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In This Issue

Little Black Bug…BIG Bite

(John Obermeyer)

If out in the fields, or around the yard, during these beautiful fall afternoons, you may have experienced very unpleasant bites on exposed skin. The big surprise is how tiny these black bugs are, barely visible without magnification. Too, I have been attempting some exterior painting on our house this fall. Start too early on these cool mornings, the paint doesn't flow well. Wait until warmup, then these black bugs are not only biting but getting into the newly painted surfaces. Their stuck bodies create an undesirable contrast to the white paint I am using!

The insidious flower bug, Orius insidiosus, (got to love that name) is present throughout the growing season, as they are common predators of small, soft-bodied insects, such as aphids. Their straw-like mouthpart sucks fluids from prey, so their habit is to pierce objects to determine if they are a good meal. Apparently, there was an abundance of aphids/mites/trips nearby that has declined with the cooler temperatures. Now these bugs are foraging for a final feast before wintering in protected areas, such as under leaf litter. The good news is that while "biting" (poking) you, they aren't sucking blood or injecting toxins. Those with more sensitive skin have noted welts where bitten. The bad news is the obvious, the little suckers give quite a bite, and they seem to be attracted to fresh paint!

Some have tried using insect repellent while working outdoors, most with little success. Probably because these bugs are most active when you are, meaning perspiration lessens the effect of the repellent and actually makes you more attractive to the hungry insects. As for my painting, the forecasted temperatures for frost by this weekend will hopefully convince them to bed down for the winter, giving me enough time to finish before the snow flies.

Tiny insidious flower bug "biting" my hand.

Closeup of insidious flower bugs attracted to freshly painted surface.

Insidious flower bugs adding contrast and texture to my painted house siding.

Soybeans and Neonicotinoids: Update From Regional Research

(Christian Krupke)

As we close out a difficult 2019 growing season, growers turn their attention to seed orders for 2020. After choosing the correct hybrid/variety, the discussion quickly turns to seed treatments – in both corn and soybeans, there are a range of options usually led by one or more protectant fungicide modes of action and neonicotinoid insecticides.

While neonicotinoid seed treatments (NSTs)have a wide range of soil-dwelling and early season pests on the label in both corn and soybeans, the vast majority of those have historically been sporadic, occasional pests. Yet, the market for seed treatments in both crops has exploded in the last 10-15 years and almost all corn and the majority of soybeans are treated with either clothianidin (Poncho) or thiamethoxam (Cruiser). That rapid increase in use rates hasn't been driven by pest outbreaks.

Led by Dr. Shawn Conley at UW-Madison, a group of entomologists, agronomists and plant pathologists recently published a meta-analysis including data from the major soybean-growing states in the US, with the goal of assessing whether neonicotinoid and fungicide seed treatments offer yield benefits.

Our analysis, spanning 12 years and 14 soybean-producing states, provided no support for the current levels of NST use in soybeans. On the contrary, our data indicated that this approach provides little to zero net benefit in most cases. This may be surprising to some, but remember that seed treatments are a form of insurance pest management. When you purchase them, you are betting that insect damage is likely to be severe enough to justify their cost. Add to that the consideration that any damage must occur in the first 2-3 weeks after planting, while insecticide levels in the plant remain high enough to kill insects. These data demonstrate that that is simply not the case very often in the principal soybean-growing regions of the country, including Indiana.

Without economic infestations of pests, there is no opportunity for this (or any) plant protection strategy to provide benefit to most producers. With NSTs in soybeans, soybean producers are purchasing insurance against pest damage that very rarely happens. Rarely doesn't mean never, and knowing your specific field history and conditions remains the best approach to minimizing risks. But it's clear that soybean producers are buying a lot of protection they just don't need.

This is the largest study of its kind to date, and provides producers and pest managers food for thought as they decide if and where they want to cut input costs heading into the 2020 season. You can read the full paper here, or a summary extension publication here.

What is the benefit of the insecticide on these soybean seeds...read this study.

