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## In This Issue



# INSECTS

## Corn Flea Beetle: Expectations for Injury in 2001

One of the many spring insects that captures our attention each year is the corn flea beetle. Not surprisingly, we've received many calls regarding these tiny insects as producers finalize their preparations for planting. The questions that follow are designed to answer many of the inquiries concerning the biology and management of these potentially damaging beetles.

*Why do we refer to these insects as corn flea beetles?*

Corn flea beetles are very small insects that cause special concern in the seed-production industry each spring, especially in years following mild winters. The "flea" beetle name is well deserved because of their size (1/16 inch, 1.8 mm) and impressive leaping ability when they are disturbed.

*Where do corn flea beetles overwinter?*

Flea beetles spend the winter as adults and are most apt to cause damage when corn plants are slowed in their development by cool spring conditions. Adult flea beetles overwinter in clumps of grass near cornfields. Following mating in the spring, females lay their eggs in the soil of cornfields. Larvae hatch from eggs in approximately 1 week and complete the larval stage and pupate in about 2 weeks. After emergence, adults feed and mate for the remainder of the summer.

*Why are corn flea beetles of more concern to the seed-production industry?*

Of primary concern to those in the seed-production business is the potential for the transmission of Stewart's bacterial wilt to susceptible inbreds or sweet corn varieties. Corn flea beetle injury to the epidermis of corn leaves, in and of itself, rarely results in economic losses due to the relatively small amount of tissue consumed. Small streaks of absent epidermal tissue serve as evidence of flea beetle feeding. The bacterium, *Erwinia stewartii*, transmitted by the feeding of flea beetles is able to overwinter in the soil and plant debris, as well as within the vectors of the disease. As many as 20% of emerging corn flea beetle adults in the spring may be infected with bacteria responsible for Stewart's wilt. By midsummer, 75% of the corn flea beetle population may serve as vectors of this disease. Seedling plants that are infected may become stunted and wilt, and may exhibit linear lesions. As the infection increases in severity, overall yellowing of leaves intensifies and moves upward on plants. These disease symptoms may be displayed in some sweet corn varieties at any stage of plant development. Most dent corn hybrids are resistant to the wilt phase of Stewart's disease following the 5-leaf stage of development. However, many hybrids are susceptible to the leaf-blight phase of this disease. Early planting dates can exacerbate the severity of Stewart's disease in susceptible inbreds or varieties. Please refer to Loretta Ortiz-Ribbing's article in this issue of the *Bulletin* for more details on Stewart's wilt.

*Are there any other hosts that corn flea beetles will feed on?*

Although corn is the preferred host, corn flea beetles are known to feed on other plants such as orchard grass, crabgrass, fall panicum, redtop, witch grass, Kentucky bluegrass, Sudan grass, yellow foxtail, giant foxtail, barley, and wheat. Foxtail, oats, and wheat are known to sustain corn flea beetle populations until their preferred host, corn, begins to emerge.

*What is the outlook for economic infestations of corn flea beetles this spring?*

Entomologists have long reported that mild winters favor the survival of flea beetles and increase the potential that Stewart's disease may be a problem. In an effort to quantify the effect of winter conditions on beetle survival, it is commonly suggested that if the average monthly temperatures (°F) for December, January, and February sum to more than 90, flea beetle survival through the winter may be good. In Figure 1, Bob Scott, Illinois State Water Survey, has provided a map for Illinois that suggests seed production fields in the southern one-third of the state are at greatest risk this spring to Stewart's disease due to the anticipated good survival of corn flea beetles through the winter.

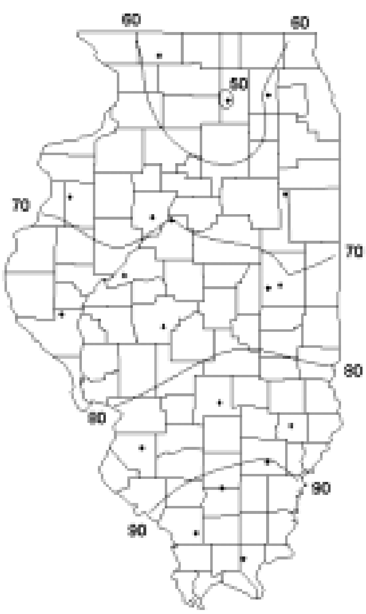


*Figure 1. Sum of monthly average temperatures (°F) from December 2000 through February 2001. (Map courtesy of Bob Scott, Illinois State Water Survey.)*

*How does anticipated corn flea beetle survival this winter compare with last year?*

For most of the state, corn flea beetle survival is expected to be much poorer this spring than last year. In 2000, we predicted that outbreaks of corn flea beetles should be anticipated even in northern counties of Illinois, and in fact, we did receive many reports of fields heavily infested with these insects last spring. With the exception of southern Illinois, we don't anticipate the level of interest in corn flea beetles this spring to match last year. However, producers even in northern Illinois should not ignore corn flea beetles. Because of the plentiful snow cover in some areas of northern Illinois, corn flea beetle survival may be better than the predictions suggest based exclusively on air temperatures.

*Can you scout for corn flea beetles and use economic thresholds to rescue infested fields?*

Despite the fact that winter may have taken its toll on flea beetles for much of the state, we encourage vigilant scouting for corn flea beetles this spring (especially in southern Illinois), particularly where sensitive inbreds (or sweet corn varieties) to Stewart's disease will be grown. If susceptible inbreds are infested before the 5-leaf stage, two to three adults per plant are found, and 10% of the plants are silver or white because of flea beetle injury, a rescue treatment may be warranted. In certain sweet corn IPM programs in the northeastern United States, consultants recommend rescue treatments when six adults are found per 100 plants. Insecticides labeled as rescue treatments for corn flea beetle control include *Ambush, *Asana XL, *Capture 2EC, *Lorsban 4E, *Penncap-M, *Pounce 3.2 EC, Sevin XLR Plus, and *Warrior (* indicates use restricted to certified applicators only).

*Do seed treatments represent a good management approach for corn flea beetle management?*

Yes, in some instances. Because most commercial hybrids are resistant to the wilt phase of Stewart's disease following the 5-leaf stage of development, a scouting and rescue treatment approach may work fine for some producers who are willing to invest the time and energy to monitor densities of corn flea beetles in their fields. Keep in mind that many hybrids remain susceptible to the leaf-blight phase of this disease. Because seed-production fields are apt to have inbreds that may be quite susceptible to Stewart's disease, the preventive seed treatment approach makes good sense. This is especially true in areas of the state where better-than-average overwintering survival is anticipated.

