

VEGETABLE CROPS HOTLINE

A newsletter for commercial vegetable growers prepared by the Purdue University Cooperative Extension Service



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Are You Applying Enough Water for Vegetables Grown in High Tunnels?

(Wenjing Guan, guan40@purdue.edu, (812) 886-0198)

We recently received several calls reporting blossom end rot of tomatoes (Figure 1). Although blossom end rot is caused by deficient supply of calcium to the developing fruit. The occurrence of this physiological disorder often relates to inconsistent supply of water.



Figure 1. Blossom end rot of tomato.

As a general rule, vegetables require 1-1.5 acre-inches of water per week. Since there is no rain in high tunnels, all the required water should be applied through irrigation. How does one determine if enough water has been applied to vegetables? This article provides some ideas.

The first information needed is the irrigated area. For example,

tomatoes are growing in a 30 × 96 high tunnel with 6 beds that are about 4 feet wide. Then the irrigated area is about 2,304 square feet ($6 \times 4 \times 96 = 2,304$). An acre has 43,560 square feet. So the irrigated area is roughly $2,304 / 43,560 = 0.05$ acre.

The second step is to decide the amount of water plants need based on the general rule that vegetables require 1-1.5 acre-inches of water per week. 1 acre-inch of water equals to 27,154 gallons. Thus, to provide enough water for vegetables grown in an 0.05 acre area (the irrigated area in our hypothetical high tunnel), 1,358 – 2,036 gallons water should be applied each week, which is equal to 194-290 gallons water per day. It will be very handy if a water meter is installed in the irrigation system that can help determine whether enough water was applied on a daily basis.

If there is no water meter, or if the irrigation system is controlled by the length of time it runs. We should know flow rate of the drip tube to be able to calculate how long the irrigation system should be operated. For example, if the drip tape has a flow rate of 0.45 gallons/minute/100 ft, which means every minute the drip tape can apply 0.45 gallons water per 100 ft. The total length of the drip tape covering 6 beds in the high tunnel is 576 ft ($96 \times 6 = 576$). In this case, a total of 2.59 gallon water ($576 \div 100 \times 0.45 = 2.59$) is applied to the high tunnel every minute. To apply 194-290 gallons water per day, the irrigation needs to run 75 – 112 minutes daily.

Another question is how often water should be applied. Answers to this question would largely depend on soil texture. The sandier the soil, the less water it holds, and water should be applied more frequently. In our high tunnel at the Southwest Purdue Ag Center that has sandy soil, we apply water 3-4 times in a day evenly divided between applications. For clay soils, it is possible to apply water less frequently. However, it is still necessary to apply water on a daily basis.

Tomato Disease Update

(Dan Egel, egel@purdue.edu, (812) 886-0198)

Below, I will briefly discuss a few of the diseases that I have observed on tomatoes recently.

Powdery mildew of tomato – Powdery mildew of tomato is not usually a common problem in Indiana. However, in recent years, there have been more reports of this disease than usual. Powdery mildew is more often observed in a greenhouse situation than in a

field.

The key symptoms of this disease are the talc-like lesions on the upper and lower leaf surfaces (Figure 1). It is important to note that the location of the upper and lower lesions do not correspond with each other. When the lesions are young, it may almost seem as if the lesions can be 'wiped off'.



Figure 1. Powdery mildew of tomato.

Few varieties exist with good levels of host resistance, although growers may notice some difference in susceptibility between varieties.

It may not be necessary to treat tomatoes affected with powdery mildew with fungicides. If fungicide treatment appears to be warranted, a few alternatives are: Fontelis®, Inspire Super®, Quadris Top®, several formulations of sulfur, Switch® and Vivando®. The products listed are all either labeled for the greenhouse or silent about greenhouse use. Check the label carefully before using any of these products.

Septoria leaf spot – I have observed several fields with this foliar disease. While Septoria leaf spot was not severe in these fields, if left unchecked, the disease can cause defoliation, reduced fruit quality and yield loss.

Lesions of Septoria leaf spot often start on the lower leaves. As the disease progresses, symptoms may begin to appear higher in the plant canopy. Larger lesions may have a gray center with a dark brown margin (Figure 2). If one uses a 10X hand lens, it is possible to see dark fungal structures (known as pycnidia) in the middle of such lesions. Leaves and stems may be affected, but fruit infection is rare. Since Septoria leaf spot requires leaf wetness for infection, this disease is most often observed in the field and not in greenhouses.



