Integrated Pest Management
University of Missouri

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Integrated Pest & Crop Management

Herbicide Options for Killing Failed Corn Stands

by Kevin Bradley

I have already received a few calls about herbicide options for killing out poor stands of Roundup Ready and/or stacked Roundup Ready/Liberty Link corn, and I expect there will be more whenever things dry out. We conducted a few trials on this several years ago, and Dr. Larry Steckel has also published some data in the weed science literature from two years of research he conducted in Tennessee. I will attempt to briefly summarize the results from everything I've seen published or done ourselves in three points below.

First, Select Max (clethodim) has a label for this use, and it works. The label specifies a rate of 6 fluid ounces of Select Max per acre, and that you must replant corn in these areas no sooner than 6 days after application. In our research with Select Max we have observed excellent control of small (V1-V3, 4-8 inch) corn stands with this product. If the corn is taller and more mature (V4-V5, >8 inches), you more than likely will not get complete control of your failed corn stand.

A second option that allows for immediate corn replanting is paraquat (Gramoxone, etc.) plus a group 5 or 7 PSII-inhbitor like metribuzin, atrazine, or linuron. Paraquat should be applied at a rate of at least 2.5 pts/A, and it will not provide adequate control of the failed corn stand if applied alone. The addition of a metribuzin product (3-4 ozs/A), Linex (1 pt/A), or atrazine (1 pt/A) to the paraquat will increase the control of the failed corn stand substantially.

Third, even if your initial corn was not Liberty Link, we have not seen very good control of corn out of Liberty (glufosinate), or even Liberty plus metribuzin combinations. Many corn varieties have tolerance to glufosinate even if it isn't listed as Liberty Link on the tag, so for all these reasons I would move away from Liberty and stick with either of the other options described above.

Fields that have been flooded and have poor stands may need to be replanted. There are several herbicide options for killing out the failed corn stand and planting back into these areas.

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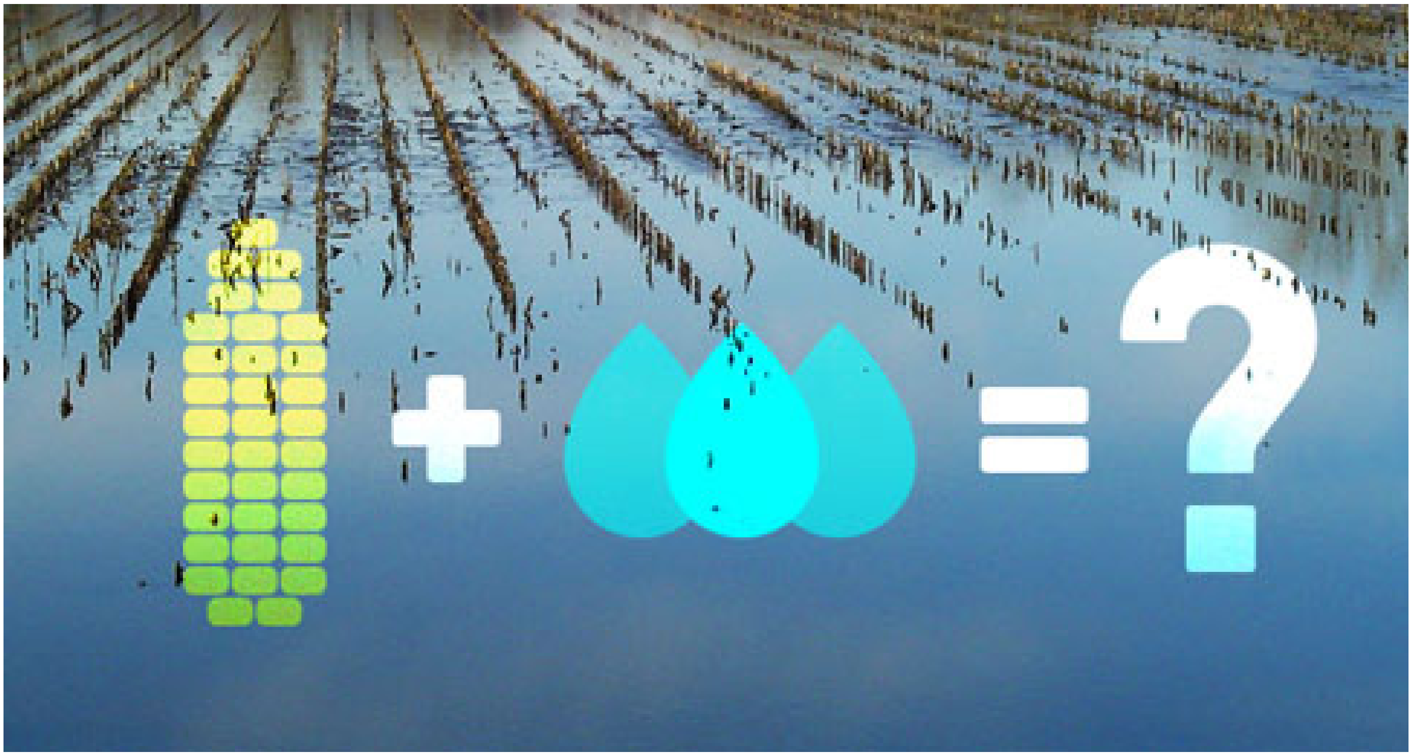
Spring 2017 Rain and Nitrogen