Seed-treatment products that contain the active ingredient imidacloprid offer seed production managers an attractive corn flea beetle management option because of their systemic (insecticide is taken up by the plant) activity. These products are manufactured by Gustafson and include Gaucho (0.165 milligrams of imidacloprid per seed), Gaucho Extra (0.60 milligrams per seed), and Prescribe (1.34 milligrams per seed). Gaucho is designed to offer protection against corn flea beetles through the first true-leaf stage of corn development. This product, because of its lowest cost of the three systemic seed treatments, may be of interest to commercial corn producers who are concerned about corn flea beetles and who are unlikely to scout their fields and use insecticides as needed. Gaucho Extra is designed to offer corn flea beetle protection through the 5-leaf stage of corn development and may be of most interest to seed-production managers. While the use of Prescribe would most likely provide very good control of corn flea beetles, this product is comparable in cost to some conventional soil insecticides and is marketed primarily for control of secondary soil insects as well as corn rootworms.—*Mike Gray*

## White Grubs: Expectations and Management Recommendations for 2001

During the past several years, producers throughout Illinois have reported increasing problems with grubs (white grubs, wireworms, grape colaspis) in corn. Speculation to date suggests that factors such as early planting, mild winters, and poor insecticide performance may be responsible for the escalating grub-related damage in some cornfields. Some questions and answers are provided and should shed some light on the biology and management of white grubs.

*What types of white grubs are most frequently found in Illinois cornfields?*

Annual and true white grubs easily can be found in any producer's cornfield throughout Illinois. The adults of annual white grubs are called southern masked chafers, whereas the adults of true white grubs are called May or June beetles. Southern masked chafers are approximately 1/2 inch in length and have yellowish brown wing covers, and the head is "mask-like" in appearance. True white grub adults are somewhat larger (3/4 inch long) and reddish brown to nearly black. Along the eastern edge of Illinois and in pockets of fields surrounding metropolitan areas of the state, Japanese beetle grubs also can be found. Japanese beetle adults are the most "handsome" of the commonly observed grub species in Illinois cornfields. The adults are shiny metallic green with bronzed wing covers. On each side of the main body are numerous tufts of white bristles.

*How easily can larvae of white grub species be identified?*

At first glance, separating species of white grub larvae may seem daunting. With a little practice, however, this task can be accomplished easily with a magnifying glass, and dividends can be reaped for making the correct identification and resulting management decision. Collectively, white grubs (as the name suggests) are creamy white and strongly C-shaped, possess three pairs of long legs, and have orange-brown heads.

The posterior end of grubs is typically darkened by fecal material in the hindgut. By examining the arrangement of bristles on the lower surface of the last abdominal segment (raster), white grub larvae can be identified correctly. Annual white grub larvae have scattered hairs on the raster, in contrast to the two parallel rows of bristles that can be observed (some magnification helps) on true white grub larvae. Japanese beetle larvae display a V-shaped pattern of bristles on their rasters (Figure 2).

*Why is it important to separate species of white grubs?*

The potential to inflict economic losses varies considerably among the grub species. Annual white grub larvae typically cause only minor injury to seedling corn plants. In experiments conducted by entomologists at Iowa State University, densities of nine annual white grubs per plant did not prevent emergence or reduce stand counts. In recent years, we have speculated that annual white grub larvae may be inflicting more of an economic "punch" because of the early planting dates and the lengthening of the feeding period. True white grubs are often implicated in stripping root hairs from corn plants. Seedling plants that are injured may become yellowish, wilt, and die when infestations are severe. In some instances, corn plants may become purple due to their inability to adequately absorb phosphorus. Like annual white grubs, larvae of the Japanese beetle are generally not considered of economic importance to corn production. However, in summer issues of the *Bulletin*, we will discuss the potential economic impact of silk-clipping activities by adult Japanese beetles.

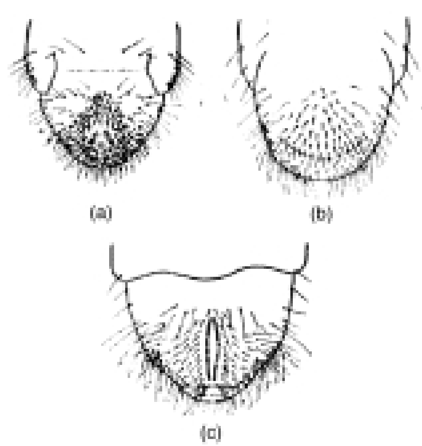

*Figure 2. (a) Japanese beetle; (b) annual white grub; (c) true white grub.*

*Why are true white grub larvae of more importance than annual or Japanese beetle larvae?*

Annual white grubs and Japanese beetles have 1-year life cycles in the Corn Belt. Pupation of annual white and Japanese beetle grubs most often takes place from mid- to late May, and in some years, early June. Because feeding ceases during pupation, annual white and Japanese beetle grubs are unable to inflict much injury to seedling corn plants. However, as mentioned previously, the trend toward earlier planting has changed this scenario to some extent. True white grubs require 3 years to complete a single generation. During the second summer of a true white grub's life cycle, severe injury can be dealt to a corn plant's root system. For this reason, accurately identifying the grub species in a producer's cornfield is essential in making the correct management recommendation.

*Are some cornfields at greater risk to true white grub infestations?*

Yes. Researchers who conducted experiments in the northern plains revealed that cornfields with borders planted to cottonwood or willow trees supported greater densities of true white grubs. Apparently, true white grub adults were fond of feeding on leaves in the windbreaks during the evening. During the day, females were prone to leave trees and travel to adjacent cornfields to deposit their eggs in the soil. Over time, densities of true white grub larvae in these cornfields increased to economic levels. In addition, fields that will be coming out of sod and devoted to corn production also are at great risk for economic infestations of white grubs.

*Are there any good scouting approaches and thresholds for true white grubs?*

Not really. Researchers have recommended taking spring soil samples (1 foot by 1 foot by 6 inches) and determining the number of larvae per sample. Twenty soil samples per 40 acres are suggested. Stands may be significantly reduced by as few as one grub per square foot of soil. Rescue treatments are not an option, so making the correct decision regarding the use of a soil insecticide at planting is crucial (Table 1).

