Soybean Aphid Fall Migrants Finding Buckthorn Plants Despite Low Aphid Numbers

The growing season of 2010 will be remembered for many reasons, including the fast-paced planting of corn, the hot summer, the early harvest, low numbers of western corn rootworms and Japanese beetles, and the lack of significant infestations of soybean aphids. Many of us will recall the swarms of soybean aphids in late summer and early fall in 2009, especially across central and southern Illinois. Those large densities of fall migrants that made their way to their overwintering host, buckthorn, were eventually killed by a fungal epizootic that swept through the population. Overcrowding of aphids on buckthorn leaves facilitated the efficiency of this disease. As a result of this epizootic, very few soybean aphids survived the winter of 2009–10, and producers were fortunate to have exceedingly low densities of this pest in their fields throughout the growing season. The unusually hot summer also kept infestations at non-economic levels. Entomologists in several north-central states likewise reported low numbers of soybean aphids.

Despite these low densities, David Voegtlin, a retired Illinois Natural History Survey entomologist, has recently observed small numbers of aphids on buckthorn plants growing on the University of Illinois campus. No aphid predators were observed on these plants. Dave and I are both amazed at the ability of these winged aphids, in spite of their low numbers, to locate buckthorn plants. Crowding on buckthorn leaves will not be an issue this fall.

It is too early to predict what 2011 will bring with regard to aphid infestations. The severity of the winter, soybean planting dates in 2011, and summer temperatures are all factors that will influence aphid densities during the next growing season.—Mike Gray

Preliminary Root Ratings for 2010 University of Illinois Corn Rootworm Trials

The western corn rootworm population was down significantly in 2010 across much of Illinois. Potential reasons include back-to-back years of saturated soil conditions at the time of corn rootworm larval hatch, increasing use of Bt corn rootworm hybrids, and aerial treatments of corn and soybean fields with tank-mixes of fungicides and insecticides. All three factors are likely contributors to the low densities of western corn rootworm adults reported by many producers, researchers, crop consultants, and certified crop advisers.

Results from our annual corn rootworm trials also revealed very low pressure in our checks (control treatments). In fact, injury in the checks at Monmouth and Perry was so low—approaching an average of zero, with no pruned roots observed—that
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the other experimental treatments were not rated. In my 23 summers at the University of Illinois, I’ve never observed this low a level of pressure in our standard corn rootworm trials that followed trap-crop conditions. Consequently, Table 1 shows only the results from our experiments in DeKalb and Urbana. Even at those locations, the overall average for our five checks was only about 2.0 (two nodes of roots destroyed). The check with the lowest injury ratings was DKC 61-22, which was treated with the low rate of Poncho (0.25 mg a.i. per seed). The other checks were treated with the low rate of Cruise (0.25 mg a.i. per seed). It has become increasingly difficult to obtain completely untreated seed (no insecticidal seed treatment) for our experiments. Neonicotinoid insecticidal seed treatments on seed corn have become the industry standard. The soil insecticides at both locations protected roots very well, with only minor scarring on most root systems. For those producers who are choosing seed for next season, don’t forget non-Bt hybrids as an option. Soil insecticides have proven reliable management tools for corn rootworms for many decades, so long as they are properly applied. Rescue treatments always remain an option for European corn borer control should this insect emerge at economic levels in isolated fields. Not surprisingly, when soil insecticides were applied in combination with Bt rootworm hybrids, very little root injury was detected. However, in my estimation, it seems doubtful that this extra investment in corn rootworm protection was worth the added cost. We are finishing our harvests and will provide yield results in the upcoming winter meetings to confirm this specula-

Table 1. Preliminary Node-Injury Ratingsa,b for Corn Rootworm Control Products in University of Illinois Research Trials near DeKalb and Urbana, 2010.

<table>
<thead>
<tr>
<th>Product</th>
<th>Rate</th>
<th>Placementc</th>
<th>DeKalb2d</th>
<th>Urbanae</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soil insecticides</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aztec 2.1G (DKC 61-22)</td>
<td>6.7 oz/1,000 row ft</td>
<td>Band</td>
<td>0.27 bcd 0.02 f</td>
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</tr>
<tr>
<td>Aztec 4.67G (Pioneer 35F40, Dekalb) &amp; (DKC 61-22, Urbana)</td>
<td>3 oz/1,000 row ft</td>
<td>SB furrow</td>
<td>0.16 cd 0.06 ef</td>
<td></td>
</tr>
<tr>
<td>Force CS (DKC 61-22)</td>
<td>8 fl oz/acre Band</td>
<td></td>
<td>0.09 d 0.13 ef</td>
<td></td>
</tr>
<tr>
<td><strong>Rootworm Bt corn hybrids</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agrisure RW (84U96 3000GT)</td>
<td>—</td>
<td>—</td>
<td>0.54 b 0.27 e</td>
<td></td>
</tr>
<tr>
<td>Agrisure RW (H-8577 3000GT)</td>
<td>—</td>
<td>—</td>
<td>0.5 bc 0.27 e</td>
<td></td>
</tr>
<tr>
<td>HxXTRA (P1162XR)</td>
<td>—</td>
<td>—</td>
<td>0.08 d 0.1 ef</td>
<td></td>
</tr>
<tr>
<td>HxXTRA (35F44)</td>
<td>—</td>
<td>—</td>
<td>0.04 d 0.02 f</td>
<td></td>
</tr>
<tr>
<td>SmartStax (DKC 61-21)</td>
<td>—</td>
<td>—</td>
<td>0.01 d 0.0 f</td>
<td></td>
</tr>
<tr>
<td>SmartStax (2D692)</td>
<td>—</td>
<td>—</td>
<td>0.03 d 0.02 f</td>
<td></td>
</tr>
<tr>
<td>YieldGard VT3 (DKC 61-19)</td>
<td>—</td>
<td>—</td>
<td>0.23 bcd 0.01 f</td>
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</tbody>
</table>