by Peter C. Scharf



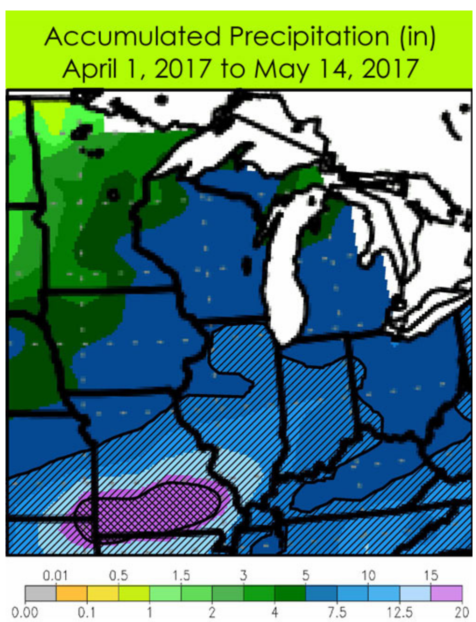
The spring was going great. Corn was nearly planted across Missouri and much of the corn belt. It was a little dry, but not too bad.

Then a couple of big weather systems dropped 5 to 15 inches of rain from Kansas to Indiana in about a week. Most of this rain fell slowly enough that it was absorbed into the soil, where it could (and in some cases did) do bad things to seeds and nitrogen.

I have heard a lot of worry about nitrogen loss, but my opinion is that not much was lost due to this rain. I do think that it left us much more vulnerable to future N loss than we were before.

Most fertilizer N was already in the nitrate form by the time the rain hit (more below), and nitrate is the form that can be lost. But for most people, the factors that control loss of nitrate do not yet add up to enough to hurt them.

Well-drained soils



Nitrogen Watch map for well-drained soils. Leaching is the main loss mechanism in these soils, and can start as soon as nitrate is formed. This will depend on N form and timing, but by April 1 nitrate was the dominant form in most fields. Cross-hatch shows areas that are on track to have 16" of April-June rain, which would create a high probability of N deficiency in corn.

Nitrogen Watch map for well-drained soils. Leaching is the main loss mechanism in these soils, and can start as soon as nitrate is formed. This will depend on N form and timing, but by April 1 nitrate was the dominant form in most fields. Cross-hatch shows areas that are on track to have 16" of April-June rain, which would create a high probability of N deficiency in corn.

For well-drained soils where leaching is the main N loss mechanism, the N has moved downward with the water—but not out of the root zone. I would guess that a lot of nitrate was moved down into the 2nd and 3rd foot of soil. Some may have moved back up with recent drying conditions pulling water back to the surface. It will take quite a bit more rain to flush nitrate out of the root zone for most folks. My rule of thumb is that 16 or more inches of rain April through June will do it.

