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Pest&Crop newsletter

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In This Issue

Alfalfa Weevil Damage Reported In Southern Indiana

(John Obermeyer)

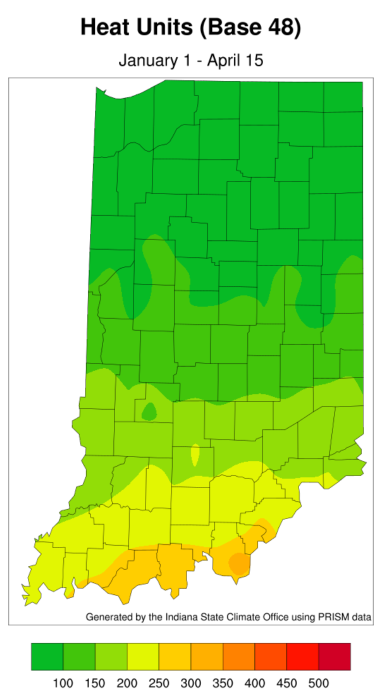
Pest managers, in southern Indiana, should now be scouting their alfalfa for leaf feeding from weevil larva. Higher risk fields are those that have been in alfalfa for over three years. Most vulnerable areas of the field are southern facing slopes that heat up first in the season. This pest is often overlooked during the early spring planting season.

Alfalfa weevil damage to upper foliage of stems.

Producers can manage this pest most effectively by utilizing heat unit accumulations data (base 48°F) to determine when sampling should begin and when an action should be taken. The management guidelines listed below should be used to determine when alfalfa weevil should be controlled in southern Indiana. Refer to the following map for alfalfa weevil development in your area.

Alfalfa Weevil Management Guidelines Southern Indiana

Heat Units	% Tip Feeding	Advisory
200		Begin sampling. South facing sandy soils should be monitored earlier.
300	25	Re-evaluate in 7-10 days using the appropriate HU or treat immediately with a residual insecticide if 3 or more larvae are noted per stem and % tip feeding is above 50%
400	50	Treat immediately with a residual insecticide.
500	75	Treat immediately.
600	75+	If cutting delayed more than 5 days, treat immediately.
750		If harvested or harvesting shortly, return to the field in 4-5 days after cutting and spray if 1) there is no regrowth and weevil larvae are present OR 2) feeding damage is apparent on 50% of the stubble and weevil larvae are present.



Alfalfa Weevil Management Guidelines, Southern Indiana.

Amanda Mosiman, Warrick County CES ANR Educator, reported significant alfalfa weevil damage to a poorly seeded alfalfa field. Though this field is only two years old, it has been seeded twice, with plenty of sparse areas to allow weeds to flourish…alfalfa weevil too!

Plenty of weeds and weevil damage in this alfalfa field. (*Photo Credit: Amanda Mosiman)*

Foliage damage from alfalfa weevil. (*Photo Credit: Amanda Mosiman*)

Did Insect Pests Freeze With Recent Low Temperatures?

(John Obermeyer)

Last week's articles were concerning the eye-popping numbers of black cutworm and armyworm moths being captured by pheromone trap cooperators and weevil damage being reported in southern Indiana alfalfa fields. Did the low temperatures (≤28°F) of April 15/16 freeze-out these pest insects? The short answer, probably not.

The black cutworm and armyworm's most vulnerable stage for freezing, the neonate (newly hatched) larvae, were likely nestled within the soil or under plants (e.g., chickweed, cereal rye, etc.) in which they were feeding. Temperatures in these micro-environments are much warmer, especially with the radiant heat from the ground. Besides, it would take more than just a few hours of freezing temperatures to cause mortality. For alfalfa weevil, they early instar larvae are able to withstand temperatures as low as -2°F, much lower than those reached in any of the past couple nights. Though the top of the alfalfa may look terrible, the weevil larvae will move to areas within the plant to commence feeding. Happy Scouting!

Alfalfa may look ugly from the freeze, the weevils are just fine.

2020 Black Cutworm Pheromone Trap Report

(John Obermeyer)

		BCW Trapped						
County	**Cooperator**	**Wk 1 4/2/20-4/8/20**	**Wk 2 4/9/20-4/15/20**	**Wk 3 4/16/20-4/22/20**	**Wk 4 4/23/20-4/29/20**	**Wk 5 4/30/20-5/6/20**	**Wk 6 5/7/20-5/13/20**	**Wk 7 5/14/20-5/20/20**
Adams	Roe/Mercer Landmark	12	17*					
Allen	Anderson/NICK	1						
Allen	Gynn/Southwind Farms	2	3					
Allen	Kneubuhler/G&K Concepts	6	2					
Bartholomew	Bush/Pioneer Hybrids	6	28*					
Clay	Mace/Ceres Solutions/Brazil	2	2					
Clay	Fitz/Ceres Solutions/Clay City	0	4					
Clinton	Emanuel/Boone Co. CES	26*	18					
Dubois	Eck/Dubois Co. CES	1						
Elkhart	Kauffman/Crop Tech	7	12					
Fayette	Schelle/Falmouth Farm Supply Inc.	46*	23					
Fountain	Mroczkiewicz/Syngenta	0	8					
Fulton	Jenkins/Ceres Solutions/Talma	0	0					
Hamilton	Campbell/Beck's Hybrids	15	10					
Hendricks	Nicholson/Nicholson Consulting	0	8					
Hendricks	Tucker/Bayer		28*					
Howard	Shanks/Clinton Co. CES		2					
Jasper	Overstreet/Jasper Co. CES	0	0					
Jasper	Ritter/Dairyland Seeds	12	11					
Jay	Boyer/Davis PAC	19*	28*					
Jay	Shrack/Ran-Del Agri Services	19*	20					
Jennings	Bauerle/SEPAC	16	29*					
Knox	Clinkenbeard/Ceres Solutions/Freelandville	0	0					
Knox	Butler/Ceres Solutions/Vincennes	0	0					
Lake	Kleine/Rose Acre Farms	60*	35*					
Lake	Moyer/Dekalb Hybrids/Shelby	4	22*					
Lake	Moyer/Dekalb Hybrids/Scheider	5	21*					
LaPorte	Rocke/Agri-Mgmt. Solutions	6	9					
Marshall	Harrell/Harrell Ag Services							
Miami	Early/Pioneer Hybrids	0	7					
Montgomery	Delp/Nicholson Consulting	2	18*					
Newton	Moyer/Dekalb Hybrids/Lake Village	0	4					
Porter	Tragesser/PPAC		1					
Posey	Schmitz/Posey Co. CES	1	5					

