Integrated Pest Management
University of Missouri

March 2017

Integrated Pest & Crop Management

Getting a Better Handle on the Condition of the Wheat Crop *by Kevin Bradley and Gregory Luce*

The condition of the wheat crop is more evident this week with the warmer temperatures we had over the weekend and especially Monday. The wheat crop varies in development between areas in the state and may vary from field to field in the more impacted areas. The further along the wheat crop, the more it may be impacted by the cold temperatures we experienced last week. In 2007, when we had the Easter freeze on April 7th of that year, we observed great differences in the wheat from Northern Missouri to the Bootheel and SW MO. That year the freeze came several weeks later on more developed wheat, the recent freeze had extremely cold temperatures, but the growth stage is the big factor in how much cold can be tolerated. See IPM Newsletter from March 9th: https://ipm.missouri.edu/IPCM/2017/3/Understanding_Wheat_Growth_Stages_for_Estimating_Wheat_Freeze_Injury/

Wheat in Missouri, from Central to Northern portions, was not yet jointed and appears to have tolerated the freeze very well. This year, as in 2007, the major concern is on the jointed wheat in the southern portions of the state. Below are some of the observations from 2007, and what to look for as you evaluate the wheat crop this season:

- The wheat in northern Missouri in 2007, as in 2017, was in much better condition (north of hwy 36) since the wheat was in earlier stages of development when the frost hit and could tolerate the cold temperatures better. There were some isolated fields showing lodging in Northern Missouri in 2007, but that wheat was further along when the freeze hit than in 2017.
- Wheat in central portions of the state were more of a mixed bag in 2007. Some fields showed very little damage and others had a very high percentage of weak stems and bad heads. Wheat in southern Missouri was naturally further along and in more sensitive growth stages, and the temperatures were nearly as cold.
- In 2007, earlier planted fields were generally worse. They broke dormancy sooner and were at a more vulnerable stage when the freeze occurred.
- Lodging showed up very significantly in many fields in SW and SE MO and to some extent in parts of central MO. The lodged wheat picture **(figure 1)** came from SW MO where weakened stems gave way due to heavy rains after the freeze.

Figure 1: Lodged wheat field from SW Missouri in 2007 following heavy rain after the Easter freeze.

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- High nitrogen and/or high seeding rates contributed to more injury and lodging in 2007. Succulent growth has more water, less sugars in the plant cells and the wheat was further along in growth stage. Water freezes more easily than sugar water.
- When evaluating stem and head damage a box cutter **(figure 2),** razor blade or very sharp knife works well. The growing point can be found on pre-jointed wheat near the base of the tiller. In jointed wheat the head can be found by splitting the stem open and finding the growing point above the highest joint. The growing point and the developing head should be bright white to yellow-green in color and be turgid. Freeze injury will cause this area to become off colored or brown and will look water soaked. Time and warm weather helps make a better evaluation of bad vs good wheat heads **(figure 3)**.
- To evaluate the stems the leaf sheaths must be removed and you can see if the area below the lowest node is healthy or weakened and browning **(figure 4)**.
- Weakened stems will not be able to support the plant even if the growing point is still alive. In most cases an extremely damaged stem is going to have a wheat head that is already dead or showing signs of decay.

figure 2: using a box cutter to evaluate stem and head damage.

figure 3: bad wheat head (left) next to a good wheat head (right)

figure 4: weakened stem with leaf sheaths removed showing browning.

Wheat Management Decisions

As it becomes clearer whether or not a field is worth keeping, the main question is how to handle the plant matter out there. Some growers may be able to use the wheat for hay or haylage and that would certainly be a good option. If the wheat is to be destroyed, glyphosate is an effective option but the rate should be kept high due to the very slow growth of the wheat **(figure 5)**.Gramoxone or Liberty may also be an alternative, especially if going to corn and atrazine can be applied in combination with either of these herbicides. However, neither Gramoxone nor Liberty alone will provide effective control of most wheat stands. It will most likely be difficult to get decent coverage of lodged wheat with any herbicide treatment, especially contact herbicides like Gramoxone or Liberty. Tillage could be an alternative but is not required. For soybeans or corn that are glyphosate tolerant, then any post-emergence glyphosate application would kill surviving wheat plants.

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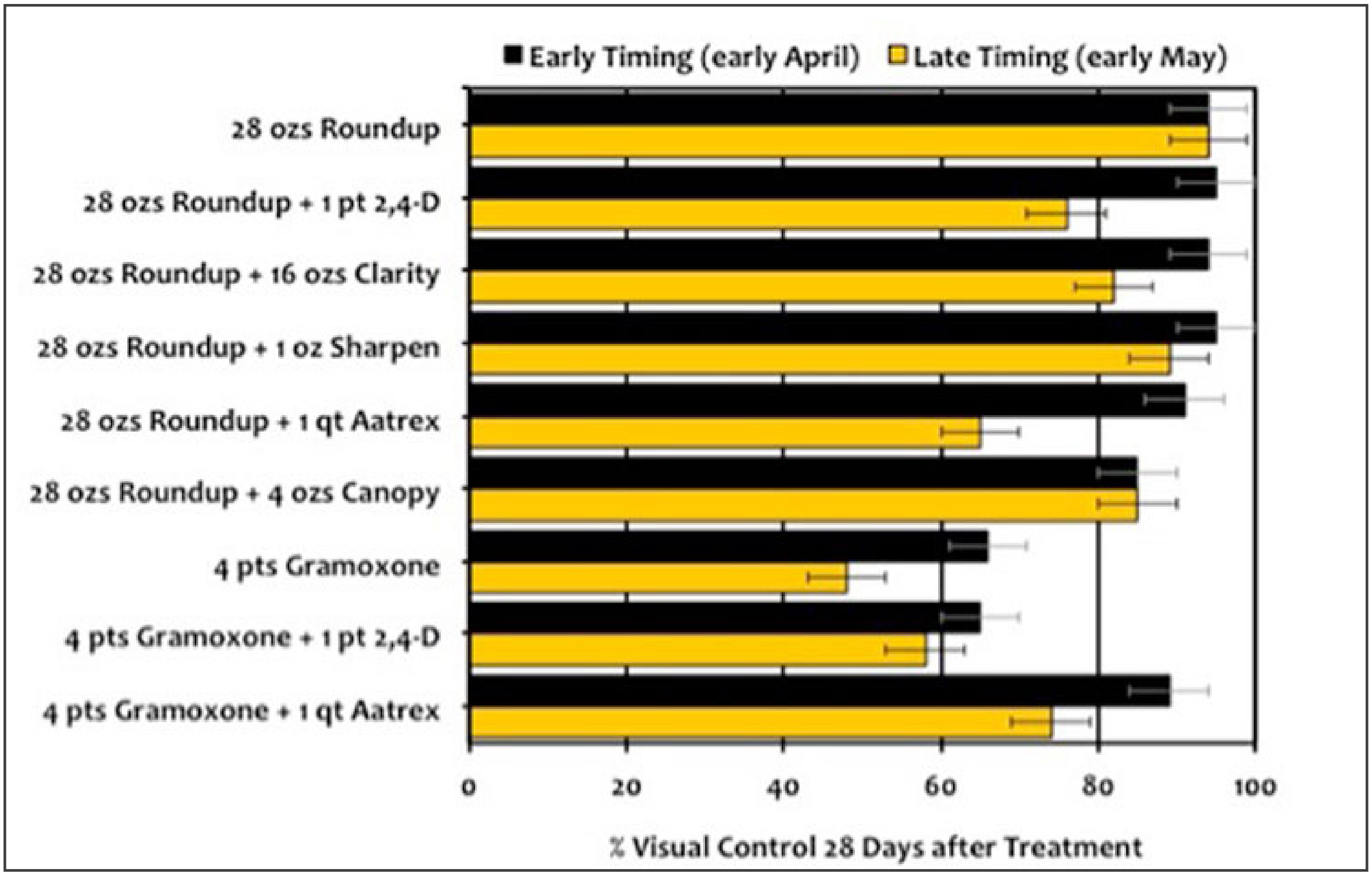