The "Zipper" Pattern of Poor Kernel Set in Corn

(Bob Nielsen)

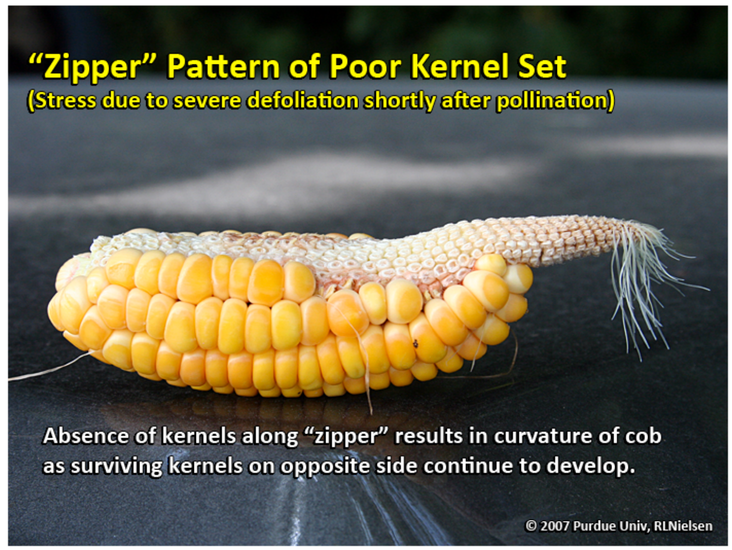
The occurrence of severe photosynthetic stress (severe drought, extreme heat, severe nutrient deficiency, severe foliar disease) during or shortly after pollination in corn often results in poorly filled ears due to incomplete pollination or abortion of young kernels. Often such poor "kernel set" occurs primarily on the tip end of a cob, but some times the problem manifests itself down one side of the cob, affecting several rows of potential kernels. Such a pattern of poor kernel set is euphemistically referred to as a "zipper ear".

DISCLAIMER: Not to be confused with the Kuhn Rikon Corn Zipper kitchen gadget!

The absence of kernels on the tips of ears as a result of stress can be explained physiologically from the standpoint that tip silks are usually the last to emerge from the husk during pollination and, thus, are usually the last to capture pollen if pollen is still available. If pollen is no longer available when the tip silks emerge, then the tip ovules are never fertilized (in a sexual context) and no kernels develop (i.e., blank cob tips or "tip back"). If pollen capture by the later emerging tip silks is successful and the tip ovules are fertilized, then the tip kernels are younger relative to the others on the cob. Younger kernels at the tips of ears are more vulnerable to abortion when severe photosynthetic stress occurs early in the grain fill process… thus, the usual pattern of poor kernel set at the tips of ears.

A less common pattern of poor kernel set is one that is often described as the "zipper" pattern wherein 1 or more entire rows of kernels along one side of a cob are absent due to some combination of pollination failure and kernel abortion. A subsequent symptom that often develops on such "zipper ears" is a noticeable curvature of the cob, sometimes to the extent that folks describe it as a "banana ear". These curved ears are a consequence of the absence of kernels on one side of the cob coupled with the continued development of kernels on the other side that "force" the cob to bend or curve.

While most recognize that the absence of kernels down one side of the ear is the result of severe photosynthetic stress, it is less obvious why the problem occurred along one side of the ear rather than being localized at the tip of the ear. The cause(s) of the “zipper” pattern of kernel abortion is not well understood nor well documented. Following are a couple of ideas.



Silks “Shading” Other Silks?

In a number of fields where I have observed the “zipper” pattern, the side of the ear with the kernel set problem is the same side over which the silks draped during the pollen shed period. This leads me to speculate that perhaps the draping of the silks resulted in the underlying silks being “shaded” from initial contact with pollen, causing those silks to either a) never capture pollen and the connected ovules never fertilized or b) capture pollen later than the rest, resulting in delayed kernel development and, thus, being more vulnerable to abortion under subsequent stress. The connection between silk “draping” and “zipper” ears would be more likely in situations where silk emergence occurs several days prior to pollen shed, allowing for silk elongation and “draping” to occur.

Note: Some modern drought-tolerant hybrids have an aggressive silking habit that resists the usual delay in silk emergence under extreme drought. When soil moisture is not limiting, these hybrids often silk 3 to 4 days prior to the beginning of pollen shed. In that period of time, the first emerging silks can elongate upwards of 4 to 8 inches before pollen shed begins (Nielsen, 2018).

