Integrated Pest & Crop Management

Corn Maturity Ratings and Delayed Planting

By Brent Myers and Bill Wiebold

Rain and cool temperatures continue to interfere with planting progress across much of Missouri. Many are on edge as we wonder when we'll get to put corn in the ground. Understandably, this leaves some extra time to examine what management changes might be made as the growing season gets shorter with each day. However, we have faced this before with good results.

Yield potential has begun to decline slightly at this point and a good dose of drying will be needed to get in the field across much of the state, leading to further declines in yield potential. But yield potential is the key phrase. Many other factors besides planting date affect yield, particularly mid- to late-season drought. Given a good growing season, the opportunity for good yields still exists, and we recommend staying with plans for corn until the end of May. At that time we can expect around a 20 percent loss in yield potential and around 40 percent loss by mid-June.

Producers typically want to act if they can and one thing that could be changed until the seed is in the ground is the relative maturity rating of the corn hybrid planted. But this may not a good idea until very late in the corn planting calendar. This is counterintuitive to many because of the way we commonly rate the growing season length of hybrid seed. Typically we use the 'relative maturity rating' when referring to a hybrid and corn hybrids are usually sold as something like '110 day corn'. Naturally this leads to the literal interpretation of these numbers as a number of days. In fact relative maturity rating does not refer to calendar days, but is an index defined relative to a standard hybrid. Further terminology is more precise on the bag than in reality at later planting dates.

A shortened growing season does not necessarily translate into the need for a lower maturity rating. Relative maturity ratings apply to corn adapted or selected for a specific region that is planted 'on time'. Studies indicate that late planted corn matures in fewer calendar days than early planted corn of the same hybrid. Researchers in Indiana and Ohio (Nielsen et al. 2002) planted corn at three dates between late April and June. It was found that later planted corn matured an average of 9 days before earlier planted corn. This average includes both short and long season hybrids.

Corn growth and development is largely controlled by temperature. The standard unit of measure used to mark this progress is the Growing Degree Unit (GDU), sometimes called 'growing degree days' or 'heat units'. An older study from Minnesota (Sutton and Stucker, 1973) found that corn planted early matured about 90 Growing Degree Units (GDU) sooner than early planted corn. Relative maturity ratings, like the 110 relative maturity rating corn

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example above, are calculated from measurements of GDUs in corn development in hybrid trials. Some seed companies publish the GDUs required to reach maturity directly and seed companies differ in how they report hybrid maturity statistics. However, where they are used, both relative maturity rating and GDU are given for corn planted in the optimal window (between early-April and early-May for mid Missouri). These studies indicate that no change in relative maturity rating is required if planting happens within May and so long as adapted hybrids normal to the region are used.

Faster development of late planted corn may in part be due to the 'effective heat units' corn experiences when planted in the optimum period versus mid- to late-May and early-June. Typically GDUs are calculated on a daily basis and are accumulated starting at the date of planting and ending at kernel black layer formation. Black layer formation marks physiological maturity of the corn kernel because it ends the plant's ability to put more photosynthates into the seed. The calculation for GDU in a single day is produced in three steps as follows:

Tmax = 86° F, or the maximum daily temperature between 86° F and 50° F

Tmin = 50° F, or the minimum daily temperature between 86° F and 50° F

GDU = ((Tmax + Tmin)/2) – 50 ° F

It takes an accumulation of between 2400 and 2800 GDUs across the growing season for corn to reach physiological maturity. This range in GDU response accounts for the range in relative maturity ratings, typically between 98 and 120.

Growing degree units for a single day are somewhat like the average of the day's temperatures. However, this calculation does not consider the temperatures throughout the day, or the length of time between min and max. It just limits the calculation to the average of the minimum and maximum temperatures so long as they are between 86° F and above 50° F. Temperatures above 86° F and below 50° F are considered 'ineffective' for plant growth. However, there is a big difference between the effective thermal units in a typical late April day than in a typical late May day. And the emergence lag means that later planted corn is developing in a different thermal environment than its relative maturity rating was designed for.

So back to the initial question, 'should we plant earlier maturing corn for later planting dates?' Probably not. Early maturing corn will also have accelerated development when planted late. We need to make use of whatever growing season is left with as late maturing hybrid we can plant, including late planting acceleration of corn development. Given the Nielsen study referenced above it seems reasonable to subtract 0.25 relative maturity days per days delayed.

For example if 110 day corn was bred and selected for planting by May 1, and not planted until May 30, a delay of 30 days, then we would subtract (0.25 x 30) = 7.5 days from the maturity rating. This would result in an estimated relative maturity rating of about 103.

Nielsen, R.L., P.R. Thomison, G.A. Brown, A.L. Halter, J. Wells, and K.L. Wuethrich. 2002. Delayed planting effects on flowering and grain maturation of dent corn. Agronomy Journal 94(3): 549–558.

Sutton, L.M., and R.E. Stucker. 1974. Growing degree days to black layer compared to Minnesota relative maturity rating of corn hybrids. Crop Science 14(3): 408–412.

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Continue Checking for Wheat Diseases

By Laura Sweets

It is difficult to summarize the current disease picture for winter wheat in Missouri unless to say that it is as variable as the weather has been. There is also a range in stage of growth although across the state wheat development is behind normal. The May 5 "Crop Progress and Condition" report from the Missouri Field Office of the National Agricultural Statistics Service reported 13 percent of the wheat crop headed which is 33 days behind last year and 17 days behind normal. With the majority of the crop still to head and flower, it is important to continue to scout wheat for foliage diseases and to consider the risk of the development of Fusarium head blight.

So what is the current disease situation on winter wheat in Missouri?

Foliage diseases: Powdery mildew was an issue earlier in the season, particularly in southwest Missouri. Septoria leaf blotch is beginning to develop. Digital images from one field in east central Missouri showed moderate to high levels of Septoria while some fields in central Missouri show only a trace amount in the lower canopy. Neither leaf rust nor stripe rust have been reported on wheat in Missouri thus far. But if conditions continue to remain wet, foliage diseases could increase in severity. Descriptions of the common wheat foliage diseases are given below.

Septoria Leaf Blotch

Septoria Leaf Blotch

Lesions of **Septoria leaf blotch** begin as light yellow flecks or streaks. These flecks expand into yellow to reddish-brown, irregularly shaped blotches. Dark brown specks (fruiting bodies or pycnida of the causal fungus, *Septoria tritici*) may be scattered within the centers of mature lesions. Lesions may coalesce killing larger areas of leaf tissue.

Stagonospora glume blotch (formerly called Septoria glume blotch) may also begin as light yellow flecks or streaks on leaves. The lesions also turn yellow to reddish-brown but usually have a more oval to lens shaped appearance than those of Septoria leaf blotch. Again, the dark brown specks or fungal fruiting bodies of the causal fungus *Stagonospora nodorum* may be evident within the lesions. Symptoms of Stagonospora glume blotch are more common on heads than foliage of wheat. Infected heads will have dark blotches on the glumes.

