Integrated Pest & Crop Management

A Lot of Calls about Carryover

by Kevin Bradley

Over the past two days, I've received numerous calls of herbicide carryover injury from applications of herbicides that contain fomesafen made last season.

Fomesafen is the active ingredient in the herbicides Dawn, Flexstar, Flexstar GT, Prefix, Rhythm, Marvel and a variety of other generic products, and in recent years has become one of the most common active ingredients applied post-emergence for the control of glyphosate-resistant waterhemp in soybean. Of the herbicides that we typically apply post-emergence in soybeans, fomesafen is one of the most persistent and has one of the longest periods of soil residual activity. Because of this soil persistence as well as the sensitivity of corn to fomesafen residues, the label of most fomesafen products like Flexstar and Prefix requires a 10-month rotational interval between fomesafen applications and corn planting.

For some of the calls and complaints I've had this week related to fomesafen carryover, this 10-month rotational interval between application and planting was not followed. However, in some of these instances, there has been more than 10 months elapsed between application and planting.

There are two primary factors that influence the likelihood of fomesafen carryover injury to corn; 1) dry conditions following application, and 2) the rate and timing of the herbicide application. I also think that we should consider the impact of our colder-than-normal winter on fomesafen carryover. I can't find any research data to support this, but it makes sense to me that microbial degradation may have been reduced in response to the extended winter we just experienced.

There's no question though that the number one factor that influences the likelihood of fomesafen carryover is precipitation between application and planting. Soil moisture is critically important for herbicide degradation. If adequate rainfall is not received after application, then the chemical and microbial processes responsible for herbicide degradation are reduced significantly and the herbicide molecules are more likely to become bound (adsorbed) to soil particles. All of this results in less herbicide degradation and increases the likelihood of herbicide carryover. Injury may also be more noticeable on sandy soils, as these areas are usually better drained and hold moisture for shorter periods of time. In some of the locations that have reported fomesafen

Continued on page 3 ▶

Figure 1. Fomesafen carryover on corn leaves appears as a clearing of the veins, known as veinal chlorosis.

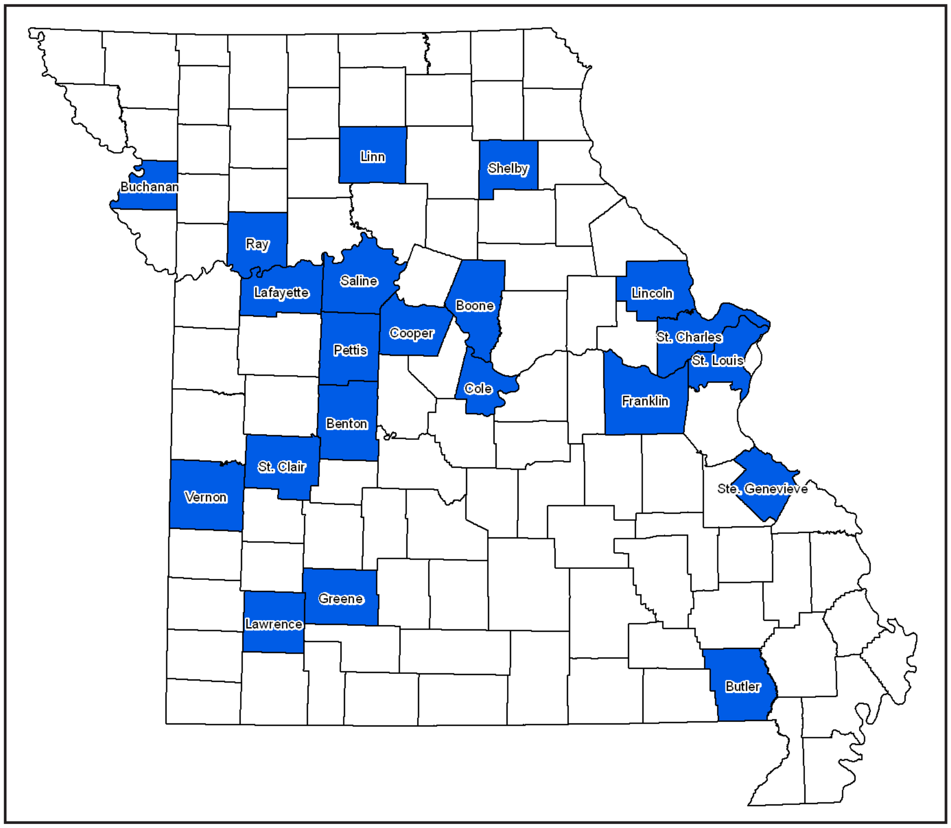
In This Issue

Monitoring Systems in place for Brown-Marmorated-Stink-Bug-and-Spotted-Wing-Drosophila for 2014

by Jaime Panero

The Lincoln University (LU) IPM program in partnership with the University of Missouri IPM program is coordinating a monitoring system for Spotted Wing Drosophila (SWD), Drosophila suzukii, starting in late May, 2014.

Quick Facts about Spotted Wing Drosophila (SWD): SWD is a very serious new invasive pest that attacks small fruit crops, some stone fruits (cherry, nectarine, peach), and wild hosts (including pokeweed, autumn olive, crabapple, nightshade, Amur honeysuckle, and wild grape). Raspberries, blackberries, blueberries, and grapes are at the greatest risk. SWD flies look similar to the small vinegar flies that are typically found around or on fermenting fruits and vegetables. However, unlike those native vinegar flies, SWD females have a serrated egg-laying device (called ovipositor) to cut a slit into the skin of intact fruit to lay their eggs. This makes SWD a more significant pest.



The first adult SWD were detected by monitoring traps in Missouri in late June, 2013. By early August, infestations of blackberry fruits had already been reported. By mid August, SWD was reported infesting crops state-wide.

