North Central Ohio Agronomy Report

Erie Basin Extension Education & Research Area

Issue 05-10

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Dear Agricultural Producer:

What a unique spring! Dry soils have allowed for an early planting in most parts of the state. Low humidities have allowed for warm days and cool nights. Dry soils warm up rapidly. Early crop emergence of both corn and soybeans have been impressive. Emergence has been good with excellent stands. I have enclosed some information on cold weather risk to corn, soybeans, and wheat since cold night time temperatures are forecast for this weekend. I hope we do not need this information.

Wheat growth and development is probably 7 -10 days ahead of normal. Six to ten day forecast as well as variety and yield potential should likely be elements of the decision making process in deciding about fungicide application. Generally wheat is relatively healthy. Low humidity and limited rainfall in some areas have helped to keep the crop fairly free of disease. Some powdery mildew is present in the lower canopy of susceptible varieties and there is some presence of Septoria/Stagonospora leaf blotch. Enclosed is a more detailed article from Purdue about head scab risk management.

Black cutworm moth flights have been fairly high and rescue spraying for cutworm has occurred already in parts of Illinois. Keep in mind most lower rates of seed treatment insecticide will provide suppression while higher rate insecticide programs should provide control. Also, general experience indicates that the Herculex® event in seed corn provides excellent control.

Limited reports of flea beetle injury have been reported. Overwintering Bean leaf beetle adults may soon feed on emerging soybean plants. Alfalfa regrowth after harvest should be monitored for evidence of alfalfa weevil larva feeding. Last year we had some isolated areas where economic feeding of Cereal leaf beetle larva occurred in wheat and oats. Adult numbers have been reported as extremely high with larva hatch in Crawford County. Their feeding may become a threat over the next two weeks

Best regards,

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Wheat Scab Risk Assessment Tool Now Available

Katelyn Willyerd, Pierce Paul, Dennis Mills, Plant Pathology
Ohio State University Extension

In Ohio, wheat typically starts heading and flowering during the third week of May. As the crop approaches these growth stages, it is time to prepare for Fusarium head bight (scab) and vomitoxin management. Wheat is most susceptible to scab during the flowering and early grain-fill stages. Weather conditions, such as high humidity and rainfall, prior to and during flowering contribute to inoculum (spore) production and spread, and infection of the wheat spike. However, cool, dry conditions may slow spore production, fungal growth, and scab development. The wheat scab risk assessment tool helps predict the risk of scab based on weather conditions leading up to flowering. The 2010 risk tool is now available online: www.wheatscab.psu.edu

To use the risk tool, you will need to identify the flowering date(s) for your winter wheat. Flowering is dependent on variety and planting date, so flowering date may vary across your farm. Check the risk tool frequently during heading stages, as weather the week before flowering contributes most to spore production and scab severity. If you anticipate flowering will occur soon, you may use forecasted weather for 1, 2, or 3 days prior to the flowering date. Since tillers will mature at slightly different times, estimate when 50% of heads show anthers as the “flowering date” for a given field.

Once you’ve selected flowering date on the tool’s calendar, choose a wheat class model. For Ohio growers, select the winter wheat model. You may select Ohio from the country-wide map and click on a weather station close to your farm for details. The tool will provide a current risk level: low, medium or high, for the selected location/flowering date. You will also be able to see the risk probability, temperatures and precipitation from the previous 7 days. Low risk probability means wheat flowering on the selected day will likely have less than 10% scab severity, according to the model. If the risk probability is in the medium or high categories, you may want to consider a fungicide application, since most winter wheat varieties are susceptible and even the most resistant varieties my become infection and contaminated with vomitoxin if weather conditions are highly favorable. In addition to favorable weather and variety susceptibility, local spore load also affects the risk of scab development. The spore levels in fields with corn residue may be quite high due to severe outbreaks of Gibberella ear rot in some areas of Ohio in 2009. Gibberella ear rot of corn and wheat scab are caused by the same fungus.

Local commentary on scab risk in Ohio will be provided by OARDC wheat pathologist and extension specialist Pierce Paul throughout the season. Check for these updates at the bottom of the risk map tool (click “View Commentary”), in C.O.R.N. newsletters or on the US Wheat and Barley Scab Initiative blog (http://scabusa.org/modules/wordpress/).

Most importantly, the risk tool should be used as part of a larger integrated management plan. This tool helps predict scab-potential based on weather, scab development on your farm will also depend on your cropping system and resistance level of your varieties. The most effective management of scab is achieved by planting resistant varieties after soybean and applying a fungicide during anthesis if the weather becomes favorable.

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At What Cold Temperatures Will Wheat be Damaged

Table from: Spring Freeze Injury Publication
Kansas State University Extension

Table 1. Temperatures that cause freeze injury to wheat at spring growth stages and symptoms and yield effect of spring freeze injury.

Growth stage	Approximate injurious temperature (two hours)	Primary symptoms	Yield effect
Tillering	12 F (-11 C)	Leaf chlorosis; burning of leaf tips; silage odor; blue cast to fields	Slight to moderate
Jointing	24 F (-4 C)	Death of growing point; leaf yellowing or burning; lesions, splitting, or bending of lower stem; odor	Moderate to severe
Boot	28 F (-2 C)	Floret sterility; spike trapped in boot; damage to lower stem; leaf discoloration; odor	Moderate to severe
Heading	30 F (-1 C)	Floret sterility; white awns or white spikes; damage to lower stem; leaf discoloration	Severe
Flowering	30 F (-1 C)	Floret sterility; white awns or white spikes; damage to lower stem; leaf discoloration	Severe
Milk	28 F (-2 C)	White awns or white spikes; damage to lower stems; leaf discoloration; shrunken, roughened, or discolored kernels	Moderate to severe
Dough	28 F (-2 C)	Shriveled, discolored kernels; poor germination	Slight to moderate

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No-Tilling Corn after First Cutting Alfalfa: Several Options Available

Bill Curran, Weed Scientist
Penn State Crop Management Extension Group (CMEG)
Penn State University Extension

Harvesting first cutting alfalfa and then no—tilling corn can be challenging and certainly carries some risk. There are primarily two challenges. First, getting acceptable control of alfalfa after first cutting requires some planning, and second, even with acceptable control, what impact can the dying alfalfa crop have on corn yield?

Glyphosate has been labeled as a pre—harvest application for stand removal in alfalfa for a number of years. Glyphosate may be applied to declining stands to help control the legumes and other plant species. This can be particularly helpful for control of perennial grasses including quackgrass or forage species such as orchardgrass. If the crop is to be harvested or grazed by livestock, you can use up to 1.5 lb ae/acre (2 quarts of a 3lb ae/gal product) in alfalfa. The minimum interval between application and harvest is 36 hours and by 5 days after application you are losing forage quality. *One of the biggest challenges to making this work is having the right weather conditions to allow timely harvest.* This treatment will also not provide sufficient control of the alfalfa, but it will suppress it and potentially allow for more timely control and reduced competition in no—till corn. In no—till corn, a POST application should be made to control the alfalfa regrowth. The plant growth regulator herbicides (2,4–D, dicamba, clopyralid — Stinger and Hornet, as well Status), should help control alfalfa post in corn. In Roundup Ready corn, glyphosate can also help suppress the legume and a growth regulator herbicide could be tank—mixed with the glyphosate.

Alternatively, delay corn planting, making sure there is adequate regrowth before making the herbicide application. A combination of 2,4–D and dicamba (Banvel or Clarity) is probably the most consistent for control of alfalfa. Glyphosate will add some alfalfa control and is a definite must if perennial grasses are present. Of course the greatest risk is not waiting and no—tilling corn as soon as possible after harvest. This is a bit risky, but can be successful if good fortune is on your side. Planting Roundup Ready corn and a "well—timed" application of a dicamba—based product (Banvel, Clarity, or Status) or perhaps a clopyralid containing product (Stinger or Hornet) tank—mixed with glyphosate could work. Use the full rate of Status or Hornet or at least 12 fl oz of Banvel or Clarity. Better yet, wait 10 to 15 days after harvest before spraying the alfalfa (minimum of six inches of regrowth) and then plant corn.

Unfortunately none of these approaches will prevent the negative effects of a dry spell early in the growing season that can be devastating to corn planted after first cutting hay. Here's where that good fortune comes in handy again.