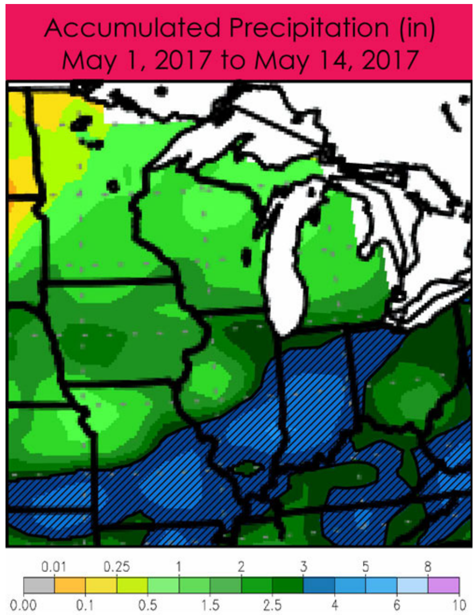
Only south Missouri has hit that mark already. The only well-drained soils with corn in that region are in creek and river bottoms and probably went underwater. Even in these fields, I suspect that not much N was lost. As the creeks came up, water came up from below in the fields, so that there was not much empty space that could be filled by water coming from above. As the waters receded, they carried away some N, but it's hard to say how much. There wouldn't be much corn on well-drained uplands in this region, but there is quite a bit of grass that received N. Although N leaching from grass is rare, it could have happened with the weather we had. If you have grass that looks like it needs more N, and you need more grass, fertilize it again.

Poorly-drained soils

Nitrogen Watch map for poorly-drained soils. Denitrification is the main loss mechanism in these soils, and losses in April are usually temperature-limited. Cross-hatch shows areas that are on track to have 12" of May-June rain, which would create a high probability of N deficiency in corn.

For poorly-drained soils, denitrification is the main way that nitrate is lost. In converts to nitrogen gas and is lost to the air. It's very temperature-sensitive since bacteria are carrying out the conversion and they do it a lot faster when they're warm.

For many fields, I think that soil temperature protected them from major N loss. Brunswick, MO, for example, had a soil temperature of 65 on April 24 and 51 on April 28. The soil temperature dropped 14 degrees in 4 days because a lot of cold water was dumped on it. At 51 degrees, denitrification is slow. Only in southwestern Missouri and southeastern Kansas do I think soils were warm enough to result in N loss to worry about. Even in those places I would expect only moderate losses.



Nitrogen Watch map for poorly-drained soils. Denitrification is the main loss mechanism in these soils, and losses in April are usually temperature-limited. Cross-hatch shows areas that are on track to have 12" of May-June rain, which would create a high probability of N deficiency in corn.

For the next big rain, I don't think that we can expect soil temperature to protect us. Poorly-drained soils will saturate more quickly than they did last time. As I write this on May 17, there is a low-pressure system slowly pushing its way across the middle of the country.

Track the situation

No matter what kind of soils you farm, or advise farmers on, there are large areas that are on track to have substantial N loss if it keeps raining at the same pace that it has so far. Cross-hatched areas in the attached Nitrogen Watch maps show where these areas are located. I call them the 'danger zone' for N loss. We update these maps weekly through the end of June. You can find them at https://plantsciences.missouri.edu/nutrientmanagement/Nitrogen/Nitrogen_watch_2017/nitrogen_watch_2017.htm

Although rainfall totals and soil drainage alone are crude indicators of whether you actually have serious N loss in a particular field, they are easy to track and give a quick picture of whether you need to look deeper.

Anhydrous out early

Because of the open fall and winter, a lot of anhydrous ammonia was applied through fall, winter, and early spring. There were not many days when you couldn't apply in Missouri. I don't have statistics, but won't be surprised if I later find that it was a record year for anhydrous application in Missouri. Timing of anhydrous application will have some impact on nitrate movement in well-drained soils, and potential for N deficiency. Any anhydrous applied before March 1 was probably 90% converted to nitrate by the time the big rains hit at the end of April, N-Serve or not. Only the luck of future weather will determine whether it's there in June and July when your crop needs it. For anhydrous applied in March, I would expect in the neighborhood of 60% converted by the time the rains hit, and therefore less downward movement of nitrate than in fields with earlier applications. Fields with anhydrous applied in April were probably more in the ballpark of 30% converted, meaning that even less N moved. For March and April applications, I see potential for N-Serve to have reduced downward movement of nitrate by slowing formation of nitrate.

Other N fertilizers

All N fertilizers other than anhydrous will have mostly converted to nitrate within 2 to 3 weeks of application in the spring. From what I know of when N was applied, most fields would have had mostly the nitrate form of N by the time the big rains hit. In well-drained soils this nitrate has moved down, but is probably still in the root zone. In poorly-drained soils, temperature has protected against large losses. In both, risk of future loss if it keeps raining is fairly high.