figure 5: Influence of herbicide treatments and application timings on the control of wheat (results averaged across 3 years).

If wheat is insured then you will need to follow the requirements agreed upon with your insurance company pertaining to recrop options.

Again, jointed wheat is the biggest concern and with the recent freeze occurring in mid-March, there is ample time to evaluate wheat stands and not rush to a decision if the stand is in question.

Understanding Wheat Growth Stages for Estimating Wheat Freeze Injury

by Gregory Luce

The very warm February stimulated wheat growth beyond what is typical for early to mid-March. It has reminded many of the 2007 warm late winter, and the infamous Easter freeze on April 7th of that year. It is likely we could see freezing temperatures several more times this late winter and early spring. Very cold temperatures March 11th and 12th throughout Missouri, and advanced wheat growth, has created some concern over the impact on the wheat crop. In 2007, the April 7th freeze caused significant impact on the wheat crop, however, Missouri wheat fields tended to respond better than expectations in most cases. There are many factors to consider and the extent of damage to the wheat crop depends on the growth stage, temperature, and duration of the low temperature. A big unknown is the weather after the freeze, which in 2007 turned out to be very favorable for recovery. To better understand what we can expect, the best guide to help assess the impact of freezing temperatures to wheat is an excellent publication entitled Spring Freeze Injury to Kansas Wheat. This reference has been used for many years to better understand the influence of growth stage on cold temperature tolerance in wheat.

Link to Kansas Wheat Freeze publication: http://www.bookstore.ksre.ksu.edu/pubs/c646.pdf

Figure 1: Temperatures that cause freeze injury to winter wheat at different growth stages. Winter wheat rapidly loses hardiness during spring growth and is easily injured by late freezes. (graph adapted from A.W. Pauli)Graph showing the temperatures that cause freeze injury to winter wheat at different growth stages.