Differential Heating Around Circumference of Ears?

Another possible contributing factor was suggested by an acquaintance of mine at DuPont Pioneer who indicated that drought researchers within that company reportedly documented that cob / ovule / kernel temperature can vary around the circumference of a developing ear of corn, with upper side of the ear potentially warmer than the lower side of the ear. If true, I presume such a difference would be caused by more exposure to sunlight on the upper side of the ears during daylight hours.

That observation reminded me of a research article published in 2001 that looked at the effects of differential heating on silk timing and kernel survival in corn (Cárcova and Otegui, 2001). In that research, the authors applied electrical heating strips at the tips or along one side of ears for a 14-day interval from about 2 days before silk emergence to about 12 days after silk emergence. The heating strips were designed in such a way as to raise the temperature of the affected area of the ear by about 9 degrees F with respect to the ambient air temperature.

Neither of the heating treatments affected silk emergence timing or the number of emerged silks, probably because the heating treatments were imposed after silk elongation had already begun within the husks. Heating the tips of ears also had no effect on final ovule numbers.

However, heating one side of the ears resulted in significant kernel abortion on the opposite, non-heated side. The authors speculated that the heating treatment may have enhanced kernel metabolic activity and increased the partitioning of photosynthetic assimilate to the developing kernels on the heated side of the ear, at the expense of lesser photosynthetic assimilate available to the developing kernels on the non-heated side of the ear.

The results of this research, coupled with the observations from DuPont Pioneer researchers that the upper sides of ears are often warmer than lower sides, would certainly offer a possible explanation of the “zipper” pattern of kernel abortion in years where the crop experiences not only excessive heat but also drought stress during or shortly after pollination. In addition to delayed metabolic rates and restricted photosynthetic assimilates, the development rate of the cooler kernels would be slower and, thus, the kernels somewhat “younger” and more vulnerable to the effects of severe stress.

As I have looked more closely at “zippered” ears in recent years, though, the “zipper” pattern does not always occur on the lower (and possibly cooler) sides of the ear. However, the concept of differential heating of ears around their circumference certainly seems plausible as a factor contributing to the “zipper” pattern of kernel abortion.

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Tassel Ears in Corn

(Bob Nielsen)

Seems like every year some fellow walks into the Chat 'n Chew Cafe carrying an odd-looking tassel that is part tassel and part ear to show off to the guys over at the corner table. Much discussion always ensues over the causes of tassel ears, but the usual consensus is that it falls into the general category of corny oddities and is rarely a yield-influencing factor.

The male and female reproductive organs of a corn plant are contained in physically separate unisexual flowers (a flowering habit called "monoecious" for you trivia fans.) The tassel represents the male flower on a corn plant, while the ear shoots represent the female flowers. Interestingly, both reproductive structures initiate as perfect (bisexual) flowers, containing both male and female reproductive structures. Soon after each each reproductive structure has initiated, the female components (gynoecia) of the tassel and the male components (stamens) of the ear shoots abort, resulting in the unisexual flowers (tassels and ears) we come to expect.

Once in a while, some or many of the female flower parts survive and develop on the tassel, resulting in individual kernels or partial ears of corn in place of part or all of the tassel. The physiological basis for the survival of the female floral parts on the tassel is likely hormonally-driven, but the environmental "trigger" that alters the hormonal balance is not known. There are also known genetic mutations that alter normal tassel development by allowing the female flower components to survive.

A "tassel ear" is an odd-looking affair and is found almost exclusively on tillers or "suckers" of a corn plant along the edges of a field or in otherwise thinly populated areas of a field. It is very uncommon to find tassel ears on the main stalk of a corn plant.

Without a protective husk covering, the kernels that develop on tassel ears are at the mercy of weathering and hungry birds. Consequently, harvestable, good quality, grain from tassel ears is rare.

Some folks lump the tassel ear symptom into the same category as the malformed tassel symptom of the so-called "crazy top" disease. These two odd tassel symptoms are not related and, in fact, look totally different. The "crazy top" disease is caused by infection of young corn plants during ponding events by the soil-borne fungus *Sclerophthora macrospora* that eventually expresses itself by altering normal tassel development (and sometimes ear shoot development) into a mass of leaf tissue.