Leaf Rust

Leaf Rust

Leaf rust lesions appear primarily on the upper leaf surfaces and leaf sheaths. Initially, lesions are small, yellow to light-green flecks. Eventually, leaf rust appears as small, circular to oval shaped, orange-red pustules. These pustules break open to release masses of orange-red spores of *Puccinia recondita*. The edges of the open pustules tend to be smooth without the tattered appearance of stem rust pustules. Heavily rusted leaves may yellow and die prematurely.

Stripe Rust

Stripe rust, caused by the fungus *Puccinia striiformis,* has become more prevalent in Missouri over the last few years. Stripe rust may develop earlier in the

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season than leaf rust or stem rust. The pustules of stripe rust are yellow or yellowish-red and occur in obvious stripes or streaks running lengthwise on the wheat leaves. This disease is more commonly associated with cooler temperatures, especially cooler night temperatures.

Stem rust, caused by the fungus *Puccinia graminis* f. sp. *tritici*, is most common on stems and leaf sheaths of wheat plants but may develop on any of the above ground portions of the plant including both upper and lower leaf surfaces and glumes and awns. Stem rust pustules are small, oval, and reddish-brown. The ruptured pustules tend to have more ragged edges than leaf rust pustules. Frequently both leaf rust and stem rust occur on the same plant and both types of pustules may develop on an individual leaf.

Powdery Mildew

Powdery mildew infections begin as light-green to yellow flecks on the leaf surface. As powdery mildew develops the leaf surfaces become covered with patches of cottony white mold growth of *Erysiphe graminis* f. sp. *tritici*, the causal fungus. These patches eventually turn a grayish-white to grayish-brown in color and small black fungal fruiting bodies may be visible within the patches of mildew growth.

The fungi which cause most of these wheat foliage diseases survive in infested wheat residues left on the soil surface. The next growing season spores are produced during moist periods and are carried by wind currents to susceptible wheat leaves where infection may begin. Disease problems tend to be more severe when wheat is planted in fields with infested wheat residue left on the soil surface. Eventually spores that are produced in the initial lesions on plants are wind blown to other leaves or other plants causing secondary infection.

Leaf rust, stem rust and stripe rust are exceptions to this simplified explanation of disease development. The rust fungi do not survive in infested residue left in a field. Rather, the rust fungi are reintroduced into this area each season when spores are carried up on air currents from the southern United States.

Most of the foliage diseases of wheat are favored by warm, wet or humid weather. Frequently infection begins on the lower portion of the plant. If weather conditions are favorable for disease development, the disease may move up through the plant. Severely infected leaves may yellow and die prematurely. Yield losses tend to be highest when the flag leaves are heavily infected.

There are several fungicides that are labeled for use on wheat to control fungal foliage diseases. It is important to scout wheat fields and determine which leaf diseases are occurring as well as the level of their severity before making a decision to apply a foliar fungicide. In particular be on the lookout for Septoria leaf blotch, Stagonospora glume blotch, leaf rust and stripe rust. When scouting fields, try to identify the disease or diseases which are present, determine the average percent of infection on a leaf and the number of leaves showing infection and determine the stage of growth of the crop. Generally, the profitable use of foliar fungicides on wheat depends on a number of factors including varietal resistance, disease severity, effectiveness of the specific fungicides and timing of fungicide application. The greatest increases in yield are usually obtained when fungicides are applied to disease susceptible varieties with high yield potential at the early boot to head emergence growth stage when the flag leaf is in danger of severe infection. Fungicide applications are seldom beneficial if applied after flowering or after the flag leaf is already severely infected. It is also important to read the fungicide label for specific information on rates, recommended timing of application, frequency of applications, preharvest intervals and grazing restrictions.

The North Central Regional Committee on Management of Small Grain Diseases (NCERA-184) developed a table containing information on fungicide efficacy for control of certain foliar diseases of wheat. These efficacy ratings were determined by field testing the materials over multiple years and locations by members of the committee. This table is included in this issue of the IPCM newsletter.

If foliar fungicide applications are being considered it is important to scout fields first. Look for the presence of foliage diseases which might be impacting yield and could be controlled with a fungicide application. But also scout fields for stage of growth. The unusually cool temperatures during March and April have resulted in a late wheat crop. Most parts of the state are reporting

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wheat 14-17days behind average as far as stage of growth. Many of the wheat foliar fungicides are applied at flag leaf emergence, heading or until the beginning of flowering. Most of these fungicides have harvest restrictions of Feekes growth stage 10.5 (head completely emerged) or 30, 35 or 40 days prior to harvest. Due to the cool temperatures, wheat may just be approaching these growth stages. If yield potential is good and weather conditions continue to be conducive for disease development, foliar fungicide applications may be warranted.

Virus diseases: Barley yellow dwarf seems to be the most obvious virus disease occurring on wheat in Missouri this season. Symptoms of wheat spindle streak mosaic and wheat soil-borne mosaic may be more difficult to detect but these virus diseases frequently occur in combination with barley yellow dwarf in wheat in Missouri. Descriptions of these common wheat virus diseases were given in the March 29, 2013 issue of the *Integrated Pest and Crop Management Newsletter*.

Fusarium Head Blight

Fusarium Head Blight

Fusarium head blight or Scab: It is later in the year than normal to be thinking about Fusarium head blight or scab but with the unusually late development of the wheat crop, the wheat in the southern part of the state may be in or just past a susceptible stage of growth and wheat in the remainder of the state could be in the susceptible stage of growth, i.e. flowering, in the next week or two. If fungicide applications for Fusarium head blight management are being considered the stage of growth needs to be monitored carefully. If the frequent rains continue throughout the state conditions could be conducive for the development of Fusarium head blight in fields in which the crop is beginning to flower or is flowering.

Fusarium head blight or scab of wheat develops on plants in the flowering to early grain fill stages of growth. Infection is very dependent on environmental conditions while wheat is in susceptible stages of growth, i.e. flowering. Moderate temperatures in the range of 77-86°F, frequent rain, overcast days, high humidity and prolonged dews favor infection and development of scab. Weather conditions over the next several weeks will determine the extent and severity of scab in this year's wheat crop. Fusarium head blight or scab problems will be more severe if rains coincide with flowering of wheat fields. If the rain continues as the crop moves through the flowering stages, the risk for scab will increase.

The characteristic symptom of scab on wheat is a premature bleaching of a portion of the head or the entire head. Superficial mold growth, usually pink or orange in color, may be evident at the base of the diseased spikelets. Bleached spikelets are usually sterile or contain shriveled and or discolored seed.

