PEST MANAGEMENT & CROP DEVELOPMENT
BULLETIN

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INSECTS

Mark Your Calendars for the 1998 University of Illinois Agronomy Day: August 27

On August 27, the 42nd Annual Agronomy Day will take place at the Crop Sciences Research and Education Center (South Farm) beginning at 7 a.m. This program serves as an annual showcase for faculty to discuss their latest research findings with clientele throughout Illinois and also from neighboring states. The theme for this year's event is *Agricultural Information: Seeds for Success*. With so many new and revolutionary innovations in the use of seeds for crop production and protection purposes, and rapid changes in the delivery of information to clientele, this year's program-planning committee has endeavored to feature topics that capture these new developments. The Department of Crop Sciences, in cooperation with some other units on campus, will feature four separate tours this year, with five speakers at each tour. A selection of just a few of the topics to be offered at this year's program includes the following:

The Use of Neural Networks to Predict Corn Yield
Herbicide Resistance and Weed Management
The Use of Smart Sprayers to Target Weeds
Transgenic Technology and Insect Management
Increasing Yields with Genetic Diversity
Soybean Cyst Nematode: An Examination of the Management Options
Narrow-Row Corn Production: Another Season of Results
Research Advances with Wheat Scab and White Mold

In addition to the tours, numerous educational displays will be featured beneath the "Big Top." Presenters will be available to answer questions about the displays. So, plan for an interesting excursion to the field and through the displays and exhibits. Also, during lunch, participants are encouraged to continue discussions with speakers and solicit answers to any lingering questions that may not have been addressed on the tours. Finally, if you have any questions about the program before August 27, please give Sharon Conatser, (217)333-4424, or myself, (217)333-6652, a telephone call; e-mail addresses are sconatse@uiuc.edu and m-gray4@uiuc.edu. Both Sharon and I are coordinating this year's event, along with Bob Dunker, Farm Superintendent of the Crop Sciences Research and Education Center (South Farm).

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Table 1. Projected date when 300 heat units above base 50ºF will have accumulated after the date of an intense capture of black cutworm adults (9 or more moths caught in a pheromone trap during a 1- to 2-day period)

Crop-reporting district and location	*Date of intense capture of black cutworm adults in pheromone-baited traps*									
	4/15	*4/17*	*4/19*	*4/21*	*4/23*	*4/25*	*4/27*	*4/29*	*5/1*	*5/3*
	——————— Projected date of cutting activity by black cutworm larvae ———————									
Southwest										
Belleville	5/15	5/16	5/16	5/17	5/17	5/18	5/20	5/21	5/21	5/23
Carbondale	5/14	5/15	5/15	5/16	5/16	5/17	5/19	5/20	5/20	5/22
Southeast										
Fairfield	5/15	5/16	5/17	5/17	5/18	5/19	5/21	5/21	5/21	5/23
Rend Lake	5/14	5/15	5/16	5/17	5/17	5/19	5/21	5/21	5/21	5/23
Dixon Springs	5/11	5/12	5/12	5/13	5/14	5/16	5/18	5/19	5/19	5/22
West Southwest										
Perry	5/18	5/18	5/19	5/19	5/19	5/21	5/22	5/22	5/22	5/24
Springfield	5/18	5/18	5/19	5/19	5/20	5/21	5/23	5/23	5/23	5/25
East Southeast										
Brownstown	5/18	5/18	5/19	5/19	5/20	5/21	5/22	5/23	5/23	5/25
Olney	5/17	5/18	5/18	5/18	5/19	5/20	5/21	5/21	5/21	5/23
West										
Monmouth	5/20	5/20	5/20	5/21	5/21	5/23	5/24	5/24	5/24	5/26
Central										
Kilbourne	5/18	5/19	5/19	5/19	5/20	5/21	5/23	5/23	5/23	5/25
Peoria	5/20	5/20	5/21	5/21	5/22	5/2	5/25	5/25	5/25	5/27
Wildlife Park	5/20	5/20	5/21	5/21	5/22	5/23	5/25	5/25	5/25	5/27
Eas										
Bondville	5/20	5/20	5/20	5/21	5/21	5/23	5/24	5/24	5/24	5/27
Champaign	5/20	5/21	5/21	5/21	5/22	5/23	5/24	5/25	5/25	5/27
Stelle	5/18	5/19	5/19	5/20	5/21	5/22	5/24	5/25	5/25	5/28
Northwest										
Freeport	5/24	5/24	5/25	5/25	5/26	5/27	5/28	5/28	5/28	5/30
Northeast										
DeKalb	5/24	5/24	5/24	5/25	5/26	5/27	5/28	5/28	5/28	5/30
St. Charles	5/25	5/25	5/25	5/26	5/27	5/28	5/28	5/29	5/29	5/30

Intense Black Cutworm Moth Captures Reported from East-Central Illinois

Several cooperators reported intense flights of black cutworm moths during late April and early May in east-central Illinois. Jeff Huffman, Piatt County, found eight moths in a pheromone trap near Bement on April 30, and nine moths on May 1. Aaron Grote, United Prairie Cooperative, trapped 16 moths in a trap located near Arthur, Moultrie County. Moth captures as reported by Jim Morrison, crop systems educator, Freeport Extension Center, have slowed to just a trickle throughout late April and early May. Moths will continue their migration throughout Illinois for the rest of May, so, please continue to pass along your capture information to Kevin Steffey and me.

