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Pest&Crop newsletter

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In This Issue

Black Cutworm Moths Just Keep Coming

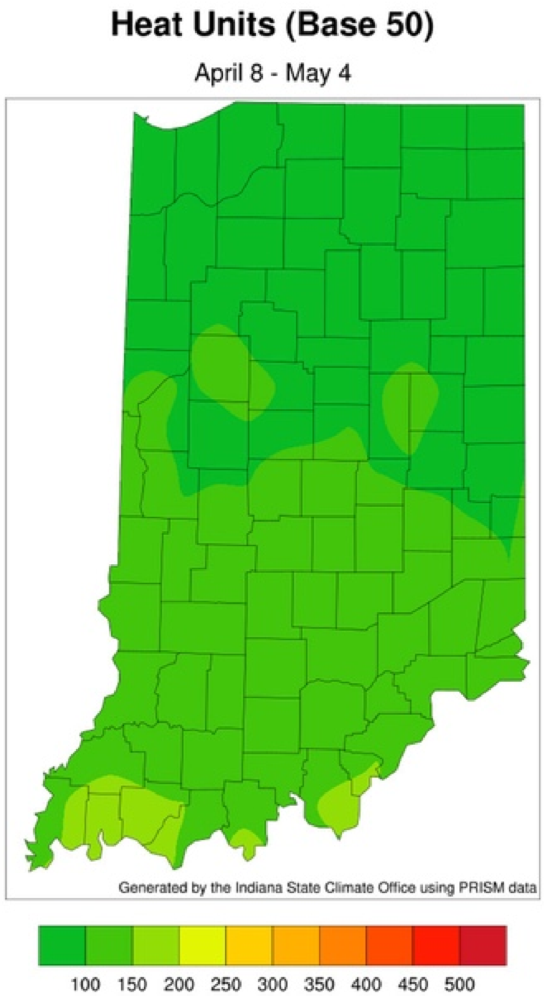
(Christian Krupke) & *(John Obermeyer)*

Black cutworm moth catches in many of our cooperator's pheromone traps continue to be quite impressive (see "Black Cutworm Adult Pheromone Trap Report"). The timing of intensive moth captures, 9 or more moths caught over a 2-night period, over the past several weeks and subsequent larval development may challenge corn that is delayed in emergence or yet to be planted. This will be especially true for fields with abundant broadleaf weeds (esp. chickweed), if producers' weed control activities are delayed or replanting is necessary because of low temperatures in the coming days (May 8-10).

Black cutworm larval instars 2 to 6, the 4th instar is left of the penny.

Refer to the map, where we are tracking black cutworm development from the time of our first widespread intensive captures, April 8, to when we expect first significant damage. Based on the growth development model, it takes approximately 300 heat units (50˚F base) from egg hatch to early 4th instar; this is the life stage when black cutworm larvae begin to cut plants. Some leaf injury may be present before then, and this is an ideal time to treat – insecticides will be more efficacious than during the period when they have begun cutting plants. Using pheromone trapping of moths and tracking of heat unit accumulations for first cutting is not an exact science, but they do give us a good indication of when to better time scouting trips.

Because of the persistent cool temperatures this spring, black cutworm larval development has been delayed, as demonstrated in the accompanying map. Meaning, the many acres of corn planted the past weeks will likely "outpace" larval development. Of those fields yet to be worked and planted, the timing may coincide with larval development, thus threatening emerging corn. Since black cutworm has been a minor pest in recent years, producers may have a false sense of security with the seed-applied insecticides – which offer plant protection that is inconsistent, at best. Timely scouting and rescue treatments of foliar insecticides when necessary are the tried and true approach with this stand reducer. Happy scouting!



2020 Black Cutworm Pheromone Trap Report

(John Obermeyer)

County	Cooperator	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
Adams	Roe/Mercer Landmark	12	17*	15*	19*	44*		
Allen	Anderson/NICK	1	1	1	5			
Allen	Gynn/Southwind Farms	2	3	0	6	15		
Allen	Kneubuhler/G&K Concepts	6	2	4	9	28*		
Bartholomew	Bush/Pioneer Hybrids	6	28*	39*	28*	14		
Clay	Mace/Ceres Solutions/Brazil	2	2	4	3	1		
Clay	Fitz/Ceres Solutions/Clay City	0	4	3	10	15*		
Clinton	Emanuel/Boone Co. CES	26*	18	28*	72*	39*		
Dubois	Eck/Dubois Co. CES	1	13	18*	16*	30*		
Elkhart	Kauffman/Crop Tech	7	12	5	10	14*		
Fayette	Schelle/Falmouth Farm Supply Inc.	46*	23	25	15	40*		
Fountain	Mroczkiewicz/Syngenta	0	8	3	4	6		
Fulton	Jenkins/Ceres Solutions/Talma	0	0	1	2	5		
Hamilton	Campbell/Beck's Hybrids	15	10	16	23*	11		
Hendricks	Nicholson/Nicholson Consulting	0	8	3	5	32*		
Hendricks	Tucker/Bayer		28*	15*				
Howard	Shanks/Clinton Co. CES		2	0	1	1		
Jasper	Overstreet/Jasper Co. CES	0	0	0	4	1		
Jasper	Ritter/Dairyland Seeds	12	11	12	2	1		
Jay	Boyer/Davis PAC	19*	28*	16*	28*	54*		
Jay	Shrack/Ran-Del Agri Services	19*	20	20*	36*	60*		
Jennings	Bauerle/SEPAC	16	29*	17	82*	58*		
Knox	Clinkenbeard/Ceres Solutions/Freelandville	0	0	0	0	0		
Knox	Butler/Ceres Solutions/Vincennes	0	0	0	6			
Lake	Kleine/Rose Acre Farms	60*	35*	26*	38*	28*		
Lake	Moyer/Dekalb Hybrids/Shelby	4	22*	6	8	15		
Lake	Moyer/Dekalb Hybrids/Scheider	5	21*	6	10	11		
LaPorte	Rocke/Agri-Mgmt. Solutions	6	9	23*	14	8		
Marshall	Harrell/Harrell Ag Services							
Miami	Early/Pioneer Hybrids	0	7	2	7	4		
Montgomery	Delp/Nicholson Consulting	2	18*	33*	51*	46*		
Newton	Moyer/Dekalb Hybrids/Lake Village	0	4	4	1	1		
Porter	Tragesser/PPAC		1	0	6	6		
Posey	Schmitz/Posey Co. CES	1	5	2	0	0		
Pulaski	Capouch/M&R Ag Services			4	11			
Pulaski	Leman/Ceres Solutions	31*	28	38*	32*	7		
Putnam	Nicholson/Nicholson Consulting	8	9	5	5	11		
Randolph	Boyer/DPAC	13*	13	11*	8	15		
Rush	Schelle/Falmouth Farm Supply Inc.	1	3	15	6	4		
Shelby	Fisher/Shelby County Co-op		0	7	21*	15		
Shelby	Simpson/Simpson Farms	0	32*	37*	65*	99*		
Stark	Capouch/M&R Ag Services							
St. Joseph	Carbiener, Breman	9	0	11				
St. Joseph	Deutscher/Helena Agri-Enterprises	2	19	1	48*			
Sullivan	Baxley/Ceres Solutions/Sullivan	0	8		11	10		
Sullivan	McCullough/Ceres Solutions/Farmersburg	0	0	10*	14*	26*		
Tippecanoe	Bower/Ceres Solutions	3	6	14*	29*	14*		
Tippecanoe	Nagel/Ceres Solutions	36*	38*	86*	88*	50*		
Tippecanoe	Obermeyer/Purdue Entomology	0	0	2	30*	27*		
Tippecanoe	Westerfeld/Bayer Research Farm	0	2	6	13	9*		
Tipton	Campbell/Beck's Hybrids	0	6	8	19	7		
Vermillion	Lynch/Ceres Solutions/Clinton	0	0	0	0	0		
White	Foley/ConAgra	5	1	4	5	4		
Whitley	Richards/NEPAC/Schrader		7		28			
Whitley	Richards/NEPAC/Kyler		13		40			