**Soil insecticides + rootworm Bt corn hybrids**

<table>
<thead>
<tr>
<th>Product</th>
<th>Rate</th>
<th>Placementc</th>
<th>DeKalb2d</th>
<th>Urbanae</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counter 20G + (HxXTRA, 35F44, DeKalb) and (SmartStak, DKC 61-21, Urbana)</td>
<td>4.5 oz/1,000 row ft</td>
<td>SB furrow</td>
<td>0.02 d 0.0 f</td>
<td></td>
</tr>
<tr>
<td>Force CS + Agrisure RW (84U96 3000 GT)</td>
<td>8 fl oz/acre Band</td>
<td></td>
<td>0.02 d 0.03 f</td>
<td></td>
</tr>
<tr>
<td>Force CS + Agrisure RW (H-8577 3000 GT)</td>
<td>8 fl oz/acre Band</td>
<td></td>
<td>0.02 d 0.02 f</td>
<td></td>
</tr>
<tr>
<td>Force CS + HxXTRA (35F44)</td>
<td>8 fl oz/acre Band</td>
<td></td>
<td>0.00 d 0.02 f</td>
<td></td>
</tr>
<tr>
<td>Force CS + YieldGard VT3 (DKC 61-19)</td>
<td>8 fl oz/acre Band</td>
<td></td>
<td>0.02 d 0.0 f</td>
<td></td>
</tr>
<tr>
<td>Lorsban 15G + HxXTRA (2K662)</td>
<td>8 oz/1,000 row ft</td>
<td>Band</td>
<td>0.02 d 0.02 f</td>
<td></td>
</tr>
<tr>
<td>SmartChoice 5G + HxXTRA (35F44 at DeKalb) &amp; (SmartStak, DKC 61-21, Urbana)</td>
<td>3.5 oz/1,000 row ft</td>
<td>SB furrow</td>
<td>0.02 d 0.0 f</td>
<td></td>
</tr>
</tbody>
</table>

**Untreated checks**

<table>
<thead>
<tr>
<th>Product</th>
<th>Rate</th>
<th>Placementc</th>
<th>DeKalb2d</th>
<th>Urbanae</th>
</tr>
</thead>
<tbody>
<tr>
<td>DKC 61-22f</td>
<td>—</td>
<td>—</td>
<td>0.63 b 0.56 d</td>
<td></td>
</tr>
<tr>
<td>Garst 85W95 GT/CB/LL9g</td>
<td>—</td>
<td>—</td>
<td>2.17 a 1.13 c</td>
<td></td>
</tr>
<tr>
<td>Golden Harvest</td>
<td>—</td>
<td>—</td>
<td>1.90 a 1.83 b</td>
<td></td>
</tr>
<tr>
<td>H8577GT/CB/LL9g</td>
<td>—</td>
<td>—</td>
<td>2.13 a 2.31 a</td>
<td></td>
</tr>
<tr>
<td>Mycogen ST-6808g</td>
<td>—</td>
<td>—</td>
<td>2.49 a 2.09 ab</td>
<td></td>
</tr>
<tr>
<td>Pioneer 35F40g</td>
<td>—</td>
<td>—</td>
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</tr>
</tbody>
</table>

aNode-injury ratings are based on the 0-to-3 root-rating scale developed by Oleson et al. (2005): 0.00, no feeding damage; 1.0, one node (circle of roots), or the equivalent of an entire node, pruned back to within approximately 1.5 in. of the stalk (or soil line if roots originate above ground nodes); 2.0, two complete nodes pruned; 3.0, three or more complete nodes pruned (greatest rating that can be given).
bMeans followed by the same letter within a column do not differ significantly (P = 0.05, Duncan’s New Multiple Range Test.)
cBand: insecticide applied in a 5-in. band over the planted row; furrow: insecticide directed into the seed furrow; SB furrow: insecticide applied through a SmartBox insecticide delivery system and directed into the seed furrow.
dDeKalb: Planted on May 10 into an area planted to a trap crop in 2009 (late-planted corn interplanted with pumpkins). Roots were evaluated on July 14.
eUrbana: Planted on May 14 into an area planted to a trap crop in 2009 (late-planted corn interplanted with pumpkins). Roots were evaluated on July 12.
fSeed treated with Poncho 250, 0.25 mg a.i. per seed.
gSeed treated with Cruiser 250, 0.25 mg a.i. per seed.

Stacks of rated roots from corn rootworm trials. (Photo courtesy of Joe Spencer, Illinois Natural History Survey.)
tion. The stand-alone Bt rootworm hybrids provided acceptable levels of root protection at DeKalb and Urbana. The Agrisure RW treatments at DeKalb did have more root injury than some of the other Bt treatments, with approximately 1/2 node of roots pruned.

I hope this information is useful to producers making decisions on seed for 2011. Please let me know if you have any questions about these results. I extend my thanks to Ron Estes and Nick Tinsley, University of Illinois Department of Crop Sciences, for their leadership in establishing these trials. The work could not have been completed without their dedication.—Mike Gray

Weeds

Weed Control Following Fall Harvest

Fall herbicide applications have become a relatively common practice for farmers in many areas of Illinois. Much recent interest has focused on applying herbicides after fall harvest to control winter annual weed species, such as common chickweed, henbit, and various mustard species. If not controlled before the onset of winter, these and other winter annual species can create dense mats of vegetation prior to spring planting. Controlling these weeds and preventing them from producing seeds are important objectives of fall herbicide applications.