Table 1 provides some updated projected cutting dates that are based upon intense flights beginning in mid-April and continuing through early May. Don't forget to refer to our earlier projected cutting dates (*Bulletin* no. 5, page 38) based upon intense flights that took place from mid-March through early April. As you begin to troubleshoot fields for early signs of black cutworm leaf feeding, Figure 1 may be of some use to you. This figure should enable you to determine the age (instar) of black cutworm larvae, the approximate number of days left to feed, and the potential number of plants that may be cut. *A reminder, don't wait for cutting as a first sign that black cutworm larvae are at work*. Your scouting efforts in cornfields that are in the seedling stage of development should concentrate on looking for small, pinhole leaf-feeding injury left behind by "nibbling" early instar black cutworm larvae. As planting delays continue and winter annual weeds flourish in untilled fields, the odds of economic infestations of black cutworm larvae increase. Please let us know if cutting infestations of black cutworms begin to surface in your region of the state. Thanks for your cooperation!

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Guide to Black Cutworm Development and Damage in Corn

Larval instar	Head capsule width	Approximate days left to feed	Potential number of plants that may be cut		
			1 leaf	2 leaf	4 leaf
4		25	4	3	1
5		21	4	3	1
6		14	4	3	1
7		5	1	1	1

Figure 1. Head-capsule gauge for determining the age (instar) of black cutworm larvae, the approximate number of days left to feed, and the potential number of plants that may be cut.

Armyworms Are Here, Too

At this time of year, we usually focus on early season insects that everyone seems to think about first—black cutworms, white grubs, and wireworms in corn, and alfalfa weevils in alfalfa. However, as black cutworm moths are making their way into Illinois in the spring, they usually are accompanied by armyworm moths, insects that share the same migratory habit. Kevin Black with Cargill in Lexington (McLean County) reported finding armyworm moths in his light trap. His report reminded me that we tend to overlook armyworms, an insect that can cause headaches in both corn and wheat during some years. So in this article, I'll review what we know about armyworms.

The armyworm moth is tan to gray-brown, with a wingspan of about 1-1/2 inches. A single small but prominent white dot in the center of each forewing is evident. The female lays small, white eggs in rows or groups, on leaves of grain or grass. The moth usually folds the leaf lengthwise and fastens the leaf about the eggs with a sticky secretion. The young larvae, the ones you might find right now, are pale green in color and have a looping habit when they crawl. When the larvae are full grown, they are approximately 1-1/2 inches long and have distinct longitudinal white, brown, and orange stripes, most notably the orange stripes just beneath the spiracles (breathing pores) on each side of the body. Black stripes on the prolegs also are noticeable.

Armyworms prefer to lay their eggs in very dense grassy vegetation, so they pose a threat to wheat growers every year. In addition, armyworms can injure seedling corn that has been no-tilled into a standing grass cover crop, like rye, or in fields that had intense grassy weed pressure at planting time.

Corn growers who are watching emerging seedlings for any sign of injury should also watch for armyworms, along with cutworms and all the other early season insects. This is particularly important in corn that was planted into a grass cover crop and in fields with a history of grassy weed problems. Armyworm larvae may feed only on leaf margins, or they may strip the plants, leaving only the stems and leaf midribs. A corn plant recovers from this injury when feeding activity is moderate, as long as the growing point of the plant has not been injured. However, entire cornfields can be defoliated when an armyworm infestation is heavy and feeding damage is severe. If 25 percent or more of the plants are being injured and some plants are being killed, a treatment may be warranted. Insecticides suggested for control of armyworms in corn are *Ambush 2E (6.4 to 12.8 oz per acre); *Asana XL (5.8 to 9.6 oz per acre); Lorsban 4E (1 to 2 pt per acre); *Penncap-M (2 to 3 pt per acre); *Pounce 3.2EC (4 to 8 oz per acre); and Sevin XLR Plus (2 to 4 pt per acre). Products preceded by an asterisk (*) are restricted for use only by certified applicators. Follow all label directions and precautions.