* = 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	4	28						
Jennings/SEPAC Ag Center	60	75	11	15	35					
Knox/SWPAC Ag Center	1162	308	56	168	64					
LaPorte/Pinney Ag Center	115	65	0	21	455					
Lawrence/Feldun Ag Center	974	347	57	741	753					
Randolph/Davis Ag Center	117	207	16	51	15					
Tippecanoe/Meigs	225	wind dmg.	6	54	151					
Whitley/NEPAC Ag Center		9		38						

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

Field Crop Disease Update 2020: Wheat – Accurate Diagnosis Of Potential Injury, Viruses, Or Other Issues In Wheat

(Darcy Telenko), *(Tom Creswell)* & *(John Bonkowski)*

Wheat has greened up and is actively growing across Indiana (except during these last few cold spells). Our southern field plots in Vincennes were at Feekes 10.3-10.4 (1/4 to 1/2 head visible) this week, while in West Lafayette plots are at Feekes 8 (last leaf visible). There have been some concerns about fields with yellow-necrotic leaves and yellow stunted patches of plants. A variety of factors can contribute to these symptoms including several wheat virus pathogens as well as soil pH, fertility, and environmental factors. It is important to observe the whole field to determine the special distribution of symptoms – are they uniform, spotty, or patterned in appearance? Are they in a low, wet area or are they along a field edge where insect vectors are moving off overwintering hosts.

There have been a number of freezing periods this spring as wheat was beginning to green up. Cold stress can lead to a number of symptoms in wheat depending on the growth stage in which the conditions occur. The freezing weather may cause the tips of young leaves to become yellow or necrotic in a uniform pattern across the field (Fig. 1). Culm damage may occur if the freeze occurs during stem elongation, this may cause the damaged area to appear discolored – bleached, soft and water-soaked (Fig. 2). The damage may also disrupt vascular tissue and lead to lodging. As we are approaching the boot and head stages in Indiana a hard freeze also has the potential to damage the spike and interfere with reproduction and grain fill. We will continue to keep a close eye on our wheat as more cold conditions are in the forecast.

Figure 1. Uniform distribution of leaf tip burn – low temperature injury. (*Photo Credit: Darcy Telenko*)

Figure 2. Discolored lesions on culm leading to stem collapse. (*Photo Credit: John Bonkowski*)

Wheat Virus Identification

There are four common viruses that cause disease in Indiana wheat. They include five strains of barley yellow dwarf virus (BYDV), wheat spindle streak mosaic virus (WSSMV), soilborne wheat mosaic virus (SBWMV), and wheat streak mosaic virus (WSMV).

You can potentially identify wheat virus identification based on symptoms in the field. However lab testing is essential for accurate diagnosis. Typically, virus infected plants appear as uneven patches of yellow to light green areas in a field, but this can easily be confused with environmental/site issues including low pH and related nutritional deficiencies.

Symptoms of wheat spindle streak mosaic virus (WSSMV) and soilborne wheat mosaic virus (SBWMV) are visible in the spring and are generally uniform across a section of the field. A yellow/green mottled, mosaic pattern will be visible on the leaves. The plants may be stunted with leaf tip dieback and lower leaves may have a reddish appearance. Plants infected by WSSMV or SBWMV may have fewer tillers, stems and heads with fewer kernels. Infection occurs in the fall. The viruses are transmitted to the wheat root by a soilborne fungus vector, Polymyxa graminis, and can survive in the soil for up to five years.

Symptoms caused by wheat streak mosaic virus (WSMV) on wheat growing in Indiana may include yellowing, stunting, and curling of leaves due to feeding by the wheat curl mite, the primary vector of WSMV (Fig. 3). Time of infection and environmental conditions will determine severity of disease; warm, dry conditions favor WSMV due to an increase in the wheat curl mite population. Wheat curl mites can transmit the virus for up to a week after feeding on an infected plant and generally move in the wind from one plant to another in a field. Early colonization of the wheat by the wheat curl mite can lead to a more pronounced WSMV symptom development, premature plant death, and greater yield loss.

Figure 3. Wheat infected by wheat spindle streak mosaic virus (WSSMV). Typical display of spindle-like chlorotic lesions of WSSMV on foliage and mosaic pattern. Yellow, mottled, mosaic patterns can also be a symptom of SBWMV infection.

Barley yellow dwarf virus (BYDV) has many different strains that can infect more than 150 different grass species, including wheat, oats, barley, rice, and corn. These viruses are vectored by aphids. Once an aphid acquires the virus by feeding on an infected host it can transmit the virus to a new host for two to three weeks. It will take two to three weeks for symptoms to appear in wheat after the initial infection while fall infections may not appear until the following spring. Symptoms of BYDV in wheat include stunted tillers and roots and discolored foliage. A reddish discoloration usually starts at the tip of the flag leaf and moves downward; eventually in wheat the leaves may appear yellow, red, or purple in color. BYDV infection can lead to reduced tillering, poor flowering and kernel sterility or failure to fill.

Management Options for Wheat Viruses

There are no control options to reduce viral symptoms in currently infected plants. However, accurate diagnosis of wheat viruses is important for future disease management plans. Healthy plants can better tolerate infection, so it is important to manage other foliar diseases in wheat and maintain adequate moisture and nutrients.

Many wheat varieties are available that have partial resistances to one or more of these wheat viruses and/or their vectors. Understanding a field's risk for a specific virus can aid in variety selection down the road, as planting a less susceptible variety is the first line of defense in viral disease management.

Removal of volunteer wheat or other grasses late in the season may also help reduce the "green bridge" for the vectors or virus survival into the next season.

If you suspect viral infection, a sample can be submitted to the Purdue Plant and Pest Diagnostic Lab (PPDL) (https://ag.purdue.edu/btny/ppdl/Pages/Submit-A-Sample.aspx). The PPDL can test for the presence of ten wheat viruses. They include five strains of barley yellow dwarf virus (BYDV; strains PAV, MAV, RMV, SGV, and RPV); wheat spindle streak mosaic virus (WSSMV); soilborne wheat mosaic virus (SBWMV); wheat streak mosaic virus (WSMV); high plains virus (HPV) and Triticum mosaic virus (TriMV). The cost of the wheat virus screen is $50, in addition to the usual sample handling fee of $11 for in-state samples and $22 for out-of-state samples.

For more information see Purdue Extension publication "Diseases of Wheat: Wheat Viruses" https://extension.purdue.edu/extmedia/BP/BP-146-W.pdf

Cold Soils & Risk Of Imbibitional Chilling Injury In Corn

(Bob Nielsen)

While the coffee shop 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 50ºF for days or longer after planting delay germination and slow emergence of the young seedlings. More importantly, soil temperatures lower than about 50F 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 40sºF down to the 30sºF.

"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 50ºF 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-50ºF 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, 2019).

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).

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.

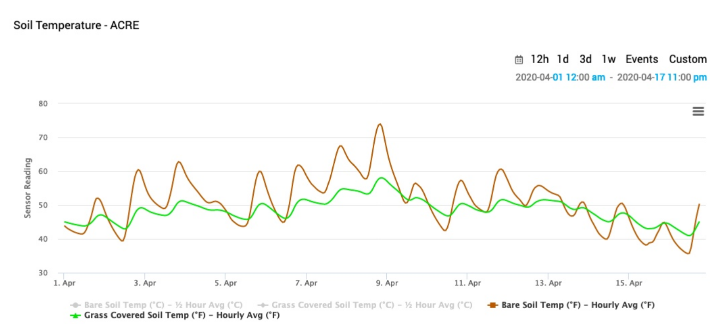


Fig. 1. Bare soil and grass-covered soil temperatures at ACRE, Apr 1-16, 2020.
Source: Purdue Univ. – Indiana Mesonet (https://campbellcloud.io/map_index.php)

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

Related Reading

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Assessing Frost/Cold Temperature Injury To Young Corn

(Bob Nielsen)

The risk of damaging spring frost events is one of the downsides to planting corn earlier than normal, but is one growers often accept when early spring field conditions are otherwise suitable for planting. However, the threat of low temperatures in late May or early June also raises the specter of frost or low temperature damage to young corn plants, regardless of planting date. Early morning temperatures in the 30s°(F) coupled with clear calm conditions overnight certainly are favorable for frost formation on exposed surfaces, including leaves of young corn plants. In other words, temperatures do not need to drop to 32°F or cooler in order for frost to form.