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More on Fusarium Head Blight in Indiana Wheat

Kiersten Wise, Botany and Plant Pathology, Field Crop Diseases
Purdue University Extension Service

Wheat in southern Indiana is heading out and beginning to flower. The recent rainy weather may have caused concern about development of Fusarium head blight, or scab, but the majority of the state is still at low to medium risk for Fusarium head blight according to the wheat scab risk model that was discussed in last week's Pest and Crop article: <http://extension.entm.purdue.edu/pestcrop/2010/issue5/index.html#fusarium>. This risk assessment tool can be accessed through <http://www.wheatscab.psu.edu/>.

There is a slight chance of rain later in the week in southern IN, followed by cool, sunny weather. The periods of sunny and dry weather after rainfall are not favorable for infection by the fungus that causes Fusarium head blight. This fungus, Fusarium graminearium, infects wheat during flowering, beginning at Feekes 10.5.1, and prefers rainy, warm, and humid weather conditions for infection and disease development.

Producers in areas of medium risk that are wary of model predictions and have Fusarium head blight-susceptible varieties planted may choose to apply a fungicide. Fungicide applications need to be made at Feekes 10.5.1, or early flowering. There are several fungicides available for Fusarium head blight control, and these are listed in the foliar fungicide efficacy table developed by the North Central Regional Committee on Management of Small Grain Diseases or NCERA-184 committee: <http://www.ppdl.purdue.edu/ppdl/wise/NCERA_184_Wheat_fungicide_chart_2010_v2.pdf>.

Caramba, Prosaro, and Proline were given a rating of "good" based on a designation system from the Regional Wheat Disease Committee. Products containing only tebuconazole (Folicur, others) were rated as fair, and propiconazole alone (Tilt, others) was rated as poor for management of Fusarium head blight. Remember, fungicides that have a strobilurin mode of action are not labeled for Fusarium head blight suppression. Be sure to follow label restrictions on how many days must pass between fungicide application and harvest.

Low levels of foliar diseases such as Septoria/Stagonospora leaf blotch have been observed in some fields, but overall, foliar disease levels are low. We will need to continue to monitor the level of risk for Fusarium head blight development in wheat in central and northern Indiana as the crop approaches heading in these areas.

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Symptoms of Low Temperature Injury to Corn and Soybean

Bob Nielsen, Professor of Agronomy and Corn Specialist
Purdue University

The severity of damage reflects the different effects of frost alone versus true lethal low temperatures, especially for corn. Corn can often survive a 'simple' frost event, wherein the exposed leaf tissue is damaged by the frost but the growing point is not exposed to truly lethal temperatures. Lethal cold temperatures (28F or less), on the other hand, can kill the growing point even if the growing point is still below ground.

1 to 2 days after freeze	About 1 week after freeze
Hypocotyl and cotyledon injury 	Likely seedling survival 
Hypocotyl injury 	Likely seedling survival 
Hypocotyl and cotyledon injury 	Likely seedling death 
A range of injuries 	Seedling death 

For clearer pictures go to:
http://www.agry.purdue.edu/ext/corn/news/articles.01/Frost_Corn_Soy-0418_Gallery.html

1 to 2 days after freeze	About 1 week after freeze
Droopy, discolored leaves 	Seedling survival 
Watersoaked, discolored leaf tissue 	Seedling death 
Appearance of growing point region 	

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Applying Soil Residual Herbicides After Corn Emergence

Aaron Hager, Weed Specialist
University of Illinois Extension

The rapid progress in planting corn in Illinois is quite different from what many farmers experienced in 2008 and 2009. A look back at *the Bulletin* articles about this time last year indicates we were by and large still waiting for field conditions to improve so planting could begin, and weed vegetation was increasingly robust. In stark contrast, this season we've already discussed how to improve the performance of soil-residual herbicides through mechanical incorporation or timely precipitation following application.

It's quite possible that the rapid planting progress has resulted in some fields' being planted before a planned soil-residual herbicide could be applied. If the corn has yet to emerge, the application could proceed as originally planned. But what if the corn has begun to emerge and the soil-residual herbicide has not yet been applied? Can the application go on as planned, or will a different product be needed?

The answer depends on the herbicide in question. Many but not all herbicides that are most often applied before corn planting or emergence can be applied after the corn has emerged.

Even if a soil-residual herbicide can be applied after crop and weed emergence, not all soil-residual herbicides will control emerged weeds, so additional management procedures (such as adding a herbicide with postemergence activity) may be needed in situations where weeds also have emerged. **Table 1** summarizes information about post-emergence applications of the more traditional soil-applied corn herbicides. Consult the respective product label for additional information, such as the need for tank-mix partners or spray additives to improve control of existing weeds.

Table 1. Maximum corn size for postemergence applications of soil-residual herbicides.

Herbicide	*Maximum corn size for broadcast application*	*Comments*
Balance Pro, Radius	Before corn emergence	Applications to emerged corn will cause injury.
Princep	Before corn emergence	Do not apply to emerged corn.
Balance Flexx, Corvus	2 leaf collars	Do not add COC or MSO after corn emergence.
Define SC	5 leaf collars	Will not control emerged weeds.
Micro-Tech	5 in.	Will not control emerged weeds.
Bullet	5 in.	Will provide control or partial control of small (<2 leaves) broadleaf and grass weed species.
Bicep II Magnum, Bicep Lite II Magnum, Cinch ATZ, Cinch ATZ Lite, Stalwart Xtra, Parallel Plus[a]	5 in.	Will provide control or partial control of small (<2 leaves) broadleaf and grass weed species.
SureStart	11 in.	Will provide control or partial control of certain small (<1.5") broadleaf weed species.
FieldMaster	11 in.	Apply POST only to glyphosate-resistant corn hybrids.
Surpass, TopNotch, FulTime, Harness, Harness Xtra, Degree, Degree Xtra, Keystone, Keystone LA, Breakfree, Breakfree ATZ, Breakfree ATZ Lite	11 in.	Surpass, TopNotch, Harness, Breakfree, and Degree will not control emerged weeds.
Atrazine	12 in.	Add COC if weeds have emerged.
Lumax, Lexar	12 in.	NIS or COC may be added for POST applications.
Guardsman Max, G-Max Lite	12 in.	Will provide control or partial control of small (<1.5") broadleaf and grass weed species.
Outlook	12 in.[b]	Will not control emerged weeds.
Expert	12 in.	Apply POST only to glyphosate-resistant corn hybrids.
Hornet WDG	20 in. (V6)[c]	POST applications must include NIS, COC, or MSO.
Resolve DF or SG	12 in. (V5)	Apply before grass weeds exceed 2 in. and broadleaves exceed 3 in.
Python WDG	2 in.	Apply before the first corn leaf unfurls.
Callisto	30 in. (V8)	POST applications should include COC and nitrogen fertilizer.
Prowl H_2O	30 in. (V8)	Will not control emerged weeds.
Camix	30 in.[d] (V8)	NIS or COC may be added for POST applications.
Dual II Magnum, Cinch, Me-Too-Lachlor II, Stalwart C, Parallel	40 in.	Will not control emerged weeds.
Sencor	Before tassel emergence	Do not add COC or POC.
Integrity	Before corn emergence	Do not apply to emerged corn.
Prequel	Before corn emergence	Do not apply to emerged corn.

[a]All of these products are labeled for directed applications to corn up to 12 in. tall.
[b]Outlook is labeled for layby applications to corn up to 36 in. tall.
[c]Hornet is labeled for directed application to corn up to 36 in. tall.
[d]Applications to corn greater than 12 in. tall should be post-directed.

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Root Development in Young Corn

Bob Nielsen, Agronomy Dept.
Purdue University Extension

Successful emergence (fast & uniform) does not guarantee successful stand establishment in corn. The next crucial phase is the establishment of a vigorous nodal root system. Success is largely dependent on the initial development of nodal roots from roughly V2 (2 leaves with visible collars) to V6.

Corn is a grass and has a fibrous type root system, as compared to soybeans or alfalfa that have tap root systems. Stunting or restriction of the nodal root system during their initial development (e.g., from dry soil, wet soil, cold soil, insect damage, herbicide damage, sidewall compaction, tillage compaction) can easily stunt the entire plant's development. In fact, when you are attempting to diagnose the cause of stunted corn early in the season, the first place to begin searching for the culprit is below ground.

To better understand rooting development and problems associated with root restrictions, it is important to recognize that root development in corn occurs in two phases. The first phase is the development of the seminal or seed root system. The second phase is the development of the nodal or crown root system.

Corny Trivia: Sometimes you may hear the seminal root system referred to as the primary root system and the nodal root system as the secondary root system. This classification was described by Cannon (1949) and certainly makes chronological sense but always confuses me from the standpoint of importance to the plant.