We encourage individuals to report white grub damage by email to sratclif@uiuc.edu. When you report damage, please include date of discovery, field location (county, township, section number), level of damage, and grub species.—*Sue Ratcliffe and Mike Gray*

**Table 1. Insecticide recommendations for white grubs in field corn.**

| *Insecticide* | *Amount of product per acre*[a] | *Placement* |
|---|---|---|
| *Aztec 2.1G | 6.7 oz/1,000 ft row | Band[b], furrow |
| *Capture 2EC | 0.3 oz/1,000 ft row | Band[b] |
| *Counter CR | 6 oz/1,000 ft row | Band[b], furrow |
| *Force 3G | 4 to 5 oz/1,000 ft row | Furrow |
| *Fortress 5G[c] | 3 oz/1,000 ft row | Furrow |
| *Lorsban 4E | 4 pt | BC-PPI[d] |
| *Lorsban 4E | 2.4 oz/1,000 ft row | Band[b] |
| *Lorsban 15G | 12 oz/1,000 ft row | Furrow |
| *Regent 4SC | 0.24 oz/1,000 ft row | Furrow |
| *Thimet 20G | 6 oz/1,000 ft row | Band[b] |

Treat at planting if crop history and previous crop losses can be directly linked to a repeated history of grub problems. To minimize potential adverse effects to wildlife, incorporate insecticide granules or apply the insecticide in-furrow (if labeled), and shut off insecticide units in turn rows.

*Use restricted to certified applicators.
[a]The formulation of the product most commonly used in Illinois is listed. If you use another formulation, *read the label* to determine the amount of product per acre. Also, read the product label for precautions and restrictions.
[b]Band = 5- to 7-inch band over the row or T-band over an open seed furrow. Refer to product label for specific information.
[c]Fortress 5G is available only in the SMARTBOX, a closed-handling and application system.
[d]BC-PPI = broadcast-preplant incorporated.

## Black Cutworm Moths Reported Throughout the State

First captures of black cutworm moths have been reported from "top to bottom" throughout the state of Illinois. Ron Hines, senior research specialist at the Dixon Springs Agricultural Center in Pope County, reported an intense capture of black cutworm moths during the evenings of April 3 and 4. As Kevin Steffey indicated in issue no. 2 of the *Bulletin*, we consider an intense capture of moths to equal nine or more moths caught over a 1- to 2-day period, using pheromone traps (sticky-wing traps). Following an intense capture, Bob Scott, Illinois State Water Survey, can offer predictions regarding when cutting of corn plants may begin to occur. Based on historical temperature records, Bob Scott indicates that cutting may begin to occur in southern Illinois cornfields near Pope County as early as April 26. This is based on a predicted accumulation of 300 heat units (base 50°F), following an intense capture of moths.

In central Illinois an intense capture of moths was reported by Doug Gucker, Piatt County Extension Unit, near the community of Cisco. On April 7, Doug found six moths in his pheromone trap, and on April 8, three black cutworm moths were found. Jeff Hoffman, Piatt County FS, also reported numerous moths in his traps during this same time frame. We will provide projected cutting dates for central Illinois in an upcoming issue of the *Bulletin*. Jim Morrison, crop systems Extension educator, Rockford Extension Center, also reported his first captures of black cutworm moths for the season. On April 10, Jim found two moths in his pheromone trap located in Winnebago County. So, black cutworm moths have made their annual spring migration throughout Illinois.

As soon as corn gets planted and begins to emerge in southern Illinois, cutting injury caused by black cutworm larvae could be evident. Be on the alert for pinholes in the leaves as soon as the seedlings emerge. Although pinhole injury is not economic, it suggests that small cutworm larvae are present and could cause economic cutting injury as soon as the larvae are large enough. As a general rule, rescue insecticide applications may be warranted when 3 to 5% of 2- to 4-leaf stage seedling corn plants are being cut below ground. Some seed-production managers begin to trigger insecticide rescue treatments when 1% of the plants have pinhole injury, assuming that this early injury may result later in economic cutting. We will continue to provide updates throughout the spring regarding the status of this sporadic pest.—*Mike Gray and Kevin Steffey*

## Other Creatures You May Encounter in the Soil

People digging in corn stubble now and in cornfields after they emerge search for a lot of things, including the possible presence of cutworms, grape colaspis larvae, white grubs, and wireworms. However, there are a lot of other creatures, mostly harmless and often beneficial, that you might encounter as you dig in the soil. Alan Mosler, Twin Count Service Company, and Kevin Black, Growmark, recently found some crane fly larvae in decaying roots of corn in Franklin County. Matt Montgomery, Extension unit educator—crop systems, Sangamon/ Menard Extension Unit, found some millipedes while he was out checking solar bait stations for detection of wireworms. Neither of these arthropods is cause for alarm, but they often are mistaken for cutworms.

Crane fly larvae are not pests of corn, but they are found occasionally in the spring during or shortly after corn planting. The body of a crane fly larva usually is dark, often the same color as the soil, and is tapered toward the front end. The larger end has four to six fleshy "horns." Obvious characteristics that distinguish crane fly larvae from cutworms are the absence of legs and a discernible head.

Some species of millipedes can injure planted seeds or growing seedlings, especially in no-till corn. However, millipedes rarely cause economic damage. Millipedes, or "thousand leggers," have a head and multisegmented body. The most distinguishing characteristic, however, is the large number of legs (30 or more pairs, usually two pairs per body segment). By comparison, cutworms have three pairs of true legs on the thoracic segments and five pairs of prolegs (false, peglike appendages) on the abdomen.

People find all sorts of organisms in the soil during the spring, and crane fly larvae and millipedes are only two examples. As the occurrence of other creatures in the soil becomes known to us, we'll offer descriptions and discuss their roles in future issues of the *Bulletin*.—*Kevin Steffey*

## Any New Products Labeled for Control of Corn Rootworm Larvae?

By now, you are aware that during the past couple of years, some new products have been registered for control of corn rootworm larvae in corn: two insecticidal seed treatments—Force ST with ProShield Technology (from Syngenta) and Prescribe (from Gustafson)—and a liquid insecticide, Capture 2EC (from FMC). We have written articles about these products, their performance in insecticide efficacy trials, and expectations for performance.

Within the past week, we learned about some rumors regarding other "new" products that are labeled for control of corn rootworm larvae. In at least one area of Illinois, the rumors suggest that "rootworm larvae" has been added to the labels of Pounce 1.5G (from FMC) and Warrior T (from Syngenta). Although it is true that both of these products are labeled for control of some soil insect pests in corn (for example, cutworms and wireworms), a review of the labels reveals that "corn rootworm larvae" is not listed. Warrior T is labeled for control of corn rootworm adults but not for control of the larvae.

With the recent spate of new products available for control of corn rootworm larvae and several other soil insect pests in corn, it's not surprising that a little confusion might occur regarding other products. The solution to knowing what is and is not labeled for control of any given insect in any given crop is to read the label. If you have any doubt about the currency of the label you are reading (some labels on the Web are outdated), contact a representative of the manufacturing company of the product in question. Don't take a rumor at face value.—*Kevin Steffey*

## Alfalfa Weevil Activity Evident in Central Illinois

In last week's issue of the *Bulletin* (no. 2, April 6, 2001), I mentioned receiving a report about alfalfa weevil activity in southwestern Illinois. Alan Mosler, Twin County Service Company, and Kevin Black, Growmark, also observed first-instar alfalfa weevils and some tip feeding in Perry County on April 5. More recently on April 9, Matt Montgomery, Extension unit educator—crop systems, Sangamon/Menard Extension Unit, also observed very young alfalfa weevil larvae and evidence of tip feeding. Undoubtedly the recent very warm weather has stirred things up in the world of alfalfa weevils.