		BCW Trapped						
		Wk 1 4/2/20-4/8/20	Wk 2 4/9/20-4/15/20	Wk 3 4/16/20-4/22/20	Wk 4 4/23/20-4/29/20	Wk 5 4/30/20-5/6/20	Wk 6 5/7/20-5/13/20	Wk 7 5/14/20-5/20/20
County	**Cooperator**							
Pulaski	Capouch/M&R Ag Services							
Pulaski	Leman/Ceres Solutions	31*	28					
Putnam	Nicholson/Nicholson Consulting	8	9					
Randolph	Boyer/DPAC	13*	13					
Rush	Schelle/Falmouth Farm Supply Inc.	1	3					
Shelby	Fisher/Shelby County Co-op		0					
Shelby	Simpson/Simpson Farms	0	32*					
Stark	Capouch/M&R Ag Services							
St. Joseph	Carbiener, Breman		9					
St. Joseph	Deutscher/Helena Agri-Enterprises	2	19					
Sullivan	Baxley/Ceres Solutions/Sullivan	0	8					
Sullivan	McCullough/Ceres Solutions/Farmersburg	0	0					
Tippecanoe	Bower/Ceres Solutions	3	6					
Tippecanoe	Nagel/Ceres Solutions	36*	38*					
Tippecanoe	Obermeyer/Purdue Entomology	0	0					
Tippecanoe	Westerfeld/Bayer Research Farm	0	2					
Tipton	Campbell/Beck's Hybrids	0	6					
Vermillion	Lynch/Ceres Solutions/Clinton	0	0					
White	Foley/ConAgra	5	1					
Whitley	Richards/NEPAC/Schrader							
Whitley	Richards/NEPAC/Kyler							

* = Intensive Capture…this occurs when 9 or more moths are caught over a 2-night period

Armyworm Pheromone Trap Report – 2020

(John Obermeyer)

County/Cooperator	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10
Dubois/SIPAC Ag Center	724	84								
Jennings/SEPAC Ag Center	60	75								
Knox/SWPAC Ag Center	1162	308								
LaPorte/Pinney Ag Center	115	65								
Lawrence/Feldun Ag Center	974	347								
Randolph/Davis Ag Center	117	207								
Tippecanoe/Meigs	225	wind dmg.								
Whitley/NEPAC Ag Center	–	–								

Wk 1 = 4/2/20-4/8/20; Wk 2 = 4/9/20-4/15/20; Wk 3 = 4/16/20-4/22/20; Wk 4 = 4/23/20-4/29/20; Wk 5 = 4/30/20-5/6/20; Wk 6 = 5/7/20-5/13/20; Wk 7 = 5/14/20-5/20/20; Wk 8 = 5/21/20 – 5/27/20; Wk 9 = 5/28/20-6/3/20; Wk 10 = 6/4/20-6/10/20; Wk 11 = 6/11/20-6/17/20

Scouringrush Control Near Drainage Ditches In Corn And Soybean Fields

(Marcelo Zimmer) & *(Bill Johnson)*

Scouringrushs and horsetails are known by many different common names such as snake grass, jointed grass, monkey grass or simply Equisetum to name a few. They all belong to the genus *Equisetum* and the USDA's plant database indicates that there are 13 species in the Mid-West. The species are separated into different subspecies by stem thickness, frequency of the vegetative form, stem height and various other subtle clues. One thing that is unique about the equisetums is that they do not produce flowers or seed and spread primarily by vegetative means. To learn more about its life cycle please read "The Ancient Horsetail (WS-29-W)." For the purpose of this article, the two species that we typically deal with, field horsetail (*Equisetum arvense*) and scouringrush horsetail (*E. hyemale*), will be referred to as horsetail and scouringrush, respectively.

Although typically not a widespread problem in corn and soybean fields, Equisetum is more of a problem around ponds and drainage ditches; however, both horsetail (an Equisetum that produces a small branched vegetative stems) and scouringrush (a species that only produces the reproductive stems) often find their way into agricultural fields. Both species prefer wet environments for reproduction, but can expand by rhizomes into dryer environments. Throughout most of Indiana, but particularly in Northern Indiana, scouringrush expands from drainage ditches into production fields leading to the need for control. The Weed Science team receives a number of calls every summer concerning the control of these weeds.

The inability to effectively control Equisetum with herbicides or tillage is well known, both in the literature as well as by word of mouth. The lack of surface area as well as the structure of the hollow and siliceous nature of the stems may all contribute to inhibit herbicide entry into the plant. The success of controlling the above ground plant relies on control of the underground portion of the plant. There has been work to find suitable herbicides with activity. Peter Sikkema of Guelph University, Canada, reported more than 80% control of field horsetail with combinations of glyphosate and flumetsulam[2]. Flumetsulam is the active ingredient of commercially available herbicide Python®. Researchers in Michigan reported 77% to 92% control with Curtail M® (MCPA + clopyralid)[3].

We conducted a field trial was conducted in Pulaski county in 2009 and 2010 to evaluate various herbicides in combination with mowing to provide better recommendations for control of scouringrush. This was done so we could provide better recommendations to our eastern cornbelt farmers and custom applicators. Products we evaluated consisted of Python®, Hornet®, Roundup Weathermax®, Sharpen®, Gramoxone Inteon®,atrazine, Milestone®, Habitat®, and Element®. The non-traditional corn or soybean products were included because of the realization that to adequately control scouringrush the infested area may need to be taken out of production while control methods are implemented to reduce infestations. To determine if we could make the scouring rush more susceptible to herbicides by stressing the scouring rush, herbicide treatments were applied on mowed and non-mowed plots (Figure 1). For the mowing treatments, a bush hog cutter type of mower was used to cut the scouring rush to a height of 4-6 inches and plants were allowed to regrow for a few days prior to treatment so herbicides could be applied to succulent regrowth. Treatments were applied in the spring (April) or the fall (November) depending on product to evaluate a longer term management approach. Mowing and fall applications were evaluated because of the lack of success reported frequently with single herbicide application trials without use of additional cultural practices like mowing or tillage.

