectrum control, including good control of the Septoria diseases and tan spot. Timing is the same as Bayleton above. One application should be adequate unless disease pressure continues to be high or a disease-susceptible variety is used.
- **Triadimefon** (Bayleton) **plus benomyl** (Benlate 50W). This combination–Bayleton 2 oz/A + Benlate 4 oz/A–provides an excellent broad spectrum control of the major foliar diseases from two systemics–a very good performer in experimental studies. One application at about the GS 10.0-10.3 should be adequate unless unusual disease pressure is encountered or a very susceptible variety is grown.
- **Propiconazole** 41.8% (Tilt). (Ciba-Geigy) is a systemic "sterol inhibitor" that provides very good control of powdery mildew and leaf rust. It is also effective on the Septoria diseases but only fair on tan spot. The rate is 4 fluid ounces of product per acre. Label restrictions require that Tilt be applied only one time at the GS 8 (flag leaf emergence). If disease pressure persists, a different fungi-

cide or combination must be used after heading. To avoid possible illegal residues, (1) Do not double-crop treated acreage when Tilt is applied to the first crop unless the second crop appears on this label. (2) Do not graze or feed forage, fodder, or straw from rotational crops planted in the fall or the spring following treatment.

- **Tilt plus mancozeb** (2-4 fl oz + 1.5 lb/A product) is an option that experimental experience and practical considerations tell us is very worthwhile. It broadens the base of disease control and may help to slow the emergence of fungus resistance to the chemical.
- **Benomyl** (Benlate 50W) (DuPont) is a systemic fungicide that provides good control of powdery mildew, Septoria leaf blotch and Septoria glume blotch. It enters the leaf tissues and provides eradicant action. It is not very effective for leaf rust. Apply Benlate 50 WP at 8 oz to 16 oz per acre at the boot stage. Repeat 14 to 21 days later. A non-phytotoxic superior-type spray oil (60 to 70 second viscosity) may be added at the rate of 1 quart per acre to improve spray coverage, or use a "spreader-sticker" spray adjuvant. Add oil or adjuvant as last ingredient to spray tank.
- **Benomyl** (Benlate 50W) **plus mancozeb** (Manzate 200 DF) (DuPont) provides a wider spectrum of control than Benlate alone. The combination of a systemic and protectant provides good control of powdery mildew as well as the Septoria diseases, tan spot and leaf rust. Apply at 4 to 8 oz/A Benlate 50 DF and Manzate 200 DF at 1.5 lbs/A (product). One time at GS 10.0-10.3 should be adequate for Missouri, unless unusual weather conditions occur. Benomyl keeps the leaf tissues green, extending the vegetative period, and the fungicide activity reduces disease. Better filling, improved yield and quality result.
- **Adjuvants and Application**–A non-phytotoxic superior type spray oil may be used with some fungicides. See under Benomyl above. The use of a spreader sticker (e.g. Triton CS-7) will improve fungicide performance. To obtain good coverage, with penetration into the leaf canopy, sufficient water should be used–not less than 15 gallons per acre for ground application; not less than 5 gallons per acre for aerial application.
- **Experimental fungicides** are being developed by several agri-chemical firms that have promise in providing control of foliar diseases of wheat. The firms may pursue label registration when supporting data are complete. Among them are:

  **Folicur** 1.2EC (Mobay), a sterol inhibitor fungicide which performs somewhat like Tilt 3.6 EC (Ciba-Geigy) under Missouri conditions.

  **Rovral** (Rhone-Poulenc) is a fungicide that has been very successful in control of fruit and vegetable diseases. It has shown promise as a wheat fungicide in Missouri experiments (1990-91).

  **Bromuconazole**, formerly EXP 10064B (Rhone-Poulenc) has shown promise in Missouri experiments, alone and in combination with Rovral (1990-1991).

  **Punch**, formerly DPX-1+6573-208 (DuPont) is a fungicide that has performed well in Missouri experiments (1990-1991).

## Spraying considerations

**1. The value of the crop.** A 40 or 60 bushel per acre crop may be able to support the additional expense to reduce disease losses. The potential price of wheat must be considered.