When significant frost develops on young corn plants, it is tempting to jump to the logical conclusion that significant plant mortality will soon follow. However, frost by itself is not a guaranteed "kiss of death" for young corn plants. What is more important is whether the temperature that accompanied the frost event was lethal or not. Most agronomists agree that "lethally cold" temperatures for young corn are those that dip to 28F or lower for 1 to 2 hours.

The effect of frost on young corn when it is accompanied by temperatures no lower than about 30°F is primarily damage and death of the exposed above ground leaf tissue. As long as the growing point of the young plant (aka the apical meristem) is still protected below the soil surface, the injured plant usually recovers from the effects of the superficial leaf damage.

Within 3 to 5 days of the frost event (more quickly with warm temperatures, more slowly if cool), elongation of the undamaged leaf tissue in the whorl will become evident. As long as the recovery is vigorous, subsequent stand establishment should be not be affected.

Plant appearance following damage by lethal cold temperatures (28°F or lower for a couple hours) may initially be similar to that due to "simple" frost damage. The difference is that there will be no subsequent elongation or "recovery" of leaf tissue from the whorl like you would see in the days following "simple" frost damage to leaves. Inspection of the growing point area (by slicing down middle of stem, through the crown of the young plant) will eventually reveal discolored, soft or mushy tissue as a consequence of the lethal temperatures.

The bottom line for diagnosing the severity of frost or low temperature injury to corn is that you generally need to wait three to five days after the weather event before you can accurately assess the extent of damage or recovery. Injury to the crop can look very serious the day after the event or even two days after the event, but recovery is likely if there is no injury to the growing points of the affected plants.

Related Reading

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7 hours post-frost.

12 hours post-frost.

60 hours post-frost, visible elongation of undamaged leaf tissue from whorl of plant.

Corn Replant Considerations

(Bob Nielsen)

- *Replant decisions for corn are often difficult to make.*
- *Key factors that play into such decisions include population and health of surviving plants, relative yield potential of replant versus original stands, and replant costs.*
- *Try to park your emotions at the gate and focus on estimating the dollar returns or losses to the replant decision itself.*

The decision to replant a field of corn because of poor stand establishment or severe damage to an otherwise good looking field of corn is often not an easy one to make. There are many uncertainties and questions involved with the decision, not to mention the emotions that often get in the way of facts and figures. The underlying question when considering a replant decision, of course, is whether or not you will end up with more dollars in your pocket at the end of the year by replanting a crappy™ stand of corn or leaving the field alone. The answer to that question relies on a few facts plus your skill at reading crystal balls.

Assessing Surviving Populations & Effect on Yield

The important facts to ascertain are the extent and severity of the stand loss throughout the entire field, plus an initial assessment of the health of the surviving plants. The goal is to estimate surviving populations of healthy plants.

Assessing the health of the surviving plants can be difficult and, frankly, many folks tend to overestimate the yield impact from the damage to the plants. Young corn plants have an amazing capacity to recover from aboveground damage caused by stresses like frost, hail, insect feeding, leaf burn from anhydrous ammonia or liquid nitrogen fertilizers, and wind (sandblasting). On the other hand, damage from belowground stresses like insect feeding, saturated soils, starter fertilizer burn, and seedling blight may not seem severe at first, but can have devastating effects over a very few number of days. If you are uncertain about the health of surviving plants on your first visit to the field, give the plants a few more days of sunshine and warmth, then evaluate stand health again. Those few days delay in making your decision will give you more confidence in your decision whether or not to replant.

Assessing and documenting plant populations and plant health across entire fields is obviously quite challenging to do efficiently on foot or even with wheels. Consumer drones (Unmanned Aerial Vehicles, aka UAVs) equipped with high quality cameras offer the potential to scout fields quickly from the air and spot / map problem areas. The challenge with UAV imagery, though, is that assessing the population and health of young corn plants (i.e., short and small) requires flying UAVs at quite low altitudes in order to accurately identify the plants. While technically feasible, such low flight altitudes greatly increase the flight time and number of UAV batteries to thoroughly cover an entire field in a systematic autonomous flight pattern. Alternatively, UAVs can simply be flown manually to quickly "spot check" areas of the field to help you decide which areas to check more thoroughly on foot.

Our research on corn yield response to plant population over the past 10 years (83 field scale trials) allows us to predict with some confidence the yield response of corn to low populations (Nielsen et al., 2019). The good news is that modern hybrids are fairly tolerant to populations in general. What this means is that not only will they tolerate high plant populations without dramatic decreases in yield, but will also tolerate low plant populations without dramatic yield decreases (Fig. 1). Because the yield response to plant population is fairly flat, the **economically optimum plant population (EOPP)** at harvest is already lower than you probably thought. Based on $3.50 market price for corn, $240 seed corn, the average EOPP for our 83 field trials was only about 25,500 plants per acre at harvest. Marginal return to seed varied +/- $1 per acre between 23,500 and 27,250 plants per acre at harvest (Fig. 2).

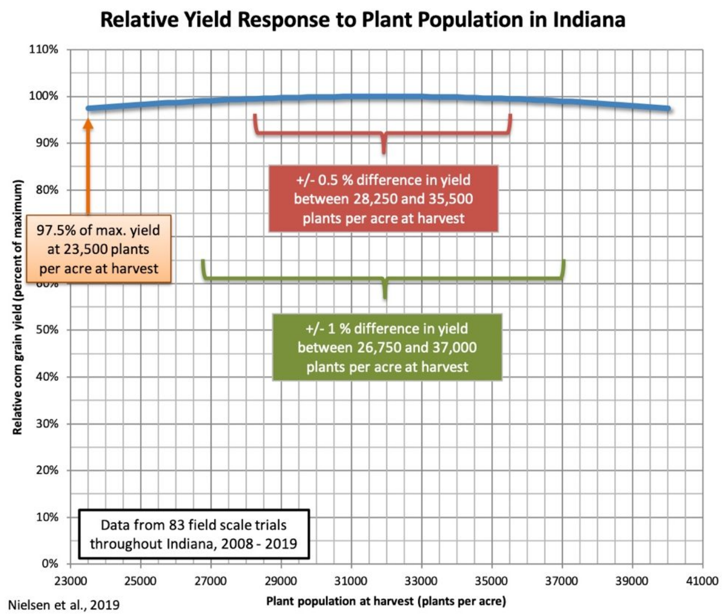

Fig. 1. Relative yield response to corn to plant population in Indiana. Average results from 83 field scale trials throughout Indiana from 2008-2019. (Nielsen et al., 2019)

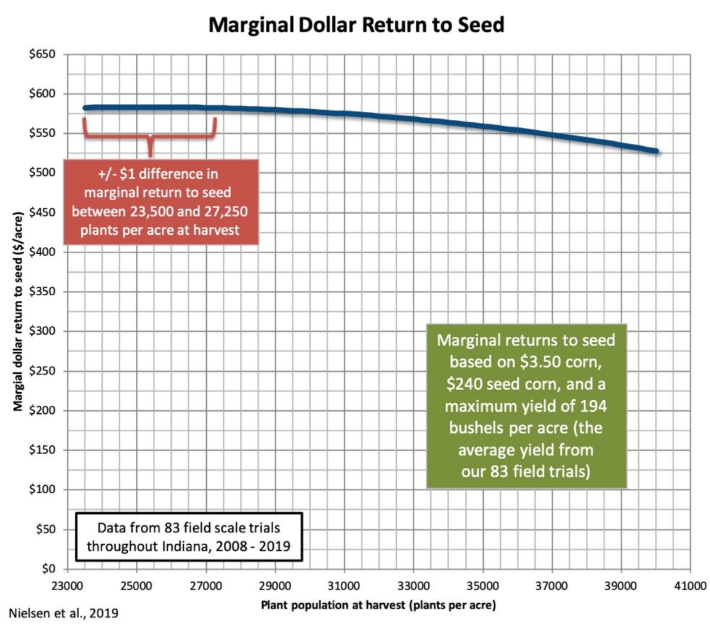

Fig. 2. Marginal dollar return to seed for a range of final plant populations of corn in Indiana. Average results from 83 field scale trials throughout Indiana from 2008-2019. (Nielsen et al., 2019)

The results of our research with plant populations in corn are most accurate within a range of 23,500 to 40,000 plants per acre at harvest because that was the most common range of populations evaluated in our field trials around the state. Extrapolating the results to populations beyond those is statistically not appropriate, but we can speculate that final populations as low as 20,000 plants per acre at harvest may result in marginal returns to seed roughly $7 per acre lower than that at the EOPP. That at least gives you an estimate to work with if you are considering replanting and your estimates of surviving populations are no lower than 20,000 plants per acre.