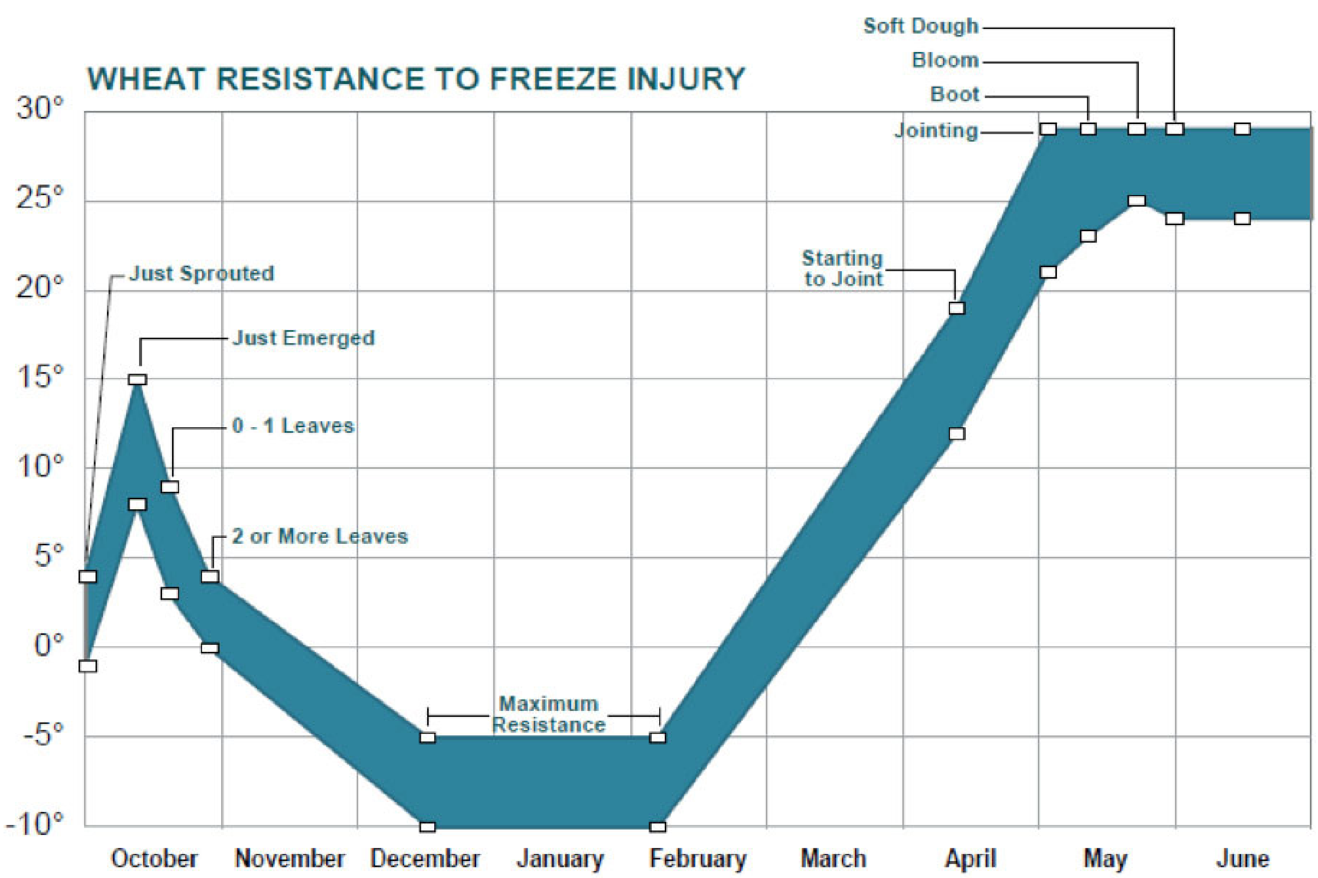


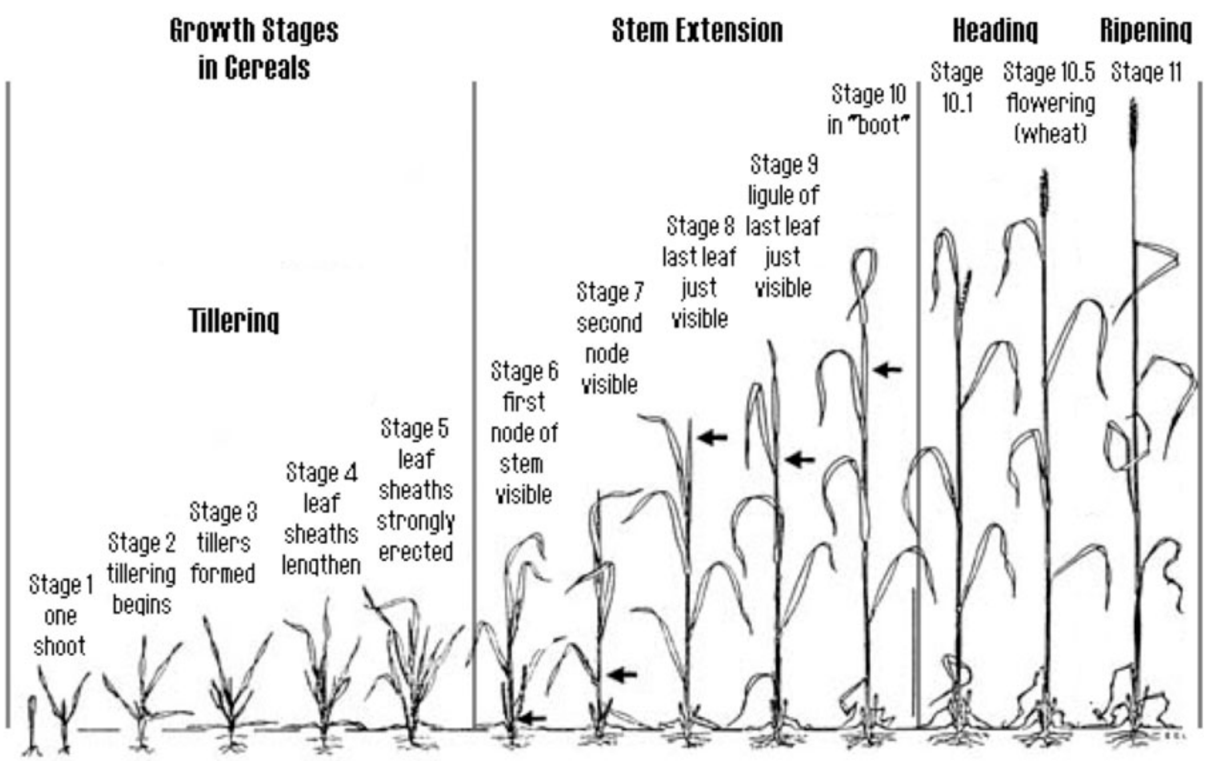
Figure 2: Temperatures that cause freeze injury to wheat at spring growth stages and symptoms and yield effect of spring freeze injury.

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

Wheat growth stage varies in Missouri from late tillering to jointing stages. (figure 3). If your wheat is in the tillering stage (the wheat is still relatively short and has prostrate growth) that crop can withstand temperatures down to about 12°F for two hours (figure 2). If the wheat is standing upright (pseudostem erection) and just prior to joint (no detectable node), the temperature that injury occurs is two hours at about 20°F. If you are able to detect a node, the temperature where injury occurs is at about 24°F for two hours. Cold injury at jointing can cause moderate to significant yield loss. Wheat is most sensitive to freezing temperatures at the heading and flowering stage. At heading and flowering, two hours at 30°F can result in severe yield loss due to sterility. Flowering begins near the center of the wheat spike (Feekes 10.5.1) followed by the top (Feekes 10.5.2), and bottom (Feekes 10.5.3) of the spike. Depending on the flowering stage, sterility may only occur on part of the spike.

The extent of injury will not be fully evident until temperature warm up and growth resumes. It is best to wait at least one week to assess the crop and the full extent of the damage becomes apparent.

Figure 3: Feekes Growth Stage Chart. (Oklahoma State University)



MU Plant Diagnostic Clinic: The Soybean Sorrows of 2016

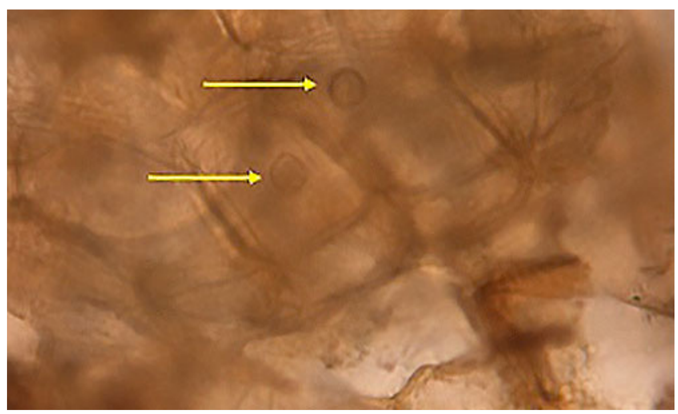
by Patricia Hosack and Lee Miller

Soybeans made up 73 of the 168 field crops submitted to the diagnostic clinic in 2016, the most of any single crop. Overall, 2016 weather was quite unusual. A mild winter and early start to spring was followed by a cool May and hot, dry June. Heavy rainfall events in July brought drought relief to many Missouri regions, but late July/August flooding for some. Environmental disorders, such as lack of or too much water, and turbulent environmental conditions predisposed soybeans to a variety of diseases.