Radicle Root and Coleoptile of pre-VE seedling

The Seminal (Seed) Root System

Seminal (seed) roots originate from the scutellar node located within the seed embryo and are composed of the radicle and lateral seminal roots. Even though the seminal roots technically are nodal roots, in practice they are usually distinguished from the nodal roots that develop l

The radicle root emerges first and elongates towards the tip end of a kernel. The lateral seminal roots emerge later from behind the coleoptile and elongate towards the dent end of a kernel.

The seminal root system helps sustain seedling development by virtue of water uptake from the soil, but a young corn seedling depends primarily on the energy reserves of the kernel's starchy endosperm for nourishment until the nodal root system develops later. Once a seedling has emerged (growth stage VE), the rate of new growth of the seminal root systems slows down dramatically as the nodal root system begins to develop from nodes above the mesocotyl.

Even though the seminal root system contributes little to the season-long maintenance of the corn plant, early damage to the radicle or lateral seminal roots can stunt initial seedling development and delay emergence. Such damage will not necessarily cause immediate death of the seedling as long as the

Seminal root system of VE seedling,
but not evidence yet of nodal root system

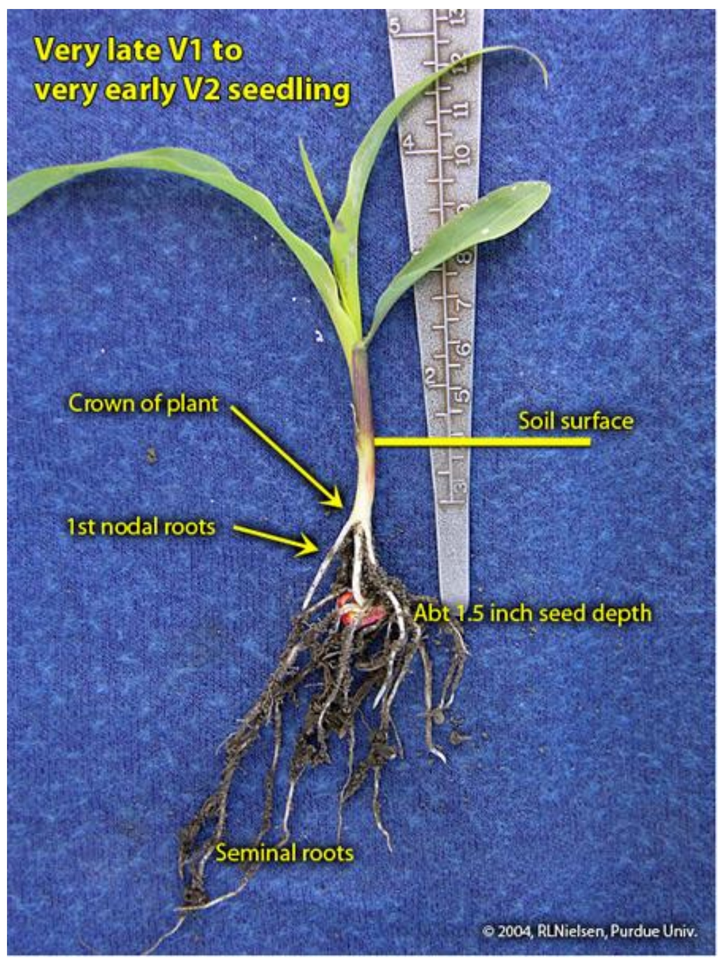
kernel itself and mesocotyl remain healthy, but may result in the seedling leafing out underground. As more and more nodal roots become established over time, damage to the seminal root system will have less and less impact on seedling survival.

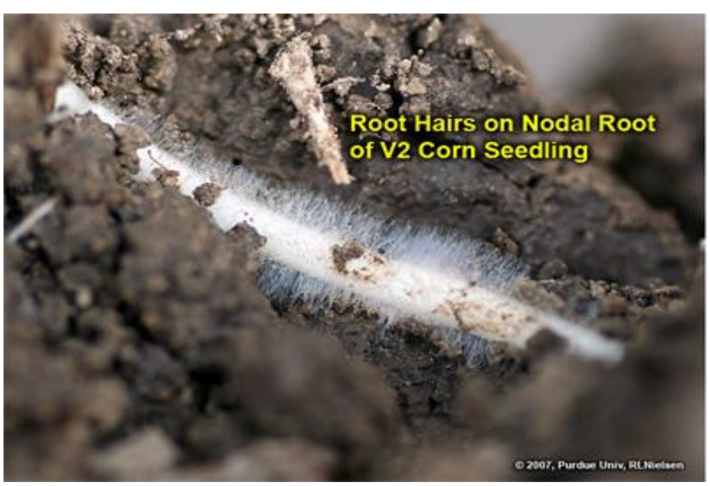
Examples of seminal root damage include imbibitional chilling injury, post-germination injury from lethal or sub-lethal cold temperatures, and “salt” injury from excessive rates of starter fertilizer placed too close to the kernel. Symptoms of such root damage include retarded root elongation, brown tissue discoloration, prolific root branching, and outright death of root tissue. If the radicle root is damaged severely during its emergence from the kernel, the entire radicle root may die. Once the radicle has elongated a half- inch or so, damage to the root tip will not necessarily kill the entire root, but rather axillary root meristems may initiate extensive root branching in response to damage to the apical meristem.

The Nodal Root System

Nodal roots develop sequentially from individual nodes above the mesocotyl, beginning with the lowermost node in the area of the young seedling known as the “crown”. Once a seedling has reached the V1 stage of development, one can usually identify the first set of nodal roots beginning to elongate from the lowermost node. By the V2 stage of development, the first set of nodal roots are clearly visible and the second set of nodal roots may be starting to elongate from the second node of the seedling. Each set or “whorl” of nodal roots begins to elongate from their respective nodes at about the same timing that each leaf collar emerges from the true whorl of the seedling.

Elongation of the stalk tissue begins between leaf stages V4 and V5. Elongation of the internode above the fifth node usually elevates the sixth node above ground. Subsequent elongation of higher-numbered stalk internodes will result in higher and higher placement of the remaining stalk nodes. Sets of nodal roots that form at above ground stalk nodes are commonly referred to as “brace” roots, but function identically to those nodal roots that form below ground. If surface soil conditions are favorable (moist and not excessively hot), brace roots will successfully penetrate the soil, proliferate, and effectively





Seminal and nodal roots of V2 seedling

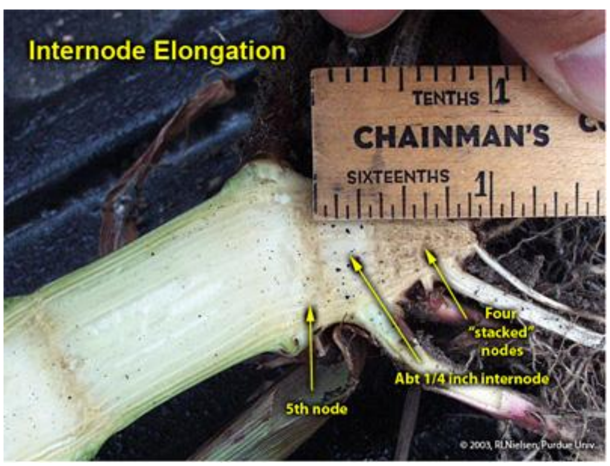
scavenge the upper soil layers for water and nutrients.

Corny Trivia: Root hairs are lateral extensions of root epidermal cells, grow to a length of several millimeters, and number about 200 per sq. millimeter (Gardner et al., 1985). Their typical life span is only about 2 days at moderate temperatures and less so at higher temperatures (Gardner et al., 1985). Root hairs are visible even on the radicle root of a young seedling. Collectively, the surface area represented by root hairs is very large and can account for a large share of nutrient and moisture uptake by the plant.

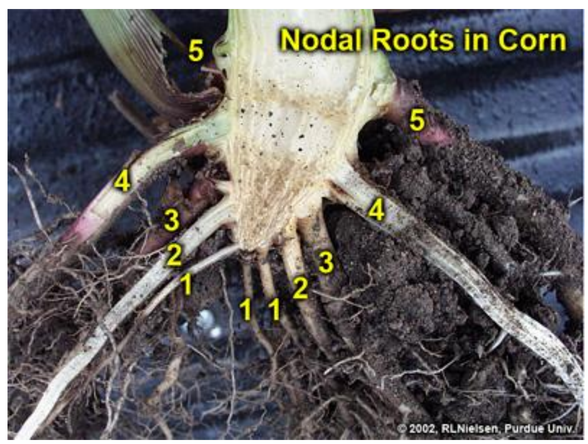
Corny Trivia: The primary meristem of a root is located near the root tip. Elongation of cells behind the meristem leads to elongation of the root.