Thanks to a grant funded by the Missouri Department of Agriculture Specialty Crops Block Grants, traps and bait for monitoring SWD can be provided for free by contacting Dr. Jaime Pinero (573-681-5522), or Jacob Wilson (573-681-5591). For additional information, contact your nearest MU Extension office.

Starting in late May, 2014, SWD monitoring traps baited with a combination of active dry yeast, sugar, and water will be deployed in at least 22 counties throughout the state (see map showing counties with trappers).

Monitoring traps will be checked on a weekly basis and SWD will be identified and counted. Data will be entered on-line into a database displayed on the MU IPM Program website (http://ipm.missouri.edu). Information about the presence, distribution, and abundance of SWD s will be posted in this website and also in the LU IPM program blog (http://www.LU-IPM.net). Email alerts will then be sent to a list serve of interested people if trap counts reach significant levels. If you are interested in receiving alerts on SWD, click here: http://ipm.missouri.edu/pestmonitoring/subscribe.htm.

If you would like to get information about SWD identification and monitoring guide that will be used to monitor for SWD in Missouri's farms, click here: http://www.lincolnu.edu/web/programs-and-projects/ipm or at: http://www.LU-IPM.net.

Another invasive insect pest that will be monitored by the LU IPM Program during 2014 is the Brown Marmorated Stink Bug (BMSB), Halyomorpha halys. The BMSBis native to China.

Quick Facts about Brown Marmorated Stink Bug (BMSB): BMSB is a voracious eater that damages fruit, vegetable, and ornamental crops in North America. BMSB infestations have spread to 41 US states and to Europe's farm basket.

Continued on page 3 ▶

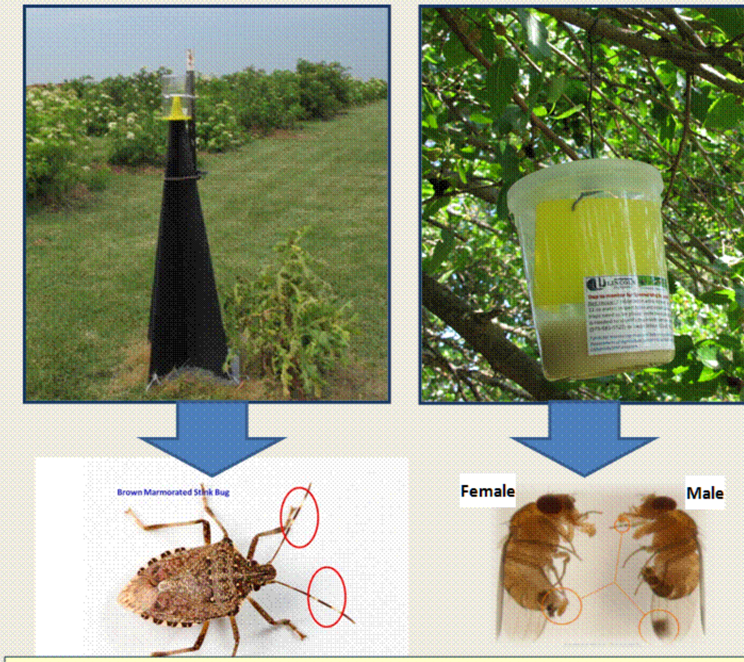
Monitoring Systems in place for Brown-Marmorated-Stink-Bug-and-Spotted-Wing-Drosophila for 2014

continued from page 2.

Adult BMSB can live through the super-cold and snowy winter by making their own antifreeze. Beginning in late May/early June this invasive stink bug will start feeding on a wide range of fruits, vegetables, and other host plants including peaches, apples, green beans, corn, soybeans, cherry, raspberries, and pears.

The nearest large BMSB populations to Missouri were detected in western Illinois in the fall of 2013, with homeowners reporting BMSB invading homes in preparation for overwintering. Proximity to forest is a risk factor for agricultural crops. Proximity to soybeans has been a risk factor for nurseries in other states. The following website presents excellent information about BMSB: http://www.stopbmsb.org.

To monitor for this species, black pyramid traps baited with pheromone lures will be deployed in late May in at least 15 farms located largely in East-Central, Central, West-Central and SW Missouri. For more information about BMSB monitoring in Missouri go to http://www.LU-IPM.net. ■



Left: Monitoring trap for BMSB. Pheromone lure is placed inside the trap top. Adult BMSB have white stripes on antennae and faint white bands on legs, and outer edges of the abdomen alternating white and dark markings ("marmorated").

Right: Monitoring trap for SWD. Best bait is a combination of active dry yeast, sugar, and water. Male SWD have one dot on each wing, females have a serrated egg-laying structure (ovipositor) used to pierce the skin of the fruit to lay the eggs

A Lot of Calls about Carryover

continued from page 1.

carryover this week, precipitation totals have been off by as much as 17 inches from the 15 year average for the time period following application to now.

The rate and the timing of the fomesafen application are two other factors that influence the likelihood of carryover injury to corn. Simply put, the higher the rate of fomesafen applied and the later the herbicide application was made, the greater the chance that some fomesafen may remain to cause carryover injury to corn. Since the labels of most fomesafen-containing products require a 10-month rotational interval between application and corn planting, late-season applications of these products in soybeans and early planting of corn the following spring can often make satisfying these intervals difficult.

The most common corn injury symptom caused by fomesafen carryover is a whitening of the leaf veins, commonly referred to as veinal chlorosis (Figures 1 and 2). Affected areas of corn leaves often take on a striped appearance, can become necrotic, and tissue near the leaf midrib may totally collapse in that region. The root system of affected plants usually remains normal, and plants can take on somewhat of a "droopy" appearance as well.