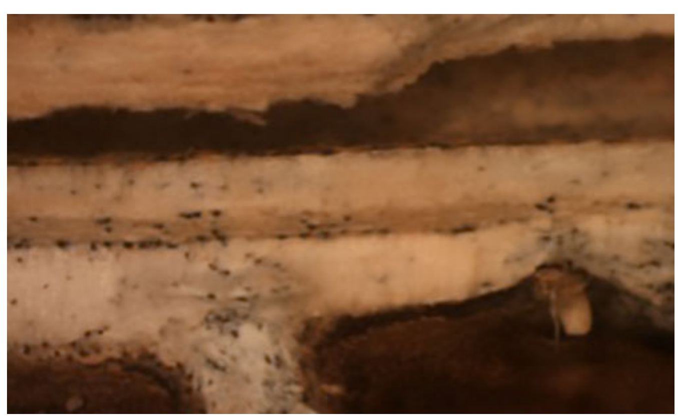
Early in the season, both seedlings and young plants were submitted with damping off or root rots. Species of Pythium are the typical causal agents of these types of disease, and are often associated with low lying areas prone to flooding or prolonged soil saturation. Symptoms include root and/or crown rot, foliar discoloration, similar to nutrient deficiency, stunting, or foliar necrosis (Picture 1). Pythium is identified by the oospores made in rotted tissues (Picture 2). Besides Pythium, other soilborne fungal pathogens can be cause the same type of symptoms. These include species of Rhizoctonia, Fusarium, and Phytophthora. Diagnosis of the causal agent can be helpful in determining management recommendations, such as crop rotation or seed treatments. Also awareness is raised to other potential issues that can correlate with early season root rots, such as stalk rots or vascular wilts. Species of Pythium are able to move from the roots into the stalk and cause crown and/or stalk rots later in the season. While species of Fusarium can be associated with minor root rots, then later develop into vascular wilts.

The hot, dry June decreased plant vigor through both heat and drought stress, and increased soybean susceptibility to charcoal rot. Other than abiotic issues such as drought stress or chemical injury, charcoal rot was the most often diagnosed problem on soybean in 2016. Charcoal rot is caused by the fungal pathogen, Macrophomina phaseolina, and typically shows up at flowering. Symptoms of charcoal rot include small leaflets, chlorotic new growth, mid-day wilting and often a light silvery-gray discoloration on the lower stems and taproot. The diagnostic sign is microsclerotia in the roots and lower stem cortex and pith tissues (Picture 3). The fungus survives as these microsclerotia on crop residue,

Picture 1: Soybean seedlings with rot at the necks. Damping off initiates at the soil line, sometimes plants push upward before symptoms of rot are apparent. Picture by Patti Hosack.



Picture 2: Pythium oospores observed in symptomatic root tissues. Picture by Patti Hosack.



Picture 3: Lower stem tissues with microsclerotia, indicative of charcoal rot. Picture by Patti Hosack.

and has a broad host range. As mentioned earlier, plant health and the environmental precursor of a hot, dry June were crucial to the prevalence of charcoal rot in 2016.

Phytophthora stem rot was the second most common disease diagnosed. Phytophthora species prefer wet conditions, and when soils are saturated produce a motile spore (zoospore) to spread from plant to plant. The disease was severe in July and August, particularly in areas prone to flooding or prolonged soil saturation. Symptoms of this disease are stunted, chlorotic plants and in severe cases, plant death (Picture 4). Stem lesions can be observed girdling stems and often blighting entire stems (Picture 5). Lesions are not superficial to the surface but cause discoloration (dry rot) through the cortex tissues. The MU plant clinic confirms Phytophthora presence by culture plating or serological testing.

Picture 4: (left) Plants showing symptoms of Phytophthora stem rot. Picture by Patti Hosack. Picture 5: (right) Stem lesion caused by Phytophthora stem rot. Picture by Patti Hosack.

Other diseases common to soybeans were also diagnosed in 2016. A list of confirmed diseases and pests diagnosed from soybean samples is below:

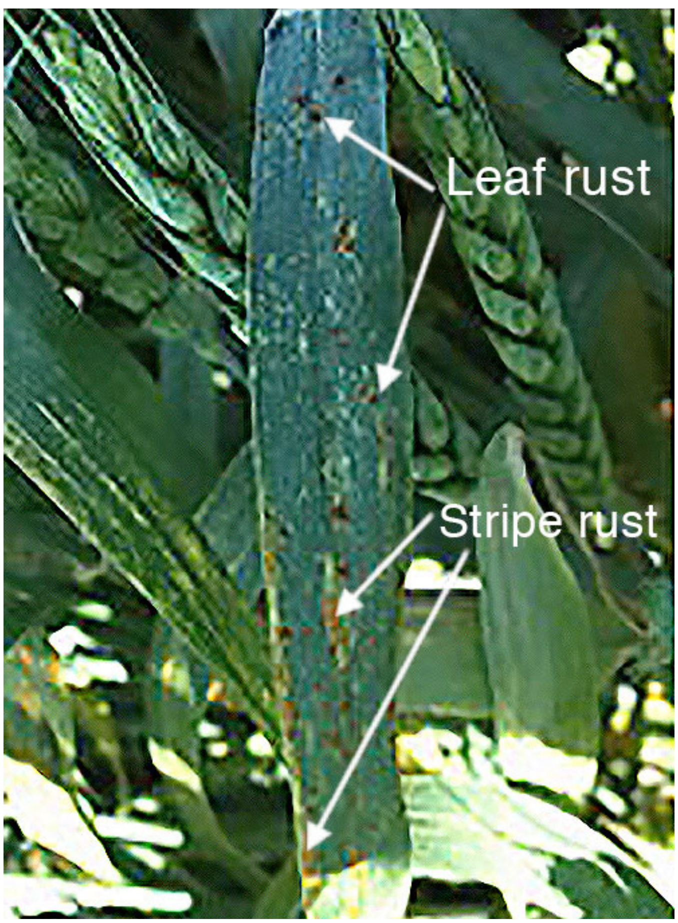
- Anthracnose stem blight / leaf spot (Colletotrichum spp.)
- Brown stem rot (Cadophora gregata)
- Charcoal rot (Macrophomina phaesolina)
- Fusarium root rot
- Phomopsis seed decay
- Phytophthora stem rot
- Pod and/or stem blight (Diaporthe spp.)
- Cercospora leaf blight
- Pythium root rot
- Rhizoctonia stem and/or root rot
- Stem borer (Dectes texanus)
- Sudden death syndrome (Fusarium virguliforme)
- Insect damage: thrips & spider mites