Figure 1. Applications made over the top of non-mowed scouringrush. Dense colonies of scouringrush are not easy to walk through.

Herbicide Efficacy on Non-Mowed Scouringrush

Some of the treatments induced a color response by turning the scouringrush black (Figure 2). This discoloration was most evident in the treatments that included Gramoxone Inteon®, atrazine, and Ignite 280®. The use of Gramoxone Inteon® alone or with atrazine decreased biomass 24% and 31% at 99 days after treatment, respectively (Figure 3), and that was the highest efficacy noted on non mowed plants. However, it should be noted that atrazine cannot be used within 66 feet of a drainage ditch, so atrazine based treatments would not be legal options near drainage ditches. None of the over-the-top treatments adequately reduced the biomass of scouringrush. Mowing was required to produce acceptable results.

Figure 2. Discoloration of scouringrush after Gramozone Inteon, Gramozone Inteon + atrazine, and Ignite 280 treatments.

Figure 3. Die back from Gramoxone Inteon applications. Stems turned black then died leaving a mat of dead material. New growth can be seen growing up out of the old growth.

Herbicide Efficacy on Mowed Scouringrush

As would be expected, mowing reduced biomass, and would be a relatively low cost and low environmental impact tactic to include in an integrated approach to controlling scouring rush. Stem counts were collect in the mowed plots during mid-summer after spring herbicide applications in 2009 and 2010. The 2009 stem counts were collected on plots that had only a spring application. The counts in 2010 were taken in plots that had two years of spring applications or one fall application. In the 2009 summer counts, before the fall-applied treatments were applied, Milestone® had the lowest amount of regrowth at 4 stems per sq. ft. (Figure 4), compared with 32 stems per sq. ft in the untreated plot (Figure 5). The Python® and Hornet® treatments provided an intermediate level of suppression of regrowth with 20 and 19 stems per sq. ft. on average.

Figure 4. Regrowth suppression from the mowed Milestone spring treatments in 2009.

Figure 5. Maximum regrowth of scouringrush in mowed plot approximately 32 stems per sq. ft.

During the following growing season, stem counts were taken on June 1, at 42 days after spring applications and 200 days after fall applications. At the time of stem counts, there was little to no regrowth in plots that received Habitat® applications in the fall (Figure 6). Mowed plots that received treatments with Milestone, Gramoxone Inteon®, atrazine, and Sharpen® had stem counts between 8 and 19 stems per sq/ft. (Figure 7).

Figure 6. Habitat applied in the fall showing no regrowth in the spring. Picture taken 200 days after fall applications.

Figure 7. Milestone applied in the fall showing a small amount of regrowth. Picture taken 200 days after fall applications.

More work needs to be done on this weed to better understand its reaction to a combination of control strategies. Although there were products such as Habitat® and Milestone® that showed promising results, these products required mowing for the full benefit. Fall applications of Habitat® on mowed plots provided the best control at 200 days after treatment. However, when Habitat® was applied over the top of non-mowed scouringrush it did not reduce biomass at 42 days after application. Milestone® and Habitat® are not labeled for row crops and have substantial rotation restrictions for the planting of some row crops (Figure 7). This may require that the area being treated would have to be taken out of production for the restricted amount of time required by the label. Gramoxone and Sharpen based treatments could also be used if supplement with mowing to reduce populations as well near water sources where atrazine would not be allowed.

Reference

1. D. Cloutier and A.K. Watson. 1985. Growth and regeneration of field horsetail (*Equisetum arvensis*). Weed Science 33:358-365.

2. G. Nice and P. Sikkema. 2007. The Ancient Horsetail. WS-29-W. https://www.extension.purdue.edu/extmedia/WS/WS-29-W.pdf. Accessed April 15, 2020.

3. R.J. Richardson and B.H. Zandstra. 2004. Equisetum Control. http://www.ipm.msu.edu/landreport/2004/equisetumControl.pdf Accessed July 19, 2010.

Cressleaf Groundsel (Packera glabella)

(Marcelo Zimmer) & *(Bill Johnson)*

Every spring we receive several calls and e-mails about a certain 3-foot tall weed with yellow flowers (Figure 1). The most common yellow flowered weeds we have in Indiana are cressleaf groundsel, the buttercup species, and dandelion. Occasionally we have some fields of canola or rapeseed in the state. But, by far the most prevalent specie we see in no-till corn and soybean fields, and occasionally pastures, is cressleaf groundsel. I have only rarely observed wild mustard in Indiana. Wild mustard is more common in the northern tier of states near the Canadian border. This year, due to warmer temperatures in early April, cressleaf groundsel is already starting to flower in fields in southern Indiana. As soon as temperatures warm in northern Indiana, this weed will bolt and flower in our northern areas as well. This article is intended to provide information on the biology and life cycle of cressleaf groundsel, as well as how to control it in fields and pastures.

Figure 1. Cressleaf groundsel plant. (*Photo Credit: Joe Ikley*)

Biology and Identification

Cressleaf groundsel is a winter annual weed that has become more prevalent in Indiana pastures and agronomic crop ground over the past decade (Figure 2). The small seeds produced by this weed allow it to thrive in reduced and no-till systems as well as poorly established pastures. Cool and wet springs of the past few years have also favored cressleaf groundsel, as it is a weed that prefers moist soils and typically struggles in hot and dry weather.

Figure 02. Field infested with cressleaf groundsel at the Southeast Purdue Agricultural Center. (*Photo Credit: Glenn Nice*)

Much like most winter annual weeds, cressleaf groundsel emerges as a rosette in the fall then bolts, flowers, and produces seed in the spring. Basal rosette leaves are deep pinnate serrations with roundly lobed leaf margins. Leaves are typically 2 to 10 inches in length (Britton and Brown 1970). Bolting stems are hollow and can reach up to three feet in height with inflorescences that contain six to twelve yellow ray flowers that are often compared to the flowers of common dandelion (Figure 3). When looking for cressleaf groundsel in older weed id or taxonomic guides be aware that it has traditionally been placed in the *Senecio* genus and only recently was placed into the *Packera* genus.