Scout for armyworms in wheat in areas of the field where the stand is particularly dense. Look for the larvae by parting the wheat plants and sifting through the litter on the ground. If you find armyworm larvae, make a note, but don't overreact. Small armyworms feed first on the lower leaves. The caterpillars then work their way upward as they grow and consume more leaf material. Armyworms usually don't cause economic losses in wheat until they begin feeding on the flag leaves. Control of small armyworm larvae is not warranted because natural enemies and diseases may cause considerable mortality in the population. Treatment may be warranted if you find six or more nonparasitized armyworms (3/4 to 1-1/4 inches long) per linear foot of row and before extensive head cutting occurs.

Insecticides suggested for control of armyworms in wheat are *Penncap-M (2 to 3 pt per acre); Sevin XLR Plus (2 to 3 pt per acre); and *Warrior 1EC (2.56 to 3.84 oz per acre). Products preceded by an asterisk (*) are restricted for use only by certified applicators. Follow all label directions and precautions.

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Other Insects in Wheat at This Time of Year

As you scout for armyworms, you likely will encounter other insects in wheat, some of which can pose a threat to optimal yield. Cereal leaf beetles and aphids could be active in wheat right now. In fact, entomologists in Kentucky have reported that aphids are appearing in seedling corn in western counties, especially in corn that has been planted into abandoned wheat acres. They also reported that cereal leaf beetles are active.

Several aphid species may be found in wheat. English grain aphids are green and have long, narrow cornicles ("tailpipes" that protrude from the rear of the abdomen) that are entirely black. The bird cherry-oat aphid is olive green, with a red-orange band across the rear of the abdomen; the tips of its cornicles are black. The greenbug, the most threatening aphid species, is bright green, with a darker stripe along the middle of its back. The tips of the cornicles are black. Entomologists have never been able to associate economic yield losses in wheat with infestations of bird cherry-oat aphids; however, both English grain aphids and greenbugs are capable of causing yield losses under the right circumstances. Cool temperatures may hold back the parasitoids that usually suppress early season populations of aphids in wheat. If aphids begin building their colonies in the absence of natural enemies, their numbers could escalate rapidly, so keep your eyes peeled.

Adult cereal leaf beetles emerge from overwintering quarters and move to wheat, where they feed before they begin laying eggs. An adult cereal leaf beetle is hard-shelled, about 3/16-inch long, with metallic blue wing covers and head, and red-orange legs and prothorax (the area just behind the head). Recently deposited eggs are elliptical, yellow, and smaller than a pinhead. Just before hatching, they turn almost black. Eggs are deposited singly or in rows of three or four, but never in clusters. They usually are found close to the mid-rib on the upper surface of a leaf. The larva resembles a slug or a small glob of mud. This "glob" is an accumulation of fecal matter carried around by the immature cereal leaf beetle. This behavior probably is a defensive mechanism that discourages some predators and parasitoids from attacking the larval stage of this pest. However, at least three parasitic wasps are natural enemies of the larvae. Another small wasp parasitizes cereal leaf beetle eggs, lady beetles prey on the eggs, and one tachinid fly parasitizes the adult. Consequently, natural enemies occasionally prevent densities of cereal leaf beetles from exceeding the economic threshold.

Adult cereal leaf beetles feed for about 2 weeks before they begin laying eggs. Eggs hatch in about 5 days, and larvae usually require 10 days to become full grown. After the larvae finish feeding, they move to the ground, pupate in the soil, and emerge as beetles after 2 to 3 weeks.

The larvae feed upon the green epidermal tissue of leaves, causing injured leaves to appear silver. Severely damaged fields look "frosted." The potential for yield loss depends upon the stage of growth of wheat plants, location of larvae on the plants, and the density of the pest. Severe damage to the flag leaf can reduce yields by 25 to 30 percent. An insecticide treatment may be justified when the combination of eggs and larvae average three or more per stem. Larvae feeding on the flag leaf cause more yield loss than larvae feeding on lower leaves of the plant.

If we hear about any developing infestations of either aphids or cereal leaf beetles in wheat, we will provide suggestions for insecticides. In the meantime, keep scouting.

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Heat-Unit Information for Alfalfa Weevils

Thus far, we have heard virtually nothing about alfalfa weevil activity around the state. Although a few folks have told us about a little bit of feeding injury here and there, we are not aware of any widespread infestations. Nor are we aware of any insecticide applications being made, even in southern Illinois. Nevertheless, alfalfa growers and their advisers should continue to monitor for alfalfa weevil larvae as the spring progresses.