Yield Potential of Damaged versus Replanted Fields

One of the numerous uncertainties with making an economic replant decision involves the difficulty in predicting yields of an untouched, but damaged, original field of corn versus that of a field replanted at some date in the future. First of all, most of us tend to overestimate yield loss due to early season stand problems. It is similarly difficult to estimate the yield potential of a replanted field. While it is tempting to follow a rule of thumb for late planting along the lines of "*2 bushel decrease per day of delayed planting beyond May 10*", that may not tell you what you need to know. The reason is that planting date itself is not an accurate predictor of absolute number of bushels per acre. Planting date is only one of about a gazillion factors that influence yield (Nielsen, 2019c). The simplest approach to estimating yield differences between replanted and surviving original stands may be to simply base it on the differences in plant population.

Seeding Rates for Replanting or Late Planting in General

The target EOPP for fields replanted in mid- to late May is essentially unchanged from that targeted with late April plantings. The only difference may be that the success rate for germination / emergence with later planting is typically greater than early plantings because of typically warmer soils in late plantings. Instead of using seeding rates 5 to 10% higher than the targeted EOPP, late planting of corn can probably be done using seeding rates much closer to the targeted final population.

Hybrid Maturities for Replanting or Late Planting in General

Replanting a damaged field of corn in mid- to late May might require the use of a shorter-season corn hybrid than the one originally planted in the field. Consult my article about hybrid maturities for delayed planting (Nielsen, 2019b) and check with your seed dealer about availability of earlier maturity hybrids that also have good disease resistance characteristics. The latter is important because late-planted corn, relative to earlier-planted corn, is vulnerable to infection at relatively younger growth stages by foliar diseases that typically begin to develop in late June – early July (e.g., gray leaf spot, northern corn leaf blight).

"Patch In" vs. "Destroy & Replant"

Another difficult replant decision is whether to kill the original stand of corn or replant right through it. My experience evaluating "patching in" versus "destroy and replant" suggests that "patching in" without killing the original stand should not be attempted unless surviving stands are roughly 25% or less of the original population. The risk with "patching in" surviving stands with populations higher than that is the original survivors will provide too much competition for the newly emerging replant population. There is also the tendency to "patch in" at the same original seeding rate, assuming that the planter will destroy quite a bit of the original stand, and then ending up with a final stand that is 1.5 times or more what you intended because a lot of the original stand survived. Another potential consequence of "patching in" is that grain moisture may be quite variable throughout the field at harvest due to earlier maturing original plants versus later maturing replanted ones.

Choosing to kill the original stand of corn before replanting turns out to be a headache, however, because of the preponderance of herbicide-tolerant traits in modern hybrids (e.g., tolerance to glyphosate, glufosinate). Fewer herbicide options exist to terminate fields of damaged corn planted to such hybrids. My colleagues in Weed Science published an article that addresses the challenges of killing an existing stand of corn prior to replanting (Ikley et al., 2017).

Potential Replant Costs

In addition to estimating the potential differences in gross income due to estimated differences in yields between replanted versus original stands of corn, the costs of replanting obviously need to be considered. Replant seed is the largest single replant cost, potentially ranging from $90 to $120 per acre. Some seed companies offer free seed for replanting as part of their customer service, others do not. Other potential replant costs to consider include fuel and labor to replant the field, possible additional herbicide, insecticide or fungicide costs, and possible additional grain drying costs after harvest.

Bottom Line

Replant decisions for corn are often difficult ones to make. Key factors that play into such decisions include population and health of surviving plants, relative yield potential of replant versus original stands, and replant costs. Try to park your emotions at the gate and focus on estimating the dollar returns or losses to the replant decision itself.

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Root Development in Young Corn

(Bob Nielsen)

Successful emergence (fast & uniform), while important, does not guarantee successful stand establishment in corn. The next crucial phase in the life of young corn plants is the initial establishment of a vigorous nodal root system. Successful stand establishment is largely dependent on the initial development of nodal roots from roughly V2 (two leaves with visible leaf 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 roots during their initial development (e.g., from excessively dry soil, excessively wet soil, extremely 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. However, in terms of importance to the corn plant, the nodal root system is clearly the primary root system.*

The Seminal (Seed) Root System

Seminal (seed) roots originate from the scutellar node located within the seed embryo. Seminal roots are composed of the radicle and lateral seminal roots. Even though the seminal roots technically are nodal roots, they are traditionally discussed separately from the nodal roots that develop later from the crown area of the seedling.

The radicle root emerges first, rupturing through the seed coat near the tip end of the kernel (Fig. 1) and briefly elongates in that direction regardless whether the kernel tip points up, down, or sideways. The lateral seminal roots emerge later from behind the coleoptile (Fig. 2) and initially elongate toward the dent end of the kernel. However, soon both sets of seminal roots change the orientation of their elongation and begin to elongate downward in response to gravity (Fig. 3).

Fig. 1. Radicle root and coleoptile of pre-VE seedling.

Fig. 2. Lateral seminal roots, coleoptile, and radicle root of pre-VE seedling.

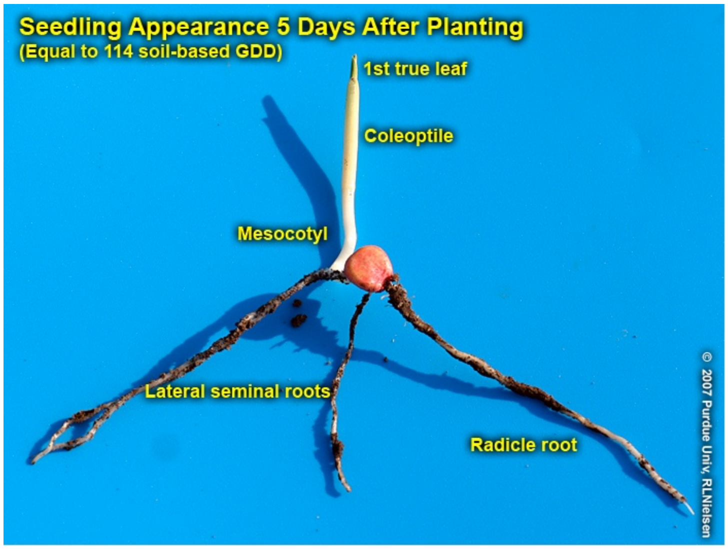

Figure 3. Seminal root system of VE seedling, but no evidence yet of nodal root system.

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. By about growth stage V1, the rate of new growth by the seminal root system slows down dramatically as the primary 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 kernel itself and mesocotyl remain healthy, but may result in delayed emergence or 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 (Nielsen, 2020a), post-germination injury from lethal or sub-lethal cold temperatures (Nielsen, 2020b), 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 images shown in Fig's. 4 – 6 show 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.

Fig. 4. Delayed emerger w/ healthy lateral seminal roots but damaged radicle root.

Fig. 5. Split coleoptile; precursor to leafing out underground.