Figure 03. Cressleaf groundsel flower. (*Photo Credit: Joe Ikley*)

Toxic Properties

The competitiveness of cressleaf groundsel with agronomic crops has not been researched, though its presence as a winter annual in no-till fields will have the same implications of slowing soil warming and drying as other winter annual weeds. The presence of this weed in pastures and hay fields should be of more concern as it does contain toxic properties when ingested by livestock. Leaves, flowers, and seeds of cressleaf groundsel contain alkaloids that will cause liver damage in livestock that is termed seneciosis and typically occurs on a chronic level (Kingsbury 1964). Symptoms of seneciosis are loss of appetite, sluggish depressed behavioral patterns, and in extreme cases aimless walking without regard to fences or structures. Although cressleaf groundsel is not as toxic as many of its relatives in the *Packera* genus, livestock producers encountering this weed in pastures or hay should take steps to avoid prolonged ingestion by animals.

Control

Herbicide applications for control of cressleaf groundsel are most effective when applied to plants in the rosette stage. Plants that are larger, or bolting are very difficult to control with herbicides. Infestations in pastures can be controlled with 2,4-D or a combination of 2,4-D and dicamba applied to rosettes in the fall or early spring prior to bolting (Nice 2008). Producers should be aware that applications of these herbicides will also kill favorable broadleaves (legumes) that are present in pastures.

Control recommendations for cressleaf groundsel in no-till agronomic crop fields has typically been to apply 2,4-D @ 1 qt/A to actively growing rosettes in the fall. Research at University of Illinois (Lake and Hager 2009) has shown that fall or spring applications of glyphosate (Roundup PowerMax II @ 22 to 44 oz/A plus liquid AMS @ 5% v/v) to 2-8 inch diameter rosettes can achieve 94% or greater control of cressleaf groundsel. We have observed that control of cressleaf groundsel with spring burndowns can be challenging if the plants are large and spray applications are made in cool weather. In situations like this, we often observe severe injury and necrosis of leaves, but new growth will appear from live buds on the plant. In some instances, resprays are needed to finish off the cressleaf groundsel.

References:

Britton, N. and A. Brown. 1970. An Illustrated Flora of the Northern United States and Canada. Volume 3. Dover Publications, Inc., New York. Pp 540-544.

Kingsbury K.M. 1964. Poisonous Plants of the United States and Canada. Pentice-Hall, Inc., Englewood Cliffs, N.J. pp 425-435

Lake, J.T. and A.G. Hager. 2009. Herbicide Selection and Application Timing for Control of Cressleaf Groundsel (Packera glabella). Weed Technol. 23:221-224

Nice, G. 2008. Guide to Toxic Plants and Forages. Purdue Extension Publication WS-37

What To Look For With Alfalfa Hurt By An Early Spring Freeze

(Keith Johnson)

Night time and early morning temperatures across Indiana dipped to lows (less than 28°F) on Wednesday and Thursday that may be concerning to alfalfa producers. Damage may be little to none, or possibly severe. Minimal damage may appear as new leaves emerging next week being bleached. Whereas, severe damage will have the plant losing its upright integrity and appearing water soaked (mushy). New seedlings will take on a water soaked appearance if freeze damaged. Variation in response could be extreme across a field due to differences in temperature because of topography. Older stands that were well managed last year will have a greater chance of survival. Please contact me at johnsonk@purdue.edu if damage is severe because of the freeze events.

Alfalfa leaflets that emerge after a freeze will be bleached. (*Photo Credit: Purdue University Plant and Pest Diagnostic Laboratory*)

Alfalfa will lose its upright integrity and appear water soaked (mushy) with severe freeze damage. (*Photo Credit: Purdue University Plant and Pest Diagnostic Laboratory*)

Cold Soils And Risk Of Imbibitional Chilling Injury In Corn

(Bob Nielsen)

While the coffeeshop rumor mills were active this past week with talk of "a lot" of corn planting going in areas of the state, in reality very little planting actually occurred (USDA Weekly Crop Progress, 13 Apr 2020). If you believe the estimates, only about 1% of the Indiana's corn crop had been planted as of 12 April. Nevertheless, based on USDA prospective planting estimates on 31 March, that would equal about 58,000 acres statewide out of the intended 5.8 million acres.

While farmers are free to plant corn whenever they choose to do do, there are risks associated with "early" planting (Nielsen, 2020). The primary risk is that associated with "cold" soil temperatures. Soils that hover around 50°F for days or longer after planting delay germination and slow emergence of the young seedlings. More importantly, soil temperatures lower than about 50°F increase the risk of "imbibitional chilling" injury to germinating seeds.

Herein lies the concern with fields that were planted during the past week, especially in central and northern Indiana. Soil temperatures at the 4-inch depth began a precipitous drop last Thursday (9 April) that accelerated over the weekend through at least today (16 April). An example of this decrease in soil temperatures is shown in Fig. 1 for the Agronomy Farm, near West Lafayette in west-central Indiana, where daily minimum soil temperatures have ranged from the 40s°F down to the 30s°F.

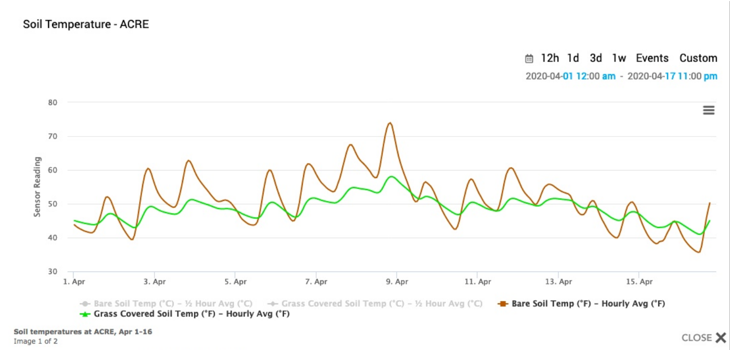


Fig. 1. Bare soil and grass-covered soil temperatures at ACRE, Apr 1-16 2020. Source: Purdue Univ. – Indiana Mesonet (https://campbellcloud.io/map_index.php)

"Imbibition" refers to the initial uptake of water by seed during the first 24 to 48 hours after being planted into moist soil. The resulting rehydration causes the seed to swell and the germination process to begin. Imbibition occurs naturally, with no physiological processes involved (e.g., dry wood will imbibe water). It also occurs whether soils are cold or warm and therein lies the potential for "imbibitional chilling" injury.

