Plant Protection Programs University of Missouri

Integrated Pest & Crop Management

Wheat Foliage Diseases and Their Management

By Laura Sweets

Last year high commodity prices increased the interest in applying foliar fungicides to winter wheat as well as to corn and soybean. This year wheat prices are not as favorable but there is still interest in applying foliar fungicides to winter wheat. There are definitely foliage diseases that can cause losses on winter wheat in Missouri. Leaf rust, stripe rust and Septoria leaf blight are the three most likely to cause losses on soft red winter wheat grown in Missouri. Powdery mildew can be a problem on hard red winter wheat and, under the correct environmental conditions, may also cause losses on soft red winter wheat. The incidence and severity of these foliage diseases will depend on the weather conditions during the growing season, the susceptibility of the variety to each of these diseases and the amount of inoculum in the field or area.

There have been reports of leaf rust developing on wheat in southern states recently. However, there have not yet been any reports of leaf rust or stripe rust on winter wheat in Missouri. We are beginning to receive reports of Septoria leaf blotch in the lower canopy in some wheat fields. The development of foliage diseases on wheat and their severity this season will depend to a large degree on the weather conditions the rest of the season. Most wheat foliage diseases are favored by warm, wet conditions. Frequent light rains, heavy dews, high relative humidity and warm temperatures would be ideal for the buildup of the foliage diseases. The buildup of foliage diseases prior to flowering can lead to yield losses, especially if weather conditions remain favorable for disease development during and after flowering. It is important to scout wheat fields for foliage diseases, especially if there are scattered periods of precipitation as the temperatures warm up. There are a number of foliar fungicides labeled for use on winter wheat. This year in particular, it will be important to evaluate fields for stand and yield potential as well as for incidence and severity of foliage diseases before making a decision on foliar fungicide application.

Lesions of **Septoria leaf blotch** begin as light yellow flecks or streaks. These flecks expand into yellow to reddish-brown, irregularly shaped blotches. Dark brown specks (fruiting bodies or pycnida of the causal fungus, *Septoria tritici*) may be scattered within the centers of mature lesions. Lesions may coalesce killing larger areas of leaf tissue.

Stagonospora glume blotch (formerly called Septoria glume blotch) may also begin as light yellow flecks or streaks on leaves. The lesions also turn yellow to reddish-brown but usually have a more oval to lens shaped appearance than those of Septoria leaf blotch. Again, the dark brown specks or fungal fruiting bodies of the causal fungus *Stagonospora nodorum* may be evident within the lesions. Symptoms of Stagonospora glume blotch are more common on heads than foliage of wheat. Infected heads will have dark blotches on the glumes.

The initial symptoms of **tan spot** are small tan to brown flecks on the leaves. These expand into tan to light brown, elliptical lesions which often have yellow borders. The centers of mature tan spot lesions may have a dark brown region caused by outgrowth of the fungus. But the fungus which causes tan spot, *Pyrenophora tritici-repentis*, does not produce pycnidia or fruiting bodies as the Septoria fungus does. So mature tan spot lesions do not have the distinct dark brown specks scattered throughout the centers of the lesions as do Septoria leaf blotch lesions. Although tan spot can occur in Missouri, it is not usually a problem in the state.

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Leaf rust lesions appear primarily on the upper leaf surfaces and leaf sheaths. Initially, lesions are small, yellow to light-green flecks. Eventually, leaf rust appears as small, circular to oval shaped, orange-red pustules. These pustules break open to release masses of orange-red spores of *Puccinia recondita*. The edges of the open pustules tend to be smooth without the tattered appearance of stem rust pustules. Heavily rusted leaves may yellow and die prematurely.

Stripe rust, caused by the fungus *Puccinia striiformis*, has become more prevalent in Missouri over the last few years. Stripe rust may develop earlier in the season than leaf rust or stem rust. The pustules of stripe rust are yellow or yellowish-red and occur in obvious stripes or streaks running lengthwise on the wheat leaves. This disease is more commonly associated with cooler temperatures, especially cooler night temperatures.

Stem rust, caused by the fungus *Puccinia graminis* f. sp. *tritici*, is most common on stems and leaf sheaths of wheat plants but may develop on any of the above ground portions of the plant including both upper and lower leaf surfaces and glumes and awns. Stem rust pustules are small, oval, and reddish-brown. The ruptured pustules tend to have more ragged edges than leaf rust pustules. Frequently both leaf rust and stem rust occur on the same plant and both types of pustules may develop on an individual leaf.