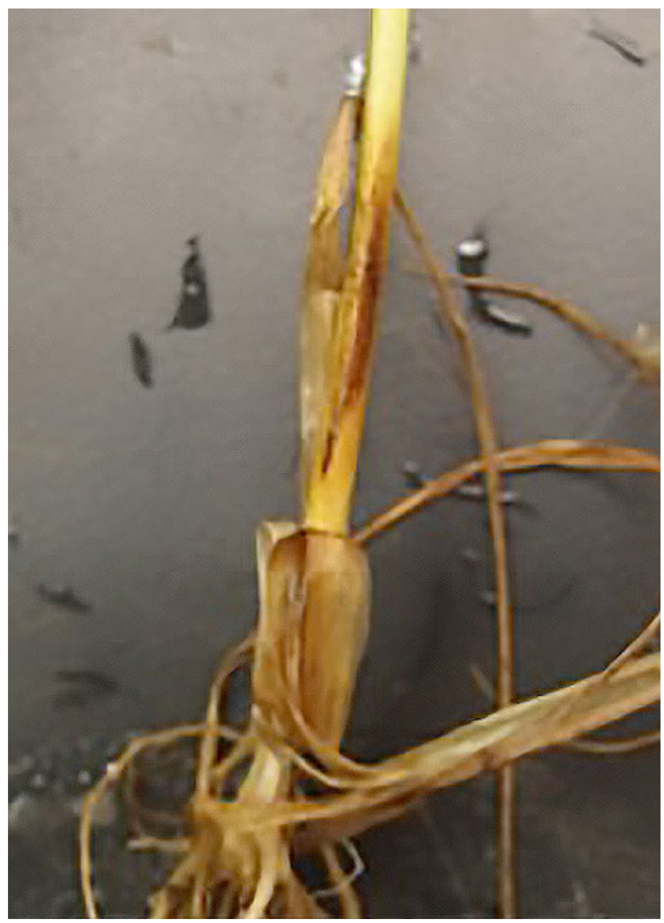
MU Plant Diagnostic Clinic: Woes of Wheat and Forage, 2016

by Patricia Hosack and Lee Miller

Corn and soybean are most often submitted to the Plant Diagnostic Clinic, but occasionally we also receive wheat and forage crops. In 2016, 18 samples of wheat, 5 samples of alfalfa and 4 samples of fescue were processed through the lab.

Wheat samples included foliar diseases that are routinely diagnosed, including bacterial leaf streak, Septoria leaf blotch and rust diseases. Rust diseases were quite notable and severe in 2016, with both leaf and stripe rust in abundance. Both types of rust were often observed on the same leaf **(Picture 1)**. Differentiation of the two rust diseases is observed in pustule development, spore coloration and spore morphology. Also, in wheat, both wheat streak mosaic virus (WSMV) and barley yellow dwarf virus (BYDV) were diagnosed. The plant clinic offers a 5 virus screen that includes WSMV, BYDV, wheat spindle streak mosaic virus (WSSMV), soil-borne wheat mosaic virus (SBWMV) and cereal yellow dwarf virus (CYDV), for an additional service fee of $20. Besides foliar issues, we also diagnosed Sharp eyespot on two samples. This disease causes an elliptical lesion on the lower stem **(Picture 2)**. Within symptomatic leaf sheath cells, right-angled mycelium is observed indicative of the fungal pathogen *Rhizoctonia cerealis.*





Picture 1: (left) Wheat leaf with both leaf and stripe rust. Leaf rust is darker in color and the pustules are scattered on the leaf. Stripe rust is more yellow and the pustules are in stripes. Picture by Patti Hosack. **Picture 2:** (right) Sharp eyespot lesion on a sample of wheat. Picture by Patti Hosack.

Picture 3: (left) A sample of alfalfa with violet root rot, note the dark purple mycelium covering the tap roots. Picture by Patti Hosack.
Picture 4: (right) Field symptoms of violet root rot include large patches with dead plants at the margins. Often a disease resistant grass species (such as fescue) grows in the voids. Picture by Wyatt Miller.

An alfalfa sample won the 'disease of the year award', with the criteria being impressive field symptoms and distinct pathogen signs. In the fall, a sample was mailed in with violet root rot. This disease is caused by the soil-borne fungus *Helicobasidium purpureum* (syn. *Rhizoctonia crocorum*). As the species name implies, the roots and crown of the plant are covered with dark purple mycelium **(Picture 3)**. Field symptoms were striking - large patches with dead or dying plants around the margin and disease resistant fescue growing in the center **(Picture 4)**. Also diagnosed from two alfalfa samples was summer black stem and leaf spot caused by the fungal pathogen, Cercospora medicaginis. This disease causes black spots (lesions) on leaves, leaf chlorosis, defoliation and black stem lesions **(Picture 5)**. Copious amounts of pathogen spores are observed within the lesions and allow for identification **(Picture 6)**. Abundant summer rainfall and high humidity in July and August spurred on black stem and leaf spot. Insect damage to alfalfa foliage, most caused by potato leafhoppers, was also observed on two samples.

Forage fescue wraps up the miscellaneous agronomic crops. The only disease diagnosed was common leaf rust caused by *Puccinia* spp.