Descriptions of alfalfa weevil larvae and the injury they cause and discussions about scouting techniques, economic thresholds, and suggested insecticides have been provided in previous issues of this *Bulletin*, so we won't use up additional space in this

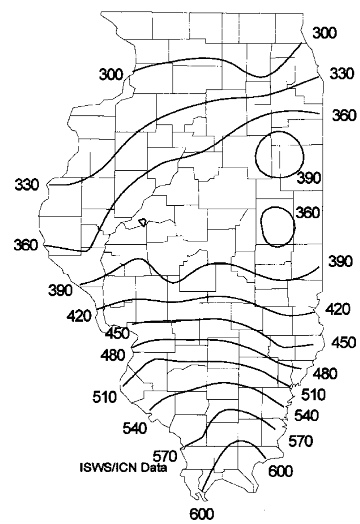

Figure 2. Actual heat-unit accumulations (base 48°F) from January 1 to May 4, 1998.

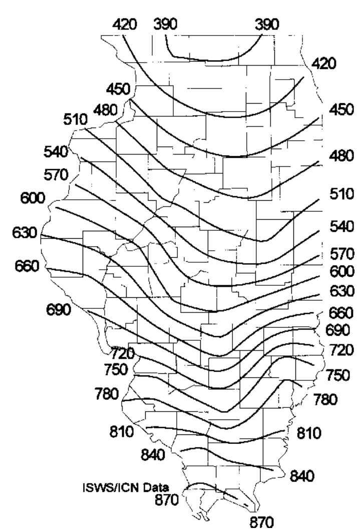

Figure 3. Projected heat-unit accumulations (base 48°F) from January 1 to May 18, 1998.

issue. Heat-unit updates are provided in Figure 2 (actual heat-unit accumulation, base 48°F, January 1 to May 4, 1998) and Figure 3 (projected heat-unit accumulation, base 48°F, January 1 to May 18, 1998). Remember, hatching of overwintering eggs usually occurs when 200 heat units accumulate, and we suggest that scouting should begin when 300 heat units accumulate. An early peak of third-stage larvae from overwintering eggs occurs after an accumulation of 325 heat units; a second major peak of thirdstage larvae from spring-deposited eggs occurs after an accumulation of 575 heat units.

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Look for a New Insect Pest in Alfalfa This Year

Entomologists in Minnesota and Wisconsin have been watching the rapid spread of an alfalfa insect pest that is new to the upper Midwest. The alfalfa blotch leafminer, *Agromyza frontella*, was first detected in northeastern Minnesota in 1994, although it may have arrived in that state as early as 1991. Since then, leaf mines and punctures (pinholes) caused by alfalfa blotch leafminer have been found in 99 counties in Minnesota, Wisconsin, Iowa, and Illinois. The only two counties in Illinois in which this insect has been confirmed are McHenry and Lake counties in the northeastern corner of the state. However, I was aware of an unconfirmed report of alfalfa blotch leafminers as far south as Champaign County in 1997.

Before invading the upper Midwest, the alfalfa blotch leafminer had been confined to the northeastern United States and Canada since its introduction into North America in 1968. Entomologists in Minnesota suspect that the pest was introduced into their state on infested hay from Ontario. The pest seems to spread faster than its major parasitoids, and severe infestations seem to lag behind the invasion front by about one year.

The alfalfa blotch leafminer overwinters as a puparium; and adults, which look like very small (1/8-inch) house flies, emerge in the spring. Mated females lay eggs under the lower epidermis of alfalfa leaflets. The females also feed on the alfalfa leaflets by cutting small holes with their ovipositors and lapping up the exposed sap and tissue. This injury leaves conspicuous pinholes on the leaflets. Larvae mine within the leaves and can be seen through the leaf surface. The last (third) instar of the larva widens its mine as it feeds, creating a characteristic blotch mine. If you look for this pest, don't confuse it with the common serpentine leafminer that creates a sinuous mine through the leaflet. The serpentine leafminer is not an economic pest.

Debate about the economic importance of the alfalfa blotch leafminer rages on. Some entomologists claim to have observed significant yield reductions caused by alfalfa blotch leafminers, and others can't obtain improvements in yield or quality of hay by spraying insecticides. Nevertheless, we are very interested in keeping track of this pest's spread into and through Illinois. If you believe you have observed the alfalfa blotch leafminer in your area, please give me a call or send me an e-mail message. I will do what I can to verify the observation and report our findings to the entomologists in Minnesota. Thanks in advance for your cooperation.

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WEEDS

Weed Resistance to Herbicides: The Problem Continues to Grow

The occurrence of weed biotypes resistant to particular herbicide families continues to increase across much of Illinois. A few years ago, there did not appear to be a great deal of interest among producers in the subject of weed resistance, but the economic impact of resistant biotypes has contributed to a high degree of interest at many levels of production agriculture in Illinois.