Alfalfa weevil adults begin laying eggs in the fall in southern Illinois, and both the eggs and adults overwinter. Therefore, larvae hatch relatively earlier in southern counties and begin feeding on the newly growing alfalfa before it attains much height. For this reason, economic infestations of alfalfa weevils occur more frequently in southern Illinois than in northern counties. However, during some years with "extended falls" (temperatures remain warmer than usual for a longer time), alfalfa weevil adults in central Illinois also lay eggs in the fall. Consequently, early-spring development of alfalfa weevil larvae in central counties is similar to development of alfalfa weevil larvae in southern counties.

Figure 3 shows degree-day accumulations (base 48°F) from January 1 through April 9, 2001. A comparison of degree-day accumulations this year with degree-day accumulations at a similar time last year (see issue no. 3, April 14, 2000) reveals that alfalfa weevil development this year is significantly behind the pace set last year.

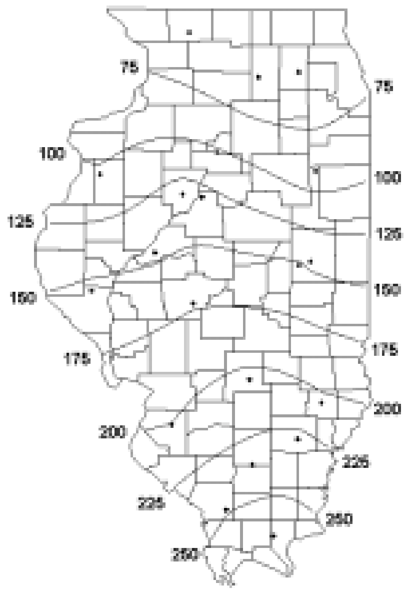


*Figure 3. Actual degree-day accumulations (base 48°F) from January 1 through April 9, 2001. (Map courtesy of Bob Scott, Illinois State Water Survey.)*

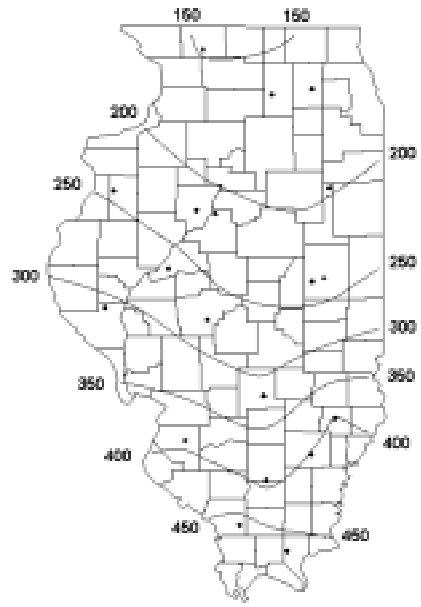


*Figure 4. Projected degree-day accumulations (base 48°F) from January 1 through April 23, 2001. (Map courtesy of Bob Scott, Illinois State Water Survey.)*

Two distinct peaks of larval activity usually occur in southern Illinois, one from fall-deposited eggs and one from spring-deposited eggs. Hatching of overwintering eggs usually occurs when 200 degree-days (above a base temperature of 48°F) have accumulated beyond January 1, and we suggest that scouting should begin when between 250 and 300 degree-days have accumulated. An early peak of third-stage larvae from overwintering eggs occurs after an accumulation of 325 degree-days; a second major peak of third-stage larvae from spring-deposited eggs occurs after an accumulation of 575 degree-days. Although we're still a long way from 325 degree-days throughout most of Illinois, a continued "string" of warm days could get us there fast.

Figure 4 shows projected degree-day accumulations (base 48°F) from January 1 through April 23, 2001. This should give you some idea of where alfalfa weevil development might be within the next couple of weeks. Remember, however, that these forecasts are based on historical temperature records. Significant fluctuations from average temperatures may speed up or slow down the accumulation of degree-days.

People throughout southern and central Illinois should be scouting for alfalfa weevils now, looking for the small larvae in folded terminal leaves and for pinholes in the leaves, the first symptom of larval injury. As the small, yellowish first instars grow into the larger, greener second instars, and ultimately third instars, the amount of injury will increase—pinholes in the leaves will be replaced with skeletonization of the leaves as the larvae consume more leaf material. The percentage of tip feeding often is used as an economic threshold for alfalfa weevils. Table 2 shows some economic thresholds for alfalfa weevils based on percentage of tip feeding associated with accumulated degree-days. Table 3 shows some economic thresholds based on numbers of alfalfa weevil larvae per stem at different alfalfa heights and values of alfalfa hay. These thresholds are published in *Pest Management of Alfalfa Insects in the Upper Midwest*, published in 1999 by the Leopold Center for Sustainable Agriculture, Iowa State University, Ames. Table 4 shows some insecticides suggested for control of alfalfa weevil larvae. Although we don't anticipate a lot of control activity any time soon in most areas of the state, the thresholds and suggested insecticides provide references for potential future use. In future issues of the *Bulletin*, we will discuss the impacts of natural enemies and insect pathogens and provide preharvest intervals for the insecticides.—*Kevin Steffey*

**Table 2. Economic thresholds for alfalfa weevils.** (Adapted from *Pest Management of Alfalfa Insects in the Upper Midwest*, 1999, Leopold Center for Sustainable Agriculture, Iowa State University, Ames.)

| *Accumulated degree-days after January 1*[a] | *Percentage tip feeding damage threshold*[b] | *Decision* |
|---|---|---|
| 150–300 | ≥25% | If less than threshold, reevaluate in 3–7 days. |
| 300–400 | 25–50% | If damage threshold is reached, determine the number of larvae per stem and the plant height. |
| 400–500 | 50–75% | If damage threshold is reached, determine the number of larvae per stem and the plant height. |
| 500–600 | 75–100% | Refer to economic thresholds based on plant height. |
| 600–harvest | 75–100% | Refer to economic thresholds based on plant height. |

a Degree-day accumulation above 48°F from January 1.

b Percentage of stems with feeding from 30- to 50-stem sample, when alfalfa weevil larvae are present.