Picture 5: (left) Alfalfa with summer black stem and leaf spot. Symptoms include black spots on leaves, chlorotic leaves and defoliation. Picture by Patti Hosack. Cercospora medicaginis spores observed in the black lesions

Picture 6: (top) Cercospora medicaginis spores observed in the black lesions on leaves and stems of alfalfa, diagnostic of summer black stem and leaf spot. Picture by Patti Hosack.

Monitoring and Integrated Pest Management of the invasive Brown Marmorated Stink Bug in fruits and vegetables

by Jaime Pinero

The invasive Brown Marmorated Stink Bug (BMSB), *Halyomorpha halys*, [picture on the side- please cite source] is currently distributed in 43 US states and 4 Canadian provinces. It is a severe agricultural pest in 9 states (largely in the Mid-Atlantic) and a nuisance problem in 21 others.

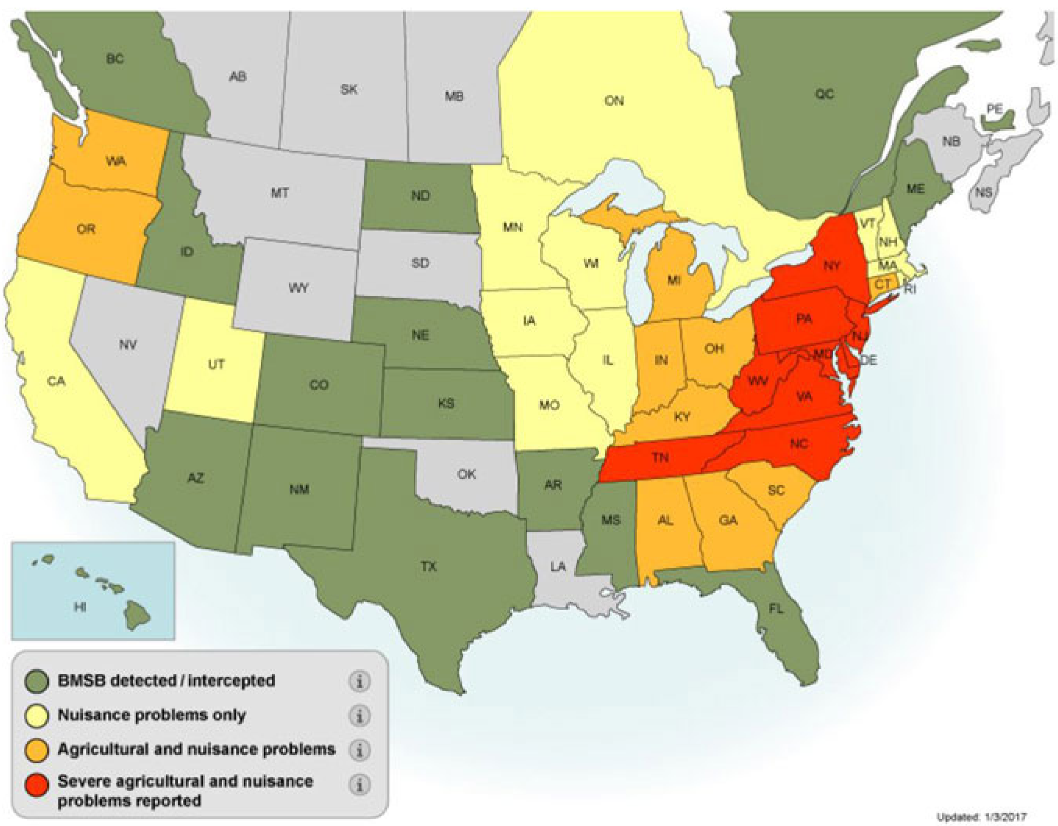
BMSB is considered to be a landscape-level threat. This means that adults frequently switch between cropped land (agronomic crops, fruits, vegetables, ornamentals) and wooded habitats. This article provides an update on monitoring and management of BMSB in specialty crops. Information provided here is summarized. The STOP Brown Marmorated Stink Bug website (http://www.stopbmsb.org) has been setup to provide current and relevant information on this pest.

Credit: Steven Valley, Oregon Department of Agriculture, Bugwood.org

BMSB has been reported to be in Missouri since 2013. While BMSB does not seem to have reached damaging populations yet, numbers have been increasing year by year as a result of breeding populations reported in Ferguson / St. Louis area in 2015, and the continued risk posed by dissemination via hitchhiking on vehicles. Therefore, farmers of specialty crops are encouraged to monitor for this invasive pest, especially if you live in St. Louis, Springfield, and Kansas City areas.

Where does BMSB spend the winter?

During the winter months BMSB enters a type of hibernation called diapause. During this time they do not feed and do not reproduce. Overwintering takes place in forested areas as well as inside houses and other buildings. In the spring, BMSB adults emerge from overwintering sites (houses, barns, storage buildings, and dead trees) and become active on nearby crops during warm sunny days. In the spring and throughout the summer, adults feed, mate, and lay eggs.



Distribution of the Brown Marmorated Stink Bug in the USA as of 1.3.2017
Credit: http://www.stopbmsb.org/where-is-bmsb/state-by-state/