When the seed swells as it rehydrates, its internal cell membrane structure is damaged. When seeds (and soil) are warm, the membrane damage is quickly repaired by the physiological activity associated with germination and "life goes on" normally. When seeds (and soil) are cold, their cell membranes are less elastic, the cell membrane damage due to swelling is more severe, and the physiological repair of the damage is slowed or stopped. Left unrepaired, this damage to cell membranes and the subsequent leakage of cell contents can result in death of the seed.

Past research on the nature and causes of imbibitional chilling injury to seed does not clearly identify the environmental conditions "in the real world" that result in a high probability of the problem. The literature implies that soil temperatures simply lower than 50°F are a key factor. It is not clear from past research whether the injury can occur with only a few hours of exposure to sub-50°F soil temperatures or whether it requires lengthier exposure to cold temperatures. What is known is that this type of chilling injury is most likely to occur during the first 24 to 48 hours after planting seed into moist soil because that is when imbibition (and corresponding seed swelling) occurs.

Identifying and Diagnosing the Problem in the Field

Identifying and the diagnosing the problem in the field is often challenging for several reasons. First of all, germination and emergence of corn in cold soils will naturally be slow. The first visual indicator of germination (other than the seed swelling) is the appearance of the radicle root between 35 and 60 Growing Degree Days (GDD) after planting (Nielsen, 2019b).

Tip: *Calculating GDDs using soil temperatures is preferred over air temperatures for predicting corn development progress prior to about the 6-leaf growth stage (V6). The reason is that the seed & young seedling responds more directly to soil temperature as long as the main growing point of the corn plant (apical meristem) remains below ground (until about V5-V6).*

When soil temperatures hover around 50°F for days or longer after planting, accumulating 35 to 60 GDD may take 1 to 2 weeks. Initially, dead seed due to imbibitional chilling injury do not look much different than live seed taking their normal "sweet time" to germinate in cold soils. However, once 60 GDD or more have accumulated, then seed that seems to be “dormant” compared to others that exhibit radicle roots, coleoptiles, and lateral seminal roots may well be the result of imbibitional chilling injury. Sometimes, instead of immediate cessation of the germination process (i.e., “dormant” seed symptom), the radicle root and coleoptile emerge from the seed coat before ceasing further development (Fig. 2).

Fig. 2. Arrested development likely due to imbibitional chilling.

Another challenge in diagnosing imbibitional chilling injury as the cause of poor stands of corn is that eventually the dead seed or seed that germinated but simply ceased further development will naturally begin to decompose. Consequently, if you wait too long to investigate a problem field, you might be tempted to diagnose seed or seedling disease as the cause of the poor stand.

Daily, or hourly, soil temperature records coupled with knowledge of a field’s planting date are useful for “pointing the finger” at imbibitional chilling injury. Because imbibition occurs within the first 24 to 48 hours after planting into moist soil, one can imagine that timing of planting relative to the onset of several days of cold soil temperatures influences the risk of imbibitional chilling injury. Anecdotal stories abound in the coffeeshops about fields planted 3 days ahead of a cold snap emerging just fine… fields planted 2 days ahead of the cold snap experiencing some emergence problems… fields planted 1 day ahead of the cold snap having more problems… and fields planted the day of the cold snap having major problems.

Factors Influencing Risk of Imbibitional Chilling Injury

- **Intensity and Duration of Cold Soils.** Obviously, 40°F soil temperatures represent a higher risk than 50°F temperatures. A single day of cold soils is likely less risky than multiple, consecutive, days of cold soils.
- **Soil Moisture.** Daily soil temperature fluctuation is more dramatic in dry soils than in moist soils. That means higher daily maximums and lower daily minimums.
- **Plant Residue Cover.** Daily soil temperatures fluctuate less in no-till fields that have a lot of surface residue from previous crops or current cover crops. In particular, soil temperatures in such fields will not drop as rapidly or dramatically in response to a cold snap as will bare fields. That’s the good news. The bad news is that soil temperatures in fields with heavy surface residues are generally lower to begin with than bare soils early in the season and so early planting of corn in no-till fields is somewhat more risky in general.
- **Seed Quality?** One can speculate that seed lots with lower than desirable cold germination ratings might be more susceptible to imbibitional chilling injury.

Bottom Line: If you were among the ambitious souls who chose to plant more than a few acres of corn during the past 7 days or so, I encourage you to scout those fields over the next week or so to assess the success of germination and emergence. Emergence success is usually lower for early planting versus later, warmer, planting. However, the risk exists for unusually lower emergence success this year because of the unusually low soil temperatures of the past week.

An Interesting Question: Bill Cox, Extension Corn Specialist at Cornell University in New York, raised a question several years ago about whether modern hybrids are still susceptible to imbibitional chilling injury (Cox, 2014). Based on a small set of trial data from Cornell’s Aurora Research Farm in Cayuga County NY, Bill concluded the answer was “*maybe not*” and that “*…the timing of the adverse conditions would have to be so unique and so time-dependent in the first 48 hours after planting that it may not be worth worrying about*“.

I admit that Bill may have a point. I have not encountered many clear-cut examples of imbibitional chilling injury in all the years I have worked with corn in Indiana, as exemplified by the fact that I have so few photos of the problem in my image collection of various corn problems. Nevertheless, the risk for imbibitional chilling injury with cold soils is real. That risk plus the indisputable fact that that cold soils are simply not conducive to desirable rapid germination and emergence of corn should always be weighed when choosing to plant corn early in soils that are cold or likely to become cold.