What exactly is a herbicide-resistant biotype? A herbicide-resistant plant may be defined as one that was once effectively controlled by a particular mode of herbicide action but which can no longer be controlled. For example, common lambsquarters usually can be effectively controlled with soil or foliar applications of atrazine, but several areas of Illinois have biotypes of common lambsquarters that can no longer be controlled with atrazine.

What are biotypes? Biotypes may be defined as "subpopulations" of a species that possess certain traits or characteristics not common to the entire species. When a particular herbicide effectively controls the majority of susceptible members of a species, only those plants (biotypes) that possess a resistance trait can survive and produce seed for future generations. This theory is often referred to as natural selection or survival of the fittest. Biological organisms (people, plants, animals, etc.) exhibit a wide range of diversity. The plants in a population that possess characteristics enabling them to survive under a wide range of environmental and other adverse conditions (such as herbicide applications) are able to produce seeds that maintain these survival characteristics. Plants less adapted generally do not survive, and hence only the fittest plants reproduce.

We should also review some definitions used in describing how herbicides work. Herbicide *mode of action* refers to the metabolic or physiological process within the plant that is impaired or inhibited by the herbicide. In other words, mode of action describes how a particular herbicide controls a plant. Herbicide *site of action* is the actual physical location within the plant where the herbicide binds or acts, in other words, the target site of the herbicide. Even though

Table 2. Herbicides and herbicide premixes containing a triazine herbicide

Trade name	*Common name*
AAtrex	atrazine
Bicep II, Bicep Lite II, Bicep II Magnum, Bicep Lite II Magnum	atrazine + *metolachlor**
Buctril + atrazine	atrazine + *bromoxynil*
Bladex, Cy-Pro	cyanazine
Bullet	atrazine + *alachlor*
Contour	atrazine + *imazethapyr*
Extrazine II, Cy-Pro AT	atrazine + cyanazine
Guardsman	atrazine + *dimethenamid*
FieldMaster	atrazine + *acetochlor* + *glyposate*
Surpass 100, Harness Xtra, FulTime	atrazine + *acetochlor*
Laddok S-12	atrazine + bentazon
Marksman	atrazine + *dicamba*
Shotgun	atrazine + *2,4-D*
Princep	simazine
Sencor, Lexone	metribuzin
Turbo	metribuzin + *metolachlor*
Canopy	metribuzin + *chlorimuron*
Axiom	metribuzin + fluthiamide

*Herbicides in *italics* have a different mode of action.

these two definitions are often used as if they were synonymous, they actually describe two completely different aspects of herbicide action. When dealing with herbicide-resistant biotypes, it can be beneficial to understand the differences between *how* and *where* herbicides work.

So what is the current status of herbicide-resistant biotypes in Illinois? There are confirmed cases of common lambsquarters, smooth pigweed, kochia, and some waterhemp biotypes that are resistant to triazine herbicides. Additionally, biotypes of waterhemp, kochia, and common cocklebur have developed resistance to ALS-inhibiting herbicides. Finally, there have been reports, as yet unconfirmed, of other weed biotypes demonstrating resistance to these and other herbicide families.

We are frequently asked about the potential for weed biotypes to develop resistance to glyphosate, the active ingredient in Roundup Ultra. With the widespread adoption of Roundup Ready soybeans and the potential for Roundup Ready corn hybrids, the selection pressure for glyphosate-resistant biotypes will increase dramatically. However, confirmed instances of glyphosateresistant weed biotypes are rare. Even though the potential to select for biotypes resistant to glyphosate may be less than for other herbicide families, widespread use of one weed control technique carries the potential to cause a shift in the weed spectrum to one that is not easily controlled. From an applied viewpoint, weeds that are difficult to control, whether due to resistance or simply due to a shift in spectrum, translate into many of the same problems for the producer.

What management steps can be implemented that could lower the potential for developing herbicide-resistant biotypes or possibly delay a shift in the weed spectrum? The following list of strategies is offered for consideration. In most instances, incorporating as many of these strategies as possible will prove more beneficial than using only one.

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

2. Rotate herbicides with different modes of action. Do not make more than two consecutive applications of herbicides with the same mode 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 one year.

3. Apply herbicides in tank-mixed, prepackaged, or sequential mixtures that include multiple modes 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 you are concerned about potentially ALS-resistant pigweed, a tank mixture of Basagran with an ALS-inhibitor would be a poor choice because 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 specie that I am concerned may develop resistance? (b) If I apply the tank-mix or premix partner alone at the rate that will be used in the tank mix, will its residual activity be similar to the other component's?