**Table 3. Economic thresholds based on numbers of alfalfa weevil larvae per stem. (**Adapted from *Pest Management of Alfalfa Insects in the Upper Midwest*, 1999, Leopold Center for Sustainable Agriculture, Iowa State University, Ames.)

| *Plant height* | *$40 per ton* | *$70 per ton* | *$100 per ton* | *Management decision* |
|---|---|---|---|---|
| 4 in. | 1.8–2.8 | 0.8–1.3 | 0.6–0.8 | Reevaluate in 4 days. If damage and larval numbers are increasing, a long-residual insecticide is recommended to prevent severe yield loss. |
| 6 in. | 2.0–3.0 | 0.8–1.5 | 0.6–1.0 | |
| 8 in. | 2.2–3.2 | 0.9–1.7 | 0.7–1.2 | |
| 10 in. | 2.3–3.5 | 0.9–1.9 | 0.8–1.4 | If alfalfa is in vegetative stages, a short-residual insecticide should be used. If fields are harvested, closely evaluate stubble damage and larval densities. |
| 12 in. | 2.4–3.8 | 1.0–2.2 | 0.9–1.6 | |
| 14 in. | 2.5–4.2 | 1.2–2.5 | 1.0–1.8 | |
| 16 in. | 2.6–4.6 | 1.5–2.8 | 1.1–2.0 | If more than 60% of alfalfa is in the bud stage, harvest is recommended. If not scheduled to be cut in 7–10 days, a short-residual insecticide is recommended. |
| 18 in. | 2.7–5.0 | 1.7–3.1 | 1.2–2.3 | |
| 20 in. | 2.8–5.8 | 2.0–3.4 | 1.4–2.6 | |
| ≥20 in. | 3.0–7.0 | 2.4–4.0 | 1.6–3.0 | |

Use lower density (number of alfalfa weevil larvae per stem) if alfalfa is drought stressed and/or control costs are relatively cheap ($7–$10 per acre).

Use higher density (number of alfalfa weevil larvae per stem) if rainfall is abundant, diseased larvae are present, or control costs are relatively high ($11–$14 per acre).

**Table 4. Insecticides suggested for control of alfalfa weevil larvae.**

| *Insecticide* | *Amount of product per acre* |
|---|---|
| *Ambush | 12.8 oz |
| *Baythroid 2 | 1.6 to 2.8 oz |
| *Furadan 4F | 1/2 to 2 pt |
| Imidan 70W | 1 to 1 1/3 lb |
| *Lorsban 4E | 1 to 2 pt |
| *Pounce 3.2EC | 8 oz |
| *Warrior | 2.56 to 3.84 oz |

*Use restricted to certified applicators.

# PLANT DISEASES

## Stewart's Bacterial Wilt—Potential Problem?

Stewart's bacterial wilt, caused by *Erwinia stewartii,* is spread by adult flea beetles that feed on corn. While this bacterial disease is more serious on sweet corn, symptoms of the disease can be seen on field corn, especially during years when high flea beetle populations survive the winter. The potential for Stewart's wilt disease development depends on the population of adult flea beetle vectors that survive the winter. This year several factors could influence flea beetle populations (refer to the flea beetle article by Mike Gray in this issue).

Typically, survival of the adult flea beetle is based on the average winter temperatures during the months of December, January, and February. Please refer to the map (Figure 1) with average winter temperatures in the article by Mike Gray in this issue, when figuring the sum of average temperatures and the potential for Stewart's wilt disease development in your area. To reiterate, when the sum of the average temperatures for these 3 months is below 80°F, most of the adult beetles are killed. Therefore, the potential for development of Stewart's bacterial wilt disease when the sum of the average mean temperatures for the 3-month period is below 90°F is low. When the sum of the mean temperatures for these 3 months falls between 90 and 100°F, the potential for disease development is moderate. When the sum of these 3 months is above 100°F, then the potential for disease development is severe. However, the effect of snow as an insulator is unknown. At this point, the overwintering population of flea beetles remains a mystery.

Two phases of Stewart's wilt can occur. The first phase is a systemic phase, infecting young corn plants. These bacteria can spread in the vascular system throughout the plant. Visible symptoms on young corn usually appear as wilting and linear green to yellow streaks following along the leaf's parallel veins. Unlike fungi, bacterial organisms that infect grasses typically create long, linear lesions because the leaf veins restrict bacterial movement. Severely infected plants may develop cavities in the stalk pith near the soil line. Plants that are not killed may produce bleached, dead tassels. Typically, commercial field corn hybrids have general resistance to this phase of the disease, although in years when high flea beetle populations occur, symptoms may be visible and death of some individual young corn plants may occur simply due to an overload of the pathogen within the resistant plant. The second, more common phase of Stewart's wilt appears as leaf blight, frequently after tasseling. Similar linear, green to yellow lesions develop along the veins, often originating from flea beetle feeding sites. The lesion areas on the corn leaf can die and may cause premature death of the entire leaf. The second phase may also predispose the corn plant to attack by fungal stalk rots, but the entire plant typically is not killed as in phase one. In most cases, no control measures are necessary on field corn. Simply be aware that the potential to see symptoms of this disease may once again be high this year.

Under the microscope Stewart's bacterial wilt can be distinguished from fungal pathogens by the presence of bacterial ooze. In the field, symptoms of Stewart's wilt may be confused with those caused by a fungal leaf blight called anthracnose, another early-season leaf blight that can produce long, linear lesions. Anthracnose leaf lesions will typically become tan in the center and have a red, brownish red, or yellow-orange border. Older anthracnose lesions will develop dark, round, fungal fruiting bodies (acervuli), with the characteristic hairlike, upright structures called setae.—*Loretta Ortiz-Ribbing*

# WEEDS

## Effectiveness of Soil-Applied Herbicides

Soil-applied herbicides still remain an important part of weed-control programs in corn- and soybean-production systems. Early preplant (EPP), preplant incorporated (PPI), and preemergence (PRE) surface are the most common types of herbicide applications to soil. Regardless of when or how a herbicide is applied to the soil, the effectiveness of soil-applied herbicides is influenced by several factors.

For a soil-applied herbicide to be effective, the herbicide needs to be available for uptake by the germinating weed seedling. The soil-applied herbicide must be absorbed into the germinating weed seedling to provide adequate control. Herbicides do not prevent weed-seed germination; rather, they are first absorbed by the root or shoot of the seedling and then exert their phytotoxic action. This generally happens before the seedling emerges from the soil. For a herbicide to be absorbed by the germinating seedlings, the herbicide must be in the soil solution or vapor phase. How is this achieved? The most common methods for herbicides to become dissolved into the soil solution are by mechanical incorporation or precipitation. Many early preplant applications in no-till systems attempt to increase the likelihood that sufficient precipitation will be received before planting to incorporate the herbicide. If, however, no precipitation is received between application and planting, mechanical incorporation, where feasible, will in most instances adequately move the herbicide into the soil solution.