Scab is caused by the fungus *Fusarium graminearum*. This fungus overwinters on host residues such as wheat stubble, corn stalks and grass residues. Spores are carried by wind currents from the residues on which they have survived to wheat heads. If environmental conditions are favorable, i.e. warm and moist, the spores germinate and invade flower parts, glumes and other portions of the spike. Scab infection occurs when favorable environmental conditions occur as the wheat crop is in the flowering to early grain fill stages.

Unfortunately, the detrimental effects of scab are not limited to its adverse effects on yield. The fungi which cause scab may also produce mycotoxins. Vomitoxin (deoxynivalenol or DON) and zearalenone may occur in wheat grain infected by scab fungi. This is a primary concern where grain is fed to non-ruminant animals. Ruminants are fairly tolerant of these two mycotoxins. Also, the fungi which cause scab may survive on the seed and can cause seedling blight and root rot problems when scabby grain is used for seed.

Crop rotation, variety selection and residue management are preventative measures for managing scab in wheat. At this point in the season the only remaining management option would the application of a fungicide to try to reduce scab levels. The fungicide table in this issue of the Integrated Pest & Crop Management Newsletter lists the fungicides labeled for the suppression of Fusarium head

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blight or scab. Growers should be scouting fields to get a feel for incidence and severity of scab in this year's wheat crop. Because of possible mycotoxin concerns and seed quality concerns, grain from fields with scab may require special handling. Wheat planted on corn, sorghum or wheat residue (even wheat double cropped with soybeans) has a greater risk for scab.

Other Head Diseases of Winter Wheat:

From flowering through the early stages of grain fill is also the time to scout for other head diseases of wheat such as loose smut, Septoria and Stagnospora infections on heads, bacterial stripe and black chaff on heads and take-all.

Loose smut is obvious as heads emerge from the boot and for several weeks after that. The kernels on infected heads are replaced with masses of powdery black spores. So the heads have a very distinct black, powdery appearance. These spores are eventually dislodged by wind and rain, so later in the season the smutted stems are less evident and only the bare rachis will be left. Spores produced on smutted heads are wind carried to adjacent plants in the field and infect through the flowers. The fungus that causes loose smut survives within the embryo of wheat seeds. If infected seed is planted, the plants growing from those seeds will be infected and develop smutted heads the next season. If seed from a field that has a "small" amount of smut in one season is used for seed, the field planted with that seed may have a substantially higher level of smut. Loose smut is best controlled by planting either disease-free seed or using a systemic fungicide seed treatment.

Septoria leaf blotch is present in the lower canopy of many fields this year. It hasn't seemed to move up in the canopy to the flag leaf or head but with increased precipitaiton and high humidity it could still develop on flag leaves and heads. On the heads dark brown to black blotches may develop. *Stagnospora nodorum* may also cause leaf lesions but is usually more common on heads- again causing dark blotches on glumes of part or all of the head.

Bacterial stripe or black chaff is a bacterial disease that produces symptoms on both leaves and heads. Water-soaked lesions may develop on young leaves. These expand into reddish-brown to brownish-black streaks on the leaves. Glumes and awns show brown-black blotches or streaks. Fungicides are not effective against bacterial stripe or black chaff so the use of resistant or tolerant varieties and crop rotation are the main management options.

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Management of Small Grain Diseases
Fungicide Efficacy for Control of Wheat Diseases (Revised 4-4-13)

The North Central Regional Committee on Management of Small Grain Diseases (NCERA-184) has developed the following information on fungicide efficacy for control of certain foliar diseases of wheat for use by the grain production industry in the U.S. Efficacy ratings for each fungicide listed in the table were determined by field testing the materials over multiple years and locations by the members of the committee. Efficacy is based on proper application timing to achieve optimum effectiveness of the fungicide as determined by labeled instructions and overall level of disease in the field at the time of application. Differences in efficacy among fungicide products were determined by direct comparisons among products in field tests and are based on a single application of the labeled rate as listed in the table. Table includes most widely marketed products, and is not intended to be a list of all labeled products.

Efficacy of fungicides for wheat disease control based on appropriate application timing

Fungicide(s)												
Class	Active ingredient	Product	Rate/A (fl. oz)	Powdery mildew	Stagonospora leaf/glume blotch	Septoria leaf blotch	Tan spot	Stripe rust	Leaf rust	Stem rust	Head scab	Harvest Restriction
Strobilurin	Picoxystrobin 22.5%	Aproach SC	6.0 - 12	G[1]	--	--	--	E	VG	--	--	Feekes 10.5 and 45 days
	Fluoxastrobin 40.3%	Evito 480 SC	2.0 – 4.0	G	--	--	VG	--	VG	--	NL	Feekes 10.5 and 40 days
	Pyraclostrobin 23.6%	Headline SC	6.0 - 9.0	G	VG	VG	E	E[2]	E	G	NL	Feekes 10.5
Triazole	Metconazole 8.6%	Caramba 0.75 SL	10.0 - 17.0	VG	VG	--	VG	E	E	E	G	30 days
	Propiconazole 41.8%	Tilt 3.6 EC[3]	4.0	VG	VG	VG	VG	VG	VG	VG	P	Feekes 10.5
	Prothioconazole 41%	Proline 480 SC	5.0 - 5.7	--	VG	VG	VG	--	VG	VG	G	30 days
	Tebuconazole 38.7%	Folicur 3.6 F[3]	4.0	G	VG	VG	VG	E	E	E	F	30 days
	Prothioconazole19% Tebuconazole 19%	Prosaro 421 SC	6.5 - 8.2	G	VG	VG	VG	E	E	E	G	30 days
Mixed modes of action[4]	Metconazole 7.4% Pyraclostrobin 12%	TwinLine 1.75 EC	7.0 – 9.0	G	VG	VG	E	E	E	VG	NL	Feekes 10.5
	Fluxapyroxad 14.3% Pyraclostrobin 28.6%	Priaxor	4.0 - 8.0	G	VG	VG	E	E[2]	E	VG	NL	Feekes 10.5
	Propiconazole 11.7% Azoxystrobin 7.0%	Quilt 200 SC[3]	10.5 - 14.0	VG	VG	VG	VG	E	E	VG	NL	Feekes 10.5
	Propiconazole 11.7% Azoxystrobin 13.5%	Quilt Xcel 2.2 SE	10.5 - 14.0	VG	VG	VG	VG	E	E	VG	NL	Feekes 10.5
	Prothioconazole 10.8% Trifloxystrobin 32.3%	Stratego YLD	4.0	G	VG	VG	VG	VG	VG	VG	NL	35 days
	Tebuconazole 22.6% Trifloxystrobin 22.6%	Absolute 500 SC	5.0	G	VG	VG	VG	VG	E	VG	NL	35 days