Before applying fall herbicide to control winter annual species, it might be worthwhile to consider some of the following aspects of fall application:

• Which weeds are present? Scout fields before making any application to determine what weeds are present and whether their densities are high enough to warrant treatment this fall. With the wide range in precipitation across the state, emergence of some winter annuals might be reduced in dry areas compared with areas where precipitation was higher in late summer and fall.

• Which product(s) are you considering? Many herbicides used before or after crop planting and emergence can be applied in the fall, but not all herbicides are labeled for fall application. Atrazine, for example, is widely used before and after corn emergence but is not labeled for fall application. Be sure

Winter annual weed species can form dense populations prior to spring planting. Common chickweed is shown here.

Butterweed.

Common chickweed.

Field pennycress.

Henbit.

Horseweed.
to check the label of every product you are considering to determine if fall application is allowed.

- When do you want to apply the herbicide(s)? Many farmers are done harvesting the 2010 crop and are considering making a herbicide application very soon. Keep in mind that some herbicides approved for fall application have timing restrictions. For example, the Dual II Magnum label indicates that fall applications should occur after October 31 and when the sustained soil temperature at the 4-inch depth is less than 55 degrees and falling. If you are considering a treatment without much soil-residual activity (for example, 2,4-D or glyphosate), time the application to occur after most winter annual species have emerged. Instead of early October, an application in mid- to late October might provide better results. If, on the other hand, your fall application will include a herbicide with soil-residual activity, the application could be made sooner.

- Combinations of herbicides can broaden the weed control spectrum. This can be very important if winter annuals have already emerged before the application is made. Combining 2,4-D and/or glyphosate with soil-residual products can improve control of emerged species and help control biennial or perennial species (discussed later). Be sure to include the appropriate spray additives with all applications.

- Location in the state can influence fall herbicide applications, which seem to “fit” better in areas of central and southern Illinois, perhaps because of generally milder average winter temperatures the farther south one ventures (contributing to better winter survival of fall-emerged weeds), as well as earlier resumption of weed growth in the spring. Also, herbicide labels may indicate that fall applications can be made only in certain geographical regions of the state.

- Fall applications that include soil-residual herbicides may not always result in a clean field by planting time. Delays in spring fieldwork may allow fields to green-up before the crop can be planted. We have occasionally observed that if the suite of winter annual weed species is successfully controlled, summer annual weed species (such as common lambsquarters and smartweed) have emerged sooner than if winter annuals were still present. (See photos below for an example.)

- Fall herbicide application is not suggested as a way to provide residual control of summer annual weed species, such as waterhemp. Control of summer annual species is improved when applications of soil-residual herbicides are made closer to planting rather than several weeks (or months) before. If a soil-residual herbicide will be part of your fall application, we suggest using a rate that will control winter annuals through the remainder of 2010, and we recommend not increasing the rate in hopes of controlling summer annual species next spring.

- Horseweed (Conyza canadensis) has become a challenging broadleaf weed in minimum-till and no-till cropping systems across much of the southern half of Illinois. Horseweed completes its life cycle in one year, but unlike many other annual species, it may exist as a winter or a summer annual. Populations of winter annual horseweed typically emerge in the fall, within a few days or weeks after seed is dispersed from the parent plant. In northern Illinois, most horseweed demonstrates a winter annual life cycle, whereas a substantially higher proportion of spring emergence occurs in areas south of (approximately) Interstate 70. Both winter and summer annual life cycles can be found across central Illinois. With the increasing prevalence of horseweed, including glyphosate-resistant populations, fall herbicide applications may prove more efficacious than spring applications. Glyphosate alone may not provide adequate control when applied in either fall or spring, but application in fall provides an opportunity to use higher application rates of products (such as 2,4-D) than are feasible in spring.

Fall months may offer a good opportunity to apply herbicides for improved control of certain biennial and perennial weed species as well as winter annual

The fall herbicide treatment applied to the plot on the right controlled most of the common chickweed, but common lambsquarters emerged much sooner when the common chickweed was controlled. The plot on the left was not treated in the fall.
species. Biennial and perennial species often become established in reduced-till or no-till fields and can be difficult to control with herbicides once populations are established.

Biennials are species that complete their life cycle over two seasons. In the first year of growth, they form a rosette of leaves (a dense cluster growing close to the ground), whose size can vary greatly in diameter by species. The rosette represents the overwintering stage of the biennial. Sometime the following spring, the biennial plant produces a flowering stalk (it bolts) that branches and gives rise to flowers and seed production.

Once bolting has initiated, biennial species can be increasingly difficult to control with herbicides. Control of biennial species that remain green into the fall months after their first season of growth, such as wild carrot and poison hemlock, can be substantially improved with fall herbicide applications as compared with spring applications. For the most effective control, consider using herbicides that translocate within the plant following absorption (such as glyphosate and 2,4-D).

Perennial weed species can be difficult to control because they store substantial food reserves in their root systems. Controlling the aboveground part of perennial species is usually not sufficient to achieve satisfactory, long-term control; the root system must be controlled as well. Translocated herbicides are usually the most effective chemical options to control perennial weed species, but the time of year these herbicides are applied can influence the level of control achieved. In the spring, perennial species rely on stored food reserves to initiate new growth, so most of the food at this time of year is moving upward from the roots to support new vegetative development. This movement means it is often difficult to get sufficient herbicide into the root when applications are made in the spring. Good control of perennial broadleaf species can be achieved when postemergence translocated herbicides are applied as food reserves are moving downward in the plant; this coincides with the time that perennial broadleaf species begin to flower and during fall months, as day length shortens and temperatures cool.