Powdery mildew infections begin as light-green to yellow flecks on the leaf surface. As powdery mildew develops the leaf surfaces become covered with patches of cottony white mold growth of *Erysiphe graminis* f. sp. *tritici*, the causal fungus. These patches eventually turn a grayish-white to grayish-brown in color and small black fungal fruiting bodies may be visible within the patches of mildew growth.

The fungi which 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. 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, leaf rust and stripe rust. When scouting fields, try to identify the disease or diseases which 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.

A management program for foliage diseases of wheat should include the following steps.

- Plant disease free seed of varieties with resistance to diseases likely to occur in your area.
- Rotate with non-host crops for one or more years.
- 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.
- Control volunteer wheat.
- Use foliar fungicides if warranted (see accompanying tables for additional information on wheat fungicides).

The North Central Regional Committee on Management of Small Grain Diseases (NCERA-184) developed a table containing information on fungicide efficacy for control of certain foliar diseases of wheat. These efficacy ratings were determined by field testing the materials over multiple years and locations by members of the committee. This table is included in this issue of the IPCM newsletter.

Also, there have been questions related to the timing of fungicide application for control of foliage

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diseases as well as the control of Fusarium head blight or scab. The Fungicide Efficacy Table does contain ratings for head scab. A second table in this issue of the IPCM newsletter covers more detailed information on the target diseases and on the timing of application and pre-harvest intervals for the labeled fungicides. Finally, stages of growth for both the Feekes scale and the Zadok's scale are included in the University of Missouri publication, IPM 1022 "Management of Soft Red Winter Wheat" which is available as a printed publication or online.

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Table 1. Overview of Wheat Fungicides by Fungicide Class

See accompanying tables for information on target diseases, timing, rates and efficacy.

Fungicide Class	Active Ingredient(s)	Product
Strobilurin		
	azoxystrobin	Quadris Flowable
	pyraclostrobin	Headline
Triazole		
	metconazole	Caramba
	propiconazole	Tilt PropiMax 3.6 EC Bumper 41.8 EC
	prothioconazole	Proline 480 SC
	tebuconazole[1]	Folicur 3.6F Embrace 3.6 L Monsoon Muscle 3.6 F Orius 3.6 F Tebucon 3.6 F Tebustar 3.6 F Tebuzol 3.6 F Tegrol 3.6 F Toledo
	prothioconazole + tebuconazole	Prosaro 421 SC
Mixed Mode of Action (triazole + strobilurin)		
	metconazole + pyraclostrobing	TwinLine
	propiconazole + azoxystrobin	Quilt
	propiconazole + trifloxystrobin	Stratego Fungicide

[1] Not all generic products containing tebuconazole are registered for use in Missouri.

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Table 2. Target Diseases and Application Timing Information for Foliar Fungicides Labeled for Use on Wheat - Information taken from current pesticide labels - April 2009

Many of these products now have supplemental labels in addition to their initial federal label. Be sure to check for supplemental labels which may contain updated information on target diseases, application timing and preharvest intervals.