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 mode 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 fields that are not infested. This may not al-

Table 3. Herbicides and herbicide premixes containing ALS-inhibitors

Trade name	*Common name*
Imidazolinones	
Pursuit	imazethapyr
Pursuit Plus	imazethapyr + *pendimethalin**
Steel	imazethapyr + imazaquin + *pendimethalin*
Contour	imazethapyr + *atrazine*
Resolve	imazethapyr + *dicamba*
Lightning	imazethapyr + imazapyr
Scepter	imazaquin
Squadron	imazaquin + *pendimethalin*
Scepter O.T.	imazaquin + *acifluorfen*
Detail	imazaquin + *dimethenamid*
Tri-Scept	imazaquin + *trifluralin*
Arsenal, Chopper	imazapyr
Sulfonylureas	
Classic, Skirmish	chlorimuron
Canopy	chlorimuron + *metribuzin*
Canopy XL, Authority Broadleaf	chlorimuron + sulfentrazone
Celebrity	nicosulfuron + *dicamba*
Pinnacle	thifensulfuron
Synchrony STS, Reliance	thifensulfuron + chlorimuron
Harmony Extra	thifensulfuron + tribenuron
Basis	thifensulfuron + rimsulfuron
Basis Gold	nicosulfuron + rimsulfuron + *atrazine*
Accent	nicosulfuron
Accent Gold	nicosulfuron + rimsulfuron + flumetsulam + clopyralid
Beacon	primisulfuron
Exceed, Spirit	prosulfuron + primisulfuron
Peak	prosulfuron
Permit	halosulfuron
Ally	metsulfuron
Oust	sulfometuron
Express	tribenuron
Glean, Telar	chlorsulfuron
Sulfonamides	
Broadstrike + Dual	flumetsulam + *metolachlor*
Hornet	flumetsulam + *clopyralid*
Scorpion III	flumetsulam + *clopyralid + 2,4-D*
Broadstrike + Treflan	flumetsulam + *trifluralin*
FirstRate	cloransulam

*Herbicides in *italics* have a different mode of action.

ways be practical, but it can help prevent the spread of resistant weed seed that in soil that adheres to the equipment.

Implementing several of these management steps can 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 utilizing tank mixtures may need to be emphasized for a longer period of time. For example, if a resistant biotype has been selected for with an ALS-inhibiting herbicide and is well established, it may take several years of using herbicides with some alternative mode of action to bring the problem to a manageable level before rotating back to the herbicide that selected for the resistant biotype.

Tables 2 and 3 contain a list of triazine and ALS-inhibiting herbicides. Because weed biotypes resistant to these herbicide families have been identified in Illinois, producers may find it beneficial to know which products on the market today have similar modes of action.

For more information on weed resistance to herbicides, consult Chapter 20 of the *1998 Illinois Agricultural Pest Management Handbook.*

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Options for Controlling Oversized Vegetation in No-Till

A wet, cool spring has delayed corn planting across much of Illinois and has also given early weeds time to grow. Some no-till fields have an impressive display of healthy vegetation that will require management before planting corn or soybeans. Atrazine, Bladex, or Extrazine II have both foliar and soil activity but are limited in the size of weeds they control when used in notill burndowns. These products have fairly good activity on annual grasses 1.5 inches or less and on many broadleaf species in the 3-to-4-inch range. Options for controlling larger vegetation in no-till situations include 2,4-D or Banvel/Clarity for broadleaf species and Touchdown 5, Roundup Ultra, or Gramoxone Extra for grass and broadleaf weeds.

2,4-D ester may be applied at 1 pint per acre before planting corn or soybeans, but at least 7 days must elapse between application and soybean planting. Banvel or Clarity may be added to many preplant corn herbicides. Roundup Ultra or Touchdown 5 may be used at 1 to 2 pints per acre in many preemergence herbicide mixes. FieldMaster, a premix of Harness Xtra and Roundup Ultra, may be applied preplant or preemergence in corn at 3.5 to 5 quarts per acre.

Gramoxone Extra may be tank-mixed with several preplant or preemergence herbicide mixes for corn or soybeans at 1.5 to 3 pints per acre, depending upon weed size. The addition of atrazine, Bladex, or Extrazine II improves control of smartweeds, giant ragweed, and marestail with Gramoxone Extra in corn. Sencor or Lexone (also in

Canopy) may be added to Gramoxone Extra for no-till soybeans.

Authority Broadleaf and Canopy XL (sulfentrazone + chlorimuron) have both foliar and soil-residual activity, primarily for broadleaf weed control, and may be applied preplant or preemergence in soybeans. Pursuit, Pursuit Plus, and Steel also have both foliar and soil-residual activity on many grass and broadleaf weed species.

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PLANT DISEASES

Wheat Fungicides: To Spray or Not to Spray

I have received a number of calls requesting information on the effectiveness of foliar fungicides for wheat. This question is difficult to answer directly because effectiveness depends upon a number of factors, including the farmer's level of risk, varietal differences, weather patterns, and wheat prices.