Many weed species, in particular small-seeded species, germinate from fairly shallow depths in the soil. The top 1 to 2 inches of soil is the primary zone of weed-seed germination and should thus be the target area for herbicide placement. Shallow incorporation can be achieved by mechanical methods or by precipitation. Which of these two methods is more consistent?

Rainfall provides for a fairly uniform incorporation, but mechanical incorporation reduces the absolute dependence on receiving timely precipitation. How much precipitation is needed and how soon after application the precipitation should be received for optimal herbicide performance depends on many factors, but generally 1/2 to 1 inch of precipitation within 7 to 10 days after application is sufficient.

Herbicides remaining on the soil surface or those placed too deeply in the soil may not be intercepted by the emerging weed seedlings. Herbicides on the soil surface are subjected to several processes that reduce their availability. Volatility (the change from a liquid to gaseous state) and photolysis (degradation due to absorption of sunlight) are two common processes that can reduce the availability of herbicides that remain on the soil surface.

Dry soil conditions may be conducive for planting but may also reduce the effectiveness of soil-applied herbicides. If applications are made prior to planting and no precipitation is received between application and planting, a shallow mechanical incorporation may help preserve much of the herbicide's effectiveness.—*Christy Sprague and Aaron Hager*

## Herbicide Resistance: Where Are We?

Herbicide-resistant weed biotypes have plagued Illinois growers for well over 20 years. Over the last decade there has been a dramatic increase in the appearance of herbicide-resistant weed biotypes, in Illinois and worldwide. Currently, there are nine confirmed herbicide-resistant weed species biotypes in Illinois, and more than 200 confirmed resistant weed biotypes worldwide. An extensive list of confirmed herbicide-resistant weed biotypes in Illinois is presented in Table 5.

*What factors have contributed to the increase in herbicide-resistant weed biotypes?*

Over the years, various characteristics of weeds, herbicides, and cultural practices have been identified as contributing factors to the development of herbicide-resistant weed populations. Many of the herbicide-resistant weed populations encountered over the years have possessed similar characteristics. These include an annual life cycle, high seed production, very little seed dormancy, more than one reproductive generation per year, and a high susceptibility to the herbicide to which the population evolved resistance. Also, there are a number of characteristics that have been associated with the herbicides to which resistance has developed. These herbicides usually act at a single site of action in the plant, are often highly effective on the weed population that has developed resistance, are usually persistent in the soil, and have a high frequency of use. Cultural practices contributing to the development of herbicide-resistant weeds include lack of a complex crop

**Table 5. Confirmed herbicide-resistant weed biotypes in Illinois.**

| ALS-resistant | Triazine-resistant | ALS/triazine-resistant |
|---|---|---|
| common cocklebur | common lambsquarters | kochia |
| common ragweed | kochia | smooth pigweed |
| eastern black nightshade | smooth pigweed | waterhemp |
| giant ragweed | waterhemp | |
| kochia | | |
| shattercane | | |
| smooth pigweed | | |
| waterhemp | | |

rotation, little or no mechanical weed control, and, most importantly, the increased use of herbicides with the same site of action. Increased use of herbicides sharing a common site of action includes multiple applications of the same herbicide in a growing season or lack of rotating herbicides with different sites of action in consecutive growing seasons. Either way, these practices increase the selection pressure for herbicide-resistant weed biotypes.

*What about resistance to glyphosate?*

We are often asked about the potential development of weed biotypes resistant to glyphosate, the active ingredient in Roundup UltraMax, Touchdown, and many other products listed in Table 3 of issue no. 1 of the *Bulletin*. Last year we indicated two weed species had developed resistance to glyphosate: a goosegrass population in Malaysia and annual ryegrass in Australia and California. These two weed species aren't of much concern for Illinois producers since they are not problematic in agronomic production systems in Illinois. However, this year we need to add horseweed *(Conyza canadensis)* (often called marestail) to the list of glyphosate-resistant weeds. Glyphosate resistance in horseweed was first suspected in a few Delaware fields in 2000 when some horseweed plants were not controlled with glyphosate. Seeds from these suspected glyphosate-resistant horseweed plants were collected and taken to the greenhouse for further testing. Dr. Mark VanGessel, a weed scientist at the University of Delaware, confirmed these populations were resistant to glyphosate, demonstrating 6- to 10-fold resistance to glyphosate, compared with susceptible horseweed populations. This is the first case of glyphosate resistance where soybean was part of the cropping system. In all cases, glyphosate was used for burndown and postemergence weed control in no-till Roundup Ready soybeans for at least 3 years.

While there are only three confirmed glyphosate-resistant weed species biotypes, there have been reports in Illinois, Iowa, and Missouri of waterhemp not being effectively controlled with glyphosate. Some of these escapes may have been due to environmental conditions; however, there are a number of populations that don't seem to fit this explanation. In all three states, weed scientists are working with waterhemp populations that were not effectively controlled with glyphosate. Dr. Pat Tranel, University of Illinois, has screened a number of Illinois waterhemp collections and found three populations that have shown increased tolerance to glyphosate. While there are no confirmed glyphosate-resistant waterhemp populations, there is still some concern that this could be a potential problem in the future.

*What can be done to prevent herbicide resistance?*

One thing we know is that continuous use of herbicides with similar sites of action increases the selection pressure for herbicide-resistant weed biotypes. The following is a list of management strategies that can be implemented to help delay the onset or development of herbicide-resistant biotypes. In most instances, incorporating a number of these strategies will prove to be more beneficial than using only one.

1. Scout your fields to know what weed spectrum you're dealing with. If you have been relying on one particular herbicide for several years and notice that some weed species that were effectively controlled in past seasons are now abundant, or some species are now present that you haven't ever dealt with before in a particular field, this could be an indication that a herbicide-resistant biotype or a shift in weed species has developed.

2. Rotate herbicides with different sites of action. Do not make more than two consecutive applications of herbicides with the same site of action against the same weed unless other effective control practices are included in the management system. Consecutive applications can be single applications in 2 years or two split applications in 1 year.

3. Apply herbicides in tank-mixed, prepackaged, or sequential mixtures that include multiple sites of action. Both herbicides in the mixture must have substantial activity against potentially resistant weeds as well as similar persistence if they possess soil activity. For example, if one is concerned about potentially ALS-resistant pigweed, a tank mixture of Basagran with an ALS inhibitor would be a poor choice since Basagran has very little activity on pigweed. A couple of guidelines may help with tank-mix or premix selection: (a) when

applied alone at the rate that will be used in the tank mixture, does the tank-mix or premix partner control the weed species that I am concerned may develop resistance? and (b) if I apply the tank-mix or premix partner alone at the rate that will be used in the tank mix, will it have residual activity similar to the other component?