**2. The variety grown.** Most current varieties of soft red winter wheat are fairly tolerant to the major foliar diseases. However, there are some that are quite susceptible to certain diseases (e.g. leaf rust, powdery mildew) and could be seriously hurt if not protected.

**3. The cultural practices.** The former cropping practices, the fertility program, the tillage practices and other factors are important to decisions involving spraying.

**4. The weather conditions.** Weather conditions in the spring and summer are critical to the prevalence, development and severity of the diseases.

**5. The disease situation.** Scouting the wheat throughout the season to determine the aggressiveness of the major foliar diseases (e.g. Septoria leaf blotch, tan spot, powdery mildew, leaf rust) is very important. The disease development is usually correlated with the frequency of rainfall and high humidity.

**6. The applicator.** Be sure to make arrangements with your applicator–whether by aircraft or ground application–ahead of time. Less than optimum timing and rates of application can make the whole operation less than profitable.

Make sure that the equipment is properly calibrated to apply the right amount of fungicide and with droplet size small enough for good coverage. Get good penetration into wheat canopy so that the leaves are well covered.

**7. The time of application.** The optimum time in Missouri for the first application is around the Growth Stage 10.0-10.3 on the Feeke's Scale. The wheat is in the late boot to early head. An exception is for Tilt (Ciba-Geigy), which is mandated by the

Environmental Protection Agency and present label to go on at Growth Stage 8 prior to emergence of heads.

**8. The fungicides.** The major labeled protectant is mancozeb (trade names: Dithane M-45 (Rohm and Haas); Manzate 200 (DuPont); Penncozeb (Ato chem).

The major labeled local systemics are Bayleton, Benlate, and Tilt.

Combinations of protectants and systemics will usually provide a wider spectrum of control.

**9. The economics.** Make sure the inputs for foliar fungicide applications will more than pay for themselves. Paying attention to the above considerations will help you to make judicious decisions. Tables 1 and 2 will help you in decision making.

Performance of the labeled fungicides has been evaluated in field experiments conducted at MU by Einar W. Palm. Since the disease picture is variable from year to year, a composite evaluation of the particular fungicides and various combinations has been made over a period of years.

Table 1, "Ratings of Foliar Fungicides for Wheat Diseases," provides observations over a 7-year period. It should be realized that the performance of the fungicides usually is more effective in a conducted experiment where application and coverage usually are better than under actual field applications. This is true especially if applied by aircraft when gallons per acre may be less and coverage and penetration into canopy are not as good as when more water is used. There are also year-to-year variations in field and weather conditions that affect performance.

The checklist on "How to Determine Whether Foliar Fungicide Applications Should be Made in Winter Wheat" (Table 2) was first prepared in 1983 and revised in 1990. It can be used to good advantage to evaluate the disease situation in a given year and make some helpful projections in what to do.

**Table 1. Major foliar fungicides for use on wheat[1]**

| Fungicide<br>Trade name<br>(manufacturer)<br>[common name] | Rate of Application[3]<br>(product) | Times | Growth Stage<br>(Feeke's Scale) | Disease Control Effectiveness[2]<br>Powdery Mildew | Septoria Diseases | Leaf Rust | Tan Spot |
|---|---|---|---|---|---|---|---|
| **Protectants** | | | | | | | |
| Dithane M45<br>(Rohm & Haas)<br>[mancozeb) or<br>Manzate 200 (DuPont)<br>[mancozeb] or<br>Penncozeb (Ato chem)<br>[mancozeb] | 2 lb. | 1-2 | 9 and 10.5 | P | G | G | G |
| **Systemics and combinations** | | | | | | | |
| Bayleton (Mobay)<br>[triadimefon] | 1-4 oz. | 1-2 | 10.0-10.3 | VG | F | VG | F |
| Bayleton + Mancozeb<br>[triadimefon +<br>mancozeb] | 2 oz. + 1.5 lb. | 1-2 | 10-10.3[5] | G | G | VG | G |
| Bayleton + Benlate<br>[triadimefon +<br>benomyl] | 2 oz. + 4 oz. | 1-2 | 10.0-10.3[5] | VG | VG | VG | VG |
| Benlate +<br>Manzate 200 Flowable<br>(DuPont)<br>[benomyl + mancozeb] | 4-8 oz. + 1-2 quarts | 1-2 | 10.0-10.3 | G | G | G | G |
| Tilt 3.6 EC (Ciba-Geigy)<br>[propiconazole] | 4 fl. oz. | 1[4] | 8.0 | VG | G | VG | F |