Figure 2. Carryover injury to corn as a result of late applications of fomesafen made to soybeans the previous season, and dry conditions following application.

The real question everyone is asking about this issue is, "Is this going to kill my corn?" All I can say is, I've rarely seen a fomesafen carryover issue in corn that is bad enough to justify killing the corn and starting over. And I don't believe this is warranted for any of the fields or photos I've seen this week either. Usually the most effective thing we can do is wait for the corn to get some good growing conditions and heat units, and the roots will grow out of that fomesafen "zone" and plants will recover. Monitor the new growth closely in the next 5 to 7 days and as long as the new leaves have a healthy green color, you should be fine for the rest of the season. ■

Missouri State Approved Soil Testing Labs for 2014

by Manjula Nathan

The Missouri Soil Testing Association (MSTA) Approval Program is designed to assure that results provided by participating public and private labs serving the citizens of Missouri agree with allowable statistical limits. This is accomplished by evaluating the soil testing laboratories in their performance through inter-laboratory sample exchanges and a statistical evaluation of the analytical data. Based on this premise, soil test results from MSTA approved labs will be accepted by the U.S. Department of Agriculture, Farm Service Agency (FSA) and Department of Natural Resources and Conservation Services (NRCS) in federally assisted cost share programs and nutrient management plans in the state of Missouri.

Beginning in 1999, MSTA combined its efforts with the North American Proficiency Testing Program (NAPT). In order to be approved by the Missouri State program, the participating labs should participate in all four quarter exchanges of the NAPT program and submit the MO State data release form each year to the NAPT coordinator. The NAPT coordinator in return sends soil test data from quarterly sample exchanges of the labs participating in MSTA program to the Missouri state coordinator. The MU Soil Testing Lab director serves as the state program coordinator and performs statistical analysis of the data as specified in the MSTA program. If a lab's results fall within the allowable limits, the lab will be placed on the Farm Service Agency's (FSA) list of approved labs. A lab that is not approved may re-apply after a year. An updated listing of Missouri State Approved Soil Testing lab list can be found at:

http://soilplantlab.missouri.edu/soil/msta.aspx

List of Missouri State Approved Soil Testing Labs, 2014

- Custom Lab
  204 C St.
  Golden City, MO 64748
  Telephone: 417-537-8337
  Fax: 417-537-8337
- Delta Soil Testing Lab
  University of Missouri
  PO Box 160
  Portageville, MO 63873
  Telephone: 573-379-5431
  Fax: 573-379-3383
- MU Soil and Plant Testing Lab
  University of Missouri
  23 Mumford Hall
  Columbia, MO 65211
  Telephone: 573-882-3250
  Fax: 573-884-4288
- Perry Agricultural Lab
  PO Box 418
  State Highway 54 East
  Bowling Green, MO 63334
  Telephone: 573-324-2931
  Fax: 573-324-5558
- Ag Source Cooperative Services
  106 N. Cecil Street
  PO Box 7
  Bonduel, WI 54107
  Telephone: 715-758-2178
  Fax: 715-758-2620
- Ag Source Harris Laboratories
  300 Speedway Circle #2
  Lincoln NE 68502
  Tel: 402-476-0300
  Fax: 402-476-0302
- Ag Source Laboratories
  1532 Dewitt
  Ellsworth, IA 50075
  Tel: 515-836-4444
  Fax: 515-836-4541
- A&L Analytical Laboratories, Inc.
  2790 Whitten Road
  Memphis, TN 38133
  Telephone: 901-213-2400
  Fax: 901-213-2440
- A&L Great Lakes Laboratory, Inc.
  3505 Conestoga Drive
  Fort Wayne, IN 46808
  Telephone: 260-483-4759
  Fax: 260-483-5274
- A&L Heartland Laboratory, Inc.
  111 Linn St.
  PO Box 455
  Atlantic, IA 50022
  Telephone: 901-213-2400
  Fax: 901-213-2440
- Brookside Lab Inc.
  200 White Mountain Drive,
  New Bremen OH 45869
  Telephone: 419-977-2766
  Fax: 419-977-2767
- Ingram's Soil Testing Center
  13343 Fitschen Road
  Athens, IL 62613
  Tel: 217-636-7500
  Fax: 217-636-7500
- Midwest Laboratories, Inc.
  13611 B St.
  Omaha, NE 68144-3693
  Telephone: 402-334-7770
  Fax: 402-334-9121
- SGS-Toulon Labs
  117 East Main St.
  Toulon, IL 61483-0518
  Telephone: 309-286-2761
  Fax: 309-286-6251
- MVTL Laboratories Inc.-New Ulm
  1126 North Front St.
  New Ulm, MN 56073-0249
  Telephone: 507-354-8517
  Fax: 507-359-2890
- Olsen's Agricultural Laboratory
  210 East First St.
  PO Box 370
  McCook, NE 69001
  Telephone: 308.345.3670
  Fax: 308-345-7880
- Spectrum Analytical
  1087 Jamison Road
  PO Box 639
  Washington Court House, OH 43160
  Telephone: 740-335-1562
  Fax: 740-335-1104
- Ward Laboratories
  4007 Cherry Ave.
  PO Box 788
  Kearney, NE 68848
  Telephone: 308-234-2418
  Fax: 308-234-1940
- Waters Agricultural Laboratories, Inc.
  257 Newton Highway
  PO Box 382
  Camilla, GA 31730
  Telephone: 229-336-7216
  Fax: 229-336-0977
- Waters Agricultural Laboratories, Inc.
  2101 Old Calhoun Road
  Owensboro, KY 42301
  Telephone: 270-685-4039
  Fax: 270-685-3989