Tassel-ear on a Tiller of Corn
© 2013 Purdue Univ, RLNielsen


Tassel-ear on a Tiller of Corn
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Frost or Freeze Damage to Immature Corn

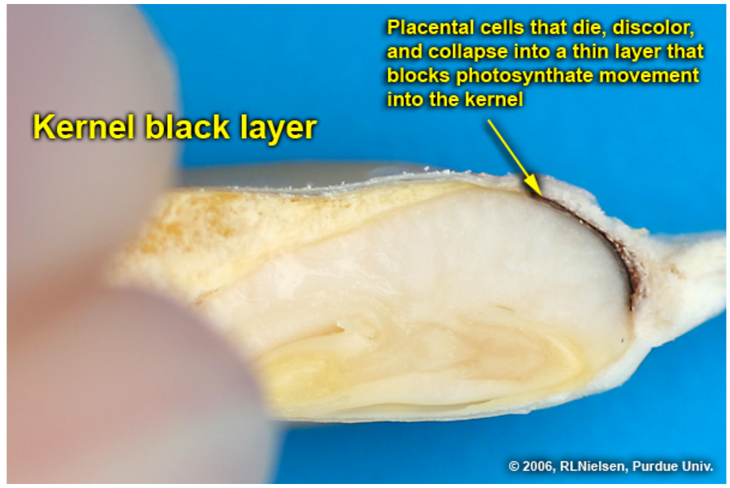
(Bob Nielsen)

Forecasts for freezing or near-freezing temperatures when late-planted fields of corn are not yet mature (i.e., not yet at kernel black layer) are naturally concerning to farmers and the grain markets. What are the consequences for grain yield, grain moisture, and harvestability of immature corn damaged by frost or freeze events?

First of all, recognize there is a difference in how the corn plant responds to “simple” frost versus lethal freezing temperatures. Frost can develop on exposed leaves (or cars or rooftops or deck chairs) at air temperatures well above 32ºF (0ºC), especially when skies are clear, humidity is low and winds are calm. Simple frost can damage or kill exposed leaf tissue (but not cars or rooftops or deck chairs). However, “simple” frost usually does not literally kill entire plants. The consensus among many agronomists is that lethal effects of cold temperature on corn occur when air temperatures remain at or below 32ºF for several hours or perhaps only minutes when temperatures dip to 28ºF (-2.2ºC) before increasing again beyond 32ºF.

When a plant experiences damage or death to leaves due to “simple” frost, photosynthesis may continue to limp along if there are any remaining green leaves. Additionally, remobilization of non-structural carbohydrates from the stalk tissue to the immature grain may continue, thus avoiding some of the potential yield loss.

However, when plants experience truly lethal cold temperatures, photosynthesis and its related metabolic activities come to a screeching halt, stopping further dry matter accumulation in the grain. Contrary to some public opinion, kernel black layer will eventually develop in grain of plants killed prematurely by lethal cold temperature or other severe late-season stresses. The reduction or lack of available photosynthate (sucrose) appears to contribute to the death of the placental cell tissue at the tips of the kernels, which will slowly collapse into a thin, black layer (Afuakwa et al., 1984).



Premature kernel black layer development can also occur in response to any extended period of severe stress during grain filling (especially late in the grain filling process) that significantly reduces photosynthesis, including cool (sub-optimal) temperatures in September and October, even before a frost or freeze event. Conversely, this may explain why kernel black layer development occurred later than expected in some late-planted Indiana corn fields in 2019. September 2019 was 4 to 7º F warmer than normal statewide (Midwest Climate Watch, MRCC, https://mrcc.illinois.edu/cliwatch/watch.htm). Consequently, photosynthetic rates in late-planted fields that were still relatively healthy were likely higher than expected for September and, therefore, greater than usual amounts of sucrose availability may have delayed the onset of kernel black layer development.

Physiological grain yield loss in response to frost or freeze damage results from the cessation of dry matter accumulation. One of the frequently cited references for yield loss estimates in these situtations is Afuakwa & Crookston (1984). Their research in Minnesota, using 80 and 105 “day” hybrids, suggested that, averaged over 4 hybrids, yield loss due to just the loss of leaves (similar to “simple” frost damage) at soft dough (R4), full dent (R5), and half-milkline was 35, 27, and 6% respectively. On the other hand, yield loss due to whole plant death (as would follow lethally cold temperatures) at soft dough (R4), full dent (R5), and half-milkline was 54, 40, and 12%, respectively. The greater yield losses in response to whole plant death are due to the inability of dead plants to remobilize stored non-structural carbohydrates from the stalk tissue to the kernels.

