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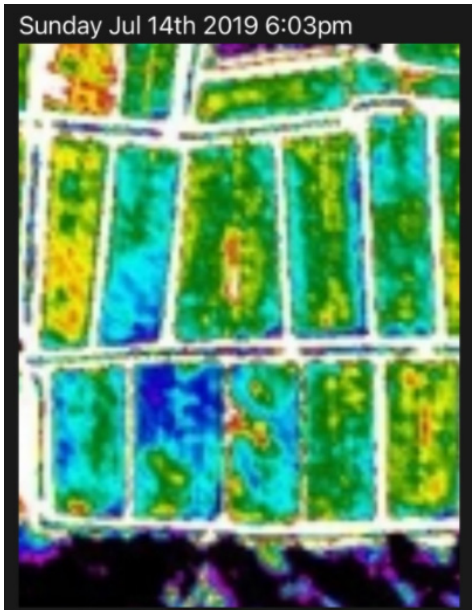
# Disease Pressure Lessons From Thermal Imagery

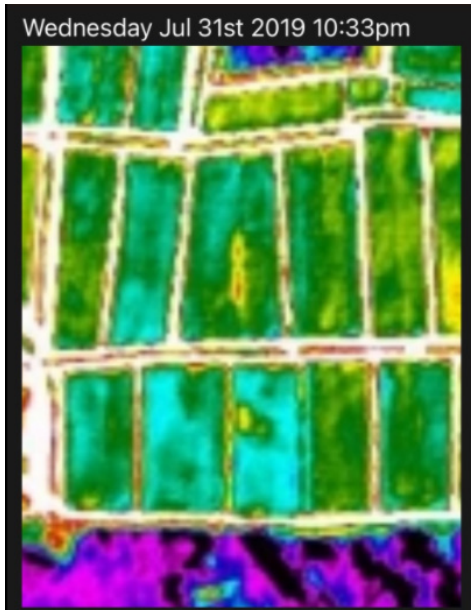
***By Allison Jonjak and Wes Normington***

Born from a desire to understand his vines better in order to manage them better, Wes Normington has explored thermal imagery of his marsh since 2018. Already he has learned some things that may be of value to growers—first, the ability to identify disease pressure sooner than physical symptoms show up on the vines; and second, the fact that last year's leaf pile can lead directly to disease hot-spots this year. Wes will continue to scout with thermal imagery, and he will also relocate his leaf pile.




A quick note: these images show purple as coldest, then blue, aqua, green, yellow, with orange being hot, red being very hot, and white being hottest.

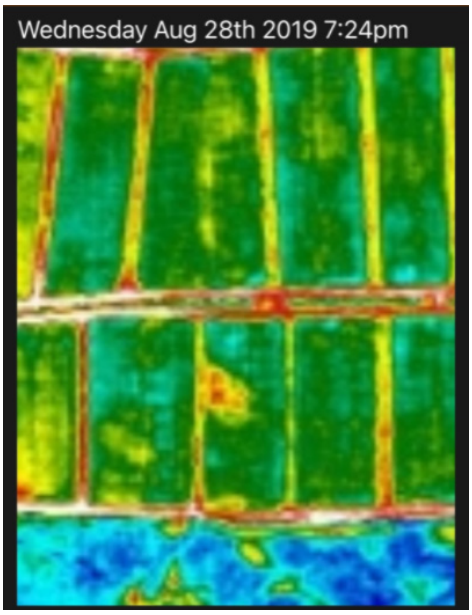
In early July, distinct color differences were visible on two beds in the south block. One showed cool, blue regions. The center bed, marked with an orange banner, had a red "hot spot". Two beds further to the north showed consistently warm, as well.




The four beds were scouted. The two consistently warm beds had been sanded, and so their warmth was from the hot sand. The north hot bed was a recent renovation so had a lot of sand showing yet which shows hot. The south had Cottonball and had a leaf pile in the corner from past years' harvest. The cool, dark blue areas on the adjacent bed were identified as areas that were retaining water. Scouts could not determine what was causing the hot spot in our center bed (which is planted to Haines). Curious about the mystery, the team at Saddle Mound ran tissue tests for all nutrients during the season and didn't find any deficiencies with these vines.

By late July, the water retention issue had been resolved, but the hot spot in our center bed was still bright on the

thermal scans—but still showed nothing when scouts put boots on the ground. The wider bed to the north, which is slightly too wide for the boom to access the center, shows a similar hot spot, which will be a clue—it is obvious in the thermal imagery, but no difference is apparent to the eye.

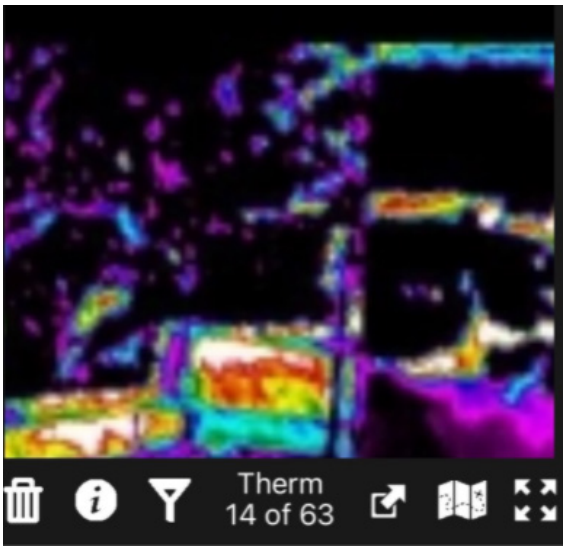