Related Reading

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The Emergence Process In Corn

(Bob Nielsen)

Successful germination alone does not guarantee successful emergence of a corn crop. Elongation of the mesocotyl must elevate the coleoptile to the soil surface before the inner true leaves emerge from the protective tissue of the coleoptile. Growth stage VE refers to the emergence of the coleoptile and/or first leaves through the soil surface (Abendroth et al., 2011).

As with all of corn growth and development, germination and emergence are influenced by temperature, especially soil temperature. Corn typically requires from 100 to 120 Growing Degree Days (GDD, Fahrenheit) to emerge. Under warm soil conditions, the calendar time from planting to emergence can be as little as 4 days. Under cold soil conditions, emergence can take as long as four weeks.

Elongation of the **mesocotyl** elevates the coleoptile and its enclosed inner leaves towards the soil surface. The mesocotyl is the tubular, white, stemlike tissue connecting the seed and the base of the coleoptile. Technically, the mesocotyl is the first internode of the stem.

Useful Tip: Mesocotyls are thought to be physiologically capable of elongating successfully from at least a 6-inch planting depth. Realistically, corn can be planted at least three inches deep (if necessary to reach adequate moisture) and still emerge successfully.

As the coleoptile tip nears the soil surface, exposure to the red light component of solar radiation reduces the production of the growth-promoting hormone indoleacetic acid (IAA) from the coleoptile tip, which reduces the supply of IAA to the mesocotyl, and consequently elongation comes to a halt (Vanderhoef & Briggs, 1978; Barker-Bridges et al., 1998). Since the depth below the soil surface at which the coleoptile tip senses red light is fairly constant, the resulting depth of the crown (base) of the coleoptile is nearly the same (1/2 to 3/4 inch) for seeding depths of one inch or greater.

Useful Tip: When corn is seeded very shallow (less than about 1/2 inch), the crown of the coleoptile will naturally be closer to the soil surface, if not right at the surface. Subsequent development of the nodal root system can be restricted by exposure to high temperatures and dry surface soils.

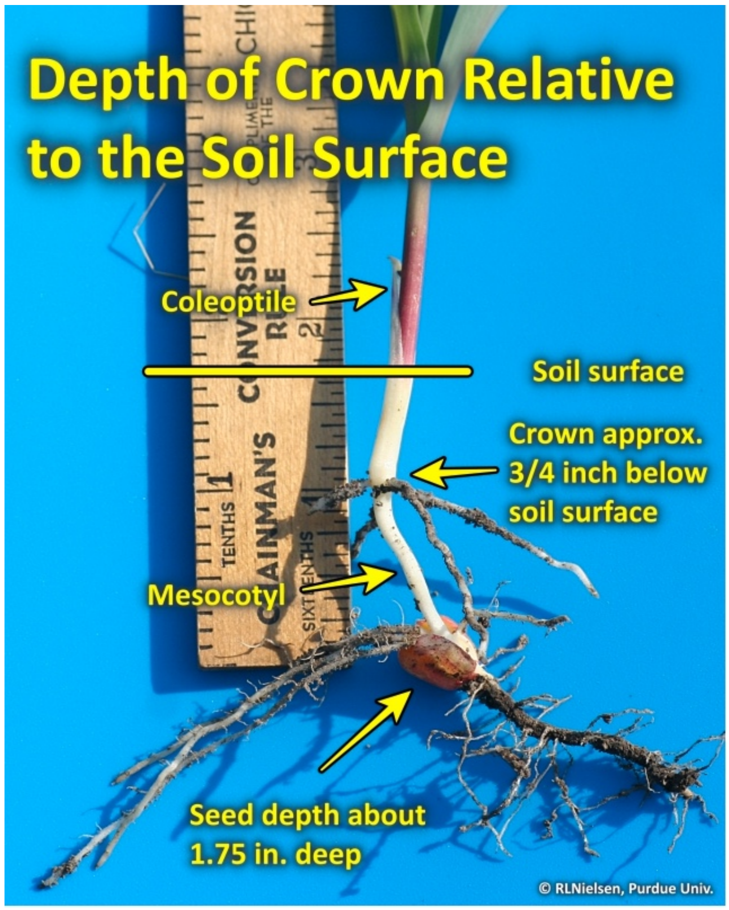
The coleoptile tissue is wrapped somewhat like inner leaves are wrapped, or rolled, in the whorl. Expansion of the inner true leaves eventually forces the coleoptile to partially unwrap near the tip, allowing the first true leaf to emerge. If mesocotyl elongation has successfully elevated the coleoptile tip to the soil surface, emergence of the first true leaves will also occur successfully at or just above the soil surface.

Troubleshooting Considerations

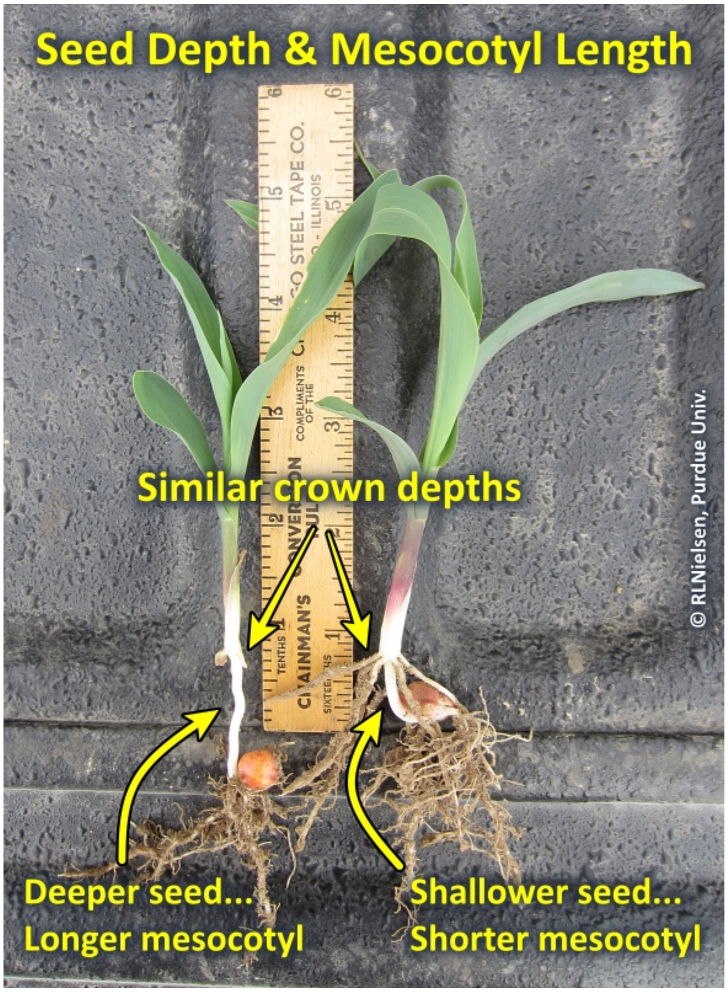
Several factors can cause the coleoptile to split prematurely, allowing the leaves to emerge underground. Usually, more than one of the following factors are present when this problem occurs, making it difficult to place the blame on any one factor.