Product active ingredient (Company)	Target Diseases Listed on Label	Application Timing Recommendations and Restrictions Preharvest Interval (PHI)
Strobilurin Products		
Headline pyraclostrobin (BASF)	Black point (*Alternaria spp., Helminthosporium* spp.), leaf rust (*Puccinia triticina*), powdery mildew (*Erysiphe graminis* f. sp. *tritici*), Septoria leaf and glume blotch (*Septoria* spp., *Stagonospora* spp.), stem rust (*Puccinia graminis* f. sp. *tritici*), stripe rust (*Puccinia striiformis* f. sp. *tritici*) and tan spot (*Pyrenophora* spp.) Headline does not control Fusarium head blight (head scab) or prevent the reductions in grain quality that can result from this disease	For optimal disease control, begin applications of Headline prior to 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. 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 or Zadok's 59).
Quadris Flowable Fungicide azoxystrobin (Syngenta)	Leaf rust (*Puccinia triticina* = *Puccinia recondita* f. sp. *tritici*), stripe rust (*Puccinia striiformis*), stem rust (*Puccinia graminis*), Septoria leaf and glume blotch (*Septoria tritici, Septoria nodorum*), tan spot (*Pyrenophora tritici-repentis*) and powdery mildew (*Erysiphe graminis*)	Quadris should be applied prior to disease development up to late head emergence (Feekes 10.5 or Zadok's 59). Do not apply within 14 days of harvest for forage and hay. Do not apply later than Feekes growth stage 10.5 (Zadok's growth stage 59). Do not apply within 45 days of harvest for grain and straw.
Triazole Products		
Bumper 41.8 EC propiconazole (Makhteshim Agan of North America, Inc.)	For control of rusts (*Puccinia* spp.), powdery mildew (*Erysiphe* spp.), leaf blight and glume blotch (*Septoria* spp.) and tan spot (*Pyrenophora teres*)	Highest yields are normally obtained when Bumper 41.8 EC is applied to the emerging flag leaf. Bumper 41.8 EC may be applied earlier if disease symptoms appear (especially applicable to barley). Do not graze or feed livestock treated wheat forage or cut the green crop for hay or silage. After harvest, the straw may be used for bedding or feed. For wheat only, Bumper 41.8 EC can be applied until full head emergence (Feekes growth stage 10.5). Do not apply after the specified growth stage to avoid possible illegal residues.
Caramba metconazole (BASF)	Black point (*Alternaria* spp., *Cochiobolus sativus, Helminthosporium* spp.), powdery mildew (*Erysiphe graminis*), rust (*Puccinia* spp.), Septoria leaf and glume blotch (*Septoria* spp., *Stagonospora* spp.), and tan spot (*Pyrenophora trichostoma*) Suppression only- Head scab (*Fusarium* spp.)	For optimal disease control, begin applications of Caramba prior to disease development. To maximize yields in cereals, it is important to protect the flag leaf. For diseases other than head scab (Fusarium head blight), apply Caramba immediately after flag leaf emergence for optimum results. For optimum suppression of Fusarium head blight (head scab), apply Caramba at the beginning of anthesis. No livestock feeding restrictions. Minimum time from application to harvest is 30 days.
Folicur 3.6 F tebuconazole (Bayer CropScience)	Rusts: leaf, stem and stripe (Puccinia spp.) Head blight or scab (Fusarium spp.)- **Suppression**	Rusts: Apply Folicur 3.6 F at the earliest sign of rust pustules on foliage. Fusarium head blight: Optimal timing of Folicur 3.6 F for Fusarium head blight suppression is the beginning of flowering on the main stem heads (Feekes 10.51). Straw may be used for bedding. Do not allow livestock to graze or feed green forage to livestock prior to 6 days after treatment with Folicur 3.6 F. Do not apply within 30 days of harvest.
Muscle 3.6F tebuconazole (SIPCAM AGRO USA, INC.)	Rusts: leaf, stem and stripe (*Puccinia* spp.) Scan or head blight (*Fusarium graminearum*) - **Suppression**	Rusts: Make an application of this product at the first sign of rust pustules on 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. Do not allow livestock to graze or feed green forage to livestock prior to 6 days after application of this product. Straw cut after harvest may be fed or used for bedding. PHI: 30 days.