[1]*Efficacy categories: NL=Not Labeled and Not Recommended; P=Poor; F=Fair; G=Good; VG=Very Good; E=Excellent; -- = Insufficient data to make statement about efficacy of this product.*

[2]*Efficacy may be significantly reduced if solo strobilurin products are applied after stripe rust infection has occurred.*

[3]*Multiple generic products containing the same active ingredients also may be labeled in some states. Products including tebuconazole incude: Embrace, Monsoon, Muscle 3.6 F, Onset, Orius 3.6 F, Tebucon 3.6 F, Tebustar 3.6 F, Tebuzol 3.6 F, Tegrol, and Toledo. Products containing propiconazole include: Bumper 41.8 EC, Fitness, Propiconazole E-AG, and PropiMax 3.6 EC. Products containing propiconazole + azoxystrobin include: Avaris 200 SC.*

[4]*Products with mixed modes of action generally combine triazole and strobilurin active ingredients. Priaxor is an exception to this general statement and combines carboxamide and strobilurin active ingredients.*

Nitrogen Watch 2013 launches

By Peter Scharf

On New Year's Day we likely had a lot of N left by last year's droughted corn still in our fields in Missouri. Most or all of that N is gone now– a few deep soil samples taken in early April did not show as much N as expected. Things have only gotten worse since then, with an additional 6 inches of rain over eastern and southwestern Missouri flushing out even more N.

Nitrogen fertilizer that has been applied may be soon to follow. How much fertilizer is lost depends on the weather, the soil, and the source and date of the N application.

Nitrate is the main form of N that is vulnerable to loss, but all fertilizer eventually will convert to nitrate in the soil. Urea, ammonium nitrate, and urea-ammonium nitrate solution are all probably more than half nitrate within two weeks of application, while anhydrous ammonia probably takes six weeks or even longer when soil temperatures are cool. This is why anhydrous ammonia is sometimes applied much earlier than other forms of N.

Between fertilizer application and crop N uptake, which for corn is mainly in June and July, more time and more rain increase the risk that the N won't be there when the crop needs it. Earlier applications are more vulnerable to loss.

Nitrogen Watch is a web-based tool to help you track rainfall and risk of N loss during spring for areas where you farm or do business. It is based on cumulative precipitation maps (Missouri and Midwest) and is updated weekly. On those maps we identify 'danger areas' that are on track to have widespread problems with N loss and deficiency in corn. 'Danger areas' have not necessarily lost enough N to cause serious N deficiency at this point, but if rains keep coming at the same rate in these areas then I expect lots of fields to have N deficiency and yield limitation. This is a serious production and environmental problem that I estimate cost Midwestern corn producers 2 billion bushels total from 2008 to 2011.

Producers and ag service providers in the 'danger areas' should prepare for rescue nitrogen fertilizer applications in the case that nitrogen deficiencies develop.

There are separate maps of 'danger areas' for well-drained and for poorly-drained soils. In well-drained soils, nitrate leaching is the main mechanism of loss. This can start whenever the N fertilizer has converted to the nitrate form. I use April 1 as a typical date to have N applied and some converted to nitrate. The eastern half of Missouri is, along with some of southwest Missouri, currently in the 'danger zone' for well-drained soils that had N applied by April 1.

In poorly-drained soils, denitrification is the main mechanism of loss. This process is fastest when soils are warm and near or at saturation. I use May 1 as a day representing when soils have warmed enough for this process to be significant, although soils were cooler on that date this year than they normally would be. Only a smattering of areas along the eastern side of the state are currently on track to have major N problems on poorly-drained soils.

Many people have not yet applied N fertilizer this year. That's good because the N is safe in the bin or the tank. It's bad because there is going to be a lot to get done in a short time.

We are now (May 14) at or near planting conditions over much of the state, and my bets are on the producers who plant when conditions are right and apply N (or finish applying N) later. This may require a shift in equipment or N source.

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Take Advantage of the Herbicide Burndown Opportunity You have Before You

By Kevin Bradley

Along with the planting delays we have experienced throughout the state, the wet conditions have also caused significant delays in the timing of our burndown herbicide applications. Many corn and soybean fields in the state are still covered with thick, green mats of winter annual weeds. Most of these weeds have begun to senesce and have already produced viable seed, but it is important to recognize that these weeds can still interfere with planting equipment and should be controlled as soon as possible.

In addition to these winter annual weeds, if there is any silver lining to the conditions we have experienced thus far it may be that many of our common summer annual weeds have already emerged in our corn and soybean fields as well. The most notable of these of course is waterhemp; our biggest problem weed throughout the state. I've checked our weed emergence models in Horizon Point for several areas around the state, talked to a number of people in different areas, and have personally been in fields in central and northeastern Missouri and in all instances the indication is that waterhemp is just starting to germinate. Of course there are a variety of other summer annual weeds that have already emerged as well; some of these include common and giant ragweed, smartweed, sunflower, giant foxtail, and others.

What all of this means is that we may have an **opportunity** here that we don't always get in a "normal" year; the opportunity to eliminate a large portion of these summer annual weed populations with our burndown herbicide applications prior to planting. This could be a blessing in disguise, as we have waterhemp populations throughout the state that we aren't controlling very well post-emergence in-crop due to their resistance to glyphosate and in many cases PPO-herbicides (Cobra, Flexstar, Phoenix, Blazer, etc.) as well.

So, I encourage you to take advantage of this situation and make sure you apply an effective **combination** of burndown herbicides for the control of the most problematic weeds that are present in your fields. I firmly believe that as a result of the prevalence of glyphosate-resistant horseweed, giant ragweed, and waterhemp throughout our state, we can no longer afford to apply glyphosate alone as a burndown and expect our fields to be clean at planting. And with the recent germination of waterhemp in many of our fields, it is perhaps even more important this year than most to make sure we add an effective tank-mix partner such as Sharpen, 2,4-D, dicamba, or metribuzin to our primary burndown herbicides which are usually either glyphosate or paraquat (Gramoxone).

For more specific information and recommendations pertaining to the efficacy of burndown herbicide applications, see our 2013 Missouri Pest Management Guide (University of Missouri Extension Publication M171).

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Heavy Rains Exclude Oxygen Needed for Seedling Health from Soils

By Bill Wiebold

Planting high quality seed does not guarantee obtaining a good stand. Several bad things can happen to good seeds. Seed germination begins with water absorption. Water absorption changes the seed from a nearly dormant organism into a living, functioning seedling. As seed tissues imbibe water, enzymes necessary for growth are activated, stored reserves break down, and cell division and expansion occur. The "bad thing" that may become apparent this spring is low oxygen availability.