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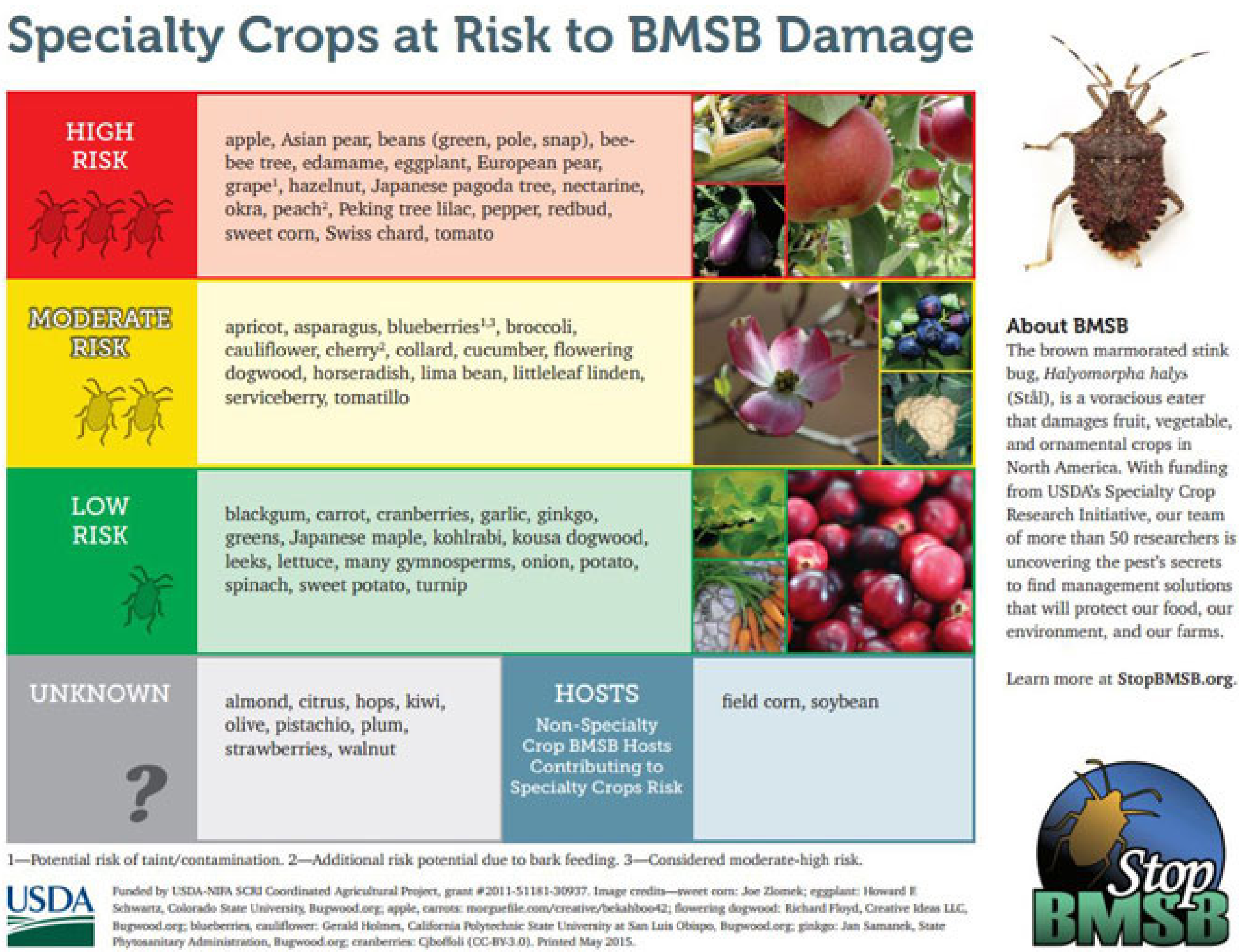
Agricultural crops being attacked by BMSB

Both adults and nymphs (immature stages) are known to cause feeding damage to crops. BMSM has a wide host range of over 300 plants. BMSB nymphs and adults feed by inserting their piercing-sucking mouthparts into fruit, nuts, seed pods, buds, leaves, and stems and appear to prefer plants bearing reproductive structures. Their mouthparts can penetrate very hard and thick tissue, such as the hazelnut hull. Feeding damage has been recorded in high value specialty crops including tree fruit (apples, peaches, pears), small fruit (e.g., raspberries, blackberries), vegetables such as tomatoes, sweet peppers, sweet corn, as well as agronomic crops such as soybeans (Fig. 2). In one study, researchers in the Mid-Atlantic reported that sweet corn, okra, and bell pepper had significant higher abundances of BMSB adults and nymphs compared with green bean, eggplant, and tomato.



Specialty crops at risk to BMSB damage
Credit: http://www.stopbmsb.org/where-is-bmsb/crops-at-risk/

Integrated Pest Management of BMSB

IPM recommendations for BMSB in specialty crops such as orchard fruit, small fruit, and vegetables have been developed by researchers across the country. Summaries of specific options that have been developed as of August, 2016, for grapes, orchard crops, and vegetables, are available at: http://www.stopbmsb.org/managing-bmsb/management-by-crop

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I. ECONOMIC THRESHOLDS.

An economic threshold is basically the density of the pest triggering a control method, usually insecticides. If left untreated, economic losses due to pest damage may occur.

In specialty crops such as apples, researchers in West Virginia and Maryland have just developed a provisional threshold of 10 BMSB accumulated in one pheromone-baited trap located within the orchard or at the orchard border. Once this threshold is reached two alternate-row-middle sprays with 7 days between reduced the number of BMSB-targeted sprays while maintaining good control.

FREE BMSB Identification Kits!

Researchers collaborating in the StopBMSB.org project have made identification kits available at no cost.

The kit includes one BMSB specimen in a bottle, stink bug ID guide, among other materials.

Click http://www.stopbmsb.org/about-us/contact-us/bmsb-kits/ to request your BMSB ID kit

Pest identification is key to IPM

II. MONITORING

Commercially available traps and pheromone lures for BMSB monitoring provide valuable information on presence/absence of BMSB and also help to decide if insecticide treatments are needed to manage this pest. Ag-Bio, Inc. (http://www.agbio-inc.com), Great Lakes IPM (http://www.greatlakesipm.com), Trece, Inc. (http://www.trece.com) and Sterling International are some of the companies that sell monitoring systems for BMSB.

Black pyramid traps. Stink bugs, including BMSB, are visually attracted to tree silhouettes. The trap recommended for monitoring is a black pyramidal trap, which represents trunk mimic, coupled with a capturing device. Researchers are trying to assess whether yellow sticky cards, which are easier to deploy, can be used for monitoring purposes.

Black pyramid trap

Pheromone lures: Various companies are now marketing the male-produced aggregation pheromone of BMSB. Research has shown than when this pheromone lure is combined with another lure termed 'MDT lure' which is also commercially available, the result is increased response by BMSB adults and nymphs, thereby increasing the efficacy of monitoring traps.

The pheromone lure that is being used in Missouri is called "Stink Bug Xtra Combo - Broad Spectrum 5-7 week lure". It has been reported to attract multiple stink bug species such as Brown, BMSB, Conchuela, Consperse, Dusky, Green (*Acrosternum*), Harlequin, and Red Shouldered stink bugs. Therefore, efforts need to me made to correctly distinguish BMSB from other similarly-looking stink bugs.