Figure 2. Septoria leaf spot of tomato.

Crop rotations of 3 to 4 years and fall tillage remain important management decisions. Currently, no commercial varieties have resistance to Septoria leaf blight. Fungicides that are likely to be effective against this disease are listed in the *MW Vegetable Production Guide* mwveguide.org. Contact products include fungicides with the active ingredient chlorothalonil (e.g., Bravo®, Echo®, Equus®, Initiate®) and mancozeb (e.g., Dithane®, Manzate®, Penncozeb®). Systemic fungicides include Aprovia Top®, Cabrio®, Fontelis®, Inspire Super®, Luna®, Priaxor®, Quadris®, Revus Top®, Rhyme®, Tanos® and Zing®. See the *MW Vegetable Guide* for details on rates, application instructions and formulation differences. Organic growers may find that fungicides that contain the active ingredient copper may help to reduce disease severity.

Tomato pith necrosis – Often the first symptom observed is a chlorosis (yellowing) of young leaves. It might be possible to observe stems that appear shriveled. This may be associated with a dark brown necrosis of the lower stem and rotten pith (Figure 3). Low night temperatures, high nitrogen levels and high humidity favor the bacterium that causes pith necrosis. Therefore, it is usually seen in a greenhouse situation. The only management recommendation is to avoid high nitrogen levels in tomato plants as well as high humidity.



Figure 3. Tomato pith necrosis. Note twisted stem and discoloration.

Fusarium crown and root rot – This disease is more often observed in a greenhouse situation where tomatoes are grown in the soil than the field, perhaps because of a lack of crop rotation in most greenhouses. The causal fungus, *Fusarium oxysporum* f.sp. *radicis-lycopersici*, survives very well in the soil in the absence of the host.

However, this disease was recently observed in the field in Indiana. Symptoms of this disease include tomato plants with lower leaves that become yellow (chlorotic) and die; plants that begin to wilt; a lesion on the lower stem at ground level (Figure 4). If tomato plants are removed from the soil and carefully split open from the ground level, a discoloration of the vascular tissue can be observed. It is important to note that this discoloration does not extend up the stem more than 6 to 8 inches. If the discoloration extends up into the plant canopy, the disease may be Fusarium wilt of tomato. Although growers may observe multiple plants begin to die of this disease over a period of days or even weeks, the fungus does not often spread from plant to plant. Temperatures from 68 to 72°F favor Fusarium crown. Therefore, this disease often starts in early in the growing season.



Figure 4. Stem lesion phase of Fusarium crown and root rot of tomato.

Crop rotations that do not include tomatoes or other solanaceous crops will help to lower the number of fungal spores in the soil. However, since the causal fungus survives for years without a host, crop rotation is not a complete solution. I also realize that many growers who produce tomatoes in high tunnels do not feel it is economically practical to rotate to another crop. To such growers, I would point to [this](https://ag.purdue.edu/arge/swpap/Documents/VEGETABLE%20DISEASES%20IN%20GREENHOUSES.pdf) article (<https://ag.purdue.edu/arge/swpap/Documents/VEGETABLE%20DISEASES%20IN%20GREENHOUSES.pdf>) about how to minimize diseases in high tunnels. Growers who plant tomatoes in bags or pots in a high tunnel instead of in the soil should avoid Fusarium crown rot since the fungus survives in the soil.

Check with your seed representative or seed catalog for tomato varieties with resistance to Fusarium crown rot. Most tomato varieties with resistance to Fusarium crown rot are indeterminate (in contrast, there are many varieties with host resistance to Fusarium wilt.) It is possible to graft your favorite tomato variety as a scion onto a rootstock variety with resistance. [This](http://www.vegetablegrafting.org/resources/rootstock-tables/tomato-rootstock-table/) table (<http://www.vegetablegrafting.org/resources/rootstock-tables/tomato-rootstock-table/>) will help one select tomato rootstocks with resistance to Fusarium crown rot and other diseases. Some

tomato seed companies will sell grafted tomatoes.

There are no fungicides to control Fusarium crown rot. Most fungicides are for foliar use; I know of no fungicides that may be sprayed on the top of the soil. Read all fungicide labels carefully. Contact me if you have questions.