Be sure to apply herbicides while the target perennial species still have ample viable leaf surface area. Warm-season perennial species, such as hemp dogbane and common pokeweed, typically lose their leaves after the first frost; treat these types of perennials before the first fall frost. Cool-season perennial species, such as dandelion and Canada thistle, often survive one or more frosts before losing their leaves; translocated herbicides can be more effective on these types of perennials if applied after a light frost. Before making any herbicide application, take the time to scout fields to determine which perennial species are present and to confirm that the plants are still actively growing.—Aaron Hager

Soil Compaction and Fall Tillage

With the early start of corn harvest, and in some cases a short wait before soybean harvest revved up, fall tillage got underway early this fall. We don’t keep statistics on tillage like we do for harvest progress, but in some areas, especially east-central Illinois, many of the harvested corn fields have already been tilled.

Soil in good condition is, by volume, about half mineral (and organic) material and about half pore space. Soil at field capacity (the amount of water held against gravity, typically about 20% to 25% of the soil volume) has about half the pore space filled with water and the other half with air. Soil compaction takes place when we compress the soil, forcing some of the air out. Mineral matter and water aren’t “compressible,” so they are unaffected. Dry soils don’t compact much because dry mineral matter is strong enough to protect pore space. Saturated soils have a lot of water and little air in the pore space, so they also don’t compact much. Moist soils are the easiest to compact.

Most soil compaction results from driving heavy equipment over soils that are at or somewhat above field capacity. Heavy rains can help puddle the surface and result in some “surface compaction” or crusting, but they don’t contribute to deep compaction. Soils in the spring, including at planting time, are often at or near field capacity, and for a time after a rain they are above field capacity.

With the removal of water by the crop and normally dry weather in the fall, soils at harvest are often dry enough to limit compaction. That was not the case in 2009, when soils were wet at harvest. Adding that compaction to spring tillage or planting-time compaction in both 2009 and 2010 means that soils in many Illinois fields this fall are more compacted than they have been for some time.

Because the physical resistance to penetration increases greatly as soils dry out, it can be difficult to get a meaningful measure of the amount of soil compaction. If soils are relatively moist, a simple tile probe can often be used to locate layers in the soil that resist the probe. Dry soils, though, provide a lot of resistance to penetration even when they aren’t compacted much. This year, it may be enough to recall soil conditions at harvest in 2009 and at planting in 2009 and 2010 to assess the likelihood that compaction is an issue. Some of the standing water we saw in May and June might have stood a little longer in the more compacted areas of fields, but with so much rainfall it was hard to tell if compaction had a direct effect. In
general, more poorly drained areas will have the most compaction.

Repeated cycles of freezing and thawing can help relieve compaction—the water volume in the pore space expands during freezing and contracts during thawing. This works on the surface of the soil, where soils typically freeze and thaw often during the winter and early spring. But at depths greater than six inches or so, soils go through only a few freeze–thaw cycles in most years. And below a foot deep, soils often freeze and thaw only once or twice during the winter. This past winter, many soils froze and stayed frozen until they thawed, with no repeated cycle at all. There was thus little relief from deeper compaction through “natural” processes.

Though heavy equipment is the main cause of deep compaction, large tractors are usually needed to help relieve compaction by pulling implements that penetrate soil into the deeper, compacted zones. Deep tillage can’t fully restore soil pore space to its “precompacted” state, but it can introduce space for air to enter the soil, which over time helps increase pore space. It also helps break up the physical barrier that compacted soil produces as it dries out.

Several types of equipment can be run deep enough to penetrate the compacted zones. The most basic are “deep rippers,” which typically consist of five or seven heavy standards on a heavy toolbar and can rip to a depth of 12 to 18 inches. Either straight points or sweeps can be used, with sweeps requiring more horsepower, and typically a little shallower, but providing more “soil shatter,” which is helpful in relieving compaction. Ripper standards with a narrow cut and straight points can be operated without disturbing much surface residue; fields following such “minimum residue disturbance” (MRD) implements can qualify as no-till.

Because the deep-ripping operation is expensive in terms of equipment wear, fuel, and time, it has been common practice to use these implements only when standing water or other signals point to the need to use them in individual fields or part of fields.

Other implements used to relieve compaction include combination disk-rippers, which typically have a front gang of straight coulters with an adjustable angle to bury more or less residue, a row or two of heavy ripping standards, and a rotating cage or tine harrow for leveling. These tend to bury more residue and to leave soil surfaces more level than do deep rippers. Some also use heavy disk harrows, often with large, notched blades that they use to penetrate to depth and with gang angles that adjust to cover the desired amount of residue.

Whatever implement is used to relieve compaction, there are a few basic principles to remember during such operations:

- Running implements to depth to relieve compaction does little good if soils are not dry enough. Soils shatter well only if they’re somewhat below field capacity. Running heavy equipment over the field pulling a heavy implement causes some compaction even when soils are dry enough—and it causes a lot of compaction when soils aren’t dry enough to shatter well. So it’s not difficult to cause as much compaction as you relieve. While it has been relatively dry in most of Illinois for the past month, water use by the corn crop ended early this year, and soils without active crop roots and with corn residue after harvest dry slowly, especially as temperatures drop. So it pays to check to see if soils are actually as dry as we think they are and that they are breaking up at the depth of tillage. As a hint, ripping to relieve compaction when soils are dry enough takes a lot of horsepower; if the implement pulls easier than you expected, it’s possible that it is running in soil wetter than was thought.