Note: Approval of soil analysis does not imply approval of fertilizer and limestone recommendations by the individual labs. The approval allows the clients to use the University of Missouri soil fertility recommendations as required by the federal and state agencies for cost share and nutrient management planning programs. In order to use the University of Missouri soil fertility recommendations and get meaningful results, it is recommended that the labs use the soil test procedures required by the MSTA program. *—Manjula Nathan, nathanm@missouri.edu* ■

Weed of the Month: the foxtails, similar yet different

by Mandy Bish and Kevin Bradley

The three most common foxtails in Missouri are yellow, green, and giant foxtail. These grasses, which invade fields of row crops and pastures across the U.S., begin germinating in late spring to early summer, and have many similar characteristics. All 3 have fibrous root systems, reproduce by seed, and form that distinctive, fuzzy, foxtail seed head (Figure 1). Each tends to grow upright and has a ligule that is a fringe of hairs at the junction where the leaf blade meets the stem (Figure 2). These properties can help distinguish the foxtails from many other common grassy weeds, which may have no ligules present or have ligules that are membranous with no hair. And, while the 3 foxtails can be challenging to differentiate from one another, they each have unique properties that can aid in foxtail identification.

Figure 1. The seed heads of giant (top), green (lower left), and yellow (lower right) foxtails. The giant foxtail seed head drops while the seed heads of the green and yellow.

Figure 2. A ligule is a thin membranous sheath that occurs at the junction between the leaf and stem. The foxtails all have a ligule that is hair-like.

Figure 3. Yellow foxtail is easily distinguished from giant and green foxtail by the presence of long, cobweb-like hairs in the collar region.

Figure 4. Foxtail seedlings, like the one pictured, are emerging in fields throughout Missouri.

One of the most distinguishing features of the foxtails is the color and size of the fuzzy foxtail seed heads (Figure 1). Yellow foxtail has a compact seed head with soft, yellow bristles (or awns) while the seed head on green foxtail is usually green or purple-tinted. Giant foxtail seed heads are also greenish in color, but are usually larger, about 3 to 8 inches long, and the seed heads of giant foxtail also droop in an arch shape unlike the more erect seed heads of green and yellow foxtail.

Knowing the differences between the seed heads is useful, if the seed heads have already formed. But what about the earlier growth stages? There are a few key, but subtle, features that you can look for when identifying foxtails prior to seed head formation.

The leaves also help to differentiate the foxtail species. Giant foxtail tends to have wider leaves (~3/8 to 5/8 inch) and dense hair growing on the upper surfaces of the leaves. Both green and yellow foxtail have narrower leaf blades (~1/8 to 3/8 inch wide). Green foxtail has a smooth upper leaf surface with no hairs, while yellow foxtail has sparse hairs on the upper leaf surface. These hairs grow up to 3/8" long, are light yellow/white and cobweb-like, and are located near the base where the leaf meets the stem (Figure 3).

In addition to the leaves, the leaf sheaths, or stems, are also different. Yellow foxtail has flat leaf sheaths with a reddish tint at the base. Green foxtail and giant foxtail both have round leaf sheaths. The leaf sheath of green foxtail is usually lined with small hairs while that of giant foxtail is smooth.

For information on herbicides that provide effective control of the foxtails, purchase or download a copy of M171, the Missouri Pest Management Guide: weedscience.missouri.edu/publications/m00171.pdf

And for more information on the identification of foxtails and other grass weeds in Missouri, purchase or download a copy of:

IPM1007, Practical Weed Science for the Field Scout: weedscience.missouri.edu/publications/ipm1007.pdf or IPM1024, Identifying Grass Seedlings: weedscience.missouri.edu/publications/ipm1024.pdf

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The "1-2-3" IPM Approach for Spotted Wing Drosophila Management

by Patrick Byers and Dr. Jaime Pinero

This document briefly discusses the most relevant Integrated Pest Management (IPM) practices that are recommended for Spotted Wing Drosophila Management (SWD) in berry crops. The "1-2-3" approach to SWD management is meant to provide easy-to-understand steps to manage SWD in small farms. The three main components being discussed here are monitoring, cultural practices, and timely application of insecticides.

1. MONITORING

For 2014, a monitoring program for susceptible crops is recommended throughout the harvest season. Place one monitoring trap baited with active dry yeast (1/2 tablespoon), sugar (2 tablespoons) and water (6 ounces) every 2-3 acres (Washington State Univ. recommends 1 trap in each crop or 1 trap per acre for large plantings). The trap needs to be hung on a plant, stake, or trellis 3–5 ft. or feet above the ground on the most shaded / coolest side of the plant canopy.

Articles discussing the importance of SWD monitoring, trap construction, and monitoring protocols can be found athttp://www.lincolnu.edu/web/programs-and-projects/ipm and http://www.LU-IPM.net

2. CULTURAL PRACTICES

Cultural controls are practices that reduce the establishment, reproduction, dispersal, and survival of immature SWD.

- Sanitation: Fruit should be harvested frequently and completely. Culled fruit should be removed from the field and either frozen, "baked" in clear plastic bags placed in the sun, or disposed of off-site.
- Canopy and water management: Prune plants to maintain an open canopy. This may make plantings less attractive to SWD and will improve spray coverage. Leaking trickle irrigation lines should be repaired, and overhead irrigation should be minimized. Allow the ground and mulch surface to dry before irrigating to increase the likelihood that larvae/pupae of SWD in the soil will desiccate and die.

3. INSECTICIDE SPRAYS

No action threshold is available for SWD and in other states traps have not consistently been able to detect adults prior to fruit infestations. Based on this information, Michigan State University researchers are recommending a more conservative approach involving application of insecticides when SWD are captured by monitoring traps and the crop being protected has the first fruit beginning to soften and turn color.