Another source that could be used to estimate yield loss due to just the loss of leaves (e.g., simple frost) is the defoliation chart from the National Crop Insurance Services corn hail loss instructions (reprinted in Klein & Shapiro, 2011). That reference suggests that 100% loss of leaves at soft dough, dent, and nearly mature (which I interpret to be half-milkline) growth stages would result in yield losses of 41, 23, and 8%, respectively.

In addition to outright physiological yield losses, damage by “simple” frost or lethal freezing temperatures can cause other problems for corn harvest, drying, and storage.

Frost damage to leaves that does not kill the stalk allows for some cannibalization of non-structural carbohydrates from the stalk tissue to the immature grain. That may be desirable in terms of minimizing yield losses, but the process physically weakens the lower stalk and increases its susceptibility to root and stalk rots (Nielsen, 2019b). Consequently, severe stalk lodging may occur before harvest that increases the risk of mechanical yield loss during harvest.

Complete and rapid whole plant death due to lethal freezing temperatures may result in affected immature plants literally collapsing to the ground. Not only does this create mechanical havoc with the eventual grain harvest, but ears literally lying on the soil surface for extended periods of time are prone to general deterioration and kernel sprouting.

The daily rate of field drydown in corn following damage by simple frost or death by lethal cold temperatures is not markedly different than grain moisture loss of corn that matures "normally" (Hicks, et al., 1976). HOWEVER, field drydown apparently is temporarily slowed or delayed immediately after such damage occurs and so gives the illusion that overall field drying rates are slower. Nevertheless, frost or freeze damage will cause a delay in the grain reaching desirable harvest moisture contents, especially when the ensuing days following a frost/freeze event are cool and not conducive for rapid grain drying anyway.

Making silage from frost-damaged corn can be problematic because of excessive whole plant moisture, lower quality, possible mold development on the kernels, and stalk nitrate accumulation (Carter & Hesterman, 1990; Lauer, 2004, 2014; Lee & Herbek, 2004; Singh & Cassida, 2019).

Frost damage to immature corn may result in smaller than normal kernels that are often misshapen and prone to breakage upon handling. These consequences can create problems with post-harvest grain drying, handling and storage (Hurburgh, 2012; Maier & Parsons, 1996).

One last comment… When freezing temperatures are accompanied by snow, that adds layers of complexities to the problem. Large amounts of wet, heavy snow can literally bring a standing corn crop to its knees, if not completely to the ground, especially when coupled with strong winds. Obviously, this creates challenges in harvesting the downed corn later. Further drydown of immature grain is also compromised when ears are laying on or near the soil surface. Immature corn grain on plants that remain standing after a snow storm will continue to dry slowly at rates dependent on temperature, sunshine, and humidity. In worst case scenarios where a corn field remains unharvested throughout the winter, there is evidence from Wisconsin (Lauer, 2010) that grain drydown will continue slowly throughout the winter months.

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Perspective from the PPDL: Leaf Spots and Stalk Rots with Mold Between Your Ears

(John Bonkowski)

The last two weeks have shown an increase in samples for stalk rots and ear rots/moldy grain at the Purdue Plant and Pest Diagnostic Laboratory, which is signaling that fields are in the middle of or nearing the end of harvest. Dr. Darcy Telenko has provided two great resources (Stalk Rots Getting You Down? & Ear and Stalk Rots) to help in identifying stalk rot diseases and how to manage them. Determining the type of pathogen is paramount in determining your management options, such as selecting hybrids with resistance to a particular pathogen, determining if/what pesticides will protect your crop, and what cultural practices will help mitigate the damage done (if only for future years).

Multiple corn leaf spot or root rot pathogens also infect the stalk and/or ear. Other ear rots can move in due to insect feeding, exposed ear tips subject to the environment, or rain getting underneath the husk. Knowing what you have earlier in the year, both from leaf spots and seedling rots/blights, can help you figure out potential risks for stalk and ear rots later in the season.