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Product active ingredient (Company)	Target Diseases Listed on Label	Application Timing Recommendations and Restrictions Preharvest Interval (PHI)
Orius 3.6F tebuconazole (Makhteshim Agan of North America, Inc.)	Rusts: leaf, stem and stripe (*Puccinia* spp.) Head blight or scab (*Fusarium* spp.)- **Suppression**	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 Feekes 10.51). 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 Orius 3.6F. Do not apply within 30 days of harvest.
Proline 480 SC prothioconazole (Bayer CropScience)	Leaf and stem diseases: leaf rust (*Puccinia recondita* f. sp. *tritici*), Septoria leaf and glume blotch (*Septoria tritici*, S. *nodorum*), stem rust (*Puccinia graminis*) and tan spot (*Pyrenophora tritici-repentis*) Fusarium head blight (*Fusarium* spp.) (**Suppression only**)	Leaf and stem diseases: Apply Proline 480 SC as a preventive foliar spray when the earliest disease symptoms appear on the leaves or stems. Fusarium head blight (suppression only): Apply Proline 480 SC within the time period from when at least 75% of the wheat heads on the main stem are fully emerged (~Feekes Growth Stage 10.4) to when 50% of the heads on the main stem are in flower (~Feekes Growth Stage 10.52). Optimal timing of application may be at or around 15% flower (~Feekes Growth Stage 10.51). Proline 480 SC may be applied up to the point where wheat heads are in the full flower growth stage (Feekes 10.52). Do not apply within 30 days of harvest.
PropiMax 3.6 EC propiconazole (Dow AgroSciences)	Early season suppression of glume blotch (*Stagonospora nodorum*), leaf blight (*Septoria tritici*), powdery mildew (*Blumeria* spp. and *Erysiphe* spp.) and tan spot (*Pyrenophora tritici-repentis*) Control of leaf diseases: glume blotch (*Stagonospora nodorum*), leaf blight (*Septoria tritici*), powdery mildew (*Blumeria* spp. and *Erysiphe* spp.), rust (*Puccinia* spp.) and tan spot (*Pyrenophora tritici-repentis*) Fusarium head blight **suppression**	For early season suppression of listed diseases apply in the spring. Follow up with a second application up to Feekes growth stage 10.5 for season long control. The minimum retreatment interval is 14 days. 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. The minimum retreatment interval is 14 days. Apply at approximately 50% flowering for Fusarium head blight suppression. Adding a penetrating type of adjuvant may increase Fusarium head blight suppression. Do not apply within 30 days of harvest for forage, 40 days of harvest for grain and straw and 45 days of harvest for hay.
Prosaro 421 SC prothioconazole + tebuconazole (Bayer CropScience)	Leaf and stem diseases: Powdery mildew (Blumeria spp. Erysiphe spp.), rusts (Puccinia spp.), Septoria leaf and glume blotch (Septoria tritici, S. nodorum) and tan spot (Pyrenophora tritici-repentis) Fusarium head blight (Fusarium spp.)- **Suppression only**	Leaf and stem diseases: Apply Prosaro 421 SC as a preventive foliar spray when the earliest disease symptoms appear on the leaves and stems. Fusarium head blight (suppression only): The optimal time to apply Prosaro 421 SC is as a preventative foliar spray at early flower (Feekes Growth Stage 10.51). 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.
Tebuzol 3.6F tebuconazole (United Phosphorus, Inc.)	Rusts: leaf, stem and stripe (*Puccinia* spp.) Head blight (*Fusarium* spp.)-Suppression	Rusts: Apply Tebuzol 3.6F at the earliest sign of rust pustules on foliage. Head blight: Optimal timing of Tebuzol 3.6F for Fusarium head blight suppression is the beginning of flowering on main stem heads (Feekes 10.51). 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 Tebuzol 3.6F. Do not apply within 30 days of harvest.
Tegrol 3.6F tebuconazole (Luxembourg-Pamol, Inc.)	Rusts: leaf, stem and stripe (*Puccinia* spp.) Scab or head blight (*Fusarium* spp.)	For rusts: Apply at the earliest sign of rust pustules on foliage. For scab or head blight: Apply once as a preventive spray at the beginning of anthesis (flowering), Feekes growth stage 10.51. Do not allow livestock to graze or feed green forage to livestock prior to 6 days after treatment with Tegrol 3.6F. Straw cut after harvest may be fed to livestock or used for bedding. Do not apply within 30 days of harvest.