Missouri Flooding Impact on Corn and Soybean Survival

by Gregory A. Luce

The historic rainfall and subsequent flooding across portions of central and southern Missouri have done tremendous damage to property. Farmers with crops planted in fields that are now flooded or saturated will be making evaluations on their corn and soybean stands. There are many factors that determine how well a seedling crop will tolerate flooding. The most important factors on flooded corn and soybean fields are:

- Duration of the flooding
- Temperature during the flood
- Rate of drying and conditions just after the flooding event

Research in flooded soils has shown that the oxygen concentration drops rapidly and is nearly depleted in 24 to 48 hours, however, moderate water movement allows some oxygen to get to the plants, and damage is not as severe. Oxygen is critical for the plant to perform basic functions including respiration, water uptake and root growth. Water-logging also leads to accumulations of compounds like CO_2, which are toxic to plants in high concentrations.

Young corn can survive flooded conditions lasting for about 2 days under warm temperatures (at or above mid-70s°F) to 4 days under cooler temperatures (at or below mid-60s°F). Survivability also is influenced by how much of the plant was submerged and how quickly the water recedes. Corn plants that survived flooded conditions should show new leaf development within 3 to 5 days after water recedes. Generally, soybeans tolerate 48 hours under water quite well. Flooding for 4 days or more can significantly reduce stands, vigor, and yield. Flooded and saturated conditions also restrict root development, thereby reducing the crop's ability to take up water and nutrients and tolerate drought stress later in the season.

Growth stage is a critical factor in survivability due to flooding. While a larger plant requires more oxygen to stay alive, smaller plants are more likely to become completely submerged and to remain submerged for longer periods.

Temperature makes a difference. If temperatures are abnormally warm during the flooding period, the crop survival period may be reduced by 50% or more. Conversely, if temperatures are cool, like they have been recently, the survival of the submerged crop increases because its metabolic processes are slowed down. Cloudy conditions decrease solar radiation and keep soils and floodwaters cooler. The down side is that cold, wet weather favors disease. Plants can be slow to recover when water recedes. Long-term impacts on the crop are often related to disease infection and retarded root development that limits access to available subsoil moisture later in the season.

Cool, wet soils are ideal for some disease development. These conditions are not only optimal for some soil pathogens, but delay plant growth and development. Delayed development can allow plants to be more susceptible to damage by soil-borne diseases that attack seeds and seedlings. Seed treatments have been shown to help, but typically only provide protection for a couple of weeks. If cool, wet conditions persist longer than two to three weeks, crop stands can be at risk. Pythium is a common disease that tends to cause the most damage to seedlings of soybean or corn, and Phytophthora can damage soybean seedlings or start infections in the early summer that may develop and kill soybean plants later in the summer.

It is important to note that the impacts of saturated and ponded areas of fields is similar in the effect on seedling corn and soybean plants as those fields that experience flooded conditions.

Replant Decisions

Deciding whether or not to replant can be a tough decision but there are some key factors to keep in mind. The effectiveness of replanting will be affected by the combination of planting date and changing environmental conditions. It is important to make the decision based on economics and not emotions. It is also important to be patient in waiting for soil conditions to be satisfactory. While this is easier said than done, jumping into the field when it is not ready can cause problems that are not easily corrected.

Below is a list of items from Dr. Bill Wiebold and Dr. Ray Massey that should be considered when making a replant decision:

- Determine the cause of the sparse stand.
- Determine the stand density and condition of the stand.
- Determine the yield potential of the sparse stand.
- Estimate the expected gross revenue from the sparse stand.
- Estimate the cost to replant.

- Estimate the yield potential and gross revenue from a replanted stand.
- Determine whether replanting will pay for itself.

The following tables provide an estimate of percent yield potential when planting corn or soybean at various dates in the season.

Table 1. Effect of planting date on corn and soybean yield in central and north Missouri.

Corn		Soybean	
Planting date	**Yield as percent of expected**	**Planting date**	**Yield as percent of expected**
May1	94	May 8	99
May 6	92	May 15	98
May 11	89	May 22	96
May 16	86	May 29	93
May 21	83	June 5	89
May 26	80	June 12	84
May 31	77	June 19	79
June 5	75	June 26	72
June 10	71	July 3	65
June 15	65	July 10	54

Table 2. Effect of planting date on corn and soybean yield in central and north Missouri.