Different Tissue Types Corn Pathogens Can Infect

Corn Pathogen	Root	Leaf	Stalk	Ear/Cob
Aspergillus	X (seedling)			X
Anthracnose		X	X	
Diplodia	X (seedling)	X	X	X
Fusarium	X	X	X	X
Gibberella			X	X
Nigrospora	X (seedling)			X
Bipolaris (NCLS)	X (seedling)	X		X
Penicillium	X (seedling)			X
Physoderma		X	X	

Anthracnose

Figure 1. Early anthracnose leaf blight lesions.

Figure 2. Anthracnose stalk rot lesions on rind.

Figure 3. Frayed and shrunken inner pith of stalk.

Too Far Gone: Various Stalk Rot Pathogens Isolated

Figure 4. Broken stalk in field.

Figure 5. Cut stalk showing shrunken inner pith.

Since August 1st, 2019, we have received 100 corn samples and were submitted primarily for leaf spot and cultural issues (See Dr. Bob Nielsen's article on Premature Plant Death Due to Drought Stress). The following sample summary only includes the samples from August 1st, so it is not indicative of the entire growing season.

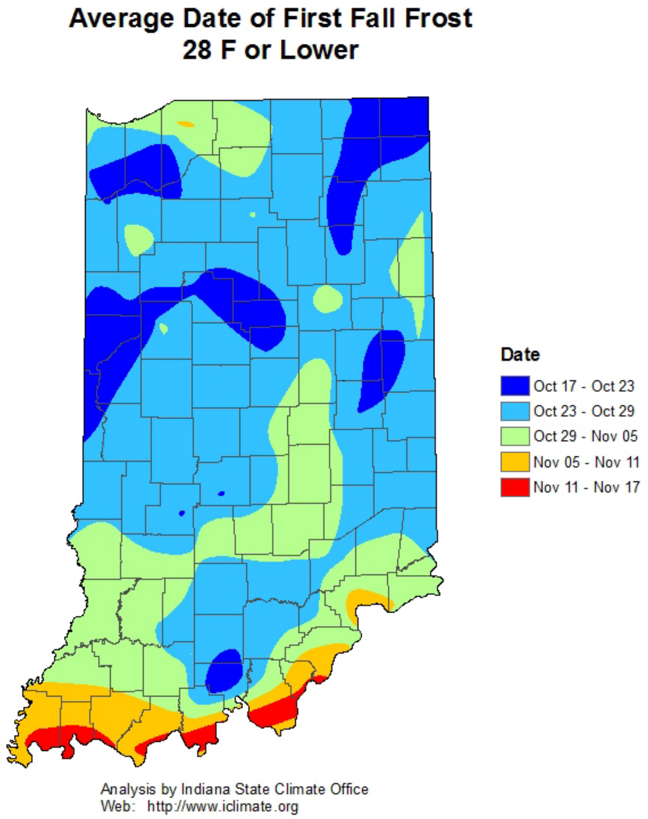
Purdue PPDL Corn Sample Summary (Aug. 1 – Oct. 6)	
Corn Disease	**Number Times Diagnosed**
Abiotic (Cultural, Environmental, Insects, Physiological)	18
Anthracnose Leaf Blight	4
Anthracnose Stalk Rot	2
Common Corn Rust	25
Common Corn Smut	1
Gray Leaf Spot	34
Gibberella Stalk Rot	2
Diplodia Leaf Streak	4
Diplodia Stalk Rot	2
Fusarium Stalk Rot	3
Northern Corn Leaf Blight	16
Northern Corn Leaf Blight	10
Physoderma Brown Spot	6
Southern Corn Rust	34
Charcoal Rot (Stalk)	2
Tar Spot of Corn	19