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Product active ingredient (Company)	Target Diseases Listed on Label	Application Timing Recommendations and Restrictions Preharvest Interval (PHI)
Tilt propiconazole (Syngenta)	Early season suppression of glume blotch (*Stagonospora nodorum*), leaf blight (*Septoria tritici*), powdery mildew (*Blumeria* spp. and *Erysiphe* spp.) and tan spot (*Pyrenophora tritici-repentis*) Control of leaf diseases: glume blotch (*Stagonospora nodorum*), leaf blight (*Septoria tritici*), powdery mildew (*Blumeria* spp. and *Erysiphe* spp.), rust (*Puccinia* spp.) and tan spot (*Pyrenophora tritici-repentis*) Fusarium head blight **suppression**	Apply Tilt 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. 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. Apply Tilt at approximately 50% flowering for Fusarium head blight suppression. Adding a penetrating type of adjuvant may increase Fusarium head blight suppression. Do not apply within 30 days of harvest for forage and 45 days of harvest for hay. Tilt may be applied through full head emergence (Feekes growth stage 10.5). Do not apply after this stage to avoid possible illegal residues.
Toledo Agricultural Fungicide tebuconazole (ROTAM North America, Inc.)	Rusts: leaf, stem and stripe (**Puccinia** spp.) Head blight or scab (**Fusarium** spp.)- **Suppression**	Rusts: Apply Toledo Agricultural Fungicide at the earliest sign of rust pustules on foliage. Fusarium head blight: Optimal timing of Toledo Agricultural Fungicide for Fusarium head blight suppression is the beginning of flowering on main stem heads (Feekes 10.51). 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 Toledo Agricultural Fungicide. Do not apply within 30 days of harvest.
Premix or Combination Products Containing Fungicides with Mixed Modes of Action		
Quilt azoxystrobin + propiconazole (Syngenta)	Early season suppression of glume blotch (*Stagonospora nodorum*), leaf blight (*Septoria tritici*), powdery mildew (*Blumeria* spp. and *Erysiphe* spp.) and tan spot (*Pyrenophora tritici-repentis*) Control of leaf diseases: glume blotch (*Stagonospora nodorum*), leaf blight (*Septoria tritici*), powdery mildew (*Blumeria* spp. and *Erysiphe* spp.), rust (*Puccinia* spp.) and tan spot (*Pyrenophora tritici-repentis*)	Apply Quilt in the spring for suppression of early season diseases. Follow up with a second application for full season control. Protecting the flag leaf is important for maximizing the potential yield. Highest yields are normally obtained when Quilt is applied when the flag leaf is 50% to fully emerged. If disease pressure is low, 10.5 fl. oz./A may be applied. Applications may be made no closer than a 14-day interval. Quilt may be applied through full head emergence (Feekes growth stage 10.5). Do not apply after this stage to avoid possible illegal residues.
Stratego Fungicide propiconazole + trifloxystrobin (Bayer CropScience)	Glume blotch (*Stagonospora nodorum*), leaf blight (*Septoria tritici*), powdery mildew (*Erysiphe graminis*), rusts (*Puccinia* spp.) and tan spot (*Pyrenophora tritici-repentis*)	Begin applications preventively when conditions are favorable for disease development. A second application (minimum interval of 14 days) may be made if needed. If one application or a total of 10 fl oz of Stratego Fungicide per season are applied, do not allow livestock to graze within the treated area 30 days after application, and do not harvest the treated crop for forage within 30 days after application or for hay within 45 days after application. If two applications or a total of 20 fl oz of Stratego Fungicide per season are applied, do not allow livestock to graze within the treated area and do not harvest the treated crop for forage or hay. Do not apply after Feekes growth stage 10.5 (full head emergence). Do not apply within 35 days of harvest.
TwinLine pyraclostrobin + metconazole (BASF)	Black point (*Alternaria* spp., *Cochiobolus sativus*, *Helminthosporium* spp.), powdery mildew (*Erysiphe graminis*), rust (*Puccinia* spp.), Septoria leaf and glume blotch (*Septoria* spp., *Stagonospora* spp.), stripe rust (*Puccinia striiformis*) and tan spot (*Pyrenophora trichostoma*)	For optimal disease control, begin applications of TwinLine prior to 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. Apply no later than the beginning of flowering (Feekes 10.5 or Zadok's 59).

This table was prepared using current company product labels and manufacturers' web sites. The 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. Product names have been used for clarity. Reference to specific trade names does not imply endorsement by the University of Missouri, nor is criticism meant for products not listed.

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Table 3. Management of Small Grain Diseases 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 U.S. 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 labeled products, and is not intended to be a list of all labeled products.

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*	*Head scab*	*Harvest Restriction*
Class	*Active Ingredient*	*Product*	*Rate/A (fl. oz)*								
Strobilurin	Azoxystrobin 22.9%	Quadris 2.08 SC	6.2-10.8	F(G)[1]	VG	VG	E	E[2]	E	NR	45 days
	Pyraclostrobin 3.6%	Headline 2.09 EC	6.0-9.0	G	VG	VG	E	E[2]	E	NR	Feekes 10.5
Triazole	Metconazole 8.6%	Caramba	10.0-17.0	__[3]	__[3]	__[3]	__[3]	E	E	G	30 days
	Propiconazole 41.8%	Tilt 3.6 EC PropiMax 3.6 EC Bumper 41.8 EC	4.0	VG	VG	VG	VG	VG	VG	P	40 days[5]
	Prothioconazole 41%	Proline 480SC	5.0-5.7	__[3]	VG	VG	VG	__[3]	VG	G	30 days
	Tebuconazole 38.7%	Folicur 3.6 F 4 Embrace 3.6 L Monsoon Muscle 3.6 F Orius 3.6 F Tebucon 3.6 F Tebustar 3.6 F Tebuzol 3.6 F Tegrol Toledo	4.0	G	VG	VG	VG	E	E	F	30 days
	Prothioconazole 19% Tebuconazole 19%	Prosaro 421 SC	6.5-8.5	G	VG	VG	VG	E	E	G	30 days
Mixed mode of action	Metconazole 7.4% Pyraclostrobin 12%	Multiva TwinLine	6.0-11.0	G	VG	VG	E	E	E	NR	Feekes 10.5 and 30 days
	Propiconazole 11.7% Azoxystrobin 7.0%	Quilt 200 SC	14.0	VG	VG	VG	VG	E	E	NR	45 days[5]
	Stratego 250 EC	10.0	G	VG	VG	VG	VG	VG	VG	NR	35 days

[1] Efficacy categories: NR=Not Recommended; P=Poor; F=Fair; G=Good; VG=Very Good; E=Excellent. Efficacy designation with a second rating in parenthesis indicates greater efficacy at higher application rates.
[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] Generic products containing tebuconazole may not be labeled in all states
[5] The pre-harvest interval for Quilt is under review by EPA and may be adjusted to consider a growth stage restriction. April 2009 the pre-harvest intervals for both Quilt and Tilt have been changed to through Feekes 10.5 with no days before harvest restriction.
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.