Diseases of tomato that I have not observed yet, but expect to see soon include:

- Bacterial spot and speck-Leaf and fruit lesions of these diseases are very common in field tomatoes.
- Bacterial canker-This disease can cause a systemic infection of tomatoes, mostly in the field.
- Early blight-Often observed to start on younger leaves and works its way higher in the canopy. Most often observed on field tomatoes.
- Leaf mold-mostly observed in greenhouses tomatoes. Yellow lesions on top of leaves are often accompanied by a gray/green mold on leaf bottoms.

Summer Field Tour – Fruit and Vegetables

Following the success of last year's Summer Field Tour at Tuttle Orchards, this year we are again planning a combined summer field tour with the Indiana Horticultural Society, the Indiana Vegetable Growers' Association and the Indiana Farm Market Association. We will be hosted by Garwood Orchards in La Porte, IN. While we encourage membership in these industry organizations, all those who are interested are welcome and invited to attend, regardless of membership status.



Garwood Orchards is one of the largest and best managed orchards in the state. It may seem puzzling that they can manage such a large operation and manage it so well. That's why we're visiting – to not only be inspired but learn a few of their tricks and see how they do it. They have aggressively planted new cultivars and crops and have been on the forefront of adopting new technologies. They are major producers of fruits and vegetables and in recent years have greatly expanded their farm market.

It may seem like quite a drive to travel to the meeting this year, especially for those in southern parts of the state, but I'm confident you'll pick up some good ideas to implement at your farm making the trip worthwhile.

Farm history

The main orchard land has been in the Garwood family since 1831, and the Garwoods have been fruit farmers since the 1920's. The orchards are owned by Tom, Mike and Brian Garwood who represent the 6th generation. Carl is pretty much "retired" from major decision-making, but like many farmers have not quite fully understood the meaning of "retirement". He still works everyday

doing many of the things nobody else wants to do. Tom’s parents James and Phyllis passed away earlier this decade and were instrumental along with Carl in growing the business from the mid 50s to the mid 90s. Despite the long history of Garwood Orchards, this is still very much a family business. The Garwoods have been very active in the Indiana Hort. Society and both Jim and Brian Garwood are past presidents and Tom and Mike have served on the IHS Executive Board or on committees. They have also been strongly involved in the Indiana Vegetable Growers’ Association.

The Garwoods currently farm over 450 acres which includes approximately 140 acres of apples. Peaches, raspberries, strawberries, plums, blueberries, cherries, and blackberries round out the rest of the fruit acreage. They now grow more vegetables than fruit which consist of bell peppers, several kinds of hot peppers, cucumbers, pickles, sweet corn, green beans, eggplant, tomatillo, and some pumpkins for u-pick.

The Garwoods have been actively replanting their orchards with newer varieties, rootstocks and growing systems. Of the apples, about 90% of trees are less than 15 years old. All recent plantings have been on the tall spindle system with trees planted 3-4 feet apart in the rows giving tree densities around 1200 trees per acre. In terms of apple varieties, Gala, Honeycrisp, Evercrisp, Fuji, Pink Lady and Pixy Crunch make up most of the plantings made in the last 5 years.

The peach variety picture consists of about 50% of the newer Paul Friday selections (Brian says they have tried most of them). Then perhaps 25% are Redhaven and other standards, and 25% are the ‘Stellar’ varieties. There is a small planting of White Lady and some of the newer varieties from Adam’s County Nursery. They have established “research” or “evaluation” blocks in which they have made small plantings of a number of new tree fruits or new varieties to test including 9 from the MAIA program.

On the small fruit side, at meeting time, the Garwoods should be just wrapping up harvest on their strawberries. They are using a 1 mil row cover for extending the season and for frost control. They also have portable irrigation. Plantings of red and black raspberries and thornless blackberries on ridges look very good. Increasingly, they are planting on plastic, especially for strawberries, peppers, eggplants, cucumbers and pumpkins.

Fruit and vegetables are sold both retail and wholesale. Retail and especially UPICK and school tours have become much more prominent at Garwoods, and the market at the farm has been expanded greatly over recent years and includes an enlarged bakery. A wide range of produce is sold in the market, as well as fresh donuts. A high percentage of their fruits and vegetables are still sold through wholesale outlets to large chain stores and through brokers. They have several cold storages, including one capable of being CA. The use of ‘Smart Fresh’ to extend storage life has been very helpful. The fruit packing line includes a waxer for wholesale sales.