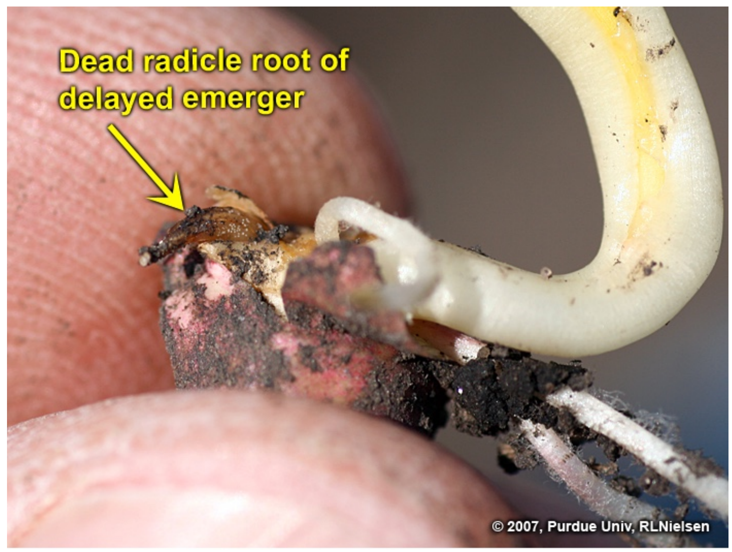

Fig. 6. Dead radicle root on a delayed emerger seedling.

The images shown in Fig's. 7 and 8 show 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.

Fig. 7. Delayed emerger with healthy lateral seminal roots and damaged, but alive, radicle root.

Fig. 8. Closer view of damaged radicle root tip with numerous adventitious roots.

Fig. 9. V1 corn seedling.

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". When the collar of the first leaf first becomes visible, the first set of nodal roots can be identified by a slight swelling at the lowermost node. By late V1, the first set of nodal roots have noticeably begun to elongate (Fig's 9 and 10). By leaf stage V2, 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.

Fig. 10 First set of nodal roots elongating from lower most node of crown area of V1 corn seedling.

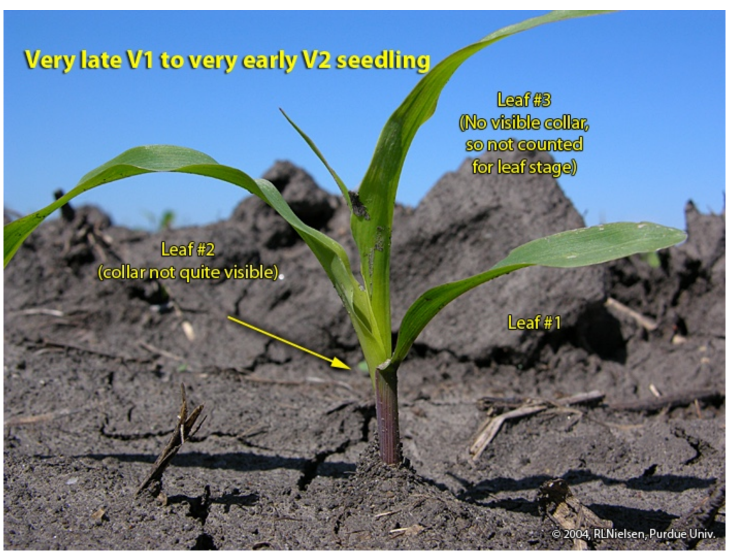

Fig. 11. Late V1 to early V2 corn seedling.

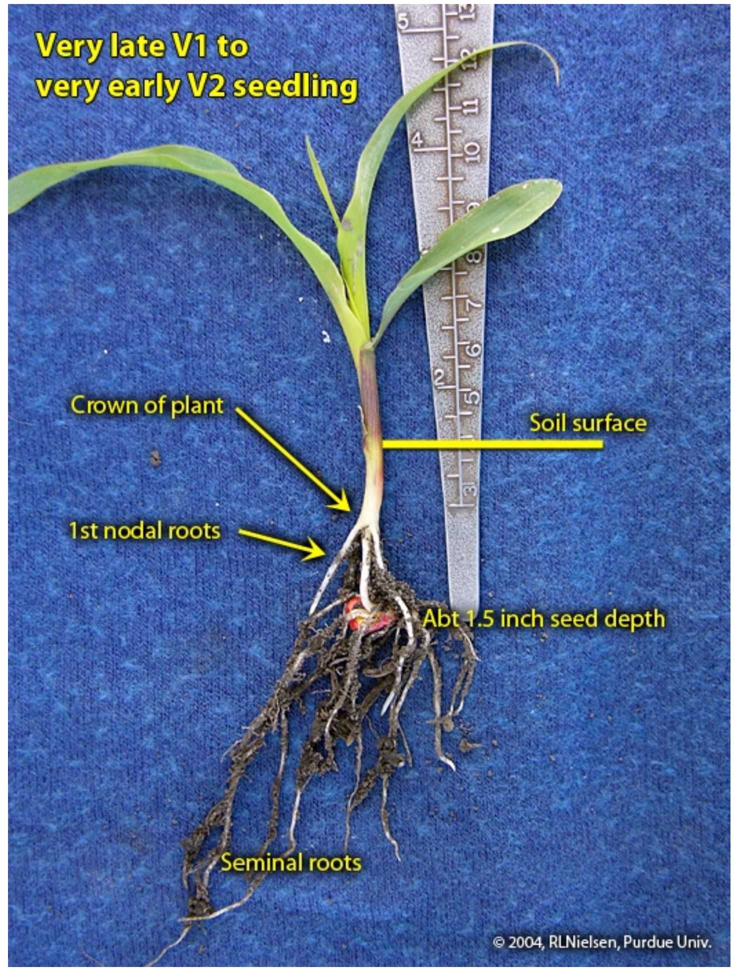

Fig. 12. Seminal and nodal roots of V2 seedling.

Regarding Seeding Depth & Rooting Depth: *Some folks believe that planting corn deeper encourages deeper rooting and vice versa. This belief is mostly myth with a slight hint of truth mixed in. It certainly is true that the depth of the SEMINAL root system is influenced by seeding depth. However, the NODAL root system that develops from the crown of the plant is not influenced much at all by seeding depth. This is because the depth of the crown is fairly constant regardless of seeding depth. During emergence of the seedling, the mesocotyl elongates and elevates the coleoptile and crown towards the soil surface. As the coleoptile nears the soil surface, changes in the ratio of red to far red wavelengths of light causes a change in the supply of one or more growth hormones from the coleoptile to the mesocotyl tissue and mesocotyl elongation consequently comes to a halt (Vanderhoef & Briggs, 1978). Since the depth at which the emerging seedling senses the change in red to far 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.*

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 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 square 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 (Fig. 13). 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.*

Fig. 13. Root hairs on a V2 corn seedling.

Corny Trivia: *The primary meristem of a root is located near the root tip (Fig. 14). Elongation of cells behind the meristem leads to elongation of the root.*

Fig. 14. Apical meristem of root.

A split stalk of an older plant will reveal a "woody" or "pithy" triangle of stalk tissue at the bottom of the corn stalk. This triangle is typically comprised of four stalk nodes, stacked sequentially with #1 at the bottom, whose associated internodes do not elongate (Fig. 15). The first internode to elongate is USUALLY the one above the fourth node, which elongates about 1/4 to 1/2 inch, above which is found the fifth node, which is typically 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 (Fig. 16).

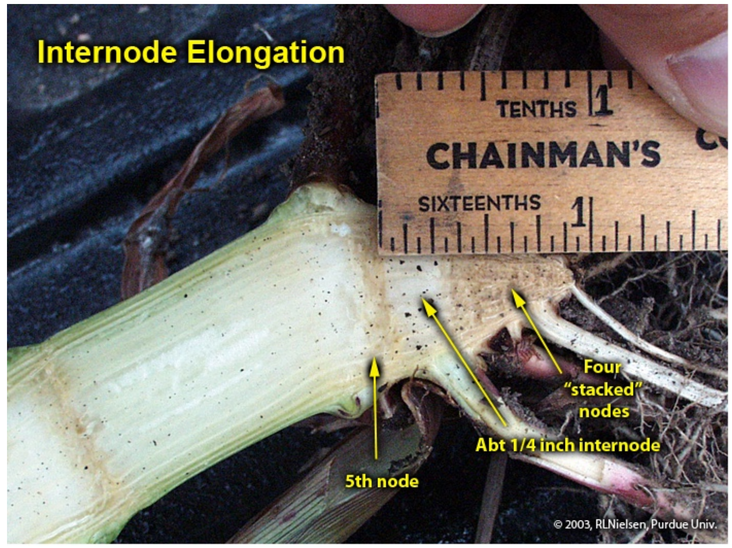

Fig. 15. Internode elongation between fourth and fifth nodes of a corn plant.