- **Exposure to sunlight** at deeper soil depths than usual due to cloddy seedbeds, dry seedbeds, sandy soils, or open seed furrows.
- **Injury from certain herbicides**, particularly under stressful environmental conditions. Symptoms include corkscrewed coleoptile, swollen mesocotyl and true leaves emerged from side of coleoptile.
- **Surface crusting, cloddy seedbeds, rocky seedbeds, planter furrow compaction, or otherwise dense surface soil** that physically restrict mesocotyl elongation and coleoptile penetration. The pressure of the expanding leaves within the coleoptile eventually ruptures the side of the coleoptile. Symptoms include corkscrewed coleoptile, swollen mesocotyl and true leaves emerged from side of coleoptile. Note the similarity to those symptoms from herbicide injury.
- **Cold temperature injury**, either from exposure to long periods of soil temperatures less than about 50F (10C) or from exposure to wide daily swings (25 to 30 degrees) in soil temperatures. Symptoms include absence of emerged coleoptile, corkscrewed mesocotyl or coleoptile and true leaves emerged from side of coleoptile. Note the similarity to those symptoms from herbicide injury.

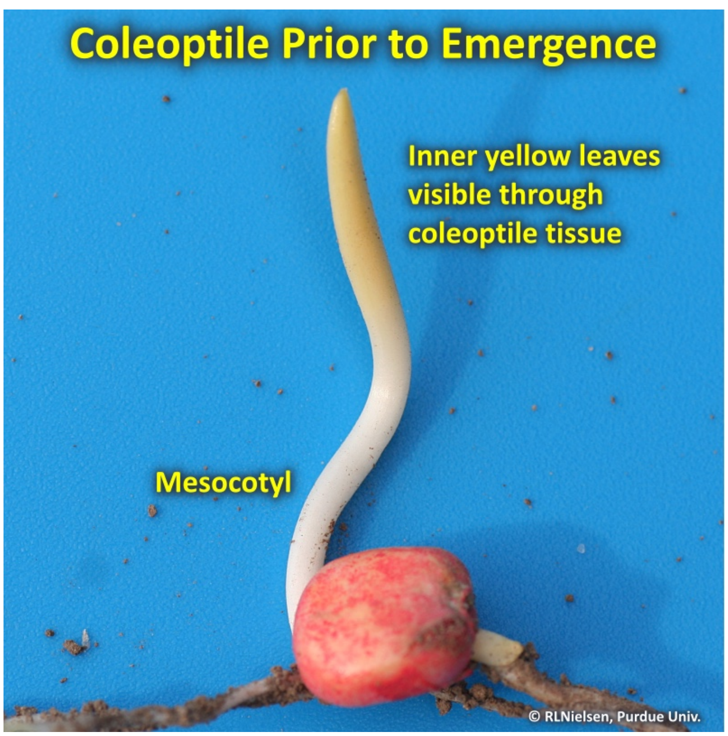
Useful Tip: The mesocotyl should remain firm, white and healthy through at least the 6-leaf stage, if not longer. If it is mushy, discolored, or damaged prior to this stage, then it is likely part of the crop problem being investigated.



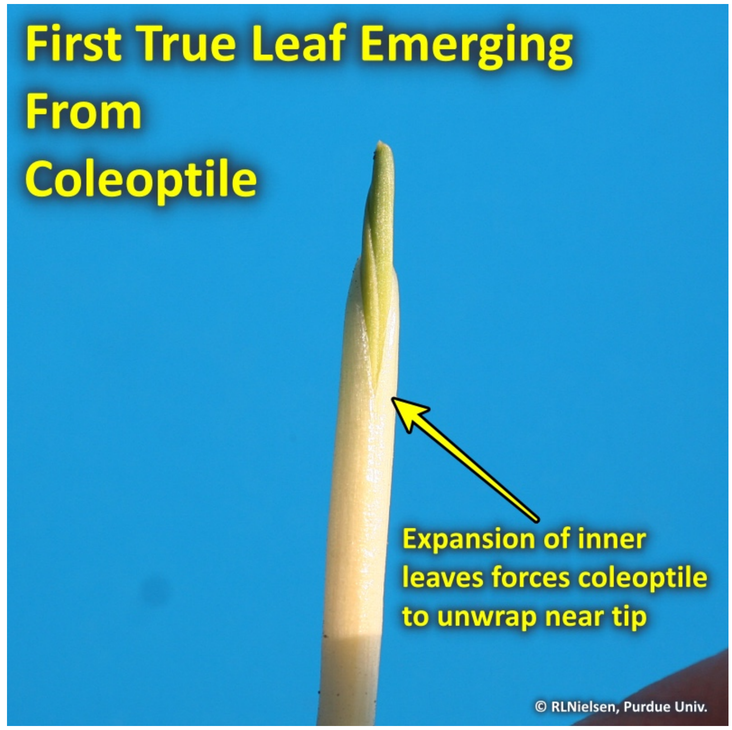
Typical crown depth relative to soil surface.



Seeding depth and mesocotyl length.