- Tillage operations can only relieve compaction to the depth at which they’re operated. A heavy axle load can cause compaction to a depth of 18 inches or more, so you can cause a net increase in compaction if it’s too wet or you’re running too shallow. While implements like the offset disk or disk harrow are often blamed for causing compaction, their real drawback is that they usually aren’t run deep enough to relieve compaction to the desired depth. The moldboard plow often has a similar limitation, though the “modified mini-moldboard” can, if operated to a depth of 12 inches or so, effectively relieve compaction.

- Primary tillage needs to leave some residue on the surface to minimize soil loss before next spring. This is especially important on slopes, where much soil loss occurs through water runoff. On flatter soils, wind erosion can be substantial, and having surface residue can effectively decrease the amount of soil picked up and blown off the field.

While we typically consider corn fields that will go back into corn in 2011 as having the highest priority for relieving compaction, there have also been questions about the need for deep tillage following soybean harvest in 2010, in preparation for corn in 2011. While soybean fields often have a mellower surface in the fall than corn fields, deeper compaction that was caused during the 2009 season is still present, and at minimum soybean stubble fields should be checked for compaction this fall. With so much less residue than in corn fields, soybean fields need as much residue as possible to be retained on the surface during the tillage process.

Finally, many who are seeing high soybean yields in 2010 are wondering why, if compaction was so widespread, soybean yields don’t seem to have suffered. We don’t have a simple explanation, but it is clear that corn and soybean responded to weather and soil conditions very differently in 2010 and that soybean plants somehow got enough water to keep them going in August, as corn was coming to an end.

This also reminds us that soil compaction, as much as we work to prevent and relieve it, does not always have a negative effect on yield; in fact, in some cases it might even increase the water
available to a crop by improving the connection of root systems with water that can move up from deeper layers in the soil. Compaction is more often negative than positive, though, so we need to pay attention to it, preventing it to the extent possible and relieving it when we can’t prevent it.—Emerson D. Nafziger

**Soybean Plants and Stems Staying Green This Year?**

Soybean harvest is on a fast track this year. The USDA-NASS crop report estimated 50% of the crop was harvested as of October 4, and with good weather forecasted through the rest of the week, the rapid pace will continue. In the last 10 years, only 2007 moved faster, with 54% harvested at a similar date. Early yield reports from growers have been mostly favorable, with numerous reports of field averages being the best some growers have ever seen. There seems to be little reason not to believe we will see the largest soybean yield average in history this year, as predicted by the last USDA yield estimate.

One issue concerning some growers is green stems and green plants remaining in fields that are otherwise ready to harvest. I wrote about green, tough stems two weeks ago, but it was difficult at the time to predict whether they were a concern or just observations of the earlier-maturing soybeans. Since then, I’ve received several calls and pictures from agronomists and growers asking why so much green continues to appear when most of the field is ready to harvest.

Green stems and green plants can be somewhat separate issues, but from the combine they may be hard to sort out. Green stems, sometimes referred to as “green stem syndrome” or “green stem disorder,” occur when stems remain green even though pods and seeds yield and mature fine (Egli and Bruening 2006). The condition can range from a nearly normal number of pods on a plant where the stems stay green to entire plants that remain green with few pods and no seeds developed.

In the latter case, entire plants that remain green can easily persist until a killing frost occurs. These situations can be entirely genetic in nature due to male sterility, in which case plants will set about 85% fewer pods, causing 4.5 times higher carbohydrate concentrations in the root, stem, and leaf matter (Wilson et al. 1978). Hill et al. (2006) evaluated 1,187 different MGI and MGII cultivars in Illinois from 2001 to 2004 and found some relationships between percentages of green stem and certain cultivars, suggesting better variety selection may be possible. However, the syndrome is illusive under different environments, and there is likely little information available to growers that can aid in their seed selection.

While genetics may play a role, these symptoms can also be almost entirely environmental (Egli and Bruening 2006). They are commonly associated with viral infections, primarily bean pod mottle virus and secondarily tobacco ringspot virus. They can also be caused by insects feeding on flowers. Stink bugs are a primary culprit, but bean leaf beetles and corn rootworm beetles are also suspects. Moreover, any other abiotic stress factors that increase flower abortion (causing pod loss), like drought, can play a role (Egli and Bruening 2006). With the number of potential causes for green stem syndrome, the culprit can be difficult to pinpoint when scouting at the end of the season.

But there is some good news. While it makes sense that individual less-productive plants reduce yield, green stem problems tend to appear in fields
with average to high yields. One reason is that the green stems are a sign of favorable growing conditions throughout the maturity of the other plants. The only real concern for most growers is how much these green plants and stems reduce harvest speed. In most cases, the green plants constitute no more than 1% of the field. Harvest speed is not too affected at such levels when harvest conditions are dry.

In some severe cases, where green plants can be 10% or greater, harvest speed can certainly be reduced. Unfortunately, there are rarely clear answers between fields for why these symptoms appear, and little can be done even if the reason is evident. In cases with high percentages of green plants, delaying harvest until after a killing frost might be an option, but monitor the weather and the integrity of the other plants so you don’t lose yield to lodging or shattering.—Vince M. Davis

References


Do You Need Sulfur for Corn?

This question of whether sulfur is needed for corn piqued my interest, and I am conducting research to try to answer it. We started a study in 2009 to evaluate the response of corn to sulfur. While some locations showed no response, others did. The responsive locations showed yield increases ranging from a few bushels to more than 50 bushels per acre compared to the untreated check. I don’t have much yield data from this year yet, but visually some trials were showing response to sulfur during the summer.

Sulfur is a very important nutrient for corn production. Historically, routine sulfur application for corn has not been recommended in Illinois because earlier research showed no response to sulfur and because soil supply, manure applications, and/or atmospheric deposition were sufficient to supply sulfur needs for this crop. However, soil sulfur levels or supply may have diminished over time as a result of several factors.