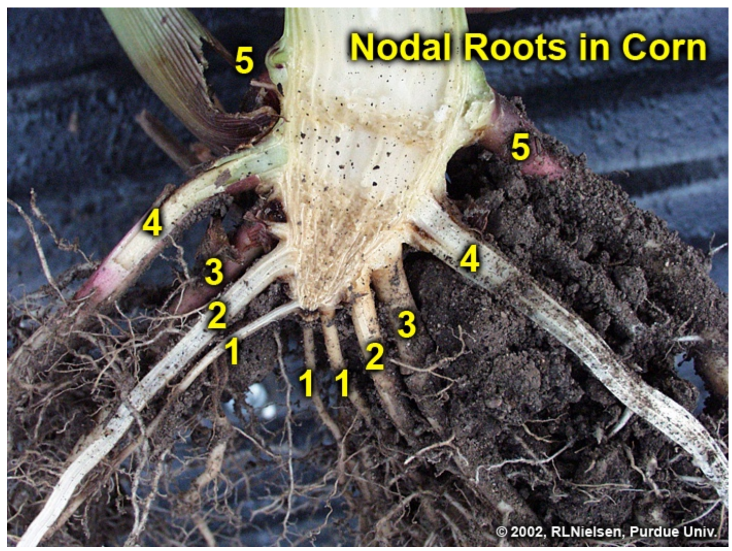

Fig. 16. Five identifiable sets or "whorls" of nodal roots in a split stalk section.

Corn seedlings transition from nutritional dependence on kernel reserves to nutritional dependence on 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).

Starter Fertilizer Note: *The success or not of this transition period that occurs around the V3 stage of development greatly influences whether the crop continues to develop strongly and uniformly. It is not uncommon for fields to develop rather uniformly up to about V3 while they are still relying upon kernel reserves. However, sometimes these heretofore uniform stands of corn "fall apart" beyond the V3 stage if* *nodal root development has been compromised by "crappy" growing conditions and the transition from kernel reserves to nodal root support fails or is less than successful. It is at this stage that starter fertilizer plays a role in ensuring that the transition period occurs successfully. At about V3, one or more of the nodal roots will tap into a starter fertilizer band placed approximately 2 inches to the side and 2 inches below the seed (the proverbial 2×2 placement). Starter fertilizer placed in this position has the advantages over seed-placed starter fertilizer because a) its position relative to nodal root development is more advantageous and b) higher rates of nitrogen and/or potassium can be used without risk of injury to the seed during germination and emergence.*

A somewhat uncommon, but dramatic, stunted root symptom is one referred to as the "floppy corn" or "rootless corn" syndrome (Nielsen, 2019a). This problem occurs most commonly 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.

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Choosing The Right Nitrogen Rate For Corn Is Important To Profitability

(Jim Camberato) & *(Bob Nielsen)*

Although nitrogen (N) fertilizer can be costly, it is needed to optimize profit in Indiana cornfields. Applying too little N reduces profit by reducing grain yield. Too much N does not return value and can also damage the environment.

Results from 167 field-scale N response trials conducted over more than 10 years underpin current region-based N recommendations. These data-driven N recommendations replaced the old yield-goal based system[1], which was proven ineffective. Current recommendations represent the N rate for maximum profit over the long-term, but differences in soil type, management, and weather can result in lower or higher N requirements in any given situation. Rainfall after N application will primarily determine the efficiency of applied N[2], with excessive rainfall causing higher N loss and greater need for fertilizer N. Although N applied prior to planting this season has not been subject to conditions promoting N loss in most areas of Indiana, N loss can occur season-long, particularly prior to the V8 growth stage when corn N uptake and water use are relatively low.

Economic optimum N rates vary by as much as 40 pounds of N per acre across regions so adjusting the N rate by region is important. Recommended rates can also be adjusted by the price of N fertilizer and the expected value of grain using tabular data in the publication "Nitrogen Management Guidelines for Corn in Indiana"[3]. With N at $0.40 per pound and corn at $3.25 per bushel, the average N rate needed on fine-textured soils to maximize profit is about 30 pounds per acre less than that needed to maximize yield. On sandy non-irrigated soils, the difference is only about 10 pounds per acre. Using the economic optimum N rate, rather than the N rate needed for maximum yield, would reduce yield 1 to 3 bushels per acre across soil textures and regions. The loss in profit when fertilizing to maximize yield would be approximately $7 per acre for fine-textured soils, but only $2 per acre on sandy non-irrigated soils.

Nitrogen rates recommended are for efficient applications of N, such as anhydrous ammonia (AA) within a couple of weeks prior to planting or sidedressed AA or liquid N. Earlier applications of liquid N[2] or surface applications of urea on no-till ground[4] can reduce profit under certain conditions. Additional details on how to manage N efficiently can also be found here[3].

Nitrogen (N) rate on-farm trial in field with hog manure applied in early August the previous year. The 16-row strips that are the most yellow-green only received 30 lbs N / acre as starter fertilizer and no sidedress N application. The economic optimum N rate for the trial turned out to be 147 total lbs of N applied per acre, with an average yield of 234 bushels / acre. Photo taken 14 August. (*Source: Bob Nielsen, DJI Zenmuse X4S camera on DJI Matrice 200 UAV at 400 ft flight altitude.*)

Resources

[1]A Historical Perspective on Nitrogen Fertilizer Rate Recommendations for Corn in Indiana (1953-2011). J. Camberato. March 2015. https://extension.purdue.edu/extmedia/ay/ay-335-w.pdf

[2]N Loss Mechanisms and Nitrogen Use Efficiency. R.L. Nielsen. 2006. http://www.agry.purdue.edu/ext/pubs/2006NLossMechanisms.pdf

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Hay Harvest Is Near

(Keith Johnson)

As we near mid-May, it is important to have hay harvest equipment in excellent condition so the forage can be harvested at optimum quality when weather conditions allow and to reduce harvest delays because of equipment breakdowns. What are "Best Management Practices" associated with haymaking?

- Take advantage of every hour that the sun shines. While mid-afternoon is the time of day that there is a slight improvement in forage quality because of elevated sugar content, if the weather forecast for drying hay to safe baling moisture is questionable, consider mowing in the morning to have more drying time.
- Mow the forage with a properly set mower-conditioner so the stems are crimped every three to four inches. This will increase rate of moisture loss.
- Lay the forage in a wide swath and not a narrow windrow. This, too, will increase drying rate.
- Consider tedding the crop if there is concern about not getting to a safe baling moisture before inclement weather occurs. Tedding should occur when the moisture is greater than 50 percent to reduce yield and quality loss from the aggressive action of tedding when the forage is too dry.
- Raking the forage into a windrow should occur when the moisture is around 40 percent. If raked at a lower moisture level, there will be loss of leaves which will result in yield and quality loss. Set the tines on the rake high enough that soil does not contaminate the forage.
- Bale small rectangular bales at 20 percent moisture, large round bales at 18 percent moisture, and large rectangular bales at 17 percent moisture. Hay baled at too high a moisture content will heat, mold, and spontaneous combustion is possible.
- Store high quality hay under cover (Examples: properly ventilated building, hay tarp properly secured) to reduce deterioration from weathering. Storing hay on a six-inch layer of very coarse rock placed on geotextile cloth will reduce (not eliminate) deterioration at the bottom of the bales.

The link below is a video about the process of making dry hay.

https://www.youtube.com/watch?time_continue=81&v=H9JDL9MjWsQ&feature=emb_logo

Many of you have put much effort into producing the forage thus far. Use best management practices to get the forage cut, dried and into storage. Be safe!

A successful hay harvest requires using proper harvest procedures of mowing, tedding, raking, and baling.

Be On The Lookout For Volunteer Hemp

(Marguerite Bolt, mbolt@purdue.edu)

Hemp can germinate in soils between 40-50°F, and with the warm temperatures in late march, volunteer and feral hemp (ditch weed) had the right conditions to pop up. Feral hemp was observed on March 29th in Jasper county (thanks Bryan Overstreet). However, the recent cold temperatures did cause some damage. 2019 hemp growers should be on the lookout for volunteers if they grew for seed/grain or harvested their fiber hemp after seed set. From an insect pest management perspective, volunteer hemp can be a food source for pests early in the season, like Cannabis aphid. Cannabis aphid overwinter as eggs in the field, so volunteer plants provide an early season meal.

