PEST MANAGEMENT & CROP DEVELOPMENT

BULLETIN

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UNIVERSITY OF ILLINOIS EXTENSION

Also in This Issue

Announcing the 2010 University of Illinois Corn & Soybean Classics

As harvest of the 2009 crop progresses, we would like to take this opportunity to announce the upcoming University of Illinois Corn & Soybean Classics. Our next series of meetings will mark the 13th iteration of the Classics, an educational program that continues the tradition of providing clientele with the most current and timely information on crop production, marketing, and pest management. Over 1,200 people attended the Corn & Soybean Classics in 2009, a number probably cut short by inclement weather at two locations. We believe the excellent attendance bears testimony that our clientele value the program highly.

These are the dates and locations for the 2010 Classics:

- January 6 (Wednesday): Mt. Vernon Holiday Inn
- January 8 (Friday): Champaign I Hotel and Conference Center
- January 11 (Monday): Springfield Crowne Plaza
- January 12 (Tuesday): Bloomington DoubleTree Hotel
- January 13 (Wednesday): Moline i wireless Center
- January 14 (Thursday): Malta Kishwaukee College

We will provide more information on the program in a future issue of *the Bulletin*. You can register by visiting www.cropsciconferences.org. If you have any comments or questions, please contact us.—*Aaron Hager*

INSECTS

Soybean Aphids Reach Impressive Levels on Buckthorn in Late September

In late September, reports of "swarms" of aphids became common across much of central and southern Illinois. On our campus, it was common to see students walking to class swatting at clouds of "gnats," as they referred to them. Treatment decisions for producers were made difficult, as many soybean fields were in late reproductive stages of development. As temperatures decline and day length shortens, winged soybean aphid females (gynoparae) abandon maturing soybean fields and fly to buckthorn. Upon their successful search for buckthorn plants, the females feed and begin producing nymphs that develop into oviparae. Late in the growing season, winged soybean aphid males also are produced on soybean plants. The males leave soybean fields and attempt to find buckthorn plants and begin mating with the oviparae. The oviparae lay eggs that overwinter on buckthorn.

In North America there are two overwintering hosts, the common buckthorn (*Rhamnus cathartica* L.) and the alderleaf buckthorn (*Rhamnus alnifolia* L'Hér). In contrast to the native alderleaf buckthorn, the common buckthorn is invasive and originated in Europe. This annual fall dispersal of soybean aphids (sexual morphs) to their primary host has been described as a "biological bottleneck" by Ragsdale and others (*Annals of the Entomological*

Society of America 97: 204–208). This so-called bottleneck could be readily observed across many areas of central and southern Illinois in late September. Aphid densities on buckthorn leaves were as high as many observers had ever witnessed.

As we have learned, accurately predicting soybean aphid infestations for the upcoming growing season has proven to be challenging. Certainly the stage has been set for abundant egg-laying on buckthorn plants this fall. Next spring, producers would be well advised to scout their soybean fields for aphids. If overwintering survival is good, natural enemy densities are low, and the growing season is relatively mild, we could see significant management issues develop with this pest in 2010.—*Mike Gray*

European Corn Borer Survey Conducted Once Again

Under the direction of Kelly Estes, an entomologist with the Illinois Natural History Survey, the fall survey of European corn borers was conducted once again. Early reviews of data indicate that densities were exceedingly low in some counties. We intend to share the full results in the November issue of *the Bulletin*. We have conducted this annual survey 11 times since the introduction of Bt hybrids. Data from the combined surveys seems to point in the direction that the widespread use of Bt hybrids has had a significant suppression effect on populations of this once-major insect pest of corn. Next year we may discontinue the survey to instead focus our survey efforts on western corn rootworm adults during the summer.

Many questions were raised this summer across the Corn Belt concerning the low densities of western corn rootworm adults. We have some historical data of western corn rootworm populations across Illinois, and it may be interesting to begin comparing these data pre-Bt and post-Bt. The very wet spring across much of the state may explain some of the low numbers observed in 2009. However, as more corn acres (first-year corn and continuous corn) are planted to Bt hybrids or treated with soil insecticides, we may be witnessing an areawide suppression of this insect pest as well.—*Mike Gray*

WEEDS

Fall-Applied Herbicides

The practice of applying herbicides in the fall specifically to control winter annual weed species has gained popularity across many areas of Illinois over the past decade. No-till fields, particularly in central and southern Illinois, often have robust weed growth before spring planting when early preplant or burndown herbicide applications are delayed. Interest has thus grown in the practice of attempting to control fall-emerging weeds soon after crop harvest.

University of Illinois weed scientists, like researchers across many other midwestern states, have investigated the efficacy of fall-applied herbicides for control of winter annual weed species. Our trials have ranged from northern to southern Illinois, beginning during the fall of 1999 and continuing into this fall. Having examined many aspects, concepts, and products or product combinations during these years, we offer the following points to consider:

• Fall herbicide applications seem to “fit” better in areas of central and southern Illinois compared with northern Illinois (approximately north of Interstate 80). This probably can be attributed to generally milder average winter temperatures the farther south one ventures (contributing to better winter survival of fall-emerged weeds) as well as to earlier resumption of weed growth in the spring. Fall-emerging weed species in the south may be able both to produce more growth in the fall before entering winter dormancy and to resume growth earlier in the spring. Thus, at any given date in spring, weed growth in no-till fields in southern Illinois typically is more ample than in no-till fields in northern Illinois.

• Application timing can be very important in achieving goals for fall applications. For example, if you are interested in a treatment without much soil-residual activity, such as 2,4-D or glyphosate, the application following harvest should occur after most weeds have emerged. Instead of applying such a treatment in mid-October, waiting until early to mid-November might provide better results. If, on the other hand, your fall application will include a herbicide with soil-residual activity, the application could occur sooner.