4. As new herbicide-tolerant/-resistant crops become available, their use should still not result in more than two consecutive applications of herbicides with the same site of action against the same weed species unless other effective practices are included in the management system.

5. Combine mechanical control practices, such as rotary hoeing and cultivation, with herbicide treatments whenever possible.

6. Clean tillage and harvest equipment before moving from fields infested with resistant weeds to those fields that are not infested. This may not always be practical, but it can help prevent the spread of resistant weed seed that is present in soil, which adheres to equipment.

Implementing several of these management strategies will help delay the development of herbicide-resistant weed biotypes, but if you are dealing with a field that already has a substantial population of a resistant biotype, strategies such as herbicide rotation and using tank mixtures may need to be emphasized for a longer time.

For additional information concerning weed resistance to herbicides, consult Chapter 14 of the *2001 Illinois Agricultural Pest Management Handbook.—Christy Sprague and Aaron Hager*

## Kochia Biology and Management

Kochia *(Kochia scoparia)* is an early-emerging summer annual species commonly found in the western United States. It is a herbaceous dicot and member of the Chenopodiaceae family (the same botanical family as common lambsquarters). Kochia was introduced into North America from Europe as an ornamental because of its red color in late summer and fall (hence, kochia's other common name, "fireweed").

In recent years, kochia has become more common in many areas of Illinois. It is commonly found along railroad rights-of-way and frequently spreads from these areas into neighboring cornfields and soybean fields. Kochia possesses several characteristics that make it well suited as a weed in agronomic production systems.

### Kochia Morphology and Biology

Kochia leaves are alternate with simple blades that are highly pubescent. Stems are erect, highly branched, often grooved on older plants, and vary in color from green to red, often with both colors present on an individual plant. Kochia has an imperfect flower that allows cross- pollination to occur, which has important implications for the spread of certain herbicide-resistance traits. Seed production is moderate to high, depending on environmental and competitive conditions. Seed dispersal occurs via a "tumbleweed" mechanism by which the mature stem detaches from its base and is subsequently blown about by wind. Kochia seed is short lived in the soil, but possesses a high initial germination rate. Results from one published study indicate that up to 93% of kochia seeds produced the previous season germinate within 1 year. Seed germination is generally greater at shallow soil depths and progressively decreases with increasing soil depth, making no-till systems a good environment for kochia. Seedling emergence can occur very early in the spring, so kochia is typically one of the first summer annual weed species to emerge. Studies have reported kochia emergence when average minimum daily soil temperature ranged from 37 to 46°F.

### Herbicide Resistance

Kochia biotypes with resistance to triazine and acetolactate-synthase (ALS) inhibiting herbicides have been well documented. Triazine-resistant kochia first appeared in 1976 along railroads in Idaho and Iowa, where triazine herbicides had been used continuously for total vegetation control. In 1987, the first kochia biotype resistant to ALS-inhibiting herbicides was discovered. Since these initial reports, herbicide resistance in kochia has spread rapidly. Most Illinois kochia samples have demonstrated resistance to triazine or ALS-inhibiting herbicides. We have documented the existence of an Illinois kochia biotype resistant to *both* triazine and ALS-inhibiting herbicides. Widespread herbicide resistance in the Illinois kochia population should be considered when formulating a chemical-control program for corn or soybeans.

### Kochia Control

One of the most effective kochia control options is tillage. Since kochia germinates very early in the season, a tillage operation prior to corn or soybean planting can sometimes eliminate most kochia for the remainder of the season. If tillage is not an option, a burndown herbicide should be selected that has good activity on kochia. Some effective burndown herbicides include Gramoxone Extra, glyphosate, and dicamba. Glyphosate rates of 0.375 lb. a.e. (13 fluid ounces of Roundup UltraMax) or less may not provide good burndown control, especially during cool temperature conditions. 2,4-D is generally less effective than dicamba. Triazine and several ALS-inhibiting herbicides have very good efficacy on kochia, but with widespread resistance to these herbicides in Illinois kochia populations, herbicides with these modes/sites of action *should not* be relied on exclusively for kochia control. Command (clomazone) is an effective soil-applied soybean herbicide, while glyphosate can be used for postemergence control in glyphosate-resistant soybean varieties. Other postemergence soybean herbicides that can suppress or control kochia include Cobra (lactofen) or Flexstar (fomesafen). Balance and Epic are effective soil-applied corn herbicides, while postemergence kochia control in corn can be obtained with Tough, Buctril, or products containing dicamba.—*Aaron Hager and Christy Sprague*

## Control of Volunteer Corn

Poor cornstalk quality last fall resulted in significant seed loss at harvest in many areas of Illinois. Indeed, many cornfields soon "greened up" following the 2000 harvest, not because of weed growth, but because of the "second" corn crop of the season. While some of this corn seed was lost due to fall germination, and some was likely lost during the winter months, volunteer corn may be a common weed problem in soybean fields and cornfields during 2001. This may not be much cause for alarm to everyone, but some volunteer corn plants may contain traits not approved for human consumption or export (StarLink and Roundup Ready, for example), which ultimately could lead to further problems during harvest. It might be timely to review options for volunteer corn control in soybeans and corn.

### Control in Soybeans

Control of volunteer corn will be much easier and more complete in soybeans than in corn. Several soil-applied and postemergence herbicide options are available that can provide excellent control of volunteer corn in soybeans. Postemergence soybean herbicides are generally more effective than soil-applied herbicides. Keep in mind, however, that volunteer corn often grows in clumps near the corn ear. Complete control of clump corn is sometimes more difficult to achieve than control of individual plants because thorough coverage of clump plants can be more difficult.

Soil-applied soybean herbicides that can provide suppression or control of volunteer corn include Scepter (or premixes containing imazaquin), Treflan (trifluralin), Command, Classic (or premixes containing chlorimuron), and Pursuit (or premixes containing imazethapyr). Most of these products can be surface applied without incorporation in no-till systems, and absence of soil disturbance may actually reduce the amount of volunteer corn emergence.

The postemergence grass control herbicides, Assure II, Fusion, Fusilade DX, Select, and Poast Plus, are effective options for volunteer corn control. It should be noted that control of volunteer corn with these herbicides may be reduced when these products are applied in combination with postemergence broadleaf herbicides. Other postemergence soybean herbicides that can suppress or control volunteer corn include Scepter, Raptor, and glyphosate. Scepter and Raptor will not provide much control of volunteer ClearField corn, and glyphosate will not provide acceptable control of volunteer glyphosate-resistant corn. Efficacy ratings, application rates, and maximum volunteer corn heights for these products appear in Table 6.