A split stalk of an older plant will reveal a "woody" triangle of stalk tissue at the bottom of the corn stalk. This triangle is typically comprised of four stalk nodes, one on top of the other, whose associated internodes do not elongate. The first internode to elongate is the one above the fourth node, which elongates about 1/4 to 1/2 inch, above which is found the fifth node (usually still below or just at the soil surface). Consequently, five sets or whorls of nodal roots will usually be detectable below ground (one set for each of the below ground stalk nodes).

Corn seedlings transition from dependence on kernel reserves to dependence on nutritional support by the nodal roots around the V3 leaf stage. Damage or stress to the first few sets of developing nodal roots during the time period V1 to V5 can severely stunt or delay a corn plant's development. Damage to the first few sets of nodal roots forces the young seedling to continue its dependence on kernel reserves longer than is optimum. If the kernel reserves are nearly exhausted, continued seedling development is easily stunted and seedling death is not uncommon. Typical stresses that can stunt initial nodal development include fertilizer salt injury, seedling diseases, herbicide injury, insect feeding damage, excessively wet or dry soils, soil compaction (tillage or planter).



Internode elongation between fourth and fifth nodes of a corn plant.



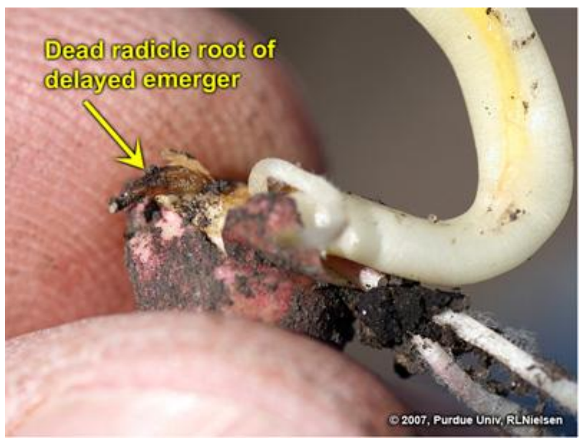
Five identifiable sets of "whorls" of nodal roots in a split stalk section

A somewhat uncommon, but dramatic, stunted root symptom is what is referred to as the "floppy corn" or "rootless corn" phenomenon. This problem occurs as a result of the detrimental effects of excessively dry surface soil near the time of initial nodal root elongation in young (V2 to V4) corn plants. Young nodal roots that emerge from the crown area of the plant will die if their root tips (and associated meristematic areas) desiccate prior to successful root establishment in moist soil. The crown of a young corn plant is typically located only 3/4 inch or so below the soil surface and so is particularly vulnerable to dry upper soil conditions.

Following is an example of a delayed emerger in a field where the "normal" emergers were already at late V1 to early V2. The radicle root was completely destroyed, though the lateral seminal roots were intact and healthy. The coleoptile on this seedling was split down the entire length of its side and would likely result in leafing out underground. The split coleoptile was likely due to the natural continued expansion of the enclosed leaves that would have otherwise emerged normally above ground.

Delayed emerger with healthy lateral seminal roots but damaged radicle root

Split coleoptile; precursor to leafing out underground



Dead radicle root on a delayed emerger seedling

Following is another example of a delayed emerger in the same field where other seedlings were late V1 to early V2. The only visible damage to this delayed emerger was its radicle root whose apical meristem had been injured. The damage was less severe than the previous example and so the seedling was less severely stunted and managed to emerge above ground.

Delayed emerger with healthy lateral seminal roots and damaged, but alive radicle root

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Seed Mixtures vs. Structured Refuges for Bt Hybrids: What's the Outlook?

Mike Gray, Professor & Interim Assistant Dean, Agriculture & Natural Resources
University of Illinois Extension

With so much of this year's corn already planted and soybean planting under way, most farmers are probably not thinking about how refuge requirements for Bt hybrids may change in the future. There is considerable discussion and debate about this topic in industry, regulatory, and academic circles, though. During the Corn and Soybean Classics this winter, I said I believe seed mixtures will likely form the future foundation of resistance management plans. For now, structured refuges are required, but many growers are hoping this regulation will change in time. The U.S. Environmental Protection Agency will continue to assess the advantages and disadvantages of seed mixtures for resistance management.

A journal article was recently published by Purdue University entomologists that described some of the benefits as well as drawbacks associated with using seed mixtures as a refuge for western corn rootworms (*Journal of Economic Entomology*, February 2010; Vol. 103, No. 1, pp. 147-157; authors A.F. Murphy, M.D. Ginzel, and C.H. Krupke).

These entomologists conducted field studies near the Purdue University campus in 2007 and 2008. Their experiments included seven treatments: block refuges of 10% and 20%, strip refuges of 10% and 20%, seed mixture refuges of 10% and 20%, and a 100% refuge. They used beetle emergence cages in the plots, took root injury ratings, and made yield assessments. The corn rootworm Bt hybrids used in the experiment expressed the Cry3Bb1 protein (MON88017 event). In addition, the Bt hybrids expressed the Cry1Ab protein (MON 810 event), and in the refuge, only this lepidopteran-specific protein. The following are quotes from the results section of the researchers' journal article.

- "In 2007 and 2008, the number of males and females emerging from refuge plants peaked consistently later in the seed mix plots than in block or strip refuge structures."
- "A greater proportion of males and females emerged from Bt-RW plants in seed mix treatments compared with the block or strip refuge structures for 10 or 20% refuge treatments in 2007 and 2008 for the first few weeks of each season. However, the proportion of males and/or females emerging from refuge plants in the seed mix plots was significantly less than the proportion emerging from block refuges for 10 or 20% refuge treatments in 2007 and 2008."
- "In 20% treatments, the mean root damage on refuge plants in a seed mix was significantly lower compared with a block or strip structure, while the 10% refuge plants demonstrated a similar trend."
- "Conversely, Bt-RW plants in a 10% seed mix had significantly greater root damage per plot compared with a strip refuge structure. The 20% refuge structures demonstrated a similar trend."
- "There were no significant differences in yield between treatments in 2007 and 2008 combined (ANOVA), although the variation within treatments was high."

The authors concluded by discussing the advantages and disadvantages of a seed mixture approach for corn rootworms. The advantages include "convenience to growers (ease of planting, compliance) and increased adult proximity of adults upon emergence." These factors are important, particularly with respect to greater synchrony of adult emergence from seed mixture refuges and Bt rootworm hybrids. The authors indicated that "mixing the seed may facilitate random mating because of increased proximity of adult beetles in both space and time, theoretically enhancing resistance management."

The disadvantages of a seed mixture approach were described as follows: "namely the potential for larval movement between refuge and Bt-RW plants that can reduce the number of susceptible beetles while increasing the number of potential heterozygotes, and exposure of later-instar larvae to sublethal doses of Bt toxin."

I commend these researchers for shedding additional light on this topic of increasing importance. Producers and everyone in the agribusiness and academic sectors working in this area look forward to the US EPA's eventual ruling on the use of seed mixtures for resistance management.

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North Central Ohio Agronomy Report

Soybean Seeding Rates to Achieve Target Stands at Harvest

Shaun Casteel, Agronomy
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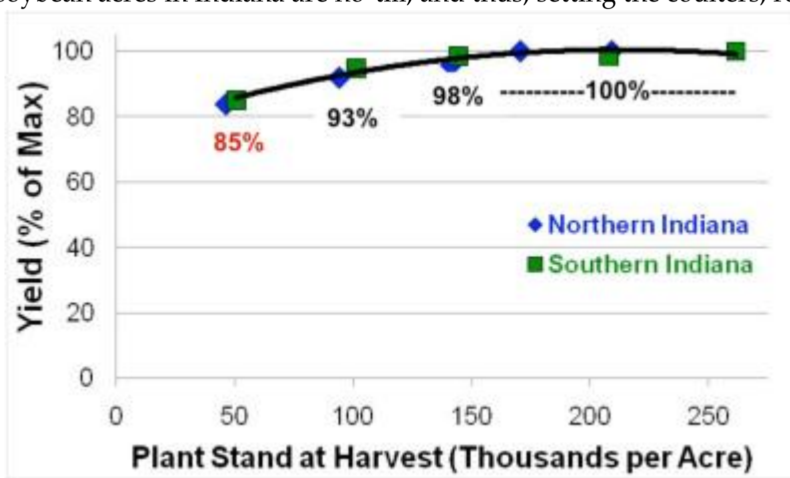
Midwestern soybean population studies have demonstrated that yield is maximized with uniform, harvest stands near 100 thousand plants per acre regardless of row width. Traditional recommendations were to seed around 130, 160, and 200 thousand seeds per acre for 30-in, 15-in, and 7.5-in soybean rows, respectively. However, I like to start at 130 to 150 thousand seeds per acre regardless of row widths then increase or decrease based (1) seed quality, (2) planting equipment and (3) field conditions.