• Be sure to know if the products you are considering applying in the fall have activity on emerged weeds. For example, if you are thinking about using simazine on fields where corn will be planted in 2010 and weeds have already emerged, you might want to consider tank-mixing another product with simazine to control the emerged weeds.

• Fall applications that include soil-residual herbicides may not always produce a clean field by planting time next spring. Delays in fieldwork caused by adverse environmental conditions may allow fields to green-up before the crop can be planted. On several occasions we’ve also observed that if we successfully control the suite of winter annual weed species, summer annual species (such as common lambsquarters and smartweed) emerge sooner than if the winter annuals were still present.

• It’s perhaps even more tenuous to expect much control of summer annual weed species such as waterhemp from fall-applied herbicides. Given waterhemp’s extended emergence duration, better control from a soil-residual herbicide often results when the application is made closer to planting compared with several weeks (or months) before.

• With the increasing prevalence of horseweed (marestail), including glyphosate-resistant populations, fall herbicide applications may prove more effective than spring ones. Glyphosate alone may not provide adequate control when applied in either fall or spring, but fall timing provides an opportunity to use higher application rates of products such as 2,4-D than are feasible in spring. However, keep in mind that emergence of horseweed may not be restricted to fall months. Repeated observations suggest the farther south you venture, the higher the proportion of horseweed that emerges during spring.—*Aaron Hager*

Pondering a Springtime Sea of Yellow

Vibrant colors in Illinois corn and soybean fields might not be the most welcome sight when farmers' attention is focused on harvesting the mature, drab-colored crops. So it may be asking a bit much for readers to recall the bright yellow flowers that have become common across Illinois' *springtime* landscape. From a distance, folks often presume that the abundant yellow flowers of spring belong to one of the mustard species common in Illinois. Sometimes that assumption is correct, but often the flowers belong instead to a nonmustard species known by several common names, including cressleaf groundsel and butterweed. What do we know about this species? When might be ideal times to implement strategies for its control?

Native to the United States, butterweed can be found from Texas east to Florida, northward along the Atlantic coast to Virginia, and west to Nebraska. Herbarium specimens from the Illinois Natural History Survey indicate that butterweed specimens were collected in the state as early as 1932. The earliest herbarium specimens generally originated from counties in southern Illinois. During the 1980s and '90s, the survey augmented its collection with specimens from more northern counties, including Champaign and Vermilion. As of 1999, butterweed specimens had been collected from 48 counties in southern and central Illinois. Currently butterweed can be found from approximately as far north as Peoria, and from border to border east to west. Typically favoring moist to saturated soils, butterweed thrives in such areas as wastelands, pastures, fence rows, and roadsides. With the increased adoption of no-till and reduced tillage conservation practices, butterweed has become more prevalent in crop production areas.

Prior to *Packera glabella,* the Latin binomial for butterweed was *Senecio glabellus*. Similar to other plants in the genus *Senecio*, butterweed plants contain compounds with poisonous properties. Plants of this genus contain hepatotoxins in the form of pyrrolizidine alkaloids. Butterweed contains five pyrolizidine alkaloids: florosenine, senicionine, integerrimine, otosenine, and senkirkine. Pyrrolizidine alkaloids from the genus *Senecio* have been studied and shown to cause toxicosis of livestock across various regions of the world.

Butterweed completes its life cycle within one year (an annual growth habit). Field research was conducted at the University of Illinois from fall 2004 through spring 2006 to determine the emergence timing and growth characteristics of butterweed in no-till fields. Emergence tended to predominate in fall and was essentially complete by November, although some occurred in the spring (**Table 1**). From these results, we generally consider butterweed to be a winter annual species.

Following fall emergence, the formation of rosettes occurs before overwintering. The rosette leaves have petioles that connect the leaves to the stem. Often the underside of the rosette leaves is deep purple. Bolting (stem elongation), flowering, and seed production occur the following spring, often during May. The stem of butterweed is glaborous and hollow. After bolting, petioles are absent from leaves on the upper part of the plant. The leaves are pubescent, generally irregular in shape, and deeply cut to the midrib. The elongated stem often has a purplish tint. A member of the *Asteraceae* family, butterweed produces two types of composite flowers. The outside portion of the flower contains ray florets, while the center part contains disk florets. The flowers are bright yellow and grouped in clusters on several flowering stalks of the plant. Seeds are easily disseminated by wind due to the white hairs (pappus) on the apex of the achene.

We have coupled what we learned about the emergence characteristics of butterweed with additional field research (four Illinois locations in fall 2004 and three of these locations in spring 2005, then repeated at four locations in fall 2005 and spring 2006). We wanted to evaluate and compare several herbicides and herbicide combinations for butterweed control and to determine if control of butterweed is achievable following a fall or early-spring herbicide application. Results are presented in **Table 2**.

Nineteen herbicide treatments, including a nontreated control, were included at each location. Many treatments were selected based on common-use practices in Illinois, while other treatments, which are not commonly used (or labeled) in fall or early spring preplant applications, were included to examine their efficacy against butter-

Table 1. Emergence timing of butterweed in Illinois.

Year[a]	*Illinois county*	*Fall-to-spring ratio (% of total emergence)*
2004	Douglas	98:2
	Piatt	100:0
	Vermillion	91:9
	Combined	96:4
2005	Champaign 1[b]	92:8
	Champaign 2[b]	87:13
	Effingham	100:0
	Fayette	100:0
	Combined	95:5

[a]Year represents the duration of a single experiment. First-year data was collected fall 2004 through spring 2005; second-year data was collected fall 2005 through spring 2006.
[b]Two experiment locations in Champaign county in 2005–2006.

Table 2. Butterweed control at soybean planting and dry weight reduction of butterweed following fall or spring herbicide applications, averaged across eight (fall) and seven (spring) environments.