They are now also concentrating on growing vegetables for wholesale including sweet corn, green beans, eggplant, pickles, cucumbers, tomatillos and peppers. They have also installed a new vegetable packing line. The Garwood’s still make their own

cider. The press is now a Frontier Technology continuous feed press housed in a separate press room. The cider is also pasteurized, using a Thermoline pasteurizer.

Garwood’s also hold a Primus GFS certificate for food safety. They have completed that audit on the ranch, packing and harvesting for several years to satisfy requirements of wholesale customers.

For more information, visit Garwood’s website:

<http://appleupick.com>

Location

Garwood Orchards, 5911 W 50 South, LaPorte, IN 46350

The orchard location can be found in Google maps:

<https://www.google.com/maps/place/Garwood+Orchards/@41.600327,-86.815679,13z/data=!4m5!3m4!1s0x0:0x678e84d551c18e95!8m2!3d41.600327!4d-86.815679?hl=en>

Also, look on the Garwood orchard Website:

<http://appleupick.com/find-us/>

Program schedule:

Tuesday June 26:

NOTE: Garwood’s are on Central Daylight (Chicago) time. Times listed are local time.

Garwood Orchard, LaPorte, IN

8:30 am Registration. Coffee and donuts.3

9:00 am Welcome and Introductions

Orchard tour – fruit

11:15 am Indiana Hort. Society business meeting

12:00 pm Lunch – cookout at the farm.

1:00 pm Field tour – vegetables

3:00 pm Farm marketing and tour of facilities

5:00 pm Conclude tour and depart

Motels in the LaPorte Co. area include:

Hampton Inn and Suites, Michigan City, IN. \$129 + tax. Phone: 855-238-159

Holiday Inn Express, La Porte, IN. \$116 + tax. Phone: 855-239-9222

Blue Jay Manor, Michigan City, IN. \$80 + tax. Phone: 877-429-7381

A Food Company Looking for Partner Growers in Indiana

[Seal the Seasons](#) is a growing food company founded on supporting local growers by making local food available all year-round. Seal the Seasons partners with local family farms on a state-by-state basis to source local food (focused primarily on fruit and vegetables), freeze it, and sell to grocers, with the grower proudly featured on the bag, in the grower’s state.

Seal the Seasons has already successfully partnered with growers

across the Southeast, Northeast and Mid-Atlantic and is looking forward to partner with growers in Indiana as it strives to support local agriculture and integrate quality Indiana frozen produce into conventional grocery stores. Any interested growers, food processors or copackers should reach out to Alex Piasecki at alex@sealtheseasons.com



Upcoming Events

Southwest Purdue Ag Center High Tunnel Tour

Date: June 13, 2018 7:00-9:00 pm Eastern Time

Location: Southwest Purdue Agricultural Center, 4369 North Purdue Road, Vincennes, IN, 47591

Seedless cucumber production in high tunnels will be the highlight of this year's event.

- You will see 16 cucumber varieties grown in a high tunnel, and be able to taste them.
- We will share with you yield results of grafted cucumber plants that have started to produce since middle April in an unheated high tunnel.
- You will also see cucumbers grown in the high tunnels with different pruning and trellising systems.
- Entomologist Laura Ingwell will join us at the event to discuss cucumber beetle management approaches.

Other things you will see at this event include: summer squashes growing in a high tunnel; different pruning and trellising systems for growing tomato and pepper; annual strawberry production with low tunnel systems.

Registration will begin at 6:30 pm. The tour is free; to register please call (812) 886-0198. For more information please contact Wenjing Guan (guan40@purdue.edu). This event is sponsored by North-Central Sustainable Agriculture Research and Education.



High Tunnel Tour Southwest Purdue Ag Center

4369 N. Purdue Road, Vincennes, IN 47591

Wednesday, June 13, 2018

7:00 PM – 9:00 PM (EST)

Registration and self-guided tour start at 6:30 PM (EST)

Highlights of 2018 High Tunnel Tour: Seedless Cucumber Production

- Evaluate 16 seedless cucumber varieties.
- Learn cucumber grafting technique and its potential to extend early season cucumber production.
- Observe different trellises and pruning systems for growing cucumbers in high tunnels.
- Discuss management options for striped cucumber beetles.