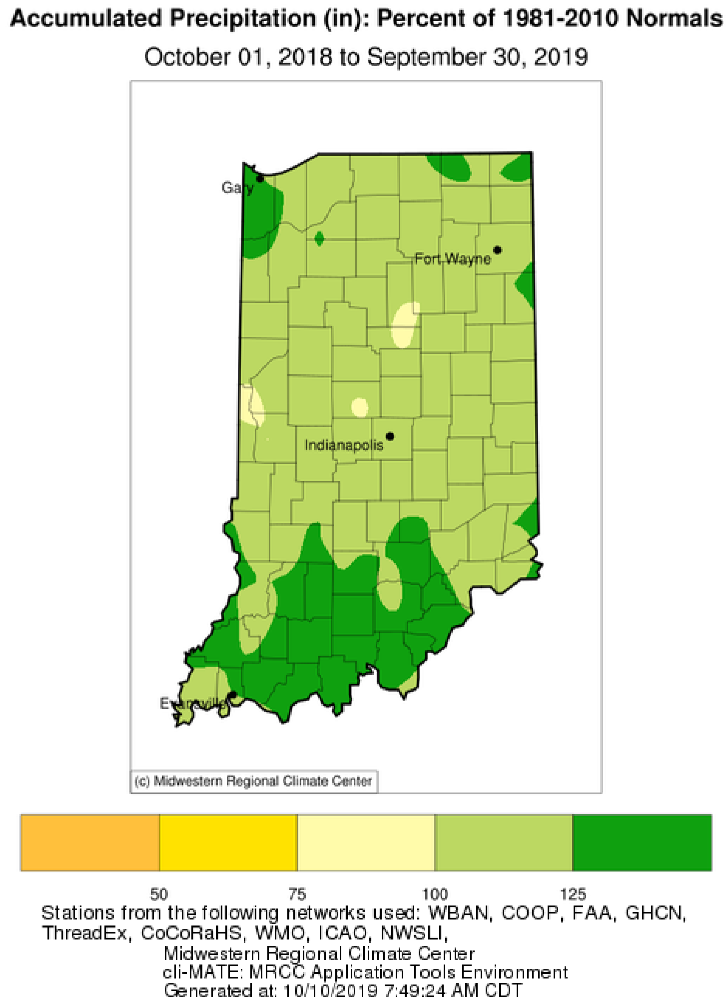
Please note that this summary only represents the samples our lab has received and it includes all diagnoses. Samples we receive often have multiple issues at once, so the number of diagnoses will be higher than the number of samples received.

Indiana Climate and Weather Report – 10/10/2019

(Beth Hall)

Fall is finally here and temperatures are starting to decline. It has been a typical fall, though with above normal temperatures one day with noticeably cooler temperatures the next. The big concern continues to be when that first hard freeze is going to occur. Within the next few weeks, Indiana will be entering the climatological average date of the first hard freeze (Figure 1). Will 2019 be average? While the Climate Prediction Center is predicting slight probabilities of below-normal temperatures from October 15-19, it is doubtful that overnight lows will get down to 28°F. Climate outlooks beyond the 19th are predicting above-normal temperatures. However, keep an eye out for cold weather systems that may pass through your area, for they could bring brief periods of freezing temperatures before returning to what is more climatologically expected.