		Fall application		*Spring application*	
Treatment	*Rate*[a]	*Control (%)*	*Dry weight reduction*[b] *(%)*	*Control (%)*	*Dry weight reduction (%)*
Canopy EX + COC[c]	1.1 oz	99	100	98	88
Command	1.3 pt	73	46	0	30
Command	2 pt	82	80	0	41
Clarity + COC	8 fl oz	12	0	0	13
Distinct + COC	4 oz	48	63	0	15
2,4-D ester + COC	1 pt	77	76	0	22
2,4-D ester + COC	2 pt	86	79	0	45
2,4-D ester + Valor + COC	1 pt + 2 oz	86	84	53	60
2,4-D ester + Scepter + COC + AMS	1 pt + 2 oz	86	82	69	59
Glyphosate + AMS	0.75 lb ae	95	98	96	86
Glyphosate + AMS	1.5 lb ae	95	99	97	88
Glyphosate + 2,4-D ester + AMS	0.75 lb ae + 1 pt	97	95	94	80
Glyphosate + 2,4-D ester + AMS	0.75 lb ae + 2 pt	97	97	95	83
Extreme + NIS + AMS	3 pt	95	98	94	88
Glyphosate + Prowl + 2,4-D ester + AMS	0.75 lb ae + 2.5 pt + 1 pt	97	96	94	80
Callisto + atrazine + COC	3 fl oz + 0.25 lb	82	83	51	54
Gramoxone Max + NIS	1.7 pt	93	89	68	67
Gramoxone Max + Princep + NIS	1.7 pt + 2 qt	97	99	84	88
Paramount + MSO	5.3 oz	4	8	0	0
$LSD_{0.05}$		8	9	7	8

[a]Rates of glyphosate expressed as lb ae/acre, all other herbicide rates as product rates.

[b]Dry weight reductions from the nontreated control.

[c]Crop oil concentrate and methylated seed oil were added at 1% v/v; liquid ammonium sulfate was added at 5% v/v; nonionic surfactant was added at 0.25% v/v.

weed. All treatments were applied at two timings: fall (mid- to late November) and spring (early to mid-April). Average diameter of butterweed rosettes was 2 to 4 inches and 6 to 8 inches when fall and spring treatments, respectively, were applied.

Butterweed control was determined by visually assessing plant biomass reduction in the treated area using a scale of 0 to 100 (0 representing no control and 100 indicating complete control). Additionally, five uniformly sized butterweed plants (2–4 and 6–8 inches in diameter for fall and spring applications, respectively) per plot were marked before herbicide application and subsequently harvested 14 days after treatment to determine herbicide efficacy based on biomass reduction. Visual assessments of herbicide efficacy were made before soybean planting, approximately 24 and 4 weeks after fall and spring applications, respectively.

Several herbicides or herbicide combinations provided better than 90% control of butterweed when applied in the fall (**Table 2**). Glyphosate alone provided 95% control of butterweed regardless of application rate; combining glyphosate with 2,4-D ester, Pursuit, or Prowl plus 2,4-D ester did not improve control compared with glyphosate alone. Control with 2,4-D ester improved when the application rate was increased from 1 pint to 2 pints but did not exceed 86%.

It's interesting to note that while some fall-applied treatments provided very good control of butterweed, less control was achieved when the identical treatments were applied in the spring. Larger cressleaf groundsel plants likely reduced the efficacy of these spring-applied treatments.

In summary, these results suggest that butterweed can be effectively controlled with several herbicides or herbicide combinations. Overall, many of these herbicides controlled butterweed when applied in the fall, but control was not always as great following an early-spring application, primarily because of larger plant size. Delays in spring burndown herbicide applications often allow butterweed plants to reach flowering and/or the stage before treatments are applied, often resulting in reduced or greatly slowed herbicide efficacy.—*Aaron Hager*

PLANT DISEASES

Diplodia Ear Rot Causing Problems in Corn Across the State

Note: Be sure to read "Fungal Ear and Stalk Rots" by Suzanne Bissonnette in the September 4 issue of the Bulletin. *This article is a follow-up.*

Diplodia ear rot, caused by the fungus *Stenocarpella maydis* (formerly *Diplodia maydis*), has been widespread in corn in Illinois this year. Reports have indicated that several fields are affected and that some may have incidence as high as 70%. Other ear rots have been reported, but Diplodia is apparently affecting the most acres this year. The high levels of infection being observed are a result of the frequent rainfall just before and throughout silking; ears are most susceptible to Diplodia from silking to approximately 3 weeks later.

Symptoms of Diplodia ear rot. Ears affected by Diplodia may have a white mold growing on and/or between the rows of corn. Ears affected within two weeks after silking may be completely "mummified," while in later infections a light, cottony growth may be observed growing on the ear. Speck-sized fruiting bodies (pycnidia) will be formed by the Diplodia ear rot fungus and often can be observed on the sides of the kernels.

What types of loss will be incurred? Kernels affected by Diplodia ear rot will be light, so overall test weight can be reduced. In fields with high levels of ear rot, discounts applied at the elevator can be expected for the presence of damaged kernels. In severe cases, the cob may also be rotted, which means that pieces of the cob will not separate well from the grain. In these cases, additional discounts for presence of foreign material may also be applied. In the U.S., the Diplodia ear rot fungus is not known to produce any mycotoxins, but other fungi may colonize affected ears and kernels, and some of these, like Fusarium, may produce mycotoxins.