If you already or plan to grow cucumbers in high tunnels, this will be a field day that you will not want to miss!!!

- In addition to cucumbers, this event will include topics on high tunnel **tomato, pepper** and **summer squash** production. You will learn about variety selection, pruning and trellising systems, as well as how to maximize benefits of using grafting technique on tomatoes.
- Last but not least, you will see a demonstration of growing **strawberries** with plasticulture and an innovative low tunnel system.



The tour is free, to register please call: Southwest Purdue Ag Program (812) 886-0198. We may be able to arrange transportation upon request. For more information, please contact Wenjing Guan at guan40@purdue.edu.

This high tunnel tour is sponsored by Purdue University and North-Central Sustainable Agriculture Research and Education (NC-SARE). Project number LNC17-390.



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2018 Indiana Hort Society Summer Field Tour

Date: June 26, 2018

Location: Garwood Orchards, 5911 W 50 South, LaPorte, IN 46350

Greenhouse and Indoor Hydroponics Workshop

Date: Sep. 5, 2018

Location: 625 Agriculture Mall Drive, West Lafayette, IN 47907

Greenhouse and Indoor Hydroponics Workshop

Wednesday, September 5, 2018
8:00am-3:00pm
(Lunch provided by ISDA)

Classroom sessions 8am-noon

Deans Auditorium
Pfendler Hall- PFEN 1159
Purdue University, 715 W State St
West Lafayette, IN 47907

Hands-on activities/tours 1:00-3:00 pm

Horticulture Greenhouse
625 Agriculture Mall Drive
West Lafayette, IN 47907



You will learn about best varieties, nutrient recipes, production systems, artificial lighting and temperature needs for hydroponic lettuce produced in greenhouses and indoors. Attendees will tour our latest state-of-the art greenhouse and indoor hydroponic facilities (built this year!) and experience many hands-on activities. Hurry up! Seating is limited!

Registration is free but required

Register Here

<https://tinyurl.com/yaxd4k2z>

Questions? Contact Lori Jolly-Brown

ljollybr@purdue.edu, 765-494-1296 or

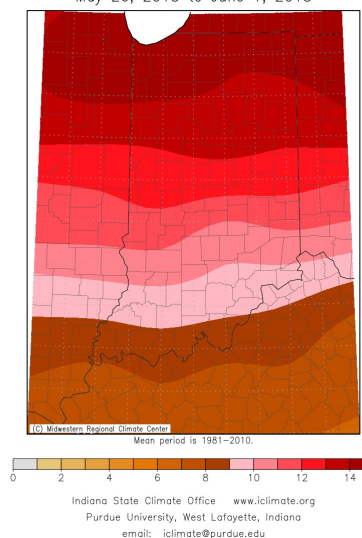
Dr. Krishna Nemali, knemali@purdue.edu

Workshop sponsored by:

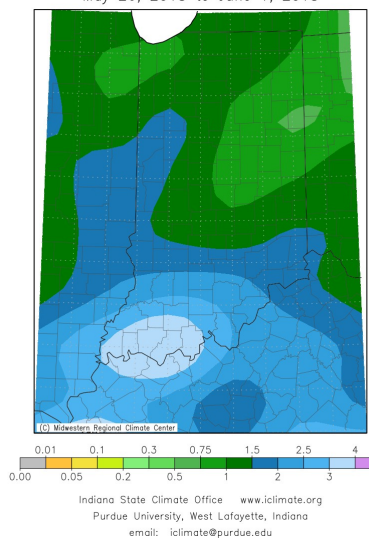


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Average Temperature (°F): Departure from Mean
May 26, 2018 to June 1, 2018