1. Seed Quality

Seed purity is usually a given in commercially purchased seed, so the focus on quality will be centered on viability. A measure of viability is the standard warm germination test, which is the percent of the seed that germinates and develops into normal seedlings under "ideal conditions" (plenty of moisture and seven days at 77°F). If a seed lot was rated at 90% germination, the maximum plant population potential would be 117 to 135 thousand plants per acre when seeded at 130 to 150 thousand seeds per acre. Cool germination and accelerated aging tests can be performed as a better indicator of the seed response to planting in cooler soils.

2. Planting Equipment

Ideal conditions begin with good seed-to-soil contact, which is a factor of the planting equipment and the field. Planting equipment varies in performance in seed placement vertically (seed depth) and horizontally (seed spacing down the row). Seed depth can be a story of too shallow (sometimes even on the soil surface), too deep, and just right depending on the equipment. In many cases, these three depths all occur with one piece of equipment across one field and thus, seeding rates should be increased ~10 to 20% from our base. A more uniform seed placement is better than clumps of seed here and there, especially as seeding rates are lowered. Nearly 70% of soybean acres in Indiana are no-till, and thus, setting the coulters, row cleaners, and any other equipment is critical to prevent "hairpinning" (placing soybeans in a slot that is lined with crop residue rather than soil) and to avoid increasing seed rates. Planters tend to have good seed placement; whereas, drills tend to be variable and will require an increase in seeding rates.



3. Field Conditions

Previous crop residue and weed density play a role in seed-to-soil contact as previously mentioned. Soil temperatures are often a few degrees cooler in our fields of no-till than conventional tillage especially early in the planting season. Seeding rates are often higher in our early plantings due to the cool and wet soils, since soybean germination is slow and disease infection can be higher. Fungicide seed treatments are normally a good fit for planting in cool, wet soils (see a recent article from Carl Bradley for more information on fungicide seed treatments, http://ipm.illinois.edu/bulletin/article.php?id=1274).

Soils and fields of Indiana vary from sands to organic mucks, from prairie flats to clay knolls, from river bottoms to rolling hills, and some combinations even occur in the same field. Seeding rates to establish the same target plant stand could potentially be different based on these inherent factors. However, we currently do not have enough data to provide such recommendations. We are conducting on-farm seeding rate trials to fine tune recommendations across various planting conditions, regions, and soils. If you are interested in participating in the research, please visit the following Web site for more details http://www.agry.purdue.edu/ext/ofr/ .

Plant populations of approximately 100 to 120 thousand plants per acre at harvest provide a savings in seed costs without sacrificing yield (Figure 1).

Seeding rates to achieve this harvest stand vary depending on seed quality, planting equipment, and field conditions as well as other emergence factors. In a few cases, increasing the plant populations above 120 thousand plants per acre may slightly increase profitability provided the market price is high enough to absorb the increased seeding rate costs (see a recent article by Vince Davis for some economic seeding rate scenarios, http://ipm.illinois.edu/bulletin/article.php?id=1296 .

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Identifying Soybean Stages of Vegetative Development

Article from: Soybean Growth and Development
Iowa State University

Subdivisions of the V stage are designated numerically as V1, V2, V3, through V(n) except the first two stages, which are designated as VE (emergence stage) and VC (cotyledon stage). The last V stage is designated V(n), where (n) represents the number for the last fully developed trifoliolate leaf. The (n) will fluctuate with variety and environmental conditions.

The V stages (node stages) following VC are defined and numbered according to the uppermost fully developed trifoliolate leaf node. A fully developed leaf node is one that has unrolled or unfolded leaflets. In other words, the leaf edges are no longer touching as they are in Figure 3. The V3 stage, for example, is defined when the leaflets on the first (unifoliolate) through the fourth node leaf are unrolled. In other words, three trifoliolates are fully developed. Similarly, the VC stage occurs when the unifoliolate leaves have unrolled.

The unifoliolate leaf node is the first node. This node is unique in that the unifoliolate (simple) leaves are produced from it on opposite sides of the stem and are borne on short petioles. All other true leaves are trifoliolate (compound) leaves borne on long petioles, and are produced singularly (from different nodes) and alternate from side to side on the stem.

The cotyledons, which are considered modified leaf storage organs, also arise opposite on the stem just below the unifoliolate node. When the unifoliolate leaves are lost through injury or natural aging, the position of the unifoliolate node can still be determined by locating the two leaf scars on the lower stem that permanently mark where the unifoliolate leaves had grown. These unifoliolate leaf scars are located just above the two opposite scars, which mark the cotyledonary node position. Any leaf scars above the opposite unifoliolate scars appear singularly and alternately on the stem, and mark node positions where trifoliolate leaves have grown.

Vegetative stages

- **VE** Emergence
- **VC** Unrolled unifoliolate leaves
- **V1** First-trifoliolate**
- **V2** Second-trifoliolate
- **V3** Third-trifoliolate
- **V(n)** nth-trifoliolate

Vegetative stages of a soybean plant*

Figure 3. Soybean leaf with folded leaflets.

*This system accurately identifies the stage of a soybean plant. However, all plants in a given field will not be in the same stage at the same time. When staging a soybean field, each specific V stage is defined only when 50 percent or more of the plants in the field are in or beyond that stage.
**A fully developed trifoliolate is one that has unrolled or unfolded leaflets.

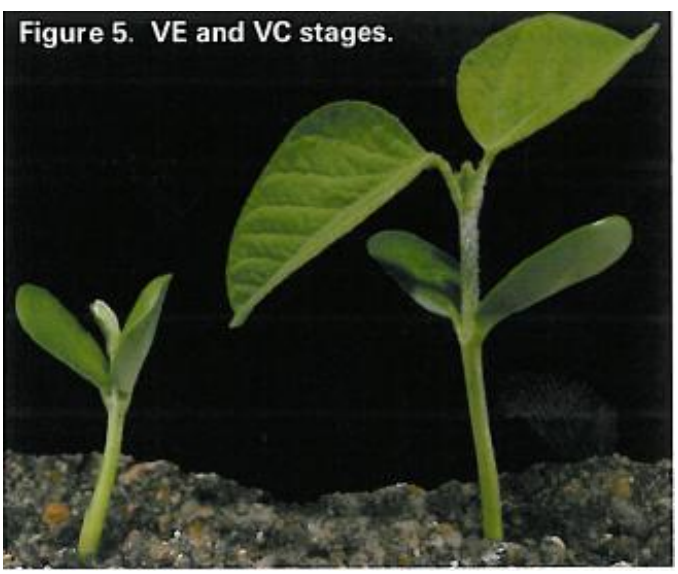
North Central Ohio Agronomy Report

Vegetative Stages and Development: VE through V1 Stages

Article from: Soybean Growth and Development
Iowa State University

The planted soybean seed begins germination by absorbing water in amounts equal to about 50 percent of its weight. Although minimum temperatures for soybean germination have been reported as low as 36ºF to 39ºF, field emergence is usually more rapid and more uniform if soil temperatures are above 65ºF. The radical, or primary root, first grows from the swollen seed (fig. 4), where it elongates downward and anchors itself in the soil. Shortly after the primary root starts to grow, the hypocotyl, the small section of the stem between the cotyledonary node and the primary root, begins elongation toward the soil surface, pulling the cotyledons with it. The anchored primary root and elongating hypocotyl provide leverage for pulling the cotyledons to the soil surface for VE or emergence. VE typically occurs one to two weeks after planting, depending on soil moisture, soil temperature, and planting depth.

Shortly, after VE the hookshaped hypocotyl straightens out and discontinues growth as the cotyledons unfold. The unfolding of the cotyledons exposes the epicotyl (young leaves, stem, and growing point located just above the cotyledonary node). The stem, which develops from the epicotyl, is the primary supporting and nutrient translocating structure of the plant. Subsequent expansion and unfolding of the unifoliolate leaves mark the initiation of the VC stage, which is followed by the numbered V stages.