I have Diplodia ear rot—what do I do now? To prevent additional fungal growth and disease spread within ears, it is best to harvest affected fields as soon as possible and to dry the grain to below 18% moisture (or below 15% for long-term storage). If you have crop insurance, contact your agent as soon as possible, as specific documentation may be needed for a claim to be filed. Despite the fact that the Diplodia ear rot fungus is not known to produce any mycotoxins in the U.S., moldy grain should always be tested before being fed to livestock. In Illinois, grain can be tested for the presence of mycotoxins at the Department of Agriculture's Centralia Animal Disease Laboratory (www.agr.state.il.us/AnimalHW/labs/centralialab.html).

How can I prevent Diplodia ear rot next year? The first step in managing Diplodia ear rot is to choose hybrids with better resistance. In a year with severe Diplodia ear rot like 2009, seed companies and growers should be able to identify hybrids to be avoided and those that appear to resist Diplodia a little better. Seed companies generally provide ratings of their hybrids for susceptibility to Diplodia ear rot. For 2010, avoid planting corn back into fields that had severe Diplodia ear rot in 2009. Although the days of the moldboard plow are gone, burying corn residue affected by Diplodia is one way to manage the inoculum levels that may be present next year. However, one must balance between tilling for disease management and leaving residue to help prevent soil erosion. Foliar fungicides should have very little effect, if any, on Diplodia ear rot, and it is important to note that none of the foliar fungicides registered for use on corn has Diplodia ear rot on the label.—*Carl A. Bradley*

Soybean Rust Confirmed in Thirteen Illinois Counties So Far in 2009

Every year since 2006, soybean rust has made its way into Illinois late in the growing season. Soybean rust was confirmed late last week in Illinois. The first two confirmations came from samples collected from soybean fields in Johnson and Massac counties; Alexander, Gallatin, Hardin, Jackson, McDonough, Pope, Pulaski, Saline, Union, White, and Williamson counties soon followed. For the most up-to-date distribution of soybean rust in Illinois and North America, go to the IPM PIPE Soybean Rust website (www.sbrusa.net).

Soybean rust found this late in the season should have no impact on soybean yields in Illinois this year; however, we were only a few weeks from having potential problems in a few late-planted double-crop fields in the very southern portion of the state. More than a few double-crop soybean fields in southern Illinois are still very green, but they are at or past the R5 (beginning seed) developmental stage. Most of the research on soybean rust in the U.S. and South America has shown that plants are most susceptible to rust and yield loss between the R1 (beginning flower) and R5 stages of development; fields in Illinois thus should be in the clear now.

Finding soybean rust in Illinois this year will have no impact on the risk for next year, although it does show that the pathogen is very capable of making it this far north. Will this pattern of late-season soybean rust always hold true for Illinois? Unfortunately, it may not. Soybean rust is still in its infancy in the U.S.—we are still experiencing it only a few years after its first introduction into North America. The pathogen is very capable of adapting, and it is likely that every year it will adapt better to surviving on the kudzu biotypes in the southern U.S. If this happens, the potential for rust's appearing earlier in the southern states will be present, which would mean a larger build-up of rust spores earlier in the season. A scenario like this would certainly put the Midwest at greater risk, depending on the presence of storm systems to push the spores northward and on local weather conditions.

It is likely that soybean rust is currently present in more than 13 counties in Illinois and that additional counties will be confirmed before the season is over. To be alerted when Illinois counties become positive, you can sign up for e-mail alerts at the IPM PIPE website (www.sbrusa.net).—*Carl A. Bradley*

CROP DEVELOPMENT

Soybean Harvest Is Underway

Soybean harvest activities will be in full force in the coming weeks as weather permits. NASS reported 6% of soybean acres were harvested as of

October 4, which is 34% behind the 5-year average. Soybean development has been a couple of weeks behind the 5-year average all season long, and 2009 will certainly go down as a unique season. Soybean development remained a few days to a week behind 2008 until the end of August, when it slipped two weeks behind 2008 because of cold August temperatures. Interestingly, the development progressed at a seemingly accelerated pace in September, closing the gap to 2008 development as maturity approaches.

These state data are consistent with observations in my research plots, where it seemed that the R3 to R5 stages developed slowly but R5 to R7 developed fast. I know the latest-planted fields still need some more heat and sunshine, but unfortunately in the last week or so we have been back in cooler weather patterns, with temperatures 3 to 8 °F below average. Cool, wet weather and crop development behind average have been the story all season long. Nonetheless, harvest is narrowly here, and the question of what this soybean crop can yield is soon to be answered. I hope that the answer is a plentiful and safe harvest for all of you.

Here are some meandering thoughts regarding soybean harvest:

• Make certain your combine is properly adjusted and in good working condition. The most common loss of yield due to harvest operations is at the cutter bar, so pay particular attention to its adjustments and condition.

• As you harvest, monitor your loss to make necessary adjustments. This can be simply done by counting the soybeans left on the ground behind the combine. Harvest loss can't be eliminated, but a good goal is to lose no more than 1 bushel per acre, which is 30 to 40 soybean seeds per square yard, depending on seed size. For more information check out "Combine Settings for Minimum Harvest Loss" (extension.agron.iastate.edu/soybean/production_combineset.html).

• Combines are also good at spreading problems across fields and to different fields. Make a plan that accounts for reducing movement of weed seeds and/or sclerotia from white mold infection. If you have patches of weeds that were difficult to control, or if you are among the many growers with white mold (*Sclerotinia* stem rot) this year, combine those patches or those fields last if possible. If you can't harvest them last because of deteriorating crop conditions or logistics, clean out the combine as well as you can before leaving the infested areas and moving to other areas. Both weed seeds and sclerotia from *Sclerotinia* stem rot can survive in the soil for many years; limiting their spread can help future management challenges. (Sclerotia are the small, hard, irregularly shaped black structures found on the outside or inside of a soybean plant infected with white mold. For more information, see Carl Bradley's previous article in *the Bulletin* [issue 18, July 24] or the Purdue University Extension publication "White Mold" at www.ces.purdue.edu/extmedia/BP/BP-43-W.pdf.)