Heavy rains this spring have resulted in rapid and sustained water runoff. Flash floods warnings have been numerous this year. These conditions usually mean that water inundates portions of fields, but subsides relatively quickly. Near creeks and rivers, a longer lasting flood may cover fields for days. Even if flooding is not a problem, many of our fields have low areas in which water collects. Sometimes the "ponding" is not visible with water above soil, but the soils are water logged with water content above what we call "field capacity". Some soils are more prone to water logging than others, for example claypan soils of NE Missouri or soils high in clay content.

All of these conditions have one characteristic in common that affects germinating seeds and developing seedlings – water sits in spaces between soil particles and aggregates that should hold air. Water in soil pores

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excludes oxygen needed for seedling growth. Initially, water absorption by seeds is not dependent on oxygen. In fact, both dead and live seeds absorb water. But, once water content of seeds exceeds 35-50% continued water absorption depends on energy released by seed respiration. More importantly, all of the life processes the seedling needs to stay alive depend on respiration.

Oxygen demand by the seedling increases rapidly and that oxygen must come from air within soil pores. The heaviest demand for oxygen is centered in the growing point. Rapid cell division and elongation depends on adequate oxygen. Four factors interact to determine if seedling health will be impacted by low oxygen: seed quality, water temperature, water motion, and location of the growing point in the seedling.

Seeds with low vigor are less likely to withstand short exposures to low oxygen availability. Companies only sell high quality seed, but saved seed or seed that was not stored or handled properly might possess poor quality. Warm soil and water temperatures increase seedling respiration. So, soil oxygen is depleted more quickly if water is warm. Moving water creates turbulence which mixes air into the water. Although moving water can lodge plants, there will be slightly more oxygen in moving water than in still water. Corn plants exhibit hypogeal emergence, so the growing point stays below ground for at least three weeks. That means that the center of oxygen need is usually located where oxygen is the least available in water logged soils. Soybean plants possess epigeal emergence where the growing point is at the tip of the stem and the stem elongates above ground. This may be an advantage because the growing point may remain above the water surface.

Anaerobic respiration produces small amounts of energy and may keep the seedling alive for several days. Most seedlings can tolerate 3 or 4 days of flooding, but will often succumb to periods longer than 7 days. Plant structures experiencing reduced oxygen availability produce several toxic substances. Ethanol is harmful to organelle membranes and the enzymes necessary for life. Lactic acid reduces the pH within the cell. If pH becomes too acidic, enzymes precipitate out of solution and the cell dies.

There is not much that we can do to help seedlings experiencing reduce oxygen availability. Protecting seeds and seedlings with seed-applied fungicides and insecticides might be beneficial. These chemicals do not improve oxygen availability or reduce the formation of toxic substances, but they protect the seedlings from opportunistic microbes and insects. These organisms may cause greater harm to weakened seedlings and increase plant death.

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What if You're Going to Switch? Replant Options Following Pre-emergence Corn Herbicides

By Kevin Bradley

As a result of the continued heavy rains and slow pace of corn planting in certain regions of Missouri, some producers now wish to plant soybeans into fields where pre-emergence corn herbicides have already been applied. Questions have arisen about the replant restrictions of these herbicides and what can be done in these situations. Table 1 provides a list of some of our most common pre-emergence corn herbicides and the replant restrictions of these herbicides for corn, grain sorghum, and soybeans. As you can see from this table, soybeans **SHOULD NOT** be planted into fields where applications of atrazine or an atrazine premix have already been made this season. The label clearly states that soybeans should not be planted until the following year due to the likelihood of soybean injury from residues of atrazine that may still be present in the soil. The average field half-life of atrazine will vary dramatically depending on the soil and environmental conditions experienced, but the Herbicide Handbook published by the Weed Science Society of America lists the average field half-life of atrazine as 60 days. High soil pH's (>7.5) will also slow the degradation of atrazine, along with cool soil conditions. Fortunately, replanting corn or planting grain sorghum into these damaged areas will still be an option where atrazine or most of these atrazine premixes have been applied.

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What if You're Going to Switch? Replant Options Following Pre-emergence Corn Herbicides

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Table 1. Replanting restrictions and intervals for some common pre-emergence corn herbicides.

	Interval Between Application and Planting		
	Field Corn	Grain Sorghum	Soybean
	------------------------------------ Months ------------------------------------		
Atrazine	0	0	NY[a]
Balance Pro	0	6	6
Balance Flexx	0	6	6
Basis	0	10	0.5-10[d]
Bicep II Magnum	0	0[b]	NY[a]
Callisto	0	10	10
Callisto Xtra	0	0	NY[a]
Camix	0	0[b]	NY[a]
Cinch	0	0[b]	0
Cinch ATZ	0	0[b]	NY[a]
Corvus	0	9-17e	9
Define	0	12	0
Degree	0	NY[a]	NY[a]
Degree Xtra	0	NY[a]	NY[a]
Dual II Magnum	0	0[b]	0
Expert	0	0[b]	NY[a]
Fierce	¼-1[f]	18	0
Guardsman Max	0	0[b]	NY[a]
Harness	0	0[b]	NY[a]
Harness Xtra	0	0[b]	NY[a]
Hornet	0	12	10.5
Instigate	0	10	10
Keystone	0	0[b]	NY[a]
Lexar/Lexar EZ	0	NY[a]	NY[a]
Linex/Lorox	0[c]	0[c]	0[c]
Lumax/Lumax EZ	0	0[b]	NY[a]
Marksman	0	0	NY[a]
Outlook	0	0[b]	0
Prequel	0	10	10
Princep	0	NY[a]	NY[a]
Prowl	0	12	0
Python	0	12	0
Require Q	0	10	10
Resolve/Resolve Q	0	10	10
SureStart/TripleFLEX	0	NY[a]	NY[a]
Verdict	0	0[b]	0.5-3[g]
Zemax	0	0[b]	NY[a]
Zidua	0	NY[a]	0

[a] NY=next year.
[b] Replant interval only applies if safener-treated seed is used.
[c] Thoroughly rework soil before replanting.
[d] If 1/3 oz Basis applied, interval is 15 days. If >1/3 oz Basis applied, interval is 10 months.
[e] If 2.25 oz or less is used, sorghum can be planted 9 months after application.
[f] For the 3 oz rate, interval is 7 days for min. and no-till, and 30 days for conventional tillage.
[g] Interval will vary based on rate and soil type. Check label for specific restrictions.