Nutrients and food reserves in the cotyledons supply the needs of the young plant during emergence and for about seven to 10 days after VE, or until about the V1 stage. During this time, the cotyledons lose 70 percent of their dry weight. Cotyledons are the first photosynthetic organs of the soybean seedling and are major contributors for seedling growth. Unlike corn, where the growing point is protected beneath the soil for several weeks, the growing point of soybeans is between the cotyledons and moves above the soil surface at emergence. This makes the plant particularly susceptible to damage from hail, frost, insects, or anything that cuts the plant off below the cotyledons early in its life. Loss of one cotyledon has little effect on the growth rate of the young plant, but loss of both cotyledons at VE, or soon after, will significantly stunt the seedling and reduce yields.

After V1, photosynthesis by the developing leaves is adequate for the plant to sustain itself. New V stages appear about every five days from VC through V5, and every three days from V5 to shortly after R5, when the maximum number of nodes is developed. It will take the plant approximately four to five weeks to form all nodes.

A newly planted soybean cannot derive the energy it needs for growth from photosynthesis. It is completely dependent on its reserve of energy to germinate and push through the soil. The more energy the seed contains, the longer the seedling can grow until it becomes photosynthetically self-sufficient. In general, large seeds usually can be planted at a greater depth than a smaller seed with a smaller energy reserve.

Soil crusting can delay or prevent seedling emergence. The seedling may be completely depleted of carbohydrate reserves before emergence and the hypocotyl may be easily broken when pushing against a solid crust. Soil crusting also can reduce oxygen flow to the roots and create a barrier to water infiltration. Soil crusting is most noticeable in fields with high silt content, low organic matter, and little surface residue, especially where excessive tillage has occurred.

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Canada Thistle Management

Bill Curran, Weed Scientist
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I am probably asked about Canada thistle control more than any other weed. Many of these questions come from homeowners, but farmers also continue to battle this troublesome species. As a refresher, Canada thistle is a creeping perennial that reproduces from vegetative buds in its root system and from seed. It is difficult to control because of this extensive underground root system that stores the energy that the plant produces via photosynthesis. An integrated approach is the best method for management and being persistent in your control efforts is important. The biggest control mistake that I hear about is individuals thinking they can kill Canada thistle in spring time. Canada thistle emerges from its root system in mid to late spring (late April through May) forming rosettes. However, Canada thistle emergence can occur anytime during the growing season when soil moisture is adequate. Spring tillage or spraying Canada thistle with burndown herbicides can destroy above ground growth, but generally will not do much to the underground vegetative structures. Tillage will also cut up root segments and actually stimulate new shoots to emerge. Root pieces as small as 1/8 inch in diameter have enough energy to develop new plants. A key principle for successful control is to stress the plant and force it to use stored root reserves. This can be accomplished with herbicides, tillage, or mowing. Frequent tillage (e.g. every 30 days) or herbicide use (multiple times/season) would be necessary to significantly impact established Canada thistle. Better yet, growing hay crops that are harvested 3 to 4 times per year anyway can greatly reduce a Canada thistle infestation. With legume forages, it is important to suppress the weed prior to seeding a new crop since effective herbicides are not available and the crop is only competitive after it is established and the frequent mowing occurs. Allowing Canada thistle shoots to grow and thrive can quickly build up underground root reserves making the problem worse.

Canada thistle begins to flower in early summer (late June/early July) depending on your location. Interestingly, male and female flowers are found on different plants (dioecious habit). Applying a systemic herbicide at the bud to bloom stage can be effective, but its usefulness depends on previous efforts to reduce underground root reserves. The most effective time to spray Canada thistle with a systemic herbicide is in the fall when translocation to underground plant parts will be greatest. Herbicides including glyphosate and the plant growth regulators (2,4–D, dicamba, clopyralid, etc.) are generally the most effective, but even with a well timed application, retreatment will be necessary every 1 to 3 years. A program that combines early season suppression to reduce vegetative growth and prevent seed production (mowing, tillage, or herbicide) followed by a well-timed systemic herbicide application in September will have the greatest impact on longer-term control.

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Wild Garlic

Glenn Nice and Bill Johnson, Weed Scientists
Purdue University Extension Service

Last week I had the pleasure of being in the Southeast part of Indiana counting weeds. It is occasionally part of the job being in weed science and although it probably would not make it on the show "Dirty Jobs" it can be pretty hard on the knees. While face down I noticed that the weed we were counting the most was wild garlic (*Allium vineale* L.).

Originally introduced from Europe, wild garlic is a perennial that can be found though out the state of Indiana. It has linear leaves that are hollow and look like chives growing in the field or yard. It can be differentiated from wild onion by the fact that wild onion's leaves are not hollow[1] and wild onion often appears to be smaller in stature. If you have a chance to dig wild garlic up you will see that its leaves come from an underground bulb. No surprise there, for wild garlic is related to onion (*A. cepa* L.) we buy in the grocery store. If you break wild garlic's leaves and take a sniff, you will smell a distinct onion or garlic smell. It spreads by aerial bulbs or bulbs in the soil, seeds are reported to not be a common way of spread[1].

Wild garlic has occasionally been used as an edible and medicinal plant. Although toxicity is not commonly reported in wild garlic[2, 3, 5, 6], large doses in a short period of time may cause problems due to sulfoxides found in the plant[4], not to mention bad breath. In the article "Wild Garlic, *Allium vineale* L. – Little to Crow About," the author cited a case reported by the Indiana Academy of Science of cattle poisoning in 1917[4]. I could not find a copy of the original report for any details.

Wild garlic is most troublesome in wheat where the aerial bulbs are similar in size as wheat grain. These bulbs can get processed with the grain and taint the flavor of flower. It also can be a weed in pastures, where it can also alter the flavor of milk. Wild garlic is often present when planting soybean and corn. We have also received calls regarding wild garlic control in lawns.

Wild garlic in a no-till field in the spring. (*Photo Credit: Glenn Nice, Purdue University*)

Control: Typically in Indiana, wild garlic will have to be controlled in the fall or early spring. The bullets develop in May or June so control of plants should be done before bulb production.

Wheat. Harmony Extra SG (0.75-0.9 oz) + surfactant can be applied when wild garlic is 12″ or shorter but after 2″ to 4″ of new growth has occurred. Harmony Extra SG can be applied to wheat after the 2-leaf stage but before the wheat's flag leaf is visible. Peak also has good activity on wild garlic (0.25 to 0.5 oz) and is labeled for up to 8″ wild garlic control.

Soybean. Applications of Canopy EX (1.1 oz or more) + 2,4-D (0.5 lb ai)+ COC (1% v/v) in the fall provided above 90% control of wild garlic in the spring[7]. Synchrony XP + 2,4-D can be used in the spring 7 days before planting and Harmony Extra SG (0.45-0.9 oz) or Harmony GT at 0.08 oz/A can be used up to planting soybean before emergence. Apply Harmony Extra when wild garlic is less than 12″ tall, but when at least 2″ new growth has occurred. Classic or Synchrony XP can be used postemergence in soybean, however control is best achieved early season or in the fall. Glyphosate + 2,4-D can provide suppression to control of wild garlic in the spring burndown. Work done in southern Illinois reported 100% control with applications of glyphosate at 0.75 lb ae/a in fall and spring[8]. However, the use of glyphosate may be inconsistent and time dependent. In a study in South East Indiana, glyphosate + 2,4-D (0.75 lb ae/A + 0.5 lb ae/A) applied early (April 8) in the spring was reported to provide 88% control of wild garlic[9]. Applications 15 days later at the same rates provided only 45% control 22 days after application.

Corn. Harmony Extra SG at 0.45 to 0.9 oz/A or Harmony GT at 0.08 oz/A can be applied as a burndown treatment up to planting corn but before emergence. Apply Harmony Extra SG to wild garlic that is less than 12" but has at least 2 to 4 inches of growth in the early spring. Glyphosate (0.75 lb ae) + simazine (l lb ai) in the fall followed by glyphosate in the spring provided 100% control in a study conducted in Southern Illinois[8]. However, most of the activity most likely came from glyphosate in the treatment. See above for more information regarding glyphosate's activity.

Pasture. Products containing the herbicide active ingredient metsulfuron-methyl have excellent activity on wild garlic. Such products include Cimarron Max (0.25 oz Part A + 1 pt Part B), Cimarron Plus (0.125 to 0.25 oz), or Valuron (0.1 to 0.2 oz). Glyphosate products that are labeled for dormant applications or in renovation can provide good control of wild garlic.