• First, last, and always—think safety!

—Vince M. Davis

Corn and Frost, 2009

The "extended" 2009 growing season is about to come to an end, at least in northern Illinois, with frost or freeze predicted for this weekend for most of the area north of I-80, and frost possible into the central portions of the state. Light frost has already occurred in some of northern Illinois, where low temperatures reached the mid-30s on one or more days over the past week. Frost normally occurs in the second week of October in this part of the state, so it's not coming particularly early this year.

Unfortunately, the 2009 corn crop in many fields in the northern half of the state is not yet—as it normally would be—at the stage where frost will have no effect on yield. By now we all know the painful story of slow planting progress in Illinois in 2009; the 50% corn-planted date was about May 22, about three weeks later than normal. It was June before we reached 90% planted. Progress was a little faster than average in some pockets, but no single crop reporting district (CRD) reached 50% planted during the first half of May.

Late planting had little effect on corn yield in Illinois in 2008, because July and August temperatures were near normal, September was a good month, and the crop continued to fill into October, aided by the late frost. September was a good month to fill grain in both years, but in 2009 the cool weather in July and August and frost's coming at its normal time make this year different. The yield prediction for the state (179 bushels per acre) is the same as in 2008, so the effect of late planting on yield will be minimized again this year. But maturity is lagging far behind normal now, and frost will end the 2009 season earlier than we might have hoped in some fields.

The departure from normal GDD accumulations is striking (**Table 3**). As an example, a 105-day hybrid that needs 2,550 GDD from planting to maturity in northern Illinois would normally mature in late September, but in 2009 it would not mature until the second week of October, or close to the average date of first frost. The same hybrid planted in late May would be nearly mature by now under normal temperatures, but in early October this year, it still needs some 300 GDD to mature. It will not get that.

The GDD accumulation in May was about 10 GDD per day, so we can approximate GDD accumulations for corn planted before the end of May by adding 10 GDD for each day earlier than May 31 that the crop was planted. For example, we can add about 100 GDD to the numbers in the third GDD column in Table 3 for corn planted on May 20.

In general, the GDD-based predictions of maturity have held up fairly well this year, meaning that it took all of

Table 3. Approximate growing degree-day accumulations in different Illinois regions in 2009 and on average.

Region	*GDD from May 1 to October 4*		*GDD from May 31 to October 4*	
	2009	*Normal*	*2009*	*Normal*
North	2,440	2,760	2,130	2,430
Central	2,780	3,060	2,390	2,670
South-central	3,060	3,280	2,620	2,840
South	3,370	3,470	2,890	3,000

Source: AWS reported by NASS.

September in many fields for the crop to reach maturity. Late planting did not reduce the GGD requirement by much, if any. As the GDD numbers would suggest, the situation is a little better for late-planted corn in central and southern Illinois in 2009, but the hybrids grown in these areas typically need 2,700 to 2,800 GDD to mature. The late-planted crop thus has not quite reached maturity in many fields in central Illinois.

Statewide, only 5% of the crop has been harvested. Most harvest reports from central Illinois are from early-planted fields, where harvest moistures have been in the low to mid-20s. Some later-planted corn has been harvested, but at grain moisture percentages in the high 20s to 30. Harvest progress has been much faster in southern Illinois, where about 30% of the crop was harvested by October 4.

What will frost do to the crop? It has been a long time since a substantial amount of the Illinois corn crop was still not mature before frost arrives. Here are some points to consider as we anticipate frost or freeze in the next week:

The amount of yield loss from frost coming before the crop is mature will be directly related to the amount of fill the kernels have left to do at the time of frost. Watching kernel development over the past month has been a major sport for producers and agronomists this year, bringing the level of excitement normally associated with watching grass grow or paint dry. We have searched anxiously for the "black layer"—the layer of cells that collapses and turns dark at the base of the kernels, signaling the end of active transport of sugars into the kernel. Kernels are at their maximum weight when this happens, and so it is the point at which the crop is safe from yield loss due to frost.

Even in fields where enough GDD accumulated to reach maturity, black layer does not seem to have formed as distinctly as it usually does. In some fields, leaves died early, bringing an end to photosynthesis and cutting off the supply of sugars to the kernels before they were completely filled. When this happens, the cells that make up the black layer may not die or darken normally, so the black layer may be less distinct.

For much of the crop that still has green leaf area and so is producing sugars, total GDD accumulation since planting is still less than the number required for that hybrid to reach maturity, so we would not expect a black layer yet. A good way to track kernel fill while it's happening is by watching the "milk line"—the juncture between hard starch that forms starting at the crown of the kernel and the soft, liquid ("milk")-containing part of the kernel at the base. Here is a guideline to use when monitoring kernel fill, adapted from *Crop Insights*, Vol. 19, No. 13 (Pioneer Hi-Bred International):

• Kernels have about 60% of their final dry weight (FDW) and are at about 50% to 55% moisture when the milk line first appears (beginning dent), with about 400 GDD still needed to reach maturity.

• Kernels are at about 70% of FDW and 45% to 50% moisture when the line is 1/4 of the way down the kernel, and they need about 300 more GDD.

• Kernels are at about 85% of FDW and 40% to 45% moisture when the milk line is halfway down, and they need about 200 more GDD.

• Kernels are at about 95% of FDW and 35% to 40% moisture by the time the milk line is 3/4 of the way down the kernel, and they need about 100 more GDD.

The good news here is that the potential loss of yield due to a premature end to grain-filling (such as we will get from frost in some fields) decreases fairly quickly as the milk line migrates down; the plant is more efficient (in terms of GDD) at increasing kernel dry weight early in the maturation process, so potential loss amounts decrease with time as grain filling slows.