Assessing the efficacy of an IPM program targeting SWD

It is important to highlight that an IPM program includes the use of monitoring traps to assess adult SWD population levels. Quantifying fruit infestation through fruit sampling is critical to determine the effectiveness of control systems implemented against SWD.

FRUIT SAMPLING:

- North Carolina State University researchers suggest sampling at least 30 fruits from each field to determine insecticide spray efficacy.

Continued on page 7 ▶

The “1-2-3” IPM Approach for Spotted Wing Drosophila Management

Continued from page 6.

DETECTING LARVAL INFESTATIONS:

- Fruit infestation can be analyzed through various methods. Five methods are discussed below (source: NC State):
  1. Sugar flotation: Add ¼ cup sugar to 4 cups water then lightly crush the fruit to break the skin. Place fruit and sugar-water in a one gallon zip bag and observe larvae. The larvae should float and the fruit should sink, but this isn’t always the case. A hand lens may be needed for small larvae.
  2. Salt extraction: Place fruit in a flat container in a thin layer. A dark container or a clear container against a dark surface works best. Pour salt water (1/4 cup of salt per gal of water) over fruit. After 10-15 minutes, larvae will exit fruit. If no larvae are visible, gently crush fruit to ensure salt water has penetrated. Keep in mind that larvae are more visible when moving; however, immersion in salt water will eventually kill them.
  3. Freezing or chilling: SWD eggs and larvae cease development at temperatures less than 41F, likely preventing further damage to the fruit. The longer fruit are stored and the cooler the temperature of storage, the more likely that small SWD larvae will die. Holding fruit at cooler temperatures also give growers the added benefit of determining how significant the infestation, as large larvae will exit fruit as it cools. To do this, place fruit into a sealed, clear plastic bag and freeze or refrigerate overnight. Larger larvae will exit fruit and typically die on the surface of the fruit or the bag but small larvae may not exit fruit.
  4. Direct observation: directly crush or cut the fruit, larvae may directly observed (a hand lens may be needed).
  5. Rearing flies out: Since it is practically impossible to tell SWD larvae from other vinegar fly species, then holding larvae and pupae in a container with ventilation until adult flies emerge is currently the only definitive way to confirm SWD infestations. Fruit should be held at room temperature for up to 14 days to ensure all adults will emerge.

Most effective insecticidal options (updated: May 14, 2014)

For the last five years or so, researchers have been evaluating numerous insecticides to identify the products that provide effective SWD control while reducing negative impacts to non-target organisms including pollinators. A number of registered conventional insecticides have shown to be effective against SWD in recent trials by Michigan State University researchers. Insecticides with fast knockdown activity such as the organophosphate Malathion*, the pyrethroids Asana (esfenvalerate), Danitol (fenpropathrin), Mustang Max (Zeta-cypermethrin), and Brigade (bifenthrin), and the spinosyns Delegate and Entrust (organic) have performed best. In a recent paper, researchers from Michigan State University (Van Timmeren and Isaacs, 2013) documented that spinosad (Entrust) and Spinetoram (Delegate) consistently performed as well as some pyrethroids such as Zeta-cypermethrin (Mustang Max). Malathion also showed good performance. Most insecticides lost efficacy after rainfall, and one of the exceptions was Zeta-cypermethrin (Mustang Max). Efficacy of most treatments was reduced greatly after exposure to just over 2 cm of rain. By one week after treatment adult mortality was not significantly different from the untreated controls for most insecticides that had been exposed to rain.

*While effective at suppressing SWD, malation degrades with UV light, therefore increasing the rate could help mitigate the effects of environmental degradation of this insecticide. Research done in Florida also indicates that Danitol, Mustang Max, and Delegate performed equally well at reducing adult SWD activity and injury to blueberries.

References

Cornell University SWD website: http://www.fruit.cornell.edu/spottedwing/

Lincoln University IPM program: http://www.lincolnu.edu/web/programs-and-projects/ipm and http://www.LU-IPM.net

Michigan State University: http://www.ipm.msu.edu/invasive_species/spotted_wing_drosophila

North Carolina State University: http://ncsmallfruitsipm.blogspot.com/p/spotted-wing-drosophila-general.html

Oregon State University: http://spottedwing.org ■

Continue Checking for Wheat Diseases

by Laura Sweets

It is difficult to summarize the current disease picture for winter wheat in Missouri unless to say that it is as variable as the weather has been. There is also a range in stage of growth although across the state wheat development is behind normal. The May 12 "Crop Progress and Condition" report from the Missouri Field Office of the National Agricultural Statistics Service reported 34 percent of the wheat crop headed which is about the same as last year but significantly lower than the 5-year average of 56% headed by May 12. With the majority of the crop still to head and flower, it is important to continue to scout wheat for foliage diseases and to consider the risk of the development of Fusarium head blight.

So what is the current disease situation on winter wheat in Missouri?

Foliage diseases: Have not been a significant issue yet this season. Much of the state has been cooler than normal with short periods of warm weather and the early part of the season was fairly dry. States to the south, in particular Texas, Oklahoma and Kansas, have been extremely dry so foliage diseases on wheat have not been a problem. No or low levels of diseases such as leaf rust and stripe rust in those states means little inoculum to be blown into Missouri thus lowering the potential for those diseases to develop here.

Septoria leaf blotch

Powdery mildew has been reported in one or two isolated fields but has not been as prevalent as is was in 2013. Septoria is beginning to show up but is coming in late enough in the season that impact on yield should be minimal. Neither leaf rust nor stripe rust have been reported on wheat in Missouri thus far. Although the current period of wet weather could favor the development of foliage diseases, the cool temperatures associated with this current rainy period slow down their development. The later in the season foliage diseases become established and the later they begin to increase in severity, the less yield loss is likely to occur. Descriptions of the common wheat foliage diseases are given below.