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"Refuge-in-the-Bag" Registration Approved by US EPA for Optimum AcreMax 1

Mike Gray, Professor Crop Sciences
University of Illinois Extension

On May 3, DuPont announced that the US Environmental Protection Agency (EPA) had approved the company's request for a seed mixture refuge for corn rootworms when planting Optimum Acre-Max 1 Pioneer corn hybrids (seed blend of 90% Herculex Xtra [Cry 1F + Cry34/35Ab1] and 10% Herculex I [Cry 1F]). The press release indicated that this new approach will be used in some producers' fields this year in preparation for the 2011 growing season. Farmers who elect to use Optimum Acre-Max 1 Pioneer corn hybrids will be able to reduce their corn rootworm refuge from the current structured 20% to a 10% seed mixture. According to the May 3 media alert, "In addition to the Optimum® AcreMax™ 1 product registration announced April 30, the EPA also has granted Pioneer registration for Optimum® AcreMax™ RW products, which integrate 90 percent Herculex® RW seed and 10 percent of a hybrid from the same genetic family without biotech insect protection. All seed in the bag is herbicide tolerant." Herculex RW corn hybrids express the Cry 34/35Ab1 binary proteins.

On April 30, the US EPA Office of Pesticide Programs, Biopesticides and Pollution Prevention Division, released a 33-page Biopesticides Registration Action Document titled *Optimum®AcreMax™ Bt. Corn Seed Blends*. A number of quotes from the document, which may shed some additional light on this significant development, follow.

- "Given the potential benefits attendant to the blended refuge concept, EPA concludes that it is in the best interests of the public and the environment to issue the registrations for OAM 1 and OAM RW without delay for the 2010 growing season. The registration is only effective for the current growing season. Therefore, consistent with the Agency's policy for making certain registration actions more transparent, EPA is issuing these time-limited registrations with an initial period to expire September 30, 2010, and, concurrent with their issuance, providing a 30-day public comment period on the time-limited registrations" (p. 13).
- "The data from these model simulations indicate comparative durability values of 11.3 years for the 10% blended refuge and 20.2 years for the 20% block refuge. Thus, the 10% blend was 45% less durable than the 20% block refuge currently required for single trait CRW PIPs" (p. 7).
- "Based on our current assessment, we conclude that significant acreage of a 10% seed blend with a single, non-high dose mode of action such as Cry34/35Ab1 likely increases the risk of resistance for all Bt. corn products containing Cry34/35Ab1. But, the current time-limited registration will not likely increase the risk of resistance to Cry34/35Ab1" (p. 12).
- "Pioneer projects that the time-limited registrations being granted for the 2010 growing season will result in planting on only approximately 0.042% of acres of non-Red Zone geography corn acres; and only on approximately 0.077% of

Red Zone geography corn acres. In the context of 90 million acres of corn planted in the United States annually, we conclude that plantings on such limited acreage will not have effects on CRW resistance development" (p. 12).

- "The Red Zone is defined by Pioneer as 90 counties that have a 100% chance of corn rootworm infestation in any given year. These counties are primarily located in northeastern Illinois, northwestern Indiana and, to a lesser extent, southeastern Wisconsin and southwestern Michigan. Because of the strong selection pressure present in the Red Zone, it is considered a potential area for corn rootworm resistance to develop" (p. 4).
- 90 days from the date of registration: "Pioneer must provide the Agency with a copy of the grower agreement, associated stewardship documents, and written description of a system, which assures that growers will sign grower agreements and persons purchasing OAM1 corn will annually affirm that they are contractually bound to comply with requirements of the insect resistance management (IRM) program" (p. 15).
- By December 1, 2010, for western corn rootworms and December 1, 2011, for northern corn rootworms: "Pioneer must implement an enhanced resistance monitoring plan for OAM1" (p. 15).
- By December 1, 2010: "Pioneer must submit a detailed OAM1-specific resistance monitoring and remedial action plan, including an analysis to determine the expected field performance criteria for OAM1 products so that unexpected damage can be benchmarked" (p. 15).
- "Because the refuge for corn rootworm is blended in each bag or box of OAM1 seed, no additional corn rootworm refuge is required. A refuge must be planted for corn borers. The refuge must be planted with corn hybrids that do not contain Bt technologies for the control of corn borers" (p. 16).
- "External refuges must be planted within _ mile. If perimeter or in-field strips are implemented, the strips must be at least 4 consecutive rows wide. The refuge can be protected from lepidopteran damage by use of non-Bt insecticides if the population of one or more of the target lepidopteran pests of OAM1 in the refuge exceeds economic thresholds" (p. 16).
- "We expect OAM1 to have the following benefits: (1) Reduced pesticide use in the refuge. . . . (2) Significantly less complicated refuge deployment for the corn rootworm active ingredient. . . . (3) Increased grower compliance with IRM requirements for the corn rootworm active ingredient" (p. 9).
- "In addition, *indirect benefits* of introducing Optimum® AcreMax™ 1 may include reduced energy consumption for manufacture, transport, and application of chemical insecticides; reduced waste streams arising from pesticide manufacture; reduced disposal of pesticide waste containers; and reduced residues from pesticide applications" (p. 10).

  This registration opens up a new chapter in the implementation of resistance management strategies designed to delay or prevent resistance development to Bt corn hybrids. This development raises many additional questions:
- Will Pioneer's registrations for OAM1 and OAM RW be extended to include growing seasons beyond 2010?
- Will corn growers be sufficiently interested in this seed-blend approach to IRM if 10% of the seed must serve as a refuge? Our surveys of growers at the 2010 Corn and Soybean Classics indicated that if the refuge seed comprises 6% to 10% of a bag, interest in this approach fell below 60%. (See this article in issue 2 of *the Bulletin* for more details.)
- Will the US EPA extend registrations to other companies that allow seed mixtures to form the core of their IRM plans for Bt hybrids?
- Although producers who plant SmartStax hybrids in 2010 must implement a structured 5% refuge, will this requirement change to a seed- mixture IRM approach at the 5% level in subsequent growing seasons?
- With the likely transition to seed mixtures as the IRM foundation for corn rootworms, how much longer will the agribusiness community sustain the discovery, development, and marketing costs associated with soil insecticides?
- If corn rootworm resistance to Bt does develop at some point, what options will remain for growers to control this insect pest effectively? With crop rotation no longer an effective management option in many areas of the "Red Zone," we could have some significant challenges to confront if the soil insecticide market were to completely "dry up."

As I've indicated in earlier articles in the Bulletin, the early planting this season and favorable root establishment could help corn rootworm populations rebound from the past two seasons. Large root systems at the time of larval hatch (usually late May across central Illinois) could lower intraspecific competition for larval feeding sites and result in greater densities of western corn rootworms this year. I look forward to your reports this summer regarding how well corn rootworm products are performing.

North Central Ohio Agronomy Report

How Much Salt Is in the Fertilizer?

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University of Illinois Extension

This growing season has been unique in the many things farmers have been able to accomplish in such a short time, in part thanks to good weather. Many of last fall's operations were pushed into spring, and most farmers have been able to get them done and plant on time. This is certainly a good change, especially compared to the previous two springs. Although planting is progressing very well and many farmers are probably done planting, the number one question I have been asked this week is about fertilizer salt index.

Most fertilizer materials are readily soluble because they are salts. Once they are dissolved in the soil, they increase the salt concentration of the soil solution, which in turn increases the solution's osmotic potential. The greater the osmotic potential, the more difficult it is for the seeds or plants to extract the soil water they need for growth.

Materials vary in amounts of salt content. **Table 1** shows some salt index values of common fertilizer materials, calculated by comparing the osmotic potential of a given fertilizer to the osmotic potential produced by an equivalent weight of sodium nitrate added to water.

Table 1. Salt index and partial salt index of various fertilizer materials (arranged in increasing order of salt index within each category).