The dry weight numbers in the list above represent what yield we might expect if grain filling came to a sudden halt at the stage indicated. There are actually few instances in the field where grain filling comes to a sudden halt, whether from lack of moisture, frost, or even hail. That's because the plant has some sugars stored in the stalk and can continue to move some of these sugars into the kernels even when there is no more green (stems or leaves) on the plant and so no more sugar production. The amount of such "post-brown" sugar movement depends on whether the stalk and shank stay alive to enable sugar transport to continue. Temperatures no lower than 30 or 31 for several hours will often not kill the stalk tissue; in such cases, as much as half the "missing" dry weight can still move into the kernels.

There may be some fields, though, where there have been enough GDDs to reach maturity but the black layer is still not visible. It may be that the extended filling period and the slow pace of filling in recent weeks have meant an interruption of the normal end to grain fill and that the black layer cells simply aren't collapsing or forming the black pigment we usually see. In such cases, use the milk line method, and don't worry about the black layer.

When the milk line is no longer visible and there is no liquid at the base of the kernels, then the kernel is as heavy as it will get, black layer or not.

An additional observation that many have made this year is that kernel size seems to be unusually large, even in (if not especially in) later-planted fields. This is a very positive development; we often get so involved in the woes of weather and other problems that we forget to look at what the crop is actually doing in the field. So even in those fields with the milk line only halfway down, kernels may already be close to normal dry weights. In such cases frost will reduce yield, but yield will still be good.

For example, Lyle Paul, agronomist at the U of I research center near DeKalb, has been tracking kernel dry weight in corn planted early and late. On September 29, corn planted at the end of May already had kernel weights of 90,000 to 100,000 kernels per bushel, even though the kernels were less than 1/4 milk line. Kernels from early-planted corn were only at 80,000 to 90,000 per bushel, so with another week of fill, actual yields from the late-planted corn might be close to those from the early-planted corn, even though it will not fill completely. This is an example of looking at what we have rather than what we're losing; from early reports, I expect yields to be very good from most fields in most areas this year, even where the crop was planted late and came to a premature end due to frost.

The October 4 crop development report for Illinois shows an unusual lack of correlation between percentages of the crop rated as being in dent stage and the percentage rated as mature. In the Northwest CRD, only 86% of the crop is listed as in dent and 40% as mature, while in the Northeast, 93% is listed as in dent and only 10% as mature. The central and southern CRDs show the more typical (positive) correlations between percentages in these two stages. Even so, less than 90% of the crop is rated as being in the dent stage in the central districts (W, C, E). This is much less than we would have expected. One possible reason is that some hybrids do not show the typical indentation ("dent") in the crown of their kernels, even when they are fully mature, and so they are not rated as being in dent stage. As in the case with "missing" black layer, the milk line is the best indicator of actual grain-filling progress. If a milk line is visible, then the kernels are definitely in "dent" stage whether the crown is rounded or indented.

Effects of frost coming before maturity on stalk quality are a little difficult to predict, but I do not anticipate much problem from this. While movement of sugars from the stalk to the ear following a premature end to photosynthesis normally means more stalk quality problems, I expect that stalks strengthened (deposited lignins) relatively well in most fields over the past month. Having adequate lignin is important for stalk strength after freezing; stalk cells die after hard frost, and so maintaining stalk sugar content should be less important for stalk strength. Most fields have stood well up to now, and unless we get (or got) strong winds, lodging should not be a big factor this year. An exception might be fields that were planted very late and are only in dough stage; stalks in these fields may not have much lignin, and freezing might seriously weaken them.

Another issue of considerable concern is what effect frost on immature corn might have on grain dry-down rates and grain quality, especially test weights. Kernels that stop filling when they still have a milk line visible have sugars at the tip. Sugars tend to "hold on to" water more than starch, so such kernels dry more slowly. Cobs are also wetter, which means slower drying. On the other hand, frost that kills husks tends to make them dry faster, and if they loosen when they dry (not always a given), such kernels will probably be drier several weeks from now than if the weather had stayed warm and they had continued to fill.

Sugars remaining in the base of corn kernels typically darken as sugars caramelize with high-temperature drying. Tips on such kernels often shrink back, often changing the shape of the kernels. This, sometimes along with slightly lower kernel starch density, may reduce test weight. Discolored kernels with lower test weight may be subject to dockage at the time of sale. Even though neither factor has much effect on corn's feed quality, ethanol yields can be affected by the lower starch percentage.

In summary, most corn fields in the central and southern parts of Illinois are close enough to maturity that frost around October 10 should have minimal effect on yield, standability, or grain quality. In northern Illinois, fields planted late (about 10% of the acreage was planted after June 1) and with later-maturing hybrids are likely in early dent, at which stage a frost may reduce yield by 20% to 25%, and a hard freeze (28 degrees or less for several hours) may reduce yields by a third or more.

On the positive side, the corn crop has done a good job of filling grain up to now, and all indications are that yields will be good even in those fields where frost will prematurely put an end to grain filling. Frost will also kill some green weeds and, even though we would prefer that the crop make yield longer, it will start the grain dry-down process earlier than normal, and so may allow earlier harvest and reduce drying costs.—*Emerson Nafziger*

Nitrogen Applications for the 2010 Corn Crop

Unfavorable conditions this spring meant that a lot of fields were planted late and some not at all. In addition, a summer that was cooler and wetter than normal for much of Illinois has made the 2009 season a challenging one. Whether you had a good or not-so-good season this year, everyone is, or soon will be, making plans for 2010. Every year during the fall, those who apply nitrogen worry that if they wait too long for temperatures to drop sufficiently to apply nitrogen (N), soils might become too wet to do the application or to perform tillage operations. While the window of opportunity for doing all these fall field operations is not very large, it is important to exercise good judgment to realize their full potential. The management of N is important because this nutrient is both one of the most expensive inputs in today's farming operations and one that can pose environmental concerns. Whether we think of cost, environmental implications, or both, we simply cannot afford poor N management. Being smart about N use can pay large dividends. To achieve that goal, it is important to understand some key factors. The following are recommendations that will enhance the efficiency of N management this fall.