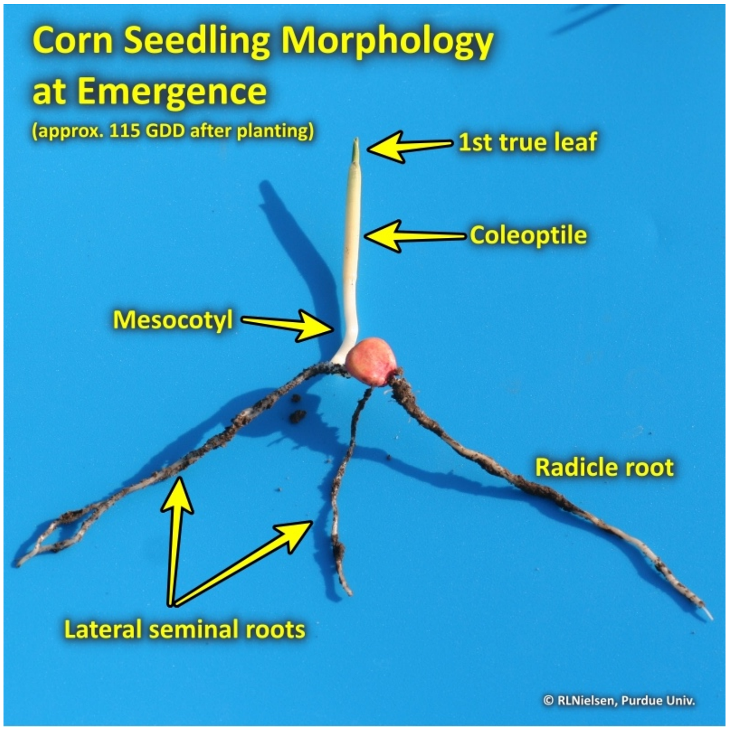


Coleoptile prior to emergence.



Inner leaves emerging from coleoptile.

Growth stage VE in corn.



Corn seedling morphology at emergence.

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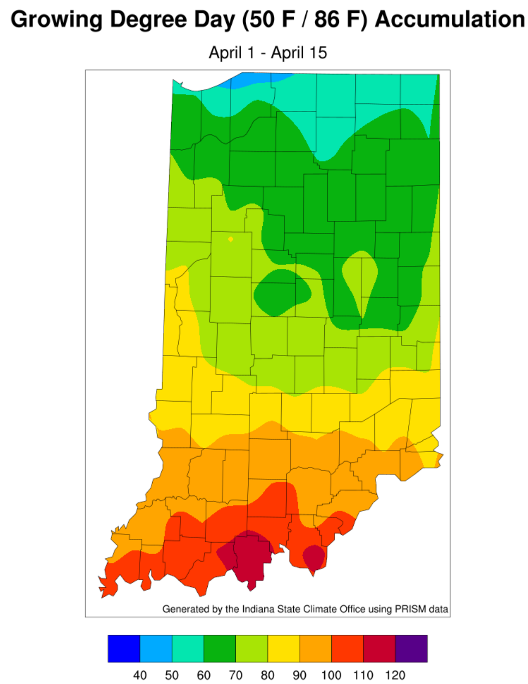
Indiana, It's Cold Outside!

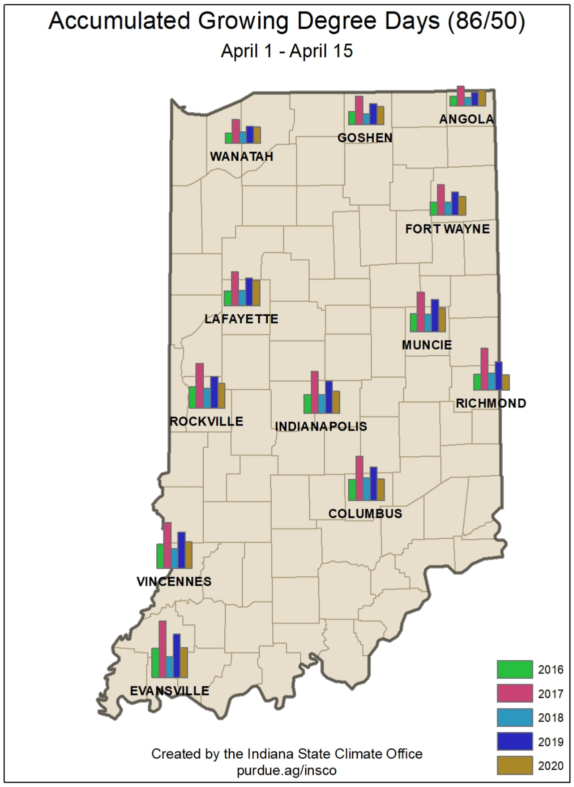
(Beth Hall)

This week brought freezing temperatures across much of Indiana – an unpleasant change from the previous weeks that were encouraging us to think about short sleeves and flip-flops! These cooler temperatures are expected to continue into next week, though the probability of freezing temperatures is low. Climate outlooks for the rest of April are steering away from the probability of below-normal temperatures while precipitation is anticipated to remain above normal.

Thanks to the warmer temperatures last week, modified growing degree day (50/86)* accumulations since April 1st are near normal across the state, but this recent cold spell will likely dampen any gains by the end of the month.

**Modified growing degree days are similar to growing degree days but use cutoff temperature thresholds of 50°F (minimum temperature) and 86°F (maximum temperature). So, if the minimum temperature was 42°F and the maximum temperature was 90°F, then instead of averaging those 2 values and subtracting 50, the minimum and maximum threshold temperatures would be averaged (e.g., (50 + 86) / 2) and then subtract 50. This is used to account for vegetative growth response to temperature extremes.*





Accumulated Growing Degree Days (86/50)
April 1 - April 15
WANATAH
GOSHEN
ANGOLA
FORT WAYNE
LAFAYETTE
MUNCIE
RICHMOND
ROCKVILLE
INDIANAPOLIS
COLUMBUS
VINCENNES
EVANSVILLE
2016
2017
2018
2019
2020
Created by the Indiana State Climate Office
purdue.ag/insco

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