When should I start monitoring for BMSB? Learning about the life cycle of insect pests is important to design effective IPM tools and strategies, including timing of monitoring. BMSB spend the winter as adults. After emerging from overwintering sites in May and June, BMSB adults begin mating and laying eggs on various host plants. Monitoring for BMSB can start in late-May, and needs to continue until early- or mid-October.

III. CHEMICAL CONTROL

Insecticide sprays is the most effective control method for BMSB. It is important to select effective insecticides given that adult BMSB are hard to kill. Whenever possible, target the nymph stage, as nymphs are more sensitive to insecticides than adults. While insecticide recommendations vary according to availability on different crops, Actara, Brigade, Danitol, Mustang Maxx, and Lannate have shown good efficacy in trials; however, multiple applications may be needed with reinfestation. Specific insecticide recommendations can be found in the production guide for the various types of crops:

- Tree-fruit and small fruit
  Midwest Fruit Pest Management Guide 2017:
  https://ag.purdue.edu/hla/Hort/Documents/ID-465.pdf

- Vegetables
  Midwest Vegetable Production Guide for Commercial Growers 2017: https://ag.purdue.edu/btny/midwest-vegetable-guide/Pages/default.aspx

ALWAYS follow label instructions and safety procedures, and check to make sure the chemical you are using is registered for use in your crop.

Notes on insecticide application:

- The overwintering generation of BMSB tends to be more susceptible to insecticides than the summer generation. Therefore, products with the best effectiveness against this pest should be used later in the season
- Insecticides should be rotated among products in different classes with different modes of action to delay the onset of resistance to pesticides.

IV. CULTURAL CONTROL

The goal of cultural control is to make the crop environment less suitable for insect pests or to manipulate the environment in such a way that insects are less likely to arrive on the cash crop. Most of the time, cultural control is used as a preventative measure. Research is being conducted in this area and no promising tactics have been identified, except for trap cropping.

Trap cropping is a behaviorally-based IPM method involving planting very attractive plants next to a higher value crop so as to congregate the pest in trap crops where they can be easily attacked by natural enemies and/or killed by insecticides. Recent research with BMSB has shown that a trap crop mixture composed of sorghum and sunflower may be an effective management tool for BMSB. For organic systems, given the lack of effectiveness of most organic (OMRI-listed) insecticides, then flaming and vacuuming can be used to kill the arriving pests. To access a webinar on organic management options for BMSB including trap cropping click here: http://articles.extension.org/pages/67200/brown-marmorated-stink-bugs:-invasion-biology-monitoring-and-management-webinar.

Funding for outreach on Brown Marmorated Stink Bug and monitoring efforts in Missouri was provided by the USDA/National Institute of Food and Agriculture (NIFA) through the Extension Implementation Program, Award No. 2014-70006-22571 to the Missouri IPM program (University of Missouri & Lincoln University).

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Weather Data for the Week Ending March 29, 2017

Station	County	Weekly Temperature (ºF)						Monthly Precipitation (in.)		Growing Degree Days‡	
		Avg. Max.	Avg. Min.	Extreme High	Extreme Low	Mean	Departure from long term avg.	March 1 - 29	Departure from long term avg.	Accumulated Since Apr 1	Departure from long term avg.
Corning	Atchison	58	44	80	41	51	+5	3.37	+1.56	*	*
St. Joseph	Buchanan	58	45	78	41	51	+4	3.08	+1.16	*	*
Brunswick	Carroll	62	47	80	44	54	+7	3.38	+1.24	*	*
Albany	Gentry	57	44	78	40	50	+4	2.68	+0.81	*	*
Auxvasse	Audrain	63	47	75	39	54	+7	3.31	+0.76	*	*
Vandalia	Audrain	62	45	78	37	53	+7	2.90	+0.26	*	*
Columbia-Bradford Research and Extension Center	Boone	62	47	77	39	54	+6	2.45	-0.30	*	*
Columbia-Capen Park	Boone	65	47	81	42	55	+7	2.57	-0.25	*	*
Columbia-Jefferson Farm and Gardens	Boone	63	48	78	40	55	+7	2.49	-0.22	*	*
Columbia-Sanborn Field	Boone	64	48	79	41	55	+6	2.55	-0.21	*	*
Columbia-South Farms	Boone	63	48	78	40	55	+7	2.58	-0.20	*	*
Williamsburg	Callaway	62	47	75	37	54	+7	3.40	+0.75	*	*
Novelty	Knox	58	45	73	37	51	+5	2.39	+0.30	*	*
Mosow Mills	Lincoln	62	46	77	36	54	+8	2.88	+0.23	*	*
Linneus	Linn	59	46	79	42	52	+6	3.68	+1.56	*	*
Monroe City	Monroe	61	46	77	38	53	+6	3.12	+1.00	*	*
Versailles	Morgan	66	50	80	48	56	+7	3.00	+0.42	*	*
Green Ridge	Pettis	63	49	77	45	55	+7	2.54	+0.16	*	*
Unionville	Putnam	56	44	69	38	49	+6	3.30	+0.84	*	*
Lamar	Barton	67	49	79	46	57	+7	2.15	-0.93	*	*
Butler	Bates	64	48	78	43	55	+8	1.96	-0.79	*	*
Cook Station	Crawford	68	50	76	46	59	+10	3.42	-0.15	*	*
Round Spring	Shannon	70	50	78	47	59	+10	4.36	+0.87	*	*
Mountain Grove	Wright	67	48	72	44	57	+9	4.65	+1.02	*	*
Delta	Cape Girardeau	66	50	73	41	58	+7	2.78	-1.27	*	*
Cardwell	Dunklin	72	52	79	43	62	+9	6.14	+1.88	*	*
Clarkton	Dunklin	70	50	79	41	60	+8	5.55	+1.69	*	*
Glennonville	Dunklin	69	52	78	43	60	+8	5.18	+1.40	*	*
Charleston	Mississippi	68	51	76	41	59	+7	5.37	+1.51	*	*
Hayward	Pemiscot	69	52	78	43	60	+7	5.50	+1.55	*	*
Portageville	Pemiscot	70	53	79	45	61	+8	5.57	+1.47	*	*
Steele	Pemiscot	70	52	78	44	61	+8	6.42	+2.31	*	*

‡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.

Weather Data provided by Pat Guinan | GuinanP@missouri.edu | (573) 882-5908

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