When to apply nitrogen in the fall. Some forms of N are more susceptible to loss than others. Chemically speaking, ammonium (NH_4^+) is a positively charged ion that behaves similarly to potassium K^+ ions. Ammonia stays in the soil, held by the negative charges of clays and organic matter, and is not susceptible to leaching or denitrification. However, through the nitrification process, NH_4^+ can convert to nitrate NO_3^-, which is susceptible to leaching and denitrification (conversion to N_2 or N_2O gas). These conversions are all mediated by soil organisms. Since temperature has an important impact on the activity of these organisms, it is critically important to wait to apply N until soil temperature at the 4-inch depth is below 50 °F and is maintained at or below this value through the winter. In most years, the 50 °F temperature allows for N applications before soils become too wet or frozen.

Application of anhydrous ammonia with a nitrification inhibitor (see the discussion below) can start after soil temperature at 4 inches is below 60 °F. Although the rate of nitrification is significantly reduced when soil temperature is below 50 °F, microbial activity continues until temperatures are below 32 °F. Since air temperatures can fluctuate substantially during the early fall, even if air temperatures are getting cooler, do not apply N before the second week of October in northern Illinois or the third week in central Illinois. Because of temperature considerations, fall N application should not be done south of a line roughly parallel to Illinois Route 16. In areas near this boundary, soil characteristics should be evaluated to determine whether fall application is appropriate. Soils with high potential for NO_3^- leaching in the fall or early spring (sandy soils or those with excessive drainage) should not receive fall N applications. Daily maximum 4-inch bare-soil temperatures for Illinois this year at the end of September to the beginning of October were in the upper 60s to lower 70s. Up-to-date soil temperatures can be accessed at www.sws.uiuc.edu/warm/soiltemp.asp. However, it is strongly recommended that temperatures of soils in individual fields be monitored prior to N application.

What to use and not to use. Anhydrous ammonia is a preferred N source for fall application because it has a slower nitrification rate than other sources. Once applied in the soil, ammonia (NH_3) reacts quickly with soil water and is converted to NH_4^+. Nitrification inhibitors (such as dicyandiamide [DCD] and nitrapyrin, also known by the trade name N-serve) are chemicals that inhibit the activity of bacteria responsible for the first step in the process of nitrification (conversion of NH_4^+ to nitrite [NO_2^-]); this intermediate can then be quickly converted to NO_3^-. Proper use of these inhibitors will reduce the rate of nitrification, thus maintaining for a longer period a greater proportion of the applied N in the NH_4^+ form. Since nitrification rates increase under warm temperatures and moist conditions, nitrification inhibitors are especially useful when those soil conditions prevail. To avoid volatilization losses during application, make sure the soil is neither too wet nor too dry to secure adequate closure of the soil behind the applicator knife. Also, it is important to apply at the proper depth; for fine-textured soils, 6 to 8 inches is sufficient to keep NH_3 gas from escaping the soil.

Another source that can be used for fall applications is ammonium sulfate ($[NH_4]_2SO_4$). Just like for anhydrous ammonia, this source should be applied late in the fall when soil temperatures are below 50 °F. This material is an excellent source for no-till fields, where broadcast applications are preferred. It can also be applied on frozen ground as long as the slope of the field is less than 5% and the potential for surface water runoff is very low. Ammonium sulfate is more acidifying than any other N source. This is not a problem as long as the pH of the soil is maintained at adequate levels. As a general rule, 5 pounds of lime is needed to neutralize 1 pound of N from ammonium sulfate compared to 2 pounds of lime per pound of N from ammonia or urea.

As mentioned, ammonium is a stable form of nitrogen that is readily adsorbed to exchange sites in the soil particles and organic matter. On the other hand, NO_3^- does not attach to exchange sites but remains in the soil solution and can be lost through denitrification and leaching. The source of N used for fall applications is thus an important consideration. Nitrogen sources containing nitrogen in the NO_3^- form (such as ammonium nitrate [NH_4NO_3] or urea ammonium nitrate [UAN]) should not be used in the fall to provide N for corn because part of the N is already in a form that can be easily leached or denitrified.

Urea ($CO[NH_2]_2$) converts to NH_3 and then to NH_4^+ within a few days of application. However, the use of urea in the fall is discouraged because it has been shown to be less effective than fall-applied anhydrous ammonia. The lower efficiency of urea is mainly due to greater risk of NO_3^- losses before rapid nutrient uptake by the crop the following spring.

Slow-release, controlled-release, and polymer-coated urea (PCU) are all common names for products that have been designed to control or reduce the conversion of urea to NH_4^+ and thus limit the potential transformation to NO_3^-. While the concept makes sense, I am currently researching it; the data is limited for determining whether such products could be used in the fall or should not be. Some of the most important considerations regarding the effectiveness of these products are the thickness of the coating, the time required for degradation of the coating, and the integrity of the coating after handling and application. Since research data is still considered preliminary, these products are not presently being recommended for fall application in Illinois. After testing ESN, a PCU product, researchers in Minnesota have indicated that fall application of this product is acceptable, but it is a high-risk operation.