If you are planting hemp in the same field as last year, your site should already be licensed for 2020. However, if you are going to plant a different crop in that 2019 hemp site, be sure to terminate volunteers. Hemp is pretty wimpy early in the season and can be terminated through tillage. Historically, feral hemp has been controlled by county weed boards with herbicide applications. Volunteers are likely to perish during a burn down targeted at broadleaf weeds.

Feral hemp found on March 29th, 2020 in Jasper County. (*Photo Credit: Bryan Overstreet*)

Feral hemp with frost damage.

Hemp Planting Almost Underway

(Marguerite Bolt, mbolt@purdue.edu)

Hemp growers and researchers are preparing to plant hemp in the next two to three weeks across the state. Planting will likely continue until the end of June depending on what type of hemp is being grown. We may even see early July plantings again for cannabinoid (CBD, CBG) producers.

The multi-year Organic Agriculture Research and Extension Initiative project is underway for this year. This project is multi-disciplinary and involves faculty in Botany and Plant Pathology, Agronomy, Entomology, and Agricultural Economics. One part of the project assesses hemp in three different rotational models. To begin this project, Meigs and SWPAC planted vetch. At Meigs, we will till the vetch today and plant hemp seed in the next two weeks. At SWPAC, we will till the vetch in the next week and plant hemp seed in the next three weeks. I am looking forward to sharing more about this project in the coming months (and years). There are several other hemp projects at Meigs and other PACs this year, as well as a lot of on-farm research. I will have no shortage of information to share!

In other news, I found flea beetles on feral hemp in Jasper County, IN (Figure 1). Growers may see some flea beetle feeding on seedlings, but it is unclear how extensive damage could be. Flea beetles are common in hemp, but last year growers did not call me about damage until mid-July. At this point, their plants could take a hit from leaf chewers. I found a lot of Red-headed flea beetles in the middle of summer last year. I am unsure of the species in figure 1, but I am hoping to catch some next time I am in one of the feral hemp patches.

Lastly, there are more opportunities for webinar-based education, with a new webinar series organized by Simon Kafari in Clark County. This webinar series runs on Tuesdays from 11 am-12 pm and interested parties can sign up by calling the Clark County Extension Office (812-256-4591) or can email Simon Kafari (skafari@purdue.edu). I hope people are able to tune in and listen to some top-notch speakers.

Figure 1. Flea beetles feeding on feral hemp in Jasper County, taken 5/1/2020.

“Murder” Hornets: Should You Panic? Probably Not. Here’s Why.

(Elizabeth Barnes), *(Cliff Sadof)* & *(Brock Harpur)*

Headlines all over the country have been sounding the alarm about “murder” hornets. Should you be worried? Yes and no. The presence of these hornets in the United States is bad news for bees and beekeepers alike but there’s no need to panic yet.

Asian giant hornets have bright yellow heads and a distinctive large body size.

(*Image taken by LiCheng Shih of flckr.com*)

Where did they come from and where are they right now?

The Asian giant hornet originally came from tropical and temperate Asia. We are currently only aware of introductions in British Columbia and Washington State. It's very unlikely that you've encountered one if you live in other parts of North America.

Are they in Indiana yet?

No, they have not been seen in Indiana nor have they been seen in any states near us. It is highly unlikely that there are any Asian giant hornets in Indiana.

What's with the name?

The name murder hornet is a misnomer. They're not malicious. They're just hungry, efficient hunters. If you're interested in learning more about this hornet, try looking under one of its other names: Asian giant hornet, giant Asian wasp, giant Japanese hornet, giant sparrow wasp, or, if you know a bit of Japanese, □□□□□□□.

Are they going to hurt me or my family?

To date, only a single colony has been discovered in Washington state. It remains unclear how successful members of that colony were at overwintering and if they established new colonies this spring. Therefore, you're very unlikely to encounter an Asian giant hornet. However, should you find a colony, don't approach them as their stings can be serious and can even lead to death. Beekeepers are the most likely to encounter Asian giant hornets and should keep aware of the states in which this hornet has been found. In general, you should use the same caution that you do with any stinging insect. They are not generally aggressive but will defend their nests or the beehive they are attacking. They generally nest in wooded areas in abandoned borrows in the ground.

How do they impact bees?

Unlike Asian honeybees (*Apis cerana*), the European honeybees (*Apis mellifera*) we keep in the United States don't have any defenses against these hornets*. Asian giant hornets mark beehives with a scent that attracts other hornets. They quickly kill the bees in the hive often by decapitating them. Once they are finished with this process, some of the hornets guard the beehive while the other hornets collect and kill the larval bees. The hornets then bring the bee larvae back to their nest to feed to the larval hornets. This process generally occurs in late summer and early fall. These hornets also eat many other types of insects like praying mantises and large caterpillars.

How are they different from native or already introduced hornets?

The simplest difference? They are BIG and have a bright yellow head. These hornets are much larger than any other wasp or bee in North America. You can find a handy size comparison here.

Can we prevent them from becoming a problem?

Officials in both Washington state and in Canada are working hard to eradicate them. There's hope of stopping them if we act aggressively right now and sustain our efforts in the coming years. It's much easier to stop invasive species before they have the opportunity to establish and multiply. You can help by learning about the invasive species that are likely to be in your area, keeping an eye out for them, and letting someone know if you see them using the resources below.

What should you do if you see one?

You probably will not see an Asian giant hornet in Indiana anytime soon but if you think you've seen this hornet or any other invasive species you should report it! Follow the steps we recommend on reportINvasive.com:

- The GLEDN Phone App
- EDDMaps
- 1-866 NO EXOTIC (1-866-663-9684)
- depp@dnr.IN.gov
- Contact your local extension educator for help!

Further reading:

- Asian Giant Hornet information from Washington State
- Information from The Entomological Society of America
- Asian Giant Hornet Factsheet

*The Asian honeybee (*Apis cerana*) has a series of really dramatic defense mechanisms that can protect them from these hornets. Once they've detected that their hive has been marked for attack by the Asian giant hornet the bees work together to make a warning noise that essentially lets the hornets know that they're prepared for a fight. Many times, the hornets will give up at this point and look for another hive. If the hornets do still land on the hive the bees will cover the hornet in a giant living ball of bees and vibrate so much that it raises the temperature of the ball high enough to kill the hornet.

Large wasps in Indiana, from left to right, bald faced hornet, European hornet, cicada killer (not to scale). (*Photo Credits: John Obermeyer, Entomology, Purdue University*)

Ready For Winter To Be Over

(Beth Hall)

The earth's position and movement around the sun welcomed the spring equinox on March 19th, and meteorologists in the northern hemisphere welcomed spring on March 1st. Unfortunately, the atmosphere – particularly over the midwestern and Great Lakes states – refused to acknowledge those dates to offer us a more traditional spring. Sure, Indiana's spring 2020 has been drier than 2019. The compromise to that gift, however, came with periods of below normal temperatures, and potentially below *freezing*, damaging conditions this Friday across much of state (Figure 1). This may not even be a one-and-done phenomenon as the National Weather Service is predicting a risk of much below-normal temperatures for the far northern counties in Indiana for May 13-15. Is Mother Nature aspiring to break low temperature records? The record latest dates for 32°F or lower minimum temperatures are mostly after May 15th, so we will just have to watch and see.

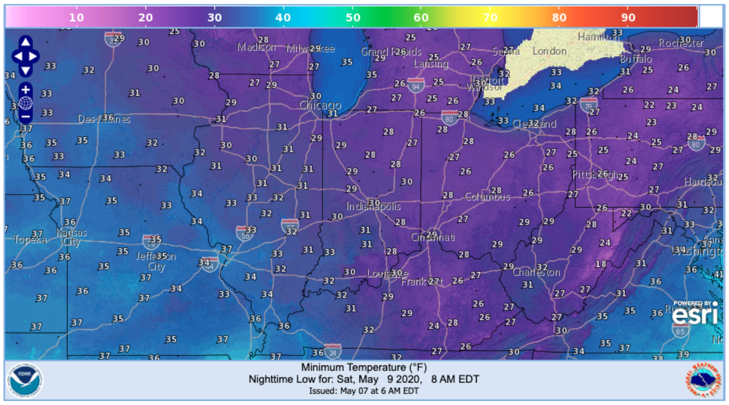

Figure 1. Forecasted minimum temperatures for early morning Saturday, May 9, 2020.