Strict air pollution standards have cleaned the air of gaseous sulfur compounds, resulting in less sulfur atmospheric deposition. In general, many agronomic inputs, including fertilizers, insecticides, and fungicides, are “cleaner,” containing less incidental sulfur. Also, the reduction in livestock operations across the state is leading to application of less manure, further reducing the amount of sulfur applied or deposited on the soil.

At the same time that less incidental sulfur is being applied or deposited, increasing crop yields mean more sulfur is being removed. All of these factors, and the fact that we saw some response during last year’s sulfur trials, would indicate a need to continue investigating sulfur fertilization for corn in Illinois.

The fact that some but not all fields responded to sulfur application in last year’s trials is a clear indication that some locations or soil conditions may be more responsive than others. This study will produce valuable information regarding the frequency of sulfur deficiency that we can expect and, most important, which Illinois regions or conditions are most likely to experience deficiencies.

We need the help of volunteers to increase the usefulness of this project to Illinois farmers. I am looking for producers throughout Illinois who are willing to participate in on-farm research to measure corn response to sulfur fertilization. The better coverage of the state we can achieve, the greater will be our ability to predict where sulfur applications will most be needed.

Express your interest. If you are interested in participating (even if you are not sure whether your particular field or equipment would fit the conditions for this study), or if you have questions about how to find sulfur fertilizer or have the fertilizer applied, please contact me (fernande@illinois.edu; 217-333-4426; Department of Crop Sciences, N-315 Turner Hall MC-046, 1102 S. Goodwin Ave., Urbana, IL 61801).

Soil conditions. We want to characterize sulfur response across the state, so we will consider all soil types. However, we are especially interested in light-colored soils (less than 2% organic matter, coarse texture, or both) and soils with an eroded phase. The only fields we will not consider are those that have received manure or sulfur application in the last five years.

Logistics. Volunteers conducting these trials will follow a simple design, applying 0 and 30 lb of sulfur per acre as a broadcast application in a uniform portion of the field. From three replications to eight are needed for each field. Figure 1 shows a layout of the treatments randomly assigned within each replication for an eight-replication study. It will be important to geo-reference each strip or clearly mark it with different-colored flags or markers in the center. Strips can be anywhere from 8 to 16 rows wide by 300 to 1,000 feet long. What is important is that the size of the strip allow accurate application of the rate and accurate measurement of yield. Also, it is preferable that the strip be wider than the harvest strip, but if the combine is at least 12 to 16 rows wide, it is possible to harvest the strip without having border rows.

Sulfur sources. While there are a few sulfur sources we prefer, we can accommodate others. We would prefer the use of ammonium sulfate (NH₄)₂SO₄ (21-0-0-24), MicroEssentials sulfur (ME S) ME S15 (13-33-0-15), or elemental...
sulfur (0-0-0-90). If your sulfur source contains other accompanying nutrients, you will need to apply the corresponding rates of those nutrients to other treatment strips to avoid a differential response. If you use ammonium sulfate, you would need to apply 26 lb N/acre to the other strips; if you use ME S15 you would need to apply 145 lb DAP (18-46-0)/acre. (For more details see the section on “Applying the treatments.”)

**Time of application.** This fall soils are dry, and harvest for most people is moving forward in a timely fashion. Applying treatments this fall would definitely be an option. Our preferred application time is the spring (preplant), but we understand that fall might be the only choice available to some of you. If you prefer to use ammonium sulfate this fall, make sure to follow guidelines for fall nitrogen applications (bulletin.ipm.illinois.edu/article.php?id=1416).

**Measurements for data collection.** The only data volunteers will have to provide is the yield for each strip. This information can be collected by yield monitor or from a weigh wagon. Volunteers will not be required to take plant or soil samples, but they need to agree for the researcher to visit the strips two or three times during the growing season.

**Applying the treatments.** There are three sulfur sources to choose from:

- **ammonium sulfate (21-0-0-24)**
  - For strips with 30 lb sulfur/acre: Apply 125 lb ammonium sulfate/acre.
  - For the strip with 0 lb sulfur/acre: Apply 26 lb nitrogen/acre. This application is made to balance the nitrogen that was applied along with the sulfur in the sulfur strip. Those 26 lb of nitrogen/acre can be applied as either 57 lb urea/acre, 94 lb UAN (28%)/acre (8.7 gal/acre), or 82 lb UAN (32%)/acre (7.4 gal/acre).
  - Do not use anhydrous ammonia because it would be difficult to apply only 32 lb of product/acre.
  - **micro essentials MES-15 (13-33-0-15)**
  - For strips with 30 lb sulfur/acre: Apply 200 lb MES-15/acre.
  - For the strip with 0 lb sulfur/acre: Apply 145 lb DAP (18-46-0)/acre. This application is made to balance the nitrogen and phosphorus that was applied along with the sulfur in the sulfur strip.
  - **elemental sulfur (0-0-0-90)**
  - I would use elemental sulfur only as a last resort, because often all of it does not become available in the year of application.
  - For the strip with 30 lb sulfur/acre: Apply 33 lb elemental S/acre.
  - For the strip with 0 lb sulfur/acre: There is no need to apply any product because the sulfur source is not accompanied by any other nutrient.

**Additional N, P, K, or other inputs.**

If the field needs additional nutrients or other inputs (insecticide, herbicide, etc.) to optimize production, make sure those inputs are applied at the same rate across the entire study site.