True Armyworm Larvae Reported in Tall Fescue and Wheat

By Wayne Bailey

Wheat, tall fescue, grass pastures, and occasionally field corn are host plants of the true armyworm (*Mythimna unipuncta* formerly *Pseudaletia unipuncta*). Infestations of true armyworm larvae have been reported from both grass pastures and wheat fields in southwest, central, and east central regions of the state. True armyworm larvae range in size from very small ¼ to ¾-inch in some tall fescue fields and grass pastures and ½ to 1-inch in size in some wheat fields, especially in far southeast Missouri counties. Some tall fescue fields, grass pastures, and wheat fields have required insecticide applications the past two weeks to reduce true armyworm numbers to below economic threshold levels. Many other fields have low numbers of larvae present which probably will not reach economic levels during spring of 2013. However, the potential for problems with true armyworm infestations remain. Scouting of fields for the presence of true armyworm larvae should continue for at least the next 2-3 weeks. Fields of tall fescue, grass pastures, and wheat should be scouted at least 2-3 times weekly to determine if larval numbers and damage are increasing to intolerable levels.

Whether an economic infestation of this pest develops in your fields is determined by several factors such as 1) high numbers of true armyworm moths migrating into your area during early spring, 2) the presence of cool, wet weather during spring, 3) presence of lush growth of grasses (especially tall fescue) and wheat during spring, and 4) lack of beneficial insects. In 2012 numbers of true armyworm moths and larvae were greatly reduced in Missouri and most southern states by drought conditions. At the same time, beneficial pathogens and biological control agents also were reduced under drought conditions, so fewer beneficial are present during spring and summer of the following year. So far in 2013, moth flights have been light to moderate with few moths captured in traps, but instead have resulted in sustained low numbers of moth captures in southwestern Missouri counties over the past few weeks and to a lesser extent into Central Missouri areas from around Mexico to Montgomery City and the Herman area. The types of damage to tall fescue and grass pastures are destruction of plant foliage along with cutting of seed heads. Heavy true armyworm infestations may defoliate and consume 100% of the grass foliage and seed heads and then move to adjoining grass pastures before continue feeding and eventually reaching maturity.

True armyworm larvae hatch from spring laid eggs and rapidly grow through approximately 7 or more worm stages (instars) as they develop from egg to adult moth. The early instars avoid light and spend much time close to the soil surface and on lower plant foliage. Feeding by early instars is usually minimal, but the amount of damage they cause rapidly increases as the larvae increase in size, become more active during daylight hours, and move upward on host plants to feed. A total of 2-3 generations may be produced each season, but only the first generation generally causes problems in grass crops and pastures. Later generation larvae tend to move to turf to feed and develop. Larvae may also cause problems on highways when they move in mass (like their armyworm name implies) and are killed by vehicle traffic. Large slick spots on the road surfaces may form and result in vehicle accidents. True armyworm larvae do not feed on legumes, only grasses.

Scouting: True armyworm moths have grayish-brown to tan colored forewings, with a white spot located in the center of each forewing, and grayish-white to pale hindwings. Larvae are almost hairless with smooth bodies. Although very small larvae are often pale green in color, they quickly change to yellowish-brown or tan bodies with tan to brown heads mottled with darker brown patterns. Three distinct broad, longitudinal dark stripes run the length of the body with one occurring on the back and one each running down each side. An additional one or more orange lines can be found running the length of each side of the body from head to tail. Larval identifying characteristics include **the presence of four pairs of abdominal prologs located in the center of the larva and a single pair of anal prologs present at the tail end of the larva. Each abdominal proleg will have a dark brown to black triangle located on the foot of the proleg.** These dark triangles are good identification characters as few other larvae possess this characteristic. Larvae of true armyworm are often active at night or on cloudy days as they avoid light. To determine the presence of small larvae scout plant debris on the ground and for feeding damage on lower plant foliage. Small larvae are best scouted during late afternoon, evening , and early morning hours. As larvae increase in size, they will feed during both night and day periods and move upward on host plants as they consume foliage. Larger larvae tend to remain on the upper regions of host plants.

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True Armyworm Larvae Reported in Tall Fescue and Wheat

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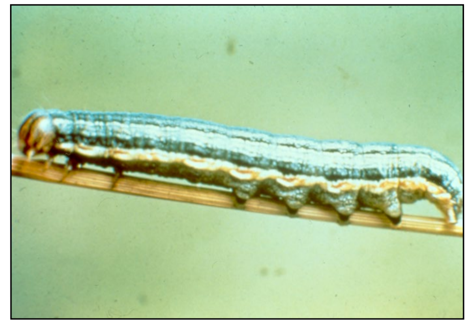
Economic Thresholds: Tall Fescue and Grass Pastures - Occasional severe pest of grass seed and forage fields. Treat when an average of 4 or more half-grown or larger worms (½ inch to 1 ½ inch larvae) per square foot are present during late spring and before more than 2% to 3% of seed heads are cut from stems in tall fescue seed fields.

Economic Thresholds: Wheat – Treat when an average of 4 or more half-grown or larger worms per square foot are present during late spring and before more than 2% to 3% of seed heads are cut from stems. Statewide true armyworm populations have been light in wheat this spring, although many fields in southwest Missouri have required an insecticide application for control of this pest. To this point in the season only vegetative feeding of wheat has been reported, with no cutting of wheat heads observed. Although foliage feeding always occurs with true armyworm larvae, cutting of wheat heads from plants occurs only in some years. The trigger to begin cutting of wheat heads by this pest is unknown. Wheat should be monitored several times per week after heading as true armyworm larvae can cut most heads from plants in a 2-3 day period once they begin cutting heads. Heads are typically cut by the larvae chewing perpendicular (straight across the stem) just below the seed head. Sometimes voles and field mice will cut heads, but they generally cut the entire stem by biting diagonally across the stem. Once cut by rodents, the cut stems and heads are often piled in small bundles on the ground, which does not occur if true armyworm larvae are responsible for the cut heads.

Economic Threshold: Field Corn – Treat seedling corn when 25% or more of plants are being damaged. Control is justified after pollen shed if leaves above ear zone are being consumed by larvae. Larvae of this pest can severely damage corn when high larval populations defoliate plants to the point of killing them. Producers are encouraged to scout corn plants weekly for the presence of true armyworm larvae. Although seedling plants are most at risk during this time of the year, corn plants can be defoliated throughout the growing season. True armyworm can be a severe pest on field corn and generally cause excessive defoliation and plant mortality. Similar to black cutworm larvae, late planted corn is at the highest risk of seedling damage by true armyworm larvae.

Due to the high commodity prices for grass hay, wheat, and field corn, the economic thresholds listed in the previous text may need to be adjusted downward to better reflect when it is economically feasible to treat an emerging pest population.