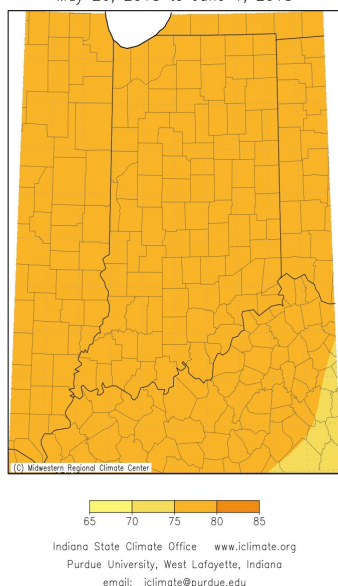


Accumulated Precipitation (in)
May 26, 2018 to June 1, 2018

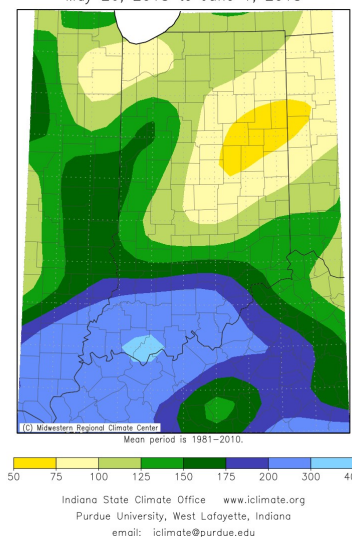


Temperature and Precipitation May 26 to June 1

Average Temperature (°F)
May 26, 2018 to June 1, 2018

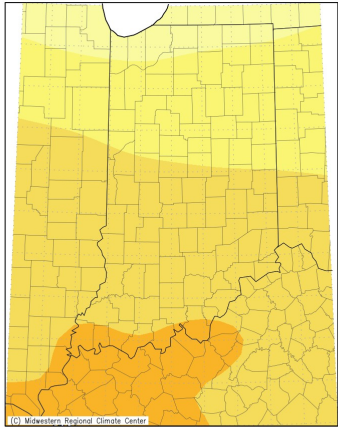


Accumulated Precipitation: Percent of Mean
May 26, 2018 to June 1, 2018



Temperature and Precipitation May 19 to May 25

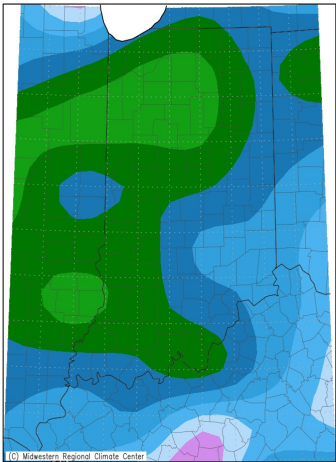
Average Temperature (°F)
May 19, 2018 to May 25, 2018



60 65 70 75 80

Indiana State Climate Office www.iclimat.org
Purdue University, West Lafayette, Indiana
email: iclimat@purdue.edu

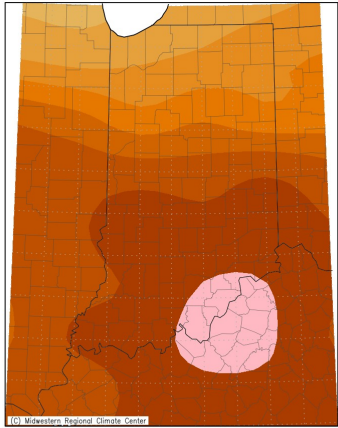
Accumulated Precipitation (in)
May 19, 2018 to May 25, 2018



0.01 0.05 0.15 0.3 0.75 1.25 1.75
0.00 0.02 0.1 0.2 0.5 1 1.5 2

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Average Temperature (°F): Departure from Mean
May 19, 2018 to May 25, 2018

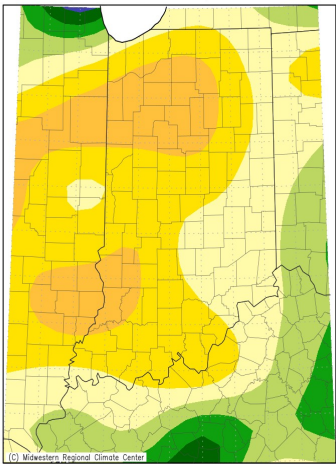


Mean period is 1981-2010.

0 1 2 3 4 5 6 7 8 9 10

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Accumulated Precipitation: Percent of Mean
May 19, 2018 to May 25, 2018



Mean period is 1981-2010.

25 50 75 100 125 150 175 200

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Editor: Wenjing Guan | Department of Horticulture and Landscape Architecture, 625 Agriculture Mall Dr., West Lafayette, IN 47907 |
(812) 886-0198