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.

Leaf rust of wheat

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.

Continued on page 9 ▶

Continue Checking for Wheat Diseases

continued from page 8.

Stripe rust of wheat

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 and Septoria leaf blotch on same wheat leaf

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. 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. Table 1 accompanies this alert.

Continued on page 10 ▶

Continue Checking for Wheat Diseases

continued from page 9.

Table 1.

Management of Small Grain Diseases

Fungicide Efficacy for Control of Wheat Diseases (Revised 4-8-14)

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, 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)												
Class	Active ingredient	Product	Rate/A (fl. oz)	Powdery mildew	Stagonospora leaf/glume blotch	Septoria leaf blotch	Tan spot	Stripe rust	Leaf rust	Stem rust	Head scab	Harvest Restriction
Strobilurin	Picoxystrobin 22.5%	Aproach SC	6.0 - 12	G[1]	--	VG	VG	E[2]	VG	VG	NR	Feekes 10.5 and 45 days
Strobilurin	Fluoxastrobin 40.3%	Evito 480 SC	2.0 – 4.0	G	--	--	VG	--	VG	--	NL	Feekes 10.5 and 40 days
Strobilurin	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	--	VG	E	E	E	G	30 days
Triazole	Propiconazole 41.8%	Tilt 3.6 EC[3]	4.0	VG	VG	VG	VG	VG	VG	VG	P	Feekes 10.5
Triazole	Prothioconazole 41%	Proline 480 SC	5.0 - 5.7	--	VG	VG	VG	--	VG	VG	G	30 days
Triazole	Tebuconazole 38.7%	Folicur 3.6 F[3]	4.0	G	VG	VG	VG	E	E	E	F	30 days
Triazole	Prothioconazole19% Tebuconazole 19%	Prosaro 421 SC	6.5 - 8.2	G	VG	VG	VG	E	E	E	G	30 days
Mixed modes of action[4]	Metconazole 7.4% Pyraclostrobin 12%	TwinLine 1.75 EC	7.0 – 9.0	G	VG	VG	E	E	E	VG	NL	Feekes 10.5
Mixed modes of action[4]	Fluxapyroxad 14.3% Pyraclostrobin 28.6%	Priaxor	4.0 - 8.0	G	VG	VG	E	VG	VG	G	NL	Feekes 10.5
Mixed modes of action[4]	Propiconazole 11.7% Azoxystrobin 7.0%	Quilt 200 SC[3]	10.5 - 14.0	VG	VG	VG	VG	E	E	VG	NL	Feekes 10.5
Mixed modes of action[4]	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
Mixed modes of action[4]	Prothioconazole 10.8% Trifloxystrobin 32.3%	Stratego YLD	4.0	G	VG	VG	VG	VG	VG	VG	NL	Feekes 10.5 35 days
Mixed modes of action[4]	Cyproconazole 7.17% Picoxystrobin 17.94%	Aproach Prima SC	3.4-6.8	G	--	VG	VG	E	VG	--	NR	45 days

[1]*Efficacy categories: NL=Not Labeled; NR=Not Recommended; P=Poor; F=Fair; G=Good; VG=Very Good; E=Excellent; -- = Insufficient data to make statement about efficacy of this product.*

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

[3]*Multiple generic products containing the same active ingredients also may be labeled in some states. Products including tebuconazole include: 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. Products containing propiconazole + azoxystrobin include: Avaris 200 SC.*

[4]*Products with mixed modes of action generally combine triazole and strobilurin active ingredients. Priaxor is an exception to this general statement and combines carboxamide and strobilurin active ingredients.*

If foliar fungicide applications are being considered it is important to scout fields first. Look for the presence of foliage diseases which might be impacting yield and could be controlled with a fungicide application. But also scout fields for stage of growth. The unusually cool temperatures during March and April have resulted in a late wheat crop. Most parts of the state are reporting wheat 14-17 days behind average as far as stage of growth. Many of the wheat foliar fungicides are applied at flag leaf emergence, heading or until the beginning of flowering. Most of these fungicides have harvest restrictions of Feekes growth stage 10.5 (head completely emerged) or 30, 35 or 40 days prior to harvest. Due to the cool temperatures, wheat may just be approaching these growth stages. If yield potential is good and weather conditions continue to be conducive for disease development, foliar fungicide applications may be warranted.

Fusarium head blight

Fusarium head blight or Scab: It is later in the year than normal to be thinking about Fusarium head blight or scab but with the unusually late development of the wheat crop, the wheat in the southern part of the state may be in or just past a susceptible stage of growth and wheat in the remainder of the state could be in the susceptible stage of growth, i.e. flowering, in the next week or two. If fungicide applications for Fusarium head blight management are being considered the stage of growth needs to be monitored carefully. If the frequent rains continue throughout the state conditions could be conducive for the development of Fusarium head blight in fields in which the crop is beginning to flower or is flowering.

Continued on page 11 ▶

Continue Checking for Wheat Diseases

continued from page 10.

Fusarium head blight or scab of wheat develops on plants in the flowering to early grain fill stages of growth. Infection is very dependent on environmental conditions while wheat is in susceptible stages of growth, i.e. flowering. Moderate temperatures in the range of 77-86°F, frequent rain, overcast days, high humidity and prolonged dews favor infection and development of scab. Weather conditions over the next several weeks will determine the extent and severity of scab in this year's wheat crop. Fusarium head blight or scab problems will be more severe if rains coincide with flowering of wheat fields. If the rain continues as the crop moves through the flowering stages, the risk for scab will increase.

The characteristic symptom of scab on wheat is a 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 and 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. Spores are carried by wind currents from the residues on which they have survived to wheat heads. 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 favorable environmental conditions occur as the wheat crop is in the flowering to early grain fill stages.