Confusion over Larvae of the True Armyworm and Grass Sawfly. Some reports of true armyworm larvae in wheat have resulted when the larvae found in fields are actually larvae of the grass sawfly. Whereas the true armyworm larvae is a lepidoterous pest related to moths and butterflies, the grass sawfly is a hymenopteran pest which is related to bees and wasps. Grass sawfly larvae may possess 5-8 pairs of abdominal prologs (7 or more common) as compared to four pairs of abdominal prologs of true armyworm larvae. Grass sawfly larvae are generally found near the flag leaf or on upper foliage of wheat and are somewhat transparent and pink to light yellowish green in color. Grass sawfly is a minor pest of wheat in Missouri with most larvae being parasitized. Only rarely do they reach populations levels where levels of plant defoliation justify control of larval infestations. They have been reported to cut wheat heads in more northern states, but this is not common observed in Missouri. In contrast, true armyworm larvae can cause significant damage to a wheat crop by both heavy vegetative feeding and severe clipping of wheat heads.



True Armyworm

Grass Sawfly

Black Cutworm Moth Numbers Low in Most Missouri Corn Fields - Although reports of black cutworm larvae and damage remain low at this point in the season, the potential for damage from this pest remains until corn plants exceed the four leaf state of growth. The most severe scenario for black cutworm damage to field corn is for large larvae to feed on emerging and recently emerged corn seedlings. Spring rains have slowed corn planting

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True Armyworm Larvae Reported in Tall Fescue and Wheat

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throughout most of Missouri this year. Similarly, black cutworm moth flights have remained low for most areas of the state. Spring rains favor the insect, but low moth flights favor the corn producers. Odds are that corn producers in Missouri will not encounter severe damage from black cutworm larvae this season. However, if heavy or sustained moth flights were undetected in an area, then large larvae may be present to feed on late planted corn seedlings. Thus, weekly or twice weekly scouting of corn seedlings for the presence of black cutworm larvae and other pests is essential to prevent severe damage to seedling corn plants. Scout corn plants regularly through the four leaf stage of plant growth. The economic threshold for black cutworm in field corn is to treat when ¾-inch or smaller larvae cause 2 to 3 percent or more of seedling plants to wilt or be cut above or below ground up to the 5-leaf stage of corn seedling growth. Several management options

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TRUE ARMYWORM - *Mythimna unipuncta* formerly *Pseudaletia unipuncta*
Tall Fescue, Grass Pastures

Comments: Occasional severe pest of grass seed and forage fields. Treat when an average of 4 or more half-grown or larger worms (1/2 to 1 1/2 inch larvae) per square foot are present during late spring and before more than 2-3 percent of seed heads are cut from stems in tall fescue seed fields. Insecticides applied as foliar broadcasts.

Insecticides Control of True Armyworm in Tall Fescue and Grass Pastures - 2013

Chemical Name	Trade Name	Rate of formulated material per acre	Preharvest Intervals
malathion	**Malathion several Products**	see specific labels	see specific labels
zeta-cypermethrin	***Mustang Max**	**2.8 to 4.0 fl oz/acre	0 days hay, forage, grazing
carbaryl	**Sevin 4F**	1 to 1 1/2 quarts/acre	14 days for forage or grazing
spinosad	**Success**	3 to 6 fl oz./acre	0 days hay, forage
spinosad	**Tracer 4SC**	1.0 to 3.0 fl oz/acre	0 days hay, forage
lambda cyhalothrin + chlorantraniliprole	***Voliam xpress**	5.0 to 8.0 fl oz	0 days hay, forage, grazing
lambda cyhalothrin	***Warrior II w zeon tech**	1.28 to 1.92 fl. oz	5 days harvest

**Note, FMC recommends a minimum rate of 3 oz/acre for true armyworm control using Mustang Max

***Designates a restricted-use pesticide. Use is restricted to certified applicators only.**

Be sure to read the label and follow all label directions, precautions, and restrictions.

TRUE ARMYWORM - *Mythimna unipuncta* formerly *Pseudaletia unipuncta* (Haworth)
Wheat 2013

Comments: Occasional severe pest of wheat and grass pastures. Treatment is justified when an average of 4 or more half-grown or larger worms per square foot are present during late spring and before more than 2% to 3% of heads are cut from stems. Scout at dusk, dawn, or at night as small larvae feed on foliage at night and remain in plant debris near ground during day. Optimal control from Success and Tracer insecticides is best achieved when they are applied at peak egg hatch or when larvae are small.

Common Name	Trade Name	Rate of formulated material per acre	Placement/ Comments	REI Hours	Pre-Harvest Intervals Days
cyfluthrin	***Baythroid XL**	1.8 to 2.4 fl oz	foliage 1st & 2nd instars only	12	30 (grain) 3 (grazing or forage)
methomyl	***Lannate SP**	1/4 to 1/2 lb	foliage	48	7 (grain) 10 (grazing or feeding)
zeta-cypermethrin	***Mustang Max**	1.76 to 4.0 fl oz	foliage	12	14 (grain. forage, hay)
chlorpyrifos	***Nufos 4E**	1 pt	foliage	24	28 (grain or straw) 14 (forage or hay)
microencapsulated methyl parathion	***Penncap-M**	2 to 3 pt	foliage	48	15 (harvest or graze)
carbaryl	**Sevin 80S**	1 1/4 to 1 7/8 lb	foliage	12	21 (grain or straw) 7 (hay or forage)
spinosad	**Tracer naturalyte**	1.5 to 3.0 fl oz	foliage, timing important	4	21 (grain or straw) 14 (forage or hay)
chlorpyrifos + bifenthrin	***Stallion**	9.25 to 11.75 fl oz	foliage	24	14 (grazing) 28 (straw)
cyfluthrin	***Tombstone Helios**	1.8 to 2.4 fl oz	foliage	12	30 (grain) 7 (grazing)
lambda-cyhalothrin	***Warrior II with Zeon**	1.28 to 1.92 fl oz	foliage	24	30 (grain or straw) 7 (hay or forage)

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Read the label to determine appropriated insecticide rates. Be sure to follow all directions, precautions and restrictions.

True Armyworm Larvae Reported in Tall Fescue and Wheat

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are available for black cutworm in field corn. Many corn hybrids now contain insecticidal traits which provide good protection from black cutworm larvae. Seed treatments will provide some control, but may be overwhelmed by heavy black cutworm larval populations. Soybean may also be attacked by black cutworm larvae, although this is far less common than attacks on field corn. Historically a good economic threshold for black cutworm feeding on soybean seedlings is 20% or more cutting of soybean seedlings. With higher commodity prices for soybean, this economic threshold is probably too conservative. As commodity prices go higher, producers can afford to treat pest infestations at lower thresholds. With this in mind, an economic threshold of 10 - 15% or more cutting may be a more reasonable economic threshold for black cutworm infestations in seedling soybean.

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TRUE ARMYWORM - *Mythimna unipuncta* formerly *Pseudaletia unipuncta* (Haworth)
Field Corn 2013

Comments: Treat seedling corn when 25% or more of plants are being damaged. Control is justified after pollen shed if leaves above ear zone are being consumed by larvae. Optimal control by Tracer is best achieved when the insecticide is applied at peak egg hatch or when larvae are small.