Material and analysis	*Salt index*	*Partial salt index*[a]
Nitrogen		
Anhydrous ammonia, 82% N	47.1	0.572
Urea, 46% N	74.4	1.618
Ammonium sulfate, 21% N, 24% S	88.3	3.252
Ammonium thiosulfate, 12% N, 26% S	90.4	7.533
Ammonium nitrate, 34% N	104	3.059
Phosphorus		
Superphosphate, 20% P_20_5	7.8	0.39
Triple superphosphate, 45% P_20_5	10.1	0.224
MAP, 10% N, 50% P_20_5	24.3	0.405
MAP, 11% N, 52% P_20_5	26.7	0.405
DAP, 18% N, 46% P_20_5	29.2	0.456
Phosphoric acid, 54% P_20_5		1.613[b]
Phosphoric acid, 72% P_20_5		1.754[b]
Potassium		
Monopotassium phosphate, 52.2% P_20_5, 34.6% K_20	8.4	0.097
Potassium sulfate, 50% K_20, 18% S	42.6	0.852
Potassium thiosulfate, 25% K_20, 17% S	68	2.72
Potassium nitrate, 13% N, 44% K_20	69.5	1.219
Potassium chloride, 60% K_20	116.2	1.936
Common liquid solutions		
2-20-20[c]	7.2	0.17
3-18-18[c]	8.5	0.22
6-24-6[c]	11.5	0.32
6-30-10[c]	13.8	0.3
9-18-9[c]	16.7	0.48
Ammonium polyphosphate, 10% N, 34% P_20_5[d]	20	0.455
4-10-10[e]	27.5	1.18
7-21-7[e]	27.8	0.79
28% N (39% ammonium nitrate, 31% urea)[e]	63	2.25
32% N (44% ammonium nitrate, 35% urea)[e]	71.1	2.221

[a]The salt index of a fertilizer containing more than one nutrient is the sum of the salt index of each component per unit (20 lb) of plant nutrient multiplied by the number of units in that formulation.

[b]Per 100 lbs of H_3PO_4.

[c]Formulated using potassium phosphate as the K source.

[d]Use with caution for seed-row placement.

[e]Not recommended for seed-row placement.

Why sodium nitrate? Simply because it is 100% soluble and it was a commonly used nitrogen (N) source when the salt index concept was proposed back in the early 1940s. The salt index of sodium nitrate is defined as 100. When you have a mixture of nutrients in a fertilizer, the sum of the salt index values ("partial salt index" in the table) represents the total salt index of that fertilizer. Something important to keep in mind is that a salt index does not predict the amount of fertilizer (rate of application) or type of formulation that could result in injury. This is because the potential for salt injury depends on additional factors, which may include the type of crop (soybeans are more susceptible than corn), the type of soil (coarse-textured soils are more prone to salt injury), the soil's moisture content (more moisture means less chance for injury), and proximity to the seed or seedling (discussed more below). The salt index does, however, classify materials relative to each other and shows which are most likely to be a problem.

Salt injury from fertilizers is typically not a problem if fertilizer and plant are separated by time, distance, or both. One example would be placement of starter fertilizer 2 inches below and 2 inches to the side of the seed row (2 x 2 placement). With this type of placement the risk of seedling injury is virtually nonexistent. However, when the fertilizer is applied in or near the seed row, salt can cause seed and seedling injury. This type of application has different names, but most common are "pop-up," "in-furrow," and "seed row."

These applications are typically made to increase the possibility that roots will intercept nutrients early in development. Studies have shown that whenever there is a response to starter, the effect is the same whether the fertilizer is placed with the seed or in some other way, such as 2 x 2 placement. Often the largest response to starter is observed for N followed by phosphorus (P), and then potassium (K).

Potassium in starter normally produces advantages when soils are very low in K. When applying fertilizer in the seed row it is critical to apply as little salt as possible. The usual recommendation is to apply no more than 10 lb of N plus K_2O per acre. This recommendation is based on K_2O from potassium chloride. If the source of K is potassium phosphate, you can afford to apply a little more because potassium phosphate has a lower salt index. Nonetheless, seed-row applications do not allow as much fertilizer, and they are riskier than 2 x 2 placement or other types of starter applications.

If you are convinced that placement with the seed (seed-row application) is the way to go, I suggest trying to use fertilizer sources and rates that minimize the chance for injury. In addition to salt injury, some N compounds (such as UAN, urea, and ammonium thiosulfate) produce free ammonia, which can cause poor germination or seedling death. The best fertilizers for seed-row application have a low salt index, N compounds that do not produce free ammonia, and potassium phosphate rather than potassium chloride as the K source.

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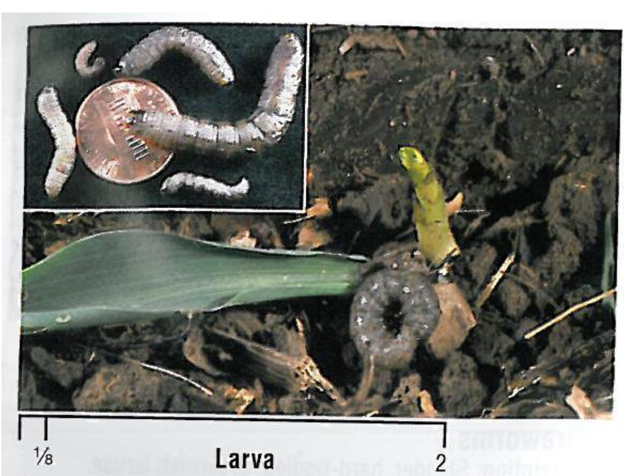
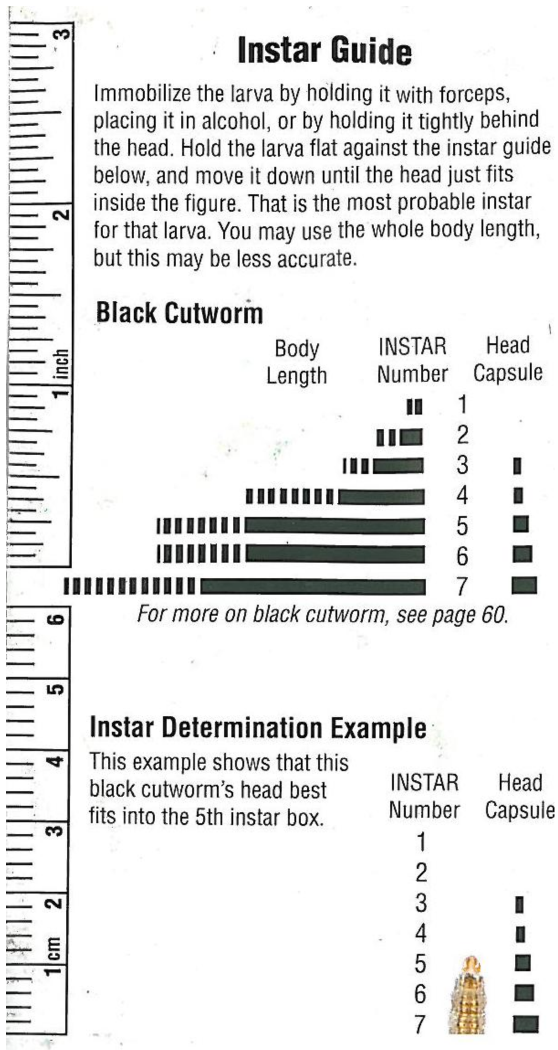
Black Cutworm

Article from: Corn & Soybean Field Guide
Purdue University Extension Service



Description: Greasy appearance; color varies from light gray to nearly black with coarse, granular skin texture, viewable with 10x magnification. When disturbed, the larvae curl up. The adult, which migrates to the Midwest from southern states in the spring, has dark forewings that are pale near the tips. A distinct "black dagger" is present on each forewing.
Time of Attack: April to June (stages VE-V8).
Damage: Leaf feeding, irregular holes, notched and cut plants (wilting), and dead plants.
Sampling: Inspect and record the damage on 20 consecutive plants in 5 areas of the field. Collect 10 larvae and determine the instar by using Instar Guide.
Economic Threshold: Control May be needed if 3-5% of the plants show damage, and 2 or more larvae (4^{th}-6^{th} stage instars) are found per 100 plants.
Suggested Insecticides (post-emerge): Ambush®, Asana®, Baythroid®, Capture®, Cobalt®, Delta Gold®, Hero®, Lorsban®, Mustang Max®, Penncap-M®, Pounce®, Proaxis®, Warrior®. Read manufacturer's label.
Reference Publication: IPM-1



Helpful Links:

http://crawford.osu.edu
http://agcrops.osu.edu
http://precisionag.osu.edu
http://www.ipm.iastate.edu
http://fcn.agronomy.psu.edu
http://www.ipm.uiuc.edu
http://www.oardc.ohio-state.edu/ohiofieldcropdisease
http://www.entm.purdue.edu/Entomology/ext/targets/newslett.htm