Potential for True Armyworm Problems in Grass Crops

By Wayne Bailey

Present Situation: Armyworm moth numbers are elevated in a couple areas of the state and relatively low in many others. This could change rapidly if additional moths either emerge from overwintering sites in Missouri or migrate into the state from more southern states. In those areas where moth numbers are elevated, producers are encouraged to scout grass, wheat, and corn fields to determine true armyworm larval numbers. If thresholds are reached or exceeded, then specific insecticides are recommended for treatment of this pest.

About every four years the True armyworm, *Mythimna unipuncta* (formerly *Pseudaletia unipuncta*), is a moderate to serious pest of many grass crops in Missouri. Although larvae of this pest may attack a wide range of host plants, most problems in Missouri occur in tall fescue seed and forage fields, wheat and other small grain crops, and occasionally to field corn. Economic important infestations of true armyworm often develop when several factors occur at the same time to favor armyworm distribution and population increases. These factors include (1) emergence of high numbers of moths from overwintering sites in the state, (2) early spring migration of moths into Missouri from more Southern states, often helped by spring storms arriving from more southern locations, (3) reduced numbers of beneficial insects which allow for better survival of armyworm larvae, (4) the occurrence of cool, wet spring conditions which favor lush growth of tall fescue and wheat plants which serves as good egg laying and larval feeding sites, and (5) the natural rhythm of true armyworm populations which often peak about every four years in Missouri. All of these factors are present to some degree this spring and certainly increase the possibility of economic infestations of true armyworm developing in areas of the state where moth captures are occurring in relative high numbers.

Monitoring of true armyworm larvae are provided by the University of Missouri IPM Network with the assistance of 33 regional extension specialists who trap armyworm moths across the state and from meteorological data provided by the statewide system of commercial agriculture weather stations. Male true armyworm moths are captured using traps baited with a synthetic version of pheromones emitted naturally by the female armyworm moths to attract males. When numbers of male moths captured in traps reach levels of 100 to 200 or more moths per night for several nights, the potential for true armyworm problems in fields located within a few miles of the trap is elevated. If several traps within a region capture high numbers of moths for several nights in the spring, then true armyworm problems may cover several thousand acres of forages in the state similar to problems experienced with this pest a few years ago in north-central Missouri, where over 500,000 acres of tall fescue were heavily infested. Wheat fields may also experience problems with true armyworm as larvae feed on foliage and occasionally will cut seed heads from developing wheat plants. In field corn, economic infestations of this pest are uncommon, but often cause severe defoliation when they occur. True armyworm moth capture counts can be found on-line at www.ipm.missouri.edu. At the site go to pest monitoring and select true armyworm. At this site you can view all moth capture numbers in the state or search for numbers by specific regions of the state. NOTE: Although elevated numbers of moth captures often result in economic infestations of true armyworm, in some years other factors (insect pathogens, predators and environmental conditions) may limit the development and growth of this pest. To determine risk from true armyworm larvae in specific fields, producers in areas of elevated moth captures are encouraged to scout for the presence of true armyworm larvae to determine larval armyworm numbers in their forage and crop fields.

Scouting for armyworm larvae is best accomplished during the night, early morning or late evening as newly

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hatched larvae avoid light and feed on the lower leaves of grasses during hours of reduced light intensity. As larvae grow in size, they will feed higher on the host plant even during daylight hours. True armyworm larvae grow through 7 or more larval or worm stages often referred to as "instars". Larvae newly emerged from eggs are very tiny, but quickly grow to about 1 ½ inches in length when full grown. Larvae are greenish-brown in color with a pale stripe running the length of the back and an orange line running the length of each side of the larva. The head capsule is light brown in color and the body is generally smooth and mostly hairless. A good identifying characteristic for this insect in the larval stage is the presence of a dark brown to black triangle located on the outside of each of the four pairs of prologs found on the middle to back part of the insect body. The tip of the foot on each of these prologs is also dark in color if viewed from under the larvae looking outward.