In recent years there has been renewed interest in using manure, poultry litter, and other organic fertilizer forms to supply not only N but also phosphorus and potassium. These animal products are excellent nutrient sources, but they should be incorporated to avoid N loss by volatilization. Most of the N is in uric acid and NH_4^+ forms that can rapidly transform to NO_3^-, so the soil temperature recommendations already discussed also apply here. Due to the length of time between application and utilization by the crop, applications should be done as far as possible from environmentally sensitive areas, such as on steep slopes and near bodies of water. If the application cannot be accomplished in late fall, do not apply on frozen soils in the winter; it is better to wait until spring. Before application, these fertilizers should be analyzed for nutrient content. Typically, if these sources are applied to meet the N needs of the crop, an overapplication of phosphorus will result. For this reason, most often the rate of application should be based on meeting the crop's phosphorus requirements rather than N requirements. Knowing the soil phosphorus level and nutrient contents of the fertilizer are a must to determine the appropriate application rate.

How much to apply. To determine the economically optimal N rate at various corn and nitrogen prices, use the N rate calculator at extension.agron.iastate.edu/soilfertility/nrate.aspx. Just remember that the calculator does not account for carryover nitrogen. This year, since it was so wet in the spring, it is unlikely that much N will be carried over even if yields were lower than expected. However, if you applied manure, you will need to adjust the values from the calculator to reflect what will be available next year. If you are planning to plant corn into a field coming off of alfalfa, chances are high that there is enough N in the soil to produce a crop without any addition of N. Once you determine how much N you will need, it is important to remember that it is not necessary to make the entire application in the fall. Some producers might find it beneficial for their production system to apply a portion of the total rate in the fall and reserve the rest for a later application in spring.

Applying N to increase crop residue breakdown. With more acres planted to corn following corn, there is great interest in corn residue management. One common question has been whether application of N, such as UAN, on the residue this fall would help with the breakdown of corn stalks. Research has shown no benefit in fall application of N to increase microbial decomposition of corn residue in order to improve corn planting operations and N for the next corn crop. Typically low temperature, and not N levels, is the limiting factor for microbial decomposition of residue.

Evaluating your situation. Overall, research on N application timing has shown that application in the spring, close to the time of rapid N uptake, maximizes yield because there is less chance for leaching or denitrification. This is especially true for years like 2009, where early spring conditions are warm and wet and corn planting is delayed in many fields. However, late-fall application of some N sources (previously discussed) is adequate, especially for medium- to fine-textured soils where cold winter temperatures prevail and early springs are not excessively wet and warm. If a full rate preplant application is not an option for you, a possibility would be to apply a portion of the total N needed in the fall and wait until the spring to apply the rest as a preplant or sidedress application. In some years sidedress applications are more effective than preplant, but the results depend on weather. Most often, though, under normal spring conditions there is little or no difference between the two times of application.

Fall applications have both economic and logistic advantages. Soil conditions are typically more conducive to application, there is more time available than during the busy planting season, equipment and labor are better distributed, and often there are price incentives to buy anhydrous ammonia. The spring typically is wet, and soil compaction, especially for manure application, is of greater concern. Also, waiting until the spring to apply fertilizer can delay planting, damage crops, and delay application of fertilizer to meet early nutrient uptake needs of the crop. Unfortunately, since spring weather conditions have a large influence on N efficiency, it is impossible to know for any given year how safe, or risky, it is to apply N in the fall. If the spring is dry, there is little risk of N loss from fall application (assuming N was applied correctly). On the other hand, if the spring is wet, the chance of N loss increases. All these points should be considered carefully to make the best possible decision. If you don't like taking big risks, but a fall application makes sense, it may be better to apply part of the N in the fall and wait until spring to apply the rest. This approach is like buying an insurance policy—it gives peace of mind but costs money, and you can never be certain whether the investment will pay off.

In a nutshell. In summary, if you are planning to apply N in the fall, heed the following guidelines:

• Wait until soil temperatures at the 4-inch depth are below 50 °F, or below 60 °F if you are using a nitrification inhibitor.

• Do not apply N before the third week of October in central Illinois, or the second week in northern Illinois, even if air temperatures are getting cooler.

• Do not apply N, or N with a nitrification inhibitor, if you are south of Illinois Route 16 or if soils are prone to leaching.

• Use a nitrification inhibitor with anhydrous ammonia applications. Ammonium sulfate is an acceptable source.

• Do not apply urea or nitrate-containing fertilizers.

• If using animal manure, make sure it is incorporated into the soil, and follow the time of application guidelines discussed for commercial N management.

• Apply the appropriate rate, taking into account leftover N when applicable, and consider applying only a portion of the total N needed in the fall and the rest in the spring.

• Do not apply N to increase residue breakdown.

• Consider the risks and benefits of fall N application. If fall application is appropriate, follow the recommendations here to help increase the efficiency.

—Fabian G. Fernandez

REGIONAL REPORTS

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)

• 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

Corn and soybean harvest is underway across the area, and with the variations in planting dates and moisture levels, yields are all across the board. Early-harvested corn was coming in with reports of 25% to 30% Diplodia infections. As farmers move into later-planted fields, reports of 2% to 8% are more common.

In the southern part of the region, many of the latest-planted fields appear to be dying prematurely. Many of these fields were planted into very wet soils, had soybean aphid problems, and have received very little rain in the last month. A combination of stresses seems to be the cause. No major disease is apparent.

Northern Illinois

Early-maturity soybean harvest began slowly lastt weekend, but the wet weather beginning on October 6 has halted everything. Some silage has been harvested. Overall, only minimal harvest has occurred. A great deal of corn throughout the northern region has not reached black layer.

According to the Illinois State Water Survey, from May 15 to October 3 at DeKalb there are 2,187 accumulated growing degree-days (GDD), which is 382 behind the 11-year average. Using Freeport data, from May 15 to October 3 there are 2,278 accumulated GDD, or 311 behind the 11-year average. Growers interested in using the survey's GDD calculator can input their own planting dates and choose the closest weather station to compute GDD at www.isws.illinois.edu/warm/cropdata/cropddcalc.asp.

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