*[1]Ratings are based on 7 years of Evaluations of Performance at the University of Missouri, plus comparative data from other States.*

*[2]Disease Control Effectiveness: VG = very good; G = good; F = fair; P = poor*

*[3]Rate of application is suggested label rate–lower rates can be used if 2 applications are made or combinations are used; use higher rates for one application.*

*[4]Tilt should be applied only one time before the boot splits and heads are visible (GS-8). If second application becomes necessary, use other product.*

*[5]Bayleton in combination with mancozeb or benomyl (Benlate) can be applied one time from growth state 10.0 to 10.3. Usually a second application will not be needed unless unusual disease pressure is experienced.*

**Table 2. How to determine whether foliar fungicide applications should be made on winter wheat.**

*Use this point system as a guide to determine your crop's need for a foliar fungicide. It is an attempt to quantify some of the "risk factors"–cultural and weather conditions, disease situations, and economic considerations. The checklist should be used BEFORE early boot stage. Inspect five areas in each 40-acre field and answer the following questions. Pick the answer that best fits your field and place the points for each "yes" answer in the column on the right labeled "your field." This system does not guarantee that yields will be increased sufficiently to pay for fungicide treatment costs. Timely spraying and good coverage are essential for success. There are many factors involved.*

| Risk Factors | Point Value if Answer is Yes | Your Field |
|---|---|---|
| **Cultural and Weather Conditions** | | |
| Wheat in field last year? | 2 | _____ |
| Foliar disease prevalence and severity in wheat last 2 seasons in State (or your area) | | |
| Moderate | 2 | _____ |
| High | 4 | _____ |
| Corn in field last year | 2 | _____ |
| Double crop soybeans in field last year | 1 | _____ |
| Wheat to be used for seed production | 4 | _____ |
| Conservation tillage–residues on surface | 2 | _____ |
| N fertilizer rate/A | | |
| Less than 80 lb/A | 1 | _____ |
| 80 to 90 lb/A | 2 | _____ |
| 90 to 100 lb/A | 3 | _____ |
| More than 100 lb/A | 6 | _____ |
| Rainfall frequency, high humidity in growth stages prior to flag leaf emergence | | |
| Normal | 2 | _____ |
| Above normal | 4 | _____ |
| Other conditions that favor disease development (e.g. 30-day weather outlook - high humidity, frequent rainfall, etc.) | 4 | _____ |
| **Disease Situation** | | |
| Wheat variety highly susceptible to foliar disease (e.g. rust or powdery mildew susceptible) | 3 | _____ |
| Wheat seed was not treated with a fungicide | 1 | _____ |
| Lower leaves with rust symptoms at jointing | 1 | _____ |
| Lower leaves with Septoria symptoms at jointing | 2 | _____ |
| Lower leaves with powdery mildew symptoms at jointing | 1 | _____ |
| **Economic Considerations** | | |
| Yield potential greater than 40 bu/acre | 2 | _____ |
| Price of wheat | | |
| $2.50-$3 | 1 | _____ |
| $3.01-$4 | 4 | _____ |
| $4.01-up | 6 | _____ |
| | **Total** | _____ |

*Add up all points. If the total is 20 or more for a seed production field or 24 or more for a grain production field, using a foliar fungicide on that field may be justified.*

**Prepared by Dr. Einar W. Palm, State Extension Plant Pathologist, University of Missouri, 1983 (Revised 1990)**

# Notes

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