—Fabián G. Fernández

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**Take Advantage of Good Soil Conditions to Apply Phosphorus and Potassium—If You Need Them**

In the last article that I wrote about phosphorus and potassium applications for this fall (bulletin.ipm.illinois.edu/article.php?id=1415), I did not talk much about fertilizer rates. I decided to cover that topic this issue. I finished the last article with a brief mention of the importance of soil testing. I will start this one by reemphasizing this practice. The most important thing to know before you get started with an application of phosphorus or potassium is to how much nutrient is needed—if any at all.

The best way to know is by conducting a soil test, which measures the availability of the nutrient for the crop.

The soil tests for phosphorus and potassium have been correlated and calibrated to determine what fertility level is needed to minimize a yield reduction due to insufficiency of these nutrients. In a yield response curve, the critical soil test level is the point at which near maximum yields are obtained. If soil test levels are below that critical value, the crop is likely not to produce maximum yield because it is limited by the lack of that nutrient. On the flip side, if the test shows the nutrient is above the
critical level, the crop is less likely to respond if additional fertilizer is applied.

Sometimes a soil test will indicate excessively high levels, in which case reducing or eliminating applications for a while may be desirable. When soil test levels are very high, the chance of yield response to additional fertilizer is low. As long as the crop has what it needs—which you can know from the soil test—it won’t care if the fertilizer was applied recently or several years ago, or how much you paid for it! Thus, the recommendation is to try to build levels to at least the critical value if the test is low, and then to maintain levels or try to increase them slightly above critical. Normally, producers who farm their own land prefer to build test levels above the critical point (the “feed the soil” approach), while those who rent land typically try to maintain test levels (the “feed the crop” approach). Whatever approach you use, what is important is to ensure that crop yield is not limited by nutrients.

Table 2 outlines the critical levels for phosphorus and potassium in corn and soybean in the different regions of Illinois. Phosphorus-supplying power regions are broadly defined by parent material and degree of weathering (Figure 2), while potassium-supplying power regions are broadly defined by function of soil cation exchange capacity (CEC; Figure 3). Table 3 shows average phosphorus and potassium removal rates in seed for corn and soybean. Additional information on phosphorus and potassium recommendations can be found in the Illinois Agronomy Handbook (https://pubsplus.uiuc.edu/C1394.html).

If your field needs an application and your budget does not allow for a full rate, it is better to apply some rather than none. Another alternative is to apply the nutrients as a starter fertilizer in the spring. Of course, these practices should be viewed as temporary measures and should not replace a sound fertility program. Applying no phosphorus or potassium results in a gradual decline in soil test levels, because the crop removes these nutrients in the grain that is taken out of the field. Applying phosphorus and potassium to maintain test levels at an optimum is considered a good practice for sustained profitability over time. However, if your field is slightly above the critical level in the optimum (maintenance) range or above (Table 2), you can likely forego the application for one year without risking yield loss. If the test levels are very high above the point where an application is not recommended (Table 2), you can likely withhold an application for more than one year and still have adequate fertility to maximize yields.

Table 2. Recommended soil test levels for phosphorus and potassium in Illinois.

<table>
<thead>
<tr>
<th>Test level (lb/acre)</th>
<th>Phosphorus&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Maintenance range</th>
<th>No application needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low supply power</td>
<td>45</td>
<td>50–70</td>
<td>&gt;70</td>
</tr>
<tr>
<td>Medium supply power</td>
<td>40</td>
<td>45–65</td>
<td>&gt;65</td>
</tr>
<tr>
<td>High supply power</td>
<td>30</td>
<td>40–60</td>
<td>&gt;60</td>
</tr>
<tr>
<td>Potassium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High CEC&lt;sup&gt;b&lt;/sup&gt;</td>
<td>300</td>
<td>300–400</td>
<td>&gt;400</td>
</tr>
<tr>
<td>Low CEC (including sands)</td>
<td>260</td>
<td>260–360</td>
<td>&gt;360</td>
</tr>
</tbody>
</table>

<sup>a</sup>To ensure adequate fertility even in years with high yield potential, it is recommended that phosphorus test levels be increased slightly above the critical level before a maintenance program is used.

<sup>b</sup>CEC: cation exchange capacity.

Table 3. Average nutrient removal in seed of corn and soybean.

<table>
<thead>
<tr>
<th>Crop</th>
<th>P&lt;sub&gt;2&lt;/sub&gt;O&lt;sub&gt;5&lt;/sub&gt; (lb/bu)</th>
<th>K&lt;sub&gt;2&lt;/sub&gt;O (lb/bu)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>0.43</td>
<td>0.28</td>
</tr>
<tr>
<td>Soybean</td>
<td>0.85</td>
<td>1.30</td>
</tr>
</tbody>
</table>

Traditionally, most farmers apply phosphorus and potassium at the same time to save time and money and to reduce the trips across the field. While this makes sense when both nutrients are needed, be sure to determine if such is the case. If soil testing shows a need to apply only one of the nutrients or less of one and more of the other, don’t worry about applying more of what you don’t need. In a recent survey of soil fertility throughout Illinois, we determined that overall many fields have sufficient phosphorus fertility built in but are low in potassium. Of course on a field-to-field basis, we saw some fields needing phosphorous and not potassium, and other fields needing both nutrients. These results underscore the importance of having recent soil test data to determine what kind of application is needed, if any at all. If you determine that an application is needed, this fall looks like an appropriate time to do it.
Unlike the last two years or so, many fields are already harvested, soil conditions are adequate to drive on the field, and fertilizer prices are lower.—Fabián G. Fernández

What Ailed Corn Following Corn in 2010?