Are foliar fungicides effective in controlling diseases? This is the easy one: definitely. The choice of product and the timing of application may vary from product to product, but they generally can improve yield. Data from the 1997 Fungicide and Nematicide Tests from the American Phytopathological Society on a wheat fungicide trial at Purdue are summarized in Table 4.

Although almost all products improved yields, was this improvement enough to actually justify the fungicide application? This, again, depends on other factors. If the weather patterns were continually favorable for foliar diseases, then simply protecting your yield with the fungicide is usually economical when compared to not treating. If you apply a fungicide and maintain your 70-bushel yield and your neighbor does not and has a 10 to 15 percent yield loss (7 to 11 bushels) due to diseases, then you have justified the application by maintaining your yields.

If, however, weather patterns do not favor diseases and you apply a fungicide, then you and your neighbor may have similar yields; and you will receive no benefits from the fungicide (unless you consider the peace of mind from not worrying about diseases). So, monitoring the weather is an important component of disease management. Wheat diseases are always more damaging in wet periods with mild to warm temperatures.

What are the economics of applying a fungicide to wheat? Plant pathologists generally agree that a fungicide application on a field crop should have at least a 2:1 return on investment. That means for every $15 spent on a fungicide, you should return a minimum of $30. Less than that may mean no economic benefits. Recent wheat prices from the CBOT, May '98 wheat to May '99 futures, were $2.98 to $3.50 per bushel, depending on delivery date. At these prices, you would need to gain 9 to 10 bushels per acre to return the $30. Can that be done? In some years, the answer is yes. From the Purdue data in Table 4, returns varied from none to a maximum of 12 bushels per acre. The average gain from a fungicide in this trial was 8 bushels per acre, not really enough to return the expected $30 per acre ($24 to $28 returned for 8 bu at the prices mentioned). If disease pressures were higher, then a greater return could be expected.

When should a fungicide be applied? With the Section 24(c) label for Tilt this year, farmers have more flexibility in fungicide-application timing. Fungicide programs should be directed toward maintaining the health of the flag leaf and flag-1 (the leaf directly below the flag). Flag-leaf losses can reduce yield, as well as test weights.

Scouting and identifying diseases should always precede any fungicide or other pesticide application. Consideration of the effects of the environment on disease progress is also important. Most foliar diseases and head diseases of wheat are favored by high moisture and mild to warm temperatures. Thus, if forecasts are for continued dry conditions, diseases will not be as important as if there were frequent rains. Fungicides will typically provide no economic return unless conditions favor disease.

In summary, the decision to apply a fungicide to wheat should be based upon proper identification of the disease or diseases present. Once the disease has been identified, then its location on the plant should also be noted. The Septoria diseases (leaf blight, glume blotch), tan spot, and scab all overwinter in debris and are splashed or windblown on the plants. The Septoria diseases and tan spot begin on the lower leaves and move upward as the season progresses. Scab spores are windblown into the open flowers, so it's a different situation.

A consideration of the use of a fungicide this year may be an application of Tilt to early flowering varieties (Clark, Ernie) because the continued rainy weather and mild temperatures will favor infection by the scab fungus. This fungus infects only open flowers, although the major damage appears much later. Tilt is labeled for scab suppression and can reduce the damage caused by this fungus, as well as the others listed above. With the 24(c) label, producers can wait well past the flag leaf stage and receive benefits from controlling late season diseases.

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Table 4. Wheat yields as affected by fungicide application, Purdue, 1997

Fungicide	*Rate/ acre*	*Growth stage at application*[1]	*Yield, bu/acre*
Penncozeb 75W	2 lb	GS 31	66.8 a
Tilt 3.6E	4 fl oz	GS 31	76.7 b
Penncozeb 75W	2 lb	GS 31	76.1 b
Tilt 3.6E	4 fl oz	GS 37	76.1 b
Tilt 3.6E	4 fl oz	GS 31, GS 37	75.5 b
Penncozeb 75W	2 lb	GS 31	77.5 b
Tilt 3.6E	4 fl oz	GS 37	77.5 b
Bayleton 50 DF	2 fl oz		
+ Penncozeb 75W	2 lb	GS 58	77.5 b
Tilt 3.6E	4 fl oz	GS 31, GS 37	77.4 b
Bayleton 50 DF	2 fl oz		
+ Penncozeb 75W	2 lb	GS 58	77.4 b
Penncozeb 75W	2 lb	GS 31	73.8 ab
Bayleton 50 DF	1 fl oz		
+ Penncozeb 75W	2 lb	GS 58	73.8 ab
Tilt 3.6E	4 fl oz	GS 31	75.2 b
Bayleton 50 DF	2 fl oz		
+ Penncozeb 75W	2 lb	GS 58	75.2 b
Folicur 3.6F	6 fl oz	GS 31	73.8 ab
Folicur 3.6F	6 fl oz	GS 37	75.4 b
Folicur 3.6F	6 fl oz	GS 58	79.0 b
Bayleton 50 DF	2 fl oz		
+ Penncozeb 75W	2 lb	GS 58	75.2 b
Tilt 3.6E	4 fl oz	GS 37	77.8 b
Untreated control			67.0 a

NOTE: Means within a column followed by a letter in common are not significantly different at P = 0.05.