Unfortunately, the detrimental effects of scab are not limited to its adverse effects on yield. The fungi which cause scab may also produce mycotoxins. Vomitoxin (deoxynivalenol or DON) and zearalenone may occur in wheat grain infected by scab fungi. This is a primary concern where grain is fed to non-ruminant animals. Ruminants are fairly tolerant of these two mycotoxins. Also, the fungi which cause scab may survive on the seed and can cause seedling blight and root rot problems when scabby grain is used for seed.

Crop rotation, variety selection and residue management are preventative measures for managing scab in wheat. At this point in the season the only remaining management option would the application of a fungicide to try to reduce scab levels. The fungicide table in this alert lists the fungicides labeled for the suppression of Fusarium head blight or scab. Growers should be scouting fields to get a feel for incidence and severity of scab in this year's wheat crop. Because of possible mycotoxin concerns and seed quality concerns, grain from fields with scab may require special handling. Wheat planted on corn, sorghum or wheat residue (even wheat double cropped with soybeans) has a greater risk for scab.

Other Head Diseases of Winter Wheat

From flowering through the early stages of grain fill is also the time to scout for other head diseases of wheat such as loose smut, Septoria and Stagnospora infections on heads, bacterial stripe and black chaff on heads and take-all.

Loose smut is obvious as heads emerge from the boot and for several weeks after that. The kernels on infected heads are replaced with masses of powdery black spores. So the heads have a very distinct black, powdery appearance. These spores are eventually dislodged by wind and rain, so later in the season the smutted stems are less evident and only the bare rachis will be left. Spores produced on smutted heads are wind carried to adjacent plants in the field and infect through the flowers. The fungus that causes loose smut survives within the embryo of wheat seeds. If infected seed is planted, the plants growing from those seeds will be infected and develop smutted heads the next season. If seed from a field that has a "small" amount of smut in one season is used for seed, the field planted with that seed may have a substantially higher level of smut. Loose smut is best controlled by planting either disease-free seed or using a systemic fungicide seed treatment.

Septoria leaf blotch is present in the lower canopy of many fields this year. It hasn't seemed to move up in the canopy to the flag leaf or head but with increased precipitaiton and high humidity it could still develop on flag leaves and heads. On the heads dark brown to black blotches may develop. Stagnospora nodorum may also cause leaf lesions but is usually more common on heads- again causing dark blotches on glumes of part or all of the head.

Bacterial stripe or black chaff is a bacterial disease that produces symptoms on both leaves and heads. Water-soaked lesions may develop on young leaves. These expand into reddish-brown to brownish-black streaks on the leaves. Glumes and awns show brown-black blotches or streaks. Fungicides are not effective against bacterial stripe or black chaff so the use of resistant or tolerant varieties and crop rotation are the main management options. ■

Potential for True Armyworm Problems in Grass Crops

by Wayne Bailey

At present economic infestations of true armyworm are being found in several southern Missouri counties. Tall fescue seed and forage producers are most at risk from this pest. Grass producers in all areas of Missouri, but especially in southwest Missouri are encouraged to scout grass pastures and grass seed fields to determine the status of true armyworm larvae. Some fields have reached or exceeded the economic thresholds listed below and required an insecticide application for true armyworm control. Other crops attacked by true armyworm include wheat and occasionally corn. Legumes such as alfalfa and clovers are not fed upon by this pest. Moth numbers reported this spring have been lower than compared to past years with severe economic infestation of true armyworm. These moth data suggest that although some fields will experience economic infestations of true armyworm larvae that require control, many other fields across Southern Missouri may not reach economic infestation thresholds. At present, tall fescue seed and grass, wheat, and corn producers are encourage to scout individual fields inorder to determine larval numbers of this pest.

About every four to five 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 to five 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 moth numbers are provided by the University of Missouri IPM program with the assistance numerous 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 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

Continued on page 13 ▶

Potential for True Armyworm Problems in Grass Crops

continued from page 12.

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.

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.

True Armyworm, Mythimna unipuncta former Pseudaletia unipuncta Tall Fescue, Grass Pastures - 2014

Occasional severe pest of grass seed and forage fields. Treat when an average of 4 or more half-grown or larger worms (1/2 to 1 1/2 inch larvae) per square foot are present during late spring and before more than 2-3 percent of seed heads are cut from stems in tall fescue seed fields. Insecticides applied as foliar broadcasts.

Chemical Name	Trade Name	Rate of Formulated Material/Acre	Preharvest Intervals
malathion	Malathion, several Products	see specific labels	see specific labels
zeta-cypermethrin	*Mustang Max	**2.8 to 4.0 fl oz/acre	0 days hay, forage, grazing
carbaryl	Sevin 4F	1 to 1 1/2 quarts/acre	14 days for forage or grazing
spinosad	Success	3 to 6 fl oz./acre	0 days hay, forage
spinosad	Tracer 4SC	1.o to 3.0 fl oz/acre	0 days hay, forage
lambda cyhalothrin + chlorantraniliprole	*Voliam xpress	5.0 to 8.0 fl oz	0 days hay, forage, grazing
lambda cyhalothrin	*Warrior II w zeon tech	1.28 to 1.92 fl. Oz	5 days harvest

**Note, FMC recommends a minimum rate of 3 oz/acre for true armyworm control using Mustang Max
*Designates a restricted-use pesticide. Use is restricted to certified applicators only.
Be sure to read the label and follow all label directions, precautions, and restrictions.

Continued on page 14 ▶

Potential for True Armyworm Problems in Grass Crops

continued from page 13.

Insecticides Labeled for Use on True Armyworm in Wheat

Comment: 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.