If true armyworm larvae are present in grass, small grain, or field corn crops, use the following thresholds to determine if treatment is justified and recommended insecticides for each specific crop.

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Table 1. Insecticides Labeled for Use on True Armyworm in Tall Fescue Seed and Forage Fields, Grass pastures, and Grass Hay Fields

Insecticides Labeled for Use on True Armyworm in Tall Fescue Seed and Forage Fields, Grass pastures, and Grass Hay Fields

Comments: Occasional severe pest of grass seed and forage fields. Treat 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 seed heads are cut from stems. Scout at dusk, dawn, or at night for best results. Small larvae feed on foliage at night and remain in plant debris near ground surface during day.

Common Name	*Trade Name*	*Rate of formulated material per acre*	*Placement*
carbaryl	**Sevin XLR Plus**	2 to 3 pt	broadcast
malathion	**57% Malathion**	1.5 to 2 pts	broadcast
zeta-cypermethrin	***Mustang Max**	2.8 to 4.0 fl oz	broadcast

* **Designates a restricted-use pesticide. Use is restricted to certified applicators only.** Regardless of the formulation selected, read the label to determine appropriated insecticide rates, directions, precautions, and restrictions.

Table 2. Insecticides Labeled for Use on True Armyworm in Wheat

Insecticides Labeled for Use on True Armyworm in Tall Fescue Seed and Forage Fields, Grass pastures, and Grass Hay Fields

Comments: Occasional severe pest of wheat and grass pastures. Treat 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.

Common Name	Trade Name	Rate of formulated material per acre	Placement
lambda-cyhalothrin	***Karate**	1.28 to 1.92 fl oz	On foliage
methomyl	***Lannate LV**	3/4 to 1-1/2 pt	
zeta-cypermethrin	***Mustang Max**	3.2 to 4.0 fl oz	broadcast
microencapsulated methyl parathion	***Penncap-M**	2 to 3 pt	
lambda-cyhalothrin	***Proaxis**	2.56 to 3.84 fl oz	
carbaryl	**Sevin XLR Plus**	2 to 3 pt	
spinosad	**Success**	3.0 to 6.0 fl oz	
spinosad	**Tracer 4SC**	1.0 to 3.0 fl oz	
lambda-cyhalothrin	***Warrior**	2.56 to 3.84 fl oz	

* **Designates a restricted-use pesticide. Use is restricted to certified applicators only.** Regardless of the formulation selected, read the label to determine appropriated insecticide rates, directions, precautions, and restrictions.

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Potential for True Armyworm Problems in Grass Crops *continued from page 45*

Table 3. Insecticides labeled for Use on True Armyworm in field corn

Insecticides Labeled for Use on True Armyworm in field corn			
Comments: Treat 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 seed heads are cut from stems. Scout at dusk, dawn, or at night for best results. Small larvae feed on foliage at night and remain in plant debris near ground surface during day. Treat seedling corn when 25% or more of plants are being damaged. Control is justified after pollen shed if leaves above ear zone are being consumed by larvae. Optimal control from Success or Tracer is best achieved when the insecticide is applied at peak egg hatch or when larvae are small.			
Common Name	***Trade Name***	***Rate of formulated material per acre***	***Placement***
permethrin	***Ambush 25W**	6.4 to 12.8 fl oz	broadcast
esfenvalerate	***Asana XL**	5.8 to 9.6 fl oz	broadcast
cyfluthrin	***Baythroid XL**	1.6 to 2.8 fl oz	broadcast
bifenthrin	***Brigade 2EC** ***Brigade 2EC** ***Brigade 2EC**	2.1 to 6.4 fl oz 2.56 fl oz 3.0 to 4.0 fl oz	broadcast PRE (pre-emergence) PPI (pre-plant incorporated)
bifenthrin	***Capture LFR** ***Capture LFR** ***Capture LFR**	3.4 to 6.8 fl oz 3.4 fl oz 4.0 to 5.3 fl oz	broadcast, band, in-furrow PRE (pre-emergence) PPI (pre-plant incorporated)
chlorpyrifos + gamma-cyhalothrin	***Cobalt**	13 to 26 fl oz	broadcast
bifenthrin	***Fanface 2EC**	2.1 to 6.4 fl oz	broadcast
zeta-cypermethrin + bifenthrin	***Hero**	4.0 to 10.3 fl oz	broadcast
methoxyfenozide	**Intrepid 2F**	4.0 to 8.0 fl oz	broadcast
methomyl	***Lannate LV**	0.75 to 1.5 pt	broadcast
chlorpyrifos	***Lorsban 4E**	1 to 2 pt	broadcast
chlorpyrifos	***Lorsban Advanced** ***Lorsban Advanced**	1 to 2 pt 1 to 2 pt	preplant, at-plant, preemerge postemergence
zeta-cypermethrin	***Mustang Max**	3.2 to 4.0 fl oz	broadcast
chlorpyrifos	***Nufos 4E**	1 to 2 pt	broadcast
microencapsulated methyl parathion	***Penncap-M**	2 to 3 pt	broadcast
permethrin	***Pounce 3.2EC**	4.0 to 8.0 fl oz	broadcast
lambda-cyhalothrin	***Proaxis**	2.56 to 3.84 fl oz	broadcast
carbaryl	**Sevin XLR Plus**	2 to 4 pt	broadcast
spinosad	**Success**	3.0 to 6.0 fl oz	broadcast
spinosad	**Tracer 4SC**	1.0 to 3.0 fl oz	broadcast
lambda-cyhalothrin	***Warrior**	2.56 to 3.84 fl oz	broadcast