In addition to being unwelcomely cold, these below-normal temperatures have had two other effects. First, growing degree days are accumulating at a slower rate. Currently, Indiana is about 50-80 units below normal modified growing degree-day accumulations (Figures 2 and 3). This has slowed a lot of plant growth and also kept soil temperatures cooler. The other effect is the reduction to evapotranspiration rates (Figure 4). April was drier than normal and May has not yet started to compensate for that. Looking at precipitation alone might lead one to assume agricultural drought is developing. However, cooler temperatures are helping to keep that moisture in the ground longer than what would otherwise be normal given the decreased precipitation.

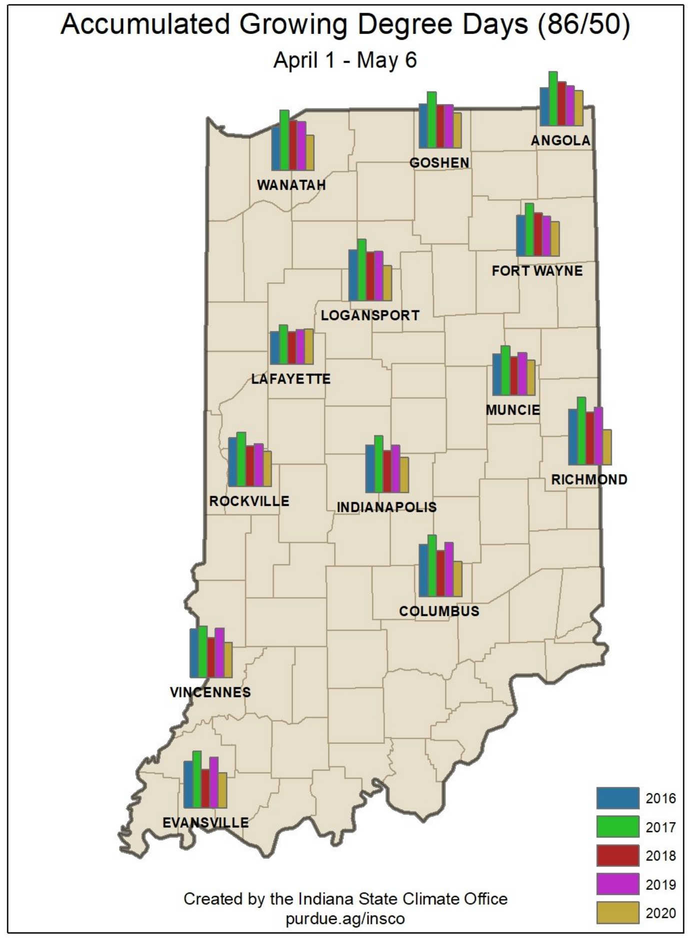

Figure 3. Modified growing degree-day for April 1 – May 6, 2020 compared to the previous 4 years.

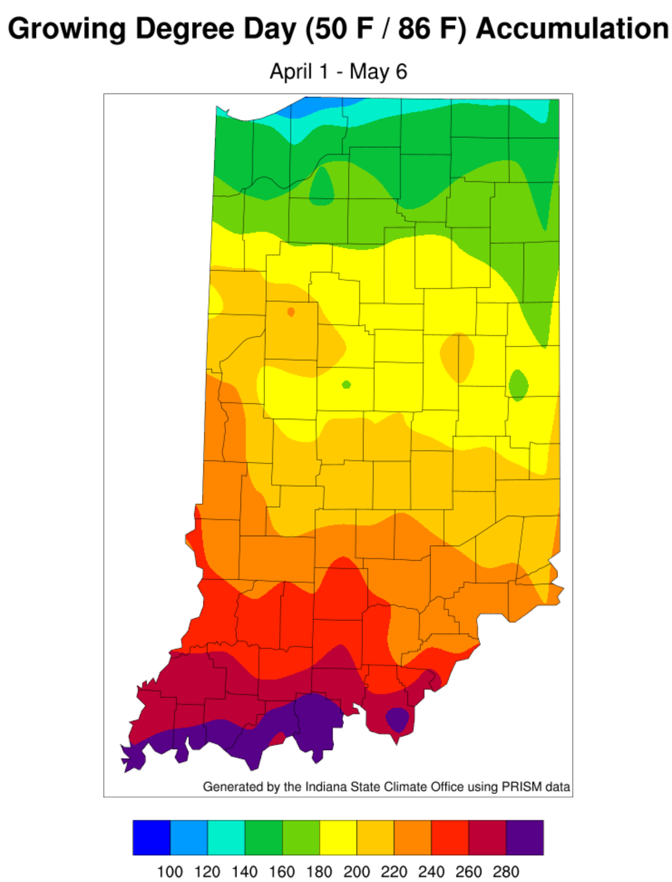

Figure 2. Modified growing degree-day accumulation for April 1 – May 6, 2020.

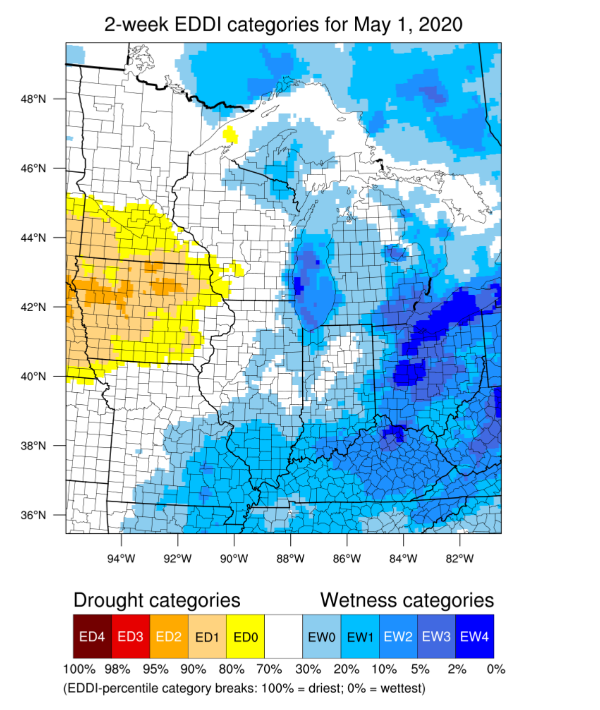

Figure 4. Two-week Evaporative Drought Demand Index (https://psl.noaa.gov/eddi/) representing April 18 – May 1, 2020.

The climate outlook for May is predicting below-normal temperatures.

The precipitation outlook is split across the state where the models are showing weak confidence for below-normal precipitation in the northern half of the state and too much uncertainty for the southern half (Figure 5).

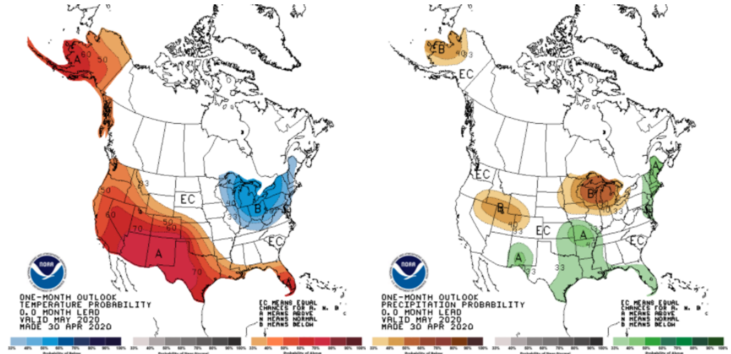

Figure 5. Climate outlooks for May 2020 that indicate the level of confidence for above- or below-normal conditions. Temperature outlook is on the left; precipitation outlook is on the right.

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