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June 5	75	June 26	72
June 10	71	July 3	65
June 15	65	July 10	54

In the case of flooded fields, once water recedes, growth will resume approximately within 3 to 5 days, this is the time to begin evaluating corn stand and plant survivability. For corn a healthy radicle root and coleoptile should be white to cream color. Conduct stand counts and utilize replant decision guides to make a determination whether to keep the existing stand. Refer to MU guide 4091: "Corn and Soybean Replant Decisions" at the following link: http://extension.missouri.edu/p/G4091 for more information.

If corn is to be chemically killed, refer to the recent IPCM Article from Dr. Kevin Bradley titled: Herbicide Options for Killing Failed Corn Stands

Stick with your plans for corn and soybeans and don't switch corn hybrids too soon.

Yield expectations of corn planted in May are still very good. There is sufficient yield potential and plenty of time for maturity to not switch crops or to a shorter season hybrid in May. With the growing season in Missouri, normally adapted, full season hybrids are safe even planted into June. There is a grain moisture advantage for early to mid-season corn hybrids over full season products that may come into consideration in late May or June. However, for now, staying with intended hybrids is the best choice.

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 with an average of 9 days less in total days than earlier planted corn. This average includes both short and long season hybrids.

This data shows that full season hybrids shorten up GDU requirements with late planting and thus allow them to be planted later and still have time to dry down adequately. Switching from a very full season hybrid in late May or early June, to a somewhat earlier hybrid would provide some drydown advantage but avoid switching to very early hybrids that are not adapted to the area. Considering the Purdue/Ohio State data, and past experience in Missouri, it is recommended to stay with normal intentions throughout May.

Armyworm Found in Some Central and Western Missouri Wheat and Pasture Fields

by Gregory A. Luce

Armyworm feeding has been reported in wheat in Central Missouri as well as some severe feeding in some grass pastures in Western and NW Missouri. Here are some facts for scouting and threshold information on this occasional pest to Missouri crops.

The true armyworm, Pseudaletia unipuncta (Haworth), overwinters as a partly grown larva in Missouri. Resident armyworms are further supplemented by migrants that arrive during the first week of April. There are two to three generations each year in Missouri, but the larvae of the first generation in May and June usually cause the most feeding damage. This insect requires 41 to 66 days to complete a generation (egg to adult). Female moths prefer to lay their eggs in dense, grassy vegetation. True armyworm larvae have two characteristics that distinguish them from other armyworm larvae by:

- White-bordered, orange line down each side of the body.
- A large, single dark spot at the base of each fleshy, abdominal proleg.

Armyworm Facts at a Glance

- Several armyworm species may attack field and forage crops in Missouri.
- True and yellowstriped armyworms are more early-season pests, whereas the beet and fall armyworms are generally late-season ones.
- The true armyworm primarily attacks grass crops (e.g., corn, fescue, sorghum, wheat) and weedy grass species, whereas the other three armyworm species also may attack alfalfa, cotton, and vegetables.

Armyworms can be serious pests of wheat when populations reach large numbers. Armyworms get their name from their migrating habit, as they sometimes start at one portion of the field and devour everything in their path. Damaging infestations of true armyworm normally occur in the spring. Besides feeding on foliage, larvae will sometimes cut the heads of maturing wheat plants.

Wheat

Rank or dense fields of grasses or wheat are the most common infestation sites for true armyworm larvae. Scouting for true armyworms is best done late in the evening or during early morning hours because the larvae are primarily nocturnal feeders. They usually remain hidden on bright, sunny days. Producers should beginning scouting their wheat fields for this pest from mid April until harvest. Take note of larval sizes, percent parasitism and the insect's pepperlike droppings on the ground.

Economic threshold

Corn

For the true armyworm, treatment is recommended when 25 percent or more of the seedling corn plants are damaged and larvae are still present. Control of fall armyworm larvae is recommended when 75 percent or more plants are infested and larvae are less than 1.25 inches in length. Insecticide applications to control larger larvae or those within the ears are not effective. In general, it is not economical to treat for fall armyworms unless infestations are severe and plants are stressed by environmental factors. Precaution: Before you select and apply an insecticide, review the manufacturer's label for information on the proper and safe use of the material.