Common Name	Trade Name	Rate of formulated material per acre	REI Hours	Pre-Harvest Intervals Days
permethrin	***Ambush 25WP**	6.4 to 12.8 fl oz	12	30 (grain or stover), 0 (forage)
permethrin	***Ambush Insecticide**	6.4 to 12.8 fl oz	12	30 (grain or stover), 0 (forage)
permethrin	***multiple products**	see specific label	12	see specific label
esfenvalerate	***Asana XL**	5.8 to 9.6 fl oz	12	21 (grain)
cyfluthrin	***Baythroid XL (for 1st & 2nd instars)**	1.6 to 2.8 fl oz	12	21 (grain or fodder) 0 (green forage)
flubendiamide	***Belt SC**	2.0 to 3.0 fl oz	12	1 (green forage and silage) 28 (grain or stover)
bifenthrin	***Brigade 2EC**	2.1 to 6.4 fl oz	12	30 (grain, fodder, graze)
chlorpyrifos + gamma-cyhalothrin	***Cobalt**	13 to 26 fl oz	24	21 (grain or ears) 14 (graze or silage haravest)
deltamethrin	***Delta Gold 1.5EC**	1.5 to 1.9 fl oz	12	21 (grain, fodder) 12 (cut forage or graze)
zeta-cypermethrin + bifenthrin	***Hero**	4.0 to 10.3 fl oz	12	30 (grain, stover, graze) 60 (forage)
methoxyfenozide	**Intrepid 2F**	4.0 to 8.0 fl oz	4	21 (grain)
methomyl	***Lannate SP**	1/4 to 1/2 lb	48	0 (ears), 3 (forage), 21 (fodder)
methomyl	***Lannate LV**	3/4 to 1 1/2 pt	48	0 (ears), 3 (forage), 21 (fodder)
chlorpyrifos	***Lorsban Advanced**	1 to 2 pt	24	21 (grain, ears ,forage, fodder)
chlorpyrifos	***Lorsban 4E**	1 to 2 pt	24	21 (grain, ears, forage, fodder)
zeta-cypermethrin	***Mustang Max**	3.2 to 4.0 fl oz	12	30 (grain, stover) 60 (forage)
chlorpyrifos	***Nufos 4E**	1 to 2 pt	24	21 (grain or ears)
microencapsulated methyl parathion	***Penncap-M**	2 to 3 pt	48	12 (grain, forage, graze)
carbaryl	**Sevin 4F**	2 to 4 pt	12	48 (grain or fodder) 14 (harvest or graze forage)
chlorpyrifos + bifenthrin	***Stallion**	9.25 to 11.75 fl oz	24	30 (grain, stover) 60 (forage)
cyfluthrin	***Tombstone Helios**	1.6 to 2.8 fl oz	12	21 (grain or fodder), 0 (forage)
spinosad	**Tracer 4SC**	1.0 to 3.0 fl oz	1	28 (grain), 3 (fodder or forage)
lambda-cyhalothrin	***Warrior II**	1.28 to 1.92 fl oz	24	21 (grain), 1 (graze, forage) 21 (treated feed or fodder)

*** Designates a restricted-use pesticide. Use is restricted to certified applicators only.**
Read the label to determine appropriated insecticide rates. Be sure to follow all directions, precautions and restrictions.

Weather Data for the Week Ending May 29, 2013

By Pat Guinan

Station	County	Weekly Temperature (°F)						Monthly Precipitation (in.)		Growing Degree Days‡	
		Avg. Max.	Avg. Min.	Extreme High	Extreme Low	Mean	Departure from long term avg.	May 1-29	Departure from long term avg.	Accumulated Since Apr.1	Departure from long term avg.
Corning	Atchison	81	60	87	47	70	+4	4.98	+0.77	550	+78
St. Joseph	Buchanan	77	58	82	46	68	+3	6.53	+2.00	515	+33
Brunswick	Carroll	77	58	85	49	67	+1	6.73	+1.98	567	+60
Albany	Gentry	78	57	84	45	67	+2	6.25	+1.70	502	+55
Auxvasse	Audrain	75	57	84	47	65	-1	6.46	+1.68	547	+28
Vandalia	Audrain	73	55	85	44	65	0	5.08	+0.29	526	+52
Columbia-Bradford Research and Extension Center	Boone	75	56	83	45	65	-2	4.52	-0.19	517	-33
Columbia-Capen Park	Boone	78	56	86	44	66	-1	5.28	+0.45	546	-34
Columbia-Jefferson Farm and Gardens	Boone	75	57	84	48	66	-1	5.06	+0.37	552	0
Columbia-Sanborn Field	Boone	76	59	85	49	67	0	5.80	+0.99	605	+22
Columbia-South Farms	Boone	75	57	83	49	66	-1	5.24	+0.49	545	-6
Williamsburg	Callaway	*	*	*	*	*	*	*	*	*	*
Novelty	Knox	73	54	83	47	63	-2	9.21	+4.64	477	+4
Linneus	Linn	74	56	83	49	65	0	6.80	+2.04	495	+32
Monroe City	Monroe	74	55	84	45	64	-2	7.84	+3.21	511	+6
Versailles	Morgan	80	61	87	51	70	+3	4.39	-0.79	677	+76
Green Ridge	Pettis	*	*	*	*	*	*	*	*	*	*
Lamar	Barton	80	62	84	53	70	+2	4.21	-1.32	569	-50
Cook Station	Crawford	79	55	85	40	68	+1	3.75	-0.88	599	-14
Round Spring	Shannon	81	53	86	40	67	0	3.03	-1.74	577	+3
Mountain Grove	Wright	77	56	83	45	67	+1	1.53	-3.23	534	+5
Delta	Cape Girardeau	82	57	90	47	70	0	4.12	-0.75	696	-35
Cardwell	Dunklin	84	61	91	51	72	0	4.69	-0.22	787	-66
Clarkton	Dunklin	83	58	91	50	71	-1	4.87	+0.60	739	-80
Glennonville	Dunklin	82	60	88	51	71	-1	4.69	+0.44	762	-59
Charleston	Mississippi	81	58	88	48	70	0	3.40	-1.29	741	+5
Portageville-Delta Center	Pemiscot	83	62	90	51	73	+1	4.63	+0.03	817	-24
Portageville-Lee Farm	Pemiscot	83	62	89	52	72	0	4.40	-0.31	808	-24
Steele	Pemiscot	84	61	91	53	73	+1	6.22	+1.04	814	-36

‡Growing degree days are calculated by subtracting a 50 degree (Fahrenheit) base temperature from the average daily temperature. Thus, if the average temperature for the day is 75 degrees, then 25 growing degree days will have been accumulated.

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