While corn yields in many parts of Illinois are less than we had expected and much less than we had hoped, corn following corn took a particularly hard hit in many areas. Because our current crop acreages in Illinois are skewed toward corn, at least 20% of the corn in Illinois in 2010 followed corn. So the effect of lower yields of corn following corn is not trivial.

This follows a period of several years during which corn following corn has yielded as much, or nearly as much, as corn following soybean. Anecdotally, many producers, especially those in the corn-rootworm-variant areas of Illinois, have found yields of corn following corn to be as high as those of corn following soybean, especially since the advent of rootworm resistance traits in hybrids in 2006 and 2007. For many of these producers, lower yields of corn following corn come as a shock.

Some people distinguish between “corn following corn” and “continuous corn,” with the former often referring to second-year corn (following soybean two years earlier) and the latter to corn that follows at least two years of corn. Our research shows that second-year corn tends to yield a little more than continuous corn, but we have not been able to determine if that calls for differences in management. Nor do we think that second-year corn fared much better than continuous corn in 2010.

We all breathed a sigh of relief when April weather was good and we were able to plant the corn crop on time. But the middle two weeks of May were cooler and much wetter than normal, and we think it’s likely that this period set the crop up for some of the problems that it experienced.

Corn following corn seemed to struggle from the start, and in many fields it never looked very good during the season. Compared to corn following soybean, emergence was uneven, crop color was not very good, and the crop seemed to struggle to take up enough nitrogen to grow well, regardless of N rates and management. With May and June so wet, many who waited to apply N until after planting struggled to get N applied on time; in these fields, N availability when the crop needed it was an issue.

Following is a list of factors that I believe may have contributed to the problems of corn following corn in 2010:

1. Even where tillage was done last fall, soils were too wet to do a good job, and more than the usual amount of residue remained on the surface, where it affected planting and early growth.

2. Soils were very wet, and fairly cold, coming into April. Some people who couldn’t do primary tillage in the fall tried to do some before planting, but soils were never in good shape to do this, and it both created more compaction and left a lot of residue on the surface.

3. Even though there was a nice stretch of weather in April to get the crop planted, soil conditions in fields following corn were not very good, and in fields where preplant nitrogen was applied and/or more tillage was done, soil conditions were probably even worse, with compaction added to cold and (still) fairly wet soils.

4. Soil temperatures didn’t start to increase until after mid-May, which meant after the corn crop was up—and in many fields already uneven and sickly looking.

5. We think that corn plants following corn in cool, wet soils tend to be affected a lot by where their roots are in relation to last year’s residue, including root remnants. A lot of the residue even in tilled fields was not buried very well, and it’s not hard to imagine that a lot of new-crop roots were close to a lot of old-crop residue. We think that’s a negative, perhaps due in part to allelopathy, perhaps from temperature effects, and maybe from some diseases that can carry over. Allelopathy starts with the release of substances as crop residue starts to break down, and it diminishes over the course of breakdown. Residue after the fall and winter was unusually well preserved into the spring in 2010, and this could have contributed to the problem.

6. Tilled corn on corn fields likely took in more of the rain that fell in May and June, and such soils were cooler, which reduced evaporation rates and resulted in a longer “soak” than where corn followed soybean.

7. From a combination of numbers 5 and 6, I think that roots were damaged early, and they may never have recovered fully. This probably reduced the ability of root systems (which got really wet during June, probably damaging them even more) to take up water and nutrients, including extra nitrogen.

8. Once soils started to warm up, we expect that old-crop residue, which was still lagging in its breakdown, started to tie up nitrogen quickly. The crop was growing fast by then and needed a lot of nitrogen, which would have been slow to release from what was tied up in the residue. With tasseling coming early, it’s likely that release of nitrogen from residue was too late to do much good.

Both corn following corn and corn following soybean suffered, we think, from having root systems damaged badly by excessive water. This meant that plants couldn’t take up enough water even during July, which led to kernel abortion. Then when it turned drier and warmer in August, the crop simply ended, with filling rates lower than expected during much of the grain-filling period.

We’ll be giving more thought to this in the coming months as we see the data from our trials. Because of the importance of continuous corn and the ques-
tions about it raised this year, I would appreciate getting comments regarding other factors that readers might have seen this year.—Emerson Nafziger

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 South-west 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.

Northern Illinois

A great deal of harvest progress has occurred in the past week, as weather conditions have been nearly ideal. The latest Illinois Weather & Crops newsletter from the National Agricultural Statistics Service lists corn harvest completion through October 3 at 51% in the northwest crop reporting district and 56% in the northeast district. Some of the southern counties within the northern region are near 70% complete. Yields have been variable, but numerous reports of totals exceeding 200 bushels per acre have been received. Some of the earlier-season corn hybrid stalks are deteriorating, and some lodging has occurred after recent storms and windy days.

Soybean harvest is nearly 90% complete, with many yields reported in the range of 55 to 65 bushels per acre. Growing conditions for soybeans this season have been excellent throughout the region, which may result in near-record average yields for some northern counties.

Southern Illinois

It should come as no surprise that this week’s USDA crop progress report shows that 2010 has been the earliest and fastest corn harvest in the past 10 years. By October 4, 74% of the state’s corn crop had been harvested. Here in the south that number was over 90%, and most harvesting effort is now focused on soybean.

Reports from the field indicate that both corn and soybean yields are good overall, although they are extremely variable in some areas due to wet field conditions early in the season. One common observation has been that flat or poorly drained areas are producing lower yields, while the better yields are coming from better-drained areas that might be considered “droughty” in normal years.

Weather and soil conditions are nearly ideal for wheat seeding, and growers have been working ground and doing a fair amount of planting prior to the “fly-free” dates of October 6–9 and October 9–12 for the northern and southern portions of the region, respectively.

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