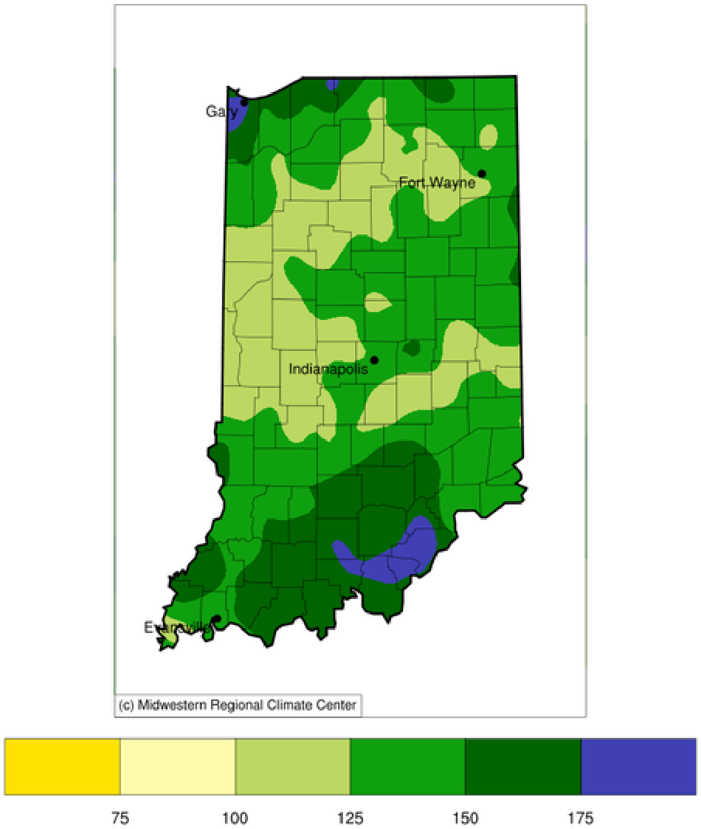




For precipitation, the annual Water Year (October 2018 through September 2019) wrapped up with Indiana experiencing slightly above-normal conditions over the 12-month period (Figure 2). However, this is where averaging data over such a long time can mask the extremes that were experienced. Recall the wet spring conditions across the state compared to the late summer conditions (Figures 3a-b). The climate outlooks are noting that Earth's oceanic-atmospheric system is transitioning to an El Niño – Southern Oscillation (ENSO) "neutral" phase. Historically, there have not been strong impacts between Midwest climate and any ENSO phase, but for broad-stroke climatology, a Neutral phase has been associated with colder winters. Over the past several decades, winter temperatures have been increasing. What does this have to do regarding precipitation? Warming winters could likely mean more winter precipitation will fall as rain rather than snow – which could lead to more runoff rather than the preferable deep soil moisture penetration. However, if a neutral ENSO pattern suggests a cooler-than-normal winter, perhaps Indiana will experience more snow.

Accumulated Precipitation (in): Percent of 1981-2010 Normals

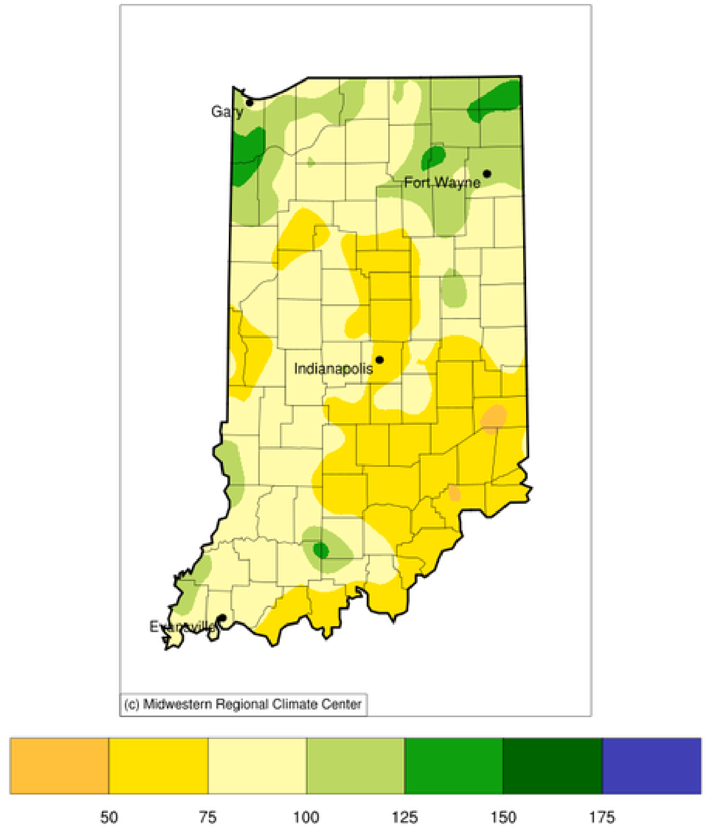
April 01, 2019 to June 30, 2019



Stations from the following networks used: WBAN, COOP, FAA, GHCN, ThreadEx, CoCoRaHS, WMO, ICAO, NWSLI,
Midwestern Regional Climate Center
cli-MATE: MRCC Application Tools Environment
Generated at: 10/10/2019 7:51:58 AM CDT

Accumulated Precipitation (in): Percent of 1981-2010 Normals

July 01, 2019 to September 30, 2019



Stations from the following networks used: WBAN, COOP, FAA, GHCN, ThreadEx, CoCoRaHS, WMO, ICAO, NWSLI,
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