[1]Growth stage 31 = one node detectable, 37 = flag leaf emerging, 58 = spike emerged.

CROP DEVELOPMENT

Wet Again: Corn Planting Delays

The official statistics indicate that 30 percent of the Illinois corn crop was planted by May 3, 1998, which is not much different than the average for that date. Planting of much of the crop in the state, however, continues to be delayed by wet soils. Following is a list of considerations as we face delays in getting the corn crop planted:

How fast are we losing yield? Estimates of yield loss are based mostly on planting-date studies that have been done periodically. Planting-date responses, like the weather, vary a great deal among years and locations. As a general summary of planting-date response in Illinois, we use the following:

—From May 1 to May 10, we lose about one-half bushel per day of delay.

—From May 10 to May 20, we lose about one bushel per day of delay.

—From May 20 to May 30, we lose about 1.5 bushels per day of delay.

—After May 30, yield losses accelerate sharply, from 2 bushels per day for the first week of June, and at least 3 bushels per day by June 10.

According to these estimates, about 15 bushels of potential yield have been lost by May 20, and about 30 bushels by May 30.

When do I switch to an earlier hybrid? In southern and central Illinois, most first-choice hybrids are not extremely full-season: The supply of accumulated growing-season temperatures (measured as growing-degree units, or GDU) is more than adequate to meet the needs of these hybrids. Most popularly grown hybrids can be planted into early June in the southern half of the state and still be expected to mature before frost.

In the northern part of the state, seasonal GDU accumulations are lower, but many of the first-choice hybrids are the same as those in Central Illinois, meaning that they are less likely to receive adequate GDUs if they are planted late. In the northernmost counties, where full-season hybrids would generally require about 2,600 GDU, such hybrids should be replaced with earlier hybrids if planting is delayed beyond May 20 to 25 or so. Such a switch is not necessary in the central part of the state (where “full-season” hybrids tend to require 2,700 to 2,800 GDUs) until after May 31, and perhaps not even then.

In actual practice, there is evidence from both research and late-planting experience that GDU requirements for late-plated corn are usually less than for corn planted early. In general, this decrease in GDU requirements was about 5 GDU for each day of planting delay from late April to mid-June. This decrease in GDU requirement probably stems mostly from the fact that as temperatures decline late in the season, the plant simply stops filling and so reaches black layer early, filling the kernels less and yielding less in the process. This acts as an additional safety factor for late-planted corn and suggests that we not rush into changing to an earlier hybrid too quickly.

How late ***can*** *we plant corn?* According to the loss estimates given above, we are likely to reach loss levels of about one-third of the potential yield by the end of the first week of June, and losses approach 50 percent by the middle of June. Anticipated losses on such a scale would likely cause a shift to another crop (possibly grain sorghum in the southern half of the state, probably soybeans in much of the state). For those who can harvest corn as a forage, it can be planted even later and still compete with other crop alternatives.

Do we change any other practices as planting is delayed? Our research shows that harvested plant population should probably not be changed very

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much as planting is delayed. With warmer soils at planting, we may want to reduce dropped-seed populations slightly in anticipation of a higher percent of the seed producing plants. Herbicide adjustments depend on time of application and type of herbicide. Unless planting is very much delayed and soils stay extremely wet, N applied in April should be adequate, particularly if expected yields are reduced. If N is to be side-dressed, slightly lower rates may be appropriate to match slightly lower expected yields, and more rapid uptake (less time for loss) as plants grow faster with warmer temperatures. Late planting also changes the expected weather at each stage of growth, and we will need to watch for insects and diseases that might take advantage of such "ecological shifts" during the season.

Is there a bright side to planting delays? Not an obvious one. While the correlation between average planting date and average yield in Illinois is not particularly strong, delays usually cut yields, and often decrease quality. Good yields are still possible, but they become statistically less likely as planting is delayed. One possible benefit might be an increase in the price of corn due to lower yields, but that requires lowered production in much of the corn-growing area. That could happen, but it will not be a result of delayed planting in much of the northern and western part of the Corn Belt, where planting progress has been good.

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