* **Designates a restricted-use pesticide. Use is restricted to certified applicators only.** Regardless of the formulation selected, read the label to determine appropriated insecticide rates, directions, precautions, and restrictions.

For more information and the IPM Pest Monitoring Network, visit ppp.missouri.edu

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ppp.missouri.edu/pestmonitoring/index.htm

Weather Data for the Week Ending April 21, 2009

By Pat Guinan

		Weekly Temperature (oF)						Monthly Precipitation (in.)		Growing Degree Days‡	
Station	County	Avg. Max.	Avg. Min.	Extreme High	Extreme Low	Mean	Departure from long term avg.	April 1 - April 21	Departure from long term avg.	Accumulated Since Apr. 1	Departure from long term avg.
Corning	Atchison	68	46	71	38	57	+3	1.39	-0.67	48	+13
St. Joseph	Buchanan	65	46	70	40	55	0	1.93	-0.67	39	-10
Brunswick	Carroll	65	42	74	33	54	-3	2.89	+0.67	35	-19
Albany	Gentry	65	44	70	35	54	-1	1.69	-0.77	33	-3
Auxvasse	Audrain	64	43	74	36	54	-2	2.22	-0.51	31	-25
Vandalia	Audrain	65	42	74	34	54	-2	2.35	-0.43	30	-14
Columbia-Jefferson Farm	Boone	64	43	74	35	54	-3	1.59	-1.33	36	-37
Columbia-South Farms	Boone	64	44	74	35	54	-3	1.76	-1.16	36	-36
Williamsburg	Callaway	64	42	73	35	54	-2	2.21	-0.86	29	-26
Novelty	Knox	63	41	72	34	53	-2	2.73	+0.26	24	-21
Linneus	Linn	65	43	71	32	54	-1	2.94	+0.55	29	-12
Monroe City	Monroe	63	42	71	35	53	-4	2.81	+0.29	25	-34
Versailles	Morgan	66	44	76	34	56	-3	1.63	-1.52	49	-49
Green Ridge	Pettis	66	44	76	34	55	-2	2.62	+0.06	41	-20
Lamar	Barton	66	46	71	38	56	-2	1.98	-0.85	58	-43
Cook Station	Crawford	66	40	78	31	54	-4	4.25	+1.33	35	-73
Round Spring	Shannon	69	40	78	32	55	-3	3.11	+0.30	36	-54
Mountain Grove	Wright	64	43	71	29	54	-3	3.52	+0.39	35	-38
Delta	Cape Girardeau	66	46	76	39	56	-3	3.47	+0.81	60	-70
Cardwell	Dunklin	69	49	78	38	58	-3	3.04	-0.25	105	-67
Clarkton	Dunklin	68	47	76	39	57	-5	3.22	+0.45	84	-81
Glennonville	Dunklin	68	48	75	37	57	-5	2.74	+0.06	90	-79
Charleston	Mississippi	67	46	76	40	56	-3	3.12	+0.07	71	-56
Portageville-Delta Center	Pemiscot	68	48	77	42	58	-3	2.68	-0.61	108	-59
Portageville-Lee Farm	Pemiscot	68	49	78	43	58	-3	2.98	-0.30	107	-57
Steele	Pemiscot	69	49	77	40	58	-3	2.52	-0.71	117	-49

* Complete data not available for report

‡Growing degree days are calculated by subtracting a 50 degree (Fahrenheit) base temperature from the average daily temperature. Thus, if the average temperature for the day is 75 degrees, then 25 growing degree days will have been accumulated.

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