TRUE ARMYWORM - Mythimna unipuncta formerly Pseudaletia unipuncta (Haworth) - Wheat 2014

Comments: 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.

Common Name	Trade Name	Rate of Formulated Material/Acre	Placement/Comments	REI Hours	Pre-harvest Interval Days
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)
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)
spinosad	Tracer naturalyte	1.5 to 3.0 fl oz	foliage, timing important	4	21 (grain or straw) 14 (forage or hay)
chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	forage	24	14 (grazing) 28 (straw)
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 or straw) 7 (hay or forage)

*Designates a restricted-use pesticide. Use is restricted to certified applicators only.
Read the label to determine appropriated insecticide rates. Be sure to follow all label directions, precautions, and restrictions.

Continued on page 15 ▶

continued from page 14.

Insecticides Labeled for Use on True Armyworm in field corn

Comment: 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.

TRUE ARMYWORM - Mythimna unipuncta formerly Pseudaletia unipuncta (Haworth) Field Corn 2014

Comments: 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 by 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/Acre	REI Hours	Pre-harvest Interval Days
cyfluthrin	*Baythroid XL	1.8 to 2.4 fl oz	12	30 (grain) 3 (grazing or forage)
methomyl	*Lannate SP	1/4 to 1/2 lb	48	7 (grain) 10 (grazing or feeding)
zeta-cypermethrin	*Mustang Max	1.76 to 4.0 fl oz	12	14 (grain, forage, hay)
chlorpyrifos	*Nufos 4E	1 pt	24	28 (grain or straw) 14 (forage or hay)
microencapsulated methyl parathion	*Penncap-M	2 to 3 pt	48	15 (harvest or graze)
carbaryl	Sevin 80S	1 1/4 to 1 7/8 lb	12	21 (grain or straw) 7 (hay or forage)
spinosad	Tracer naturalyte	1.5 to 3.0 fl oz	4	21 (grain or straw) 14 (forage or hay)
chlorpyrifos + bifenthrin	*Stallion	9.25 to 11.75 fl oz	24	14 (grazing) 28 (straw)
cyfluthrin	*Tombstone Helios	1.8 to 2.4 fl oz	12	30 (grain) 7 (grazing)
lambda-cyhalothrin	*Warrior II with Zeon	1.28 to 1.92 fl oz	24	30 (grain or straw) 7 (hay or forage)

*Designates a restricted-use pesticide. Use is restricted to certified applicators only.
Read the label to determine appropriated insecticide rates. Be sure to follow all label directions, precautions, and restrictions. ■

Weather Data for the Week Ending May 28, 2014

Station	County	Weekly Temperature (°F)						Monthly Precipitation (in.)		Growing Degree Days‡	
		Avg. Max.	Avg. Min.	Extreme High	Extreme Low	Mean	Departure from long term avg.	May 1-28	Departure from long term avg.	Accumulated Since May.1	Departure from long term avg.
Corning	Atchison	83	62	89	55	72	+7	2.08	-1.94	646	+193
St. Joseph	Buchanan	79	62	87	54	70	+5	2.48	-1.83	579	+115
Brunswick	Carroll	83	61	90	53	72	+6	0.41	-4.29	656	+166
Albany	Gentry	80	60	86	51	70	+5	2.66	-1.70	553	+124
Auxvasse	Audrain	81	61	84	56	70	+4	3.42	-1.29	609	+108
Vandalia	Audrain	82	60	87	55	70	+5	5.35	+0.68	574	+117
Columbia-Bradford Research and Extension Center	Boone	80	60	85	54	70	+4	2.57	-2.09	595	+63
Columbia-Capen Park	Boone	83	58	89	53	70	+3	2.01	-2.76	608	+46
Columbia-Jefferson Farm and Gardens	Boone	81	61	86	54	70	+4	2.78	-1.86	623	+90
Columbia-Sanborn Field	Boone	81	63	85	57	71	+4	1.74	-3.01	681	+118
Columbia-South Farms	Boone	80	61	84	54	70	+4	2.79	-1.91	616	+84
Williamsburg	Callaway	82	61	85	57	70	+5	4.17	-0.39	619	+136
Novelty	Knox	80	58	87	50	69	+4	0.98	-3.55	514	+59
Linneus	Linn	80	59	86	50	69	+4	1.45	-3.27	548	+102
Monroe City	Monroe	82	60	87	53	70	+5	3.29	-1.26	560	+72
Versailles	Morgan	81	62	86	58	71	+4	2.79	-2.34	679	+97
Green Ridge	Pettis	81	61	85	57	70	+3	2.27	-2.29	624	+111
Lamar	Barton	83	62	87	58	71	+3	1.71	-3.76	680	+79
Cook Station	Crawford	81	61	87	57	70	+3	2.70	-1.86	654	+59
Round Spring	Shannon	83	61	87	58	71	+5	2.51	-2.23	617	+61
Mountain Grove	Wright	82	62	84	60	70	+4	3.17	-1.53	625	+112
Delta	Cape Girardeau	84	64	88	63	73	+3	4.92	+0.10	704	-6
Cardwell	Dunklin	86	67	90	66	76	+4	7.54	+2.68	842	+12
Clarkton	Dunklin	87	66	90	64	75	+3	3.83	-0.37	797	0
Glennonville	Dunklin	86	67	89	66	76	+5	4.57	+0.40	818	+19
Charleston	Mississippi	85	67	89	65	75	+5	2.23	-2.35	813	+98
Portageville-Delta Center	Pemiscot	87	68	90	67	77	+5	2.82	-1.71	861	+43
Portageville-Lee Farm	Pemiscot	87	67	89	66	76	+4	2.56	-2.08	878	+69
Steele	Pemiscot	87	66	90	64	75	+3	4.19	-0.94	802	-26

‡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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