### Control in Corn

In conventional corn, no selective corn herbicide will selectively control volunteer corn. If second-year corn will be planted, control of volunteer corn in the 2001 corn crop can be enhanced with the use of herbicide-resistant/-tolerant hybrids that allow the use of herbicides that normally control corn. Table 7 lists options for volunteer corn control in the 2001 corn crop.— *Aaron Hager and Christy Sprague*

## REGIONAL UPDATE

Extension center educators, unit educators, and unit assistants in northern, west-central, east-central, and southern Illinois prepare regional reports to provide more localized insight into pest situations and crop conditions in Illinois. The reports will keep you up to date on situations in field and forage crops as they develop throughout the season. The regions have been defined broadly to include the agricultural statistics districts as designated by the Illinois Agricultural Statistics Service, with slight modifications:

- North (Northwest and Northeast districts, plus Stark and Marshall counties)

**Table 6. Herbicide options for volunteer corn control in soybean.**

| *Postemergence herbicide* | *Maximum corn size (in.)* | *Application rate[a]* | *Efficacy* |
|---|---|---|---|
| Assure II | 6 to 18 | 5 to 8 fl oz | 9 |
| Fusilade DX | 12 to 24 | 6 fl oz | 9 |
| Fusion | 12 to 24 | 6 fl oz | 9 |
| Select | 4 to 24 | 4 to 6 fl oz | 8 |
| Poast Plus | 20 | 24 fl oz | 8 |
| Extreme | Not listed on label | 3 pints | 9 |
| Glyphosate | 12 to 20 | 16 to 24 fl oz[b] | 9 |
| Raptor | 2 to 8 | 5 fl oz | 8 |
| Scepter | 8 to 12 | 1.4 to 2.8 oz | 8+ |

[a]Some product labels recommend application higher rates when tank-mixing with a postemergence broadleaf herbicide.
[b]Rates based on a glyphosate formulation containing 4 lb active ingredient/3 lb acid equivalent per gallon.

**Table 7. Herbicide options for volunteer corn control in the 2001 corn crop.**

| *If the 2000 corn hybrid was:* | *Planting one of these corn hybrids in 2001:* | *Would allow the use of these herbicide options for volunteer corn control:* |
|---|---|---|
| Conventional | ClearField | Lightning |
| | Roundup Ready | Glyphosate products labeled for use in Roundup Ready corn hybrids |
| | Liberty Link | Liberty, Liberty ATZ |
| Liberty Link | ClearField | Lightning |
| | Roundup Ready | Glyphosate products labeled for use in Roundup Ready corn hybrids |
| Roundup Ready | ClearField | Lightning |
| | Liberty Link | Liberty, Liberty ATZ |
| ClearField | Roundup Ready | Glyphosate products labeled for use in Roundup Ready corn hybrids |
| | Liberty Link | Liberty, Liberty ATZ |
| Liberty Link/ ClearField stacked traits | Roundup Ready | Glyphosate products labeled for use in Roundup Ready corn hybrids |

- West central (West and West Southwest districts, and Peoria, Woodford, Tazewell, Mason, Menard, and Logan counties from the Central district)
- East central (East and East Southeast districts [except Marion, Clay, Richland, and Lawrence counties], McLean, DeWitt, and Macon counties from the Central district)
- South (Southwest and Southeast districts, and Marion, Clay, Richland, and Lawrence counties from the East Southeast district)

We hope these reports will provide additional benefits for staying current as the season progresses.

**East-Central Illinois**

The corn-planting situation changed rapidly this week, from only a few planters in the field on Friday morning to widespread activity over the weekend and throughout the beginning of the week. The unseasonably warm temperatures caused soil temperatures to rise dramatically. Morning 4-inch bare soil temperatures have risen to near 60°F.

Over the last month, this area has received less than half the normal amount of precipitation. Dry surface soil conditions have prevailed. Despite showers and storms that moved through, planting continued.

The warm temperatures have also stimulated weed emergence. Fields are "greening up" rapidly. The weed development has coincided with the arrival of black cutworm moths. Doug Gucker, Piatt County Extension Office, reported his first moth capture and his first intense flight on the same day.

**Northern Illinois**

Field activity became more frequent around April 3, but the scattered showers on April 5 to 6 and Monday morning put fieldwork on hold.

Jim Morrison, crop systems Extension educator, reported catching several black cutworm moths in Winnebago County on April 10. However, this is not considered an intense moth capture.

Rainfall and the warm weekend temperatures contributed to further wheat and alfalfa growth.

**Southern Illinois**

Unseasonably warm weather has brought numerous changes over the past week. Temperatures have been 10 to 15 degrees above normal.

Some sands and a few other areas have been planted, but with 80°F afternoon temperatures, everyone has been thinking corn planting.

A significant amount of tillage has been done in areas where soil moisture has permitted. Many areas remain just a little too wet. Winter annual weeds have jumped in growth, and henbit is in full bloom.

Most wheat is first node and rapidly moving to GS7. Nitrogen and garlic control applications are nearing completion. Some wheat variability still exists; however, overall wheat condition is good.

Common armyworm and black cutworm moths are flying. Alfalfa weevil larvae have hatched and begun pinholing.

**West-Central Illinois**

Corn planting progressed rapidly until heavy rains set in earlier this week. Planting conditions were ideal, with germination occurring very rapidly. The wait begins to see what problems, if any, develop after planting. Anhydrous ammonia prices are decreasing from a high of well over $400 per ton.

Some polymer-coated soybeans have been planted in the Springfield area.

Alfalfa weevil activity has been observed in some fields in Menard County. Significant stand reductions from winter heaving have occurred in some fields.

Winter annuals are growing rapidly because of warm, moist soil conditions.

Wheat growth has accelerated and most fields look good.

## Beware of Phone-y Pesticides

Pesticide telemarketers are at it again, and some of them will tell you anything to make the sale. A farmer was looking for a herbicide to clean broadleaf weeds out of his sunflower field. The telemarketer had the perfect product. The farmer was excited to solve his problem. Fortunately, he found out the active ingredient and called his Extension office before he made the purchase. The active ingredient was prometone. This product is not labeled for agricultural use and would have prevented any plant growth, crops and weeds, probably for a couple of years.

Even for its proper use, this was a bad deal. The product being offered was only 2% active ingredient, while the more familiar herbicide Pramitol has the same active ingredient at 25% concentration at about the same price or cheaper.

As a rule, it is probably a bad idea to buy pesticides over the phone. But, if they do get you interested and the product really sounds good, ask them to mail you a copy of the label first. This will give you time to look it over, think about the purchase, and investigate related products.

Our consumer experts advise that once the purchase is made, you actually have better protection from poor products purchased from door-to-door salesmen than you do from telemarketers. If you purchase by credit card, your credit card company may give you the opportunity to protest the bill when deceptive advertising is used, but do you want these people to have your credit card number?—*Dennis Bowman*

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