True Armyworm larvea found in wheat field.

Grass pastures

Insecticide treatments are justified when four or more nonparasitized, half-grown or larger larvae are present per square foot.

Wheat

Insecticide treatments are warranted when an average of four or more nonparasitized, half-grown or larger true armyworm larvae per square foot are present during late spring and before two to three percent of the heads are cut from the plants. Parasitic flies commonly attack true armyworm larvae, and the flies' small, oval, yellowish eggs are laid on the larva's body or behind its head. The probability of yield loss increases when larvae destroy the flag leaf and before the plants complete the soft dough stage. Insecticides should be applied late in the afternoon to maximize larval exposure.

Numerous insecticides are labeled for armyworm control.

Always read and follow label directions.

For further information on Armyworm:
Management of the Armyworm Complex in Missouri Field Crops
MU IPM True Armyworm ID Guide: https://ipm.missouri.edu/pestmonitoring/taw/identification.cfm

Weather Data for the Week Ending May 30, 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.	May 1 - 30	Departure from long term avg.	Accumulated Since Apr 1	Departure from long term avg.
Corning	Atchison	79	52	86	48	66	-2	2.36	-1.75	637	+105
St. Joseph	Buchanan	77	55	83	47	66	-1	3.29	-1.43	634	+111
Brunswick	Carroll	79	55	84	47	67	-1	3.74	-1.25	732	+190
Albany	Gentry	75	50	82	42	63	-4	3.26	-1.36	523	+49
Auxvasse	Audrain	77	55	81	47	66	-2	4.57	-0.21	688	+115
Vandalia	Audrain	76	55	80	48	66	-1	6.35	+1.59	667	+153
Columbia-Bradford Research and Extension Center	Boone	76	54	82	46	65	-3	4.48	-0.22	638	+53
Columbia-Capen Park	Boone	81	51	86	44	65	-3	4.34	-0.39	671	+81
Columbia-Jefferson Farm and Gardens	Boone	77	54	81	46	66	-2	4.75	+0.01	680	+86
Columbia-Sanborn Field	Boone	78	56	82	49	67	-2	4.16	-0.62	758	+122
Columbia-South Farms	Boone	77	54	82	47	66	-2	4.79	-0.01	685	+95
Williamsburg	Callaway	76	53	82	46	64	-3	6.38	+1.55	641	+97
Novelty	Knox	76	52	80	45	64	-3	2.42	-2.44	570	+79
Mosow Mills	Lincoln	78	54	82	46	66	-1	5.91	+1.29	690	+156
Linneus	Linn	75	51	80	42	64	-2	2.58	-2.12	603	+107
Monroe City	Monroe	76	54	81	47	65	-3	4.37	-0.27	643	+89
Versailles	Morgan	77	54	81	48	66	-3	5.64	+0.39	737	+89
Green Ridge	Pettis	76	55	82	46	65	-3	3.30	-1.31	669	+91
Unionville	Putnam	74	52	79	44	63	-2	3.77	-2.00	536	+153
Lamar	Barton	79	57	85	47	67	-2	7.25	+1.41	720	+57
Butler	Bates	78	54	85	44	66	-2	4.08	-1.41	670	+147
Cook Station	Crawford	76	52	82	43	64	-5	7.99	+3.27	692	+56
Round Spring	Shannon	79	52	88	42	65	-3	7.72	+2.76	682	+78
Mountain Grove	Wright	76	53	84	44	65	-3	7.07	+2.39	649	+74
Delta	Cape Girardeau	80	58	86	51	68	-3	5.37	+0.54	821	+59
Cardwell	Dunklin	80	60	85	52	70	-4	6.07	+1.35	958	+58
Clarkton	Dunklin	81	59	87	52	70	-3	5.26	+1.01	912	+65
Glennonville	Dunklin	80	59	86	50	70	-3	4.79	+0.40	923	+73
Charleston	Mississippi	80	59	86	50	70	-2	4.50	+0.37	913	+114
Hayward	Pemiscot	81	61	86	52	70	-3	5.48	+1.32	915	+37
Portageville	Pemiscot	82	61	87	52	71	-2	4.23	+0.10	993	+104
Steele	Pemiscot	82	59	89	51	70	-4	4.81	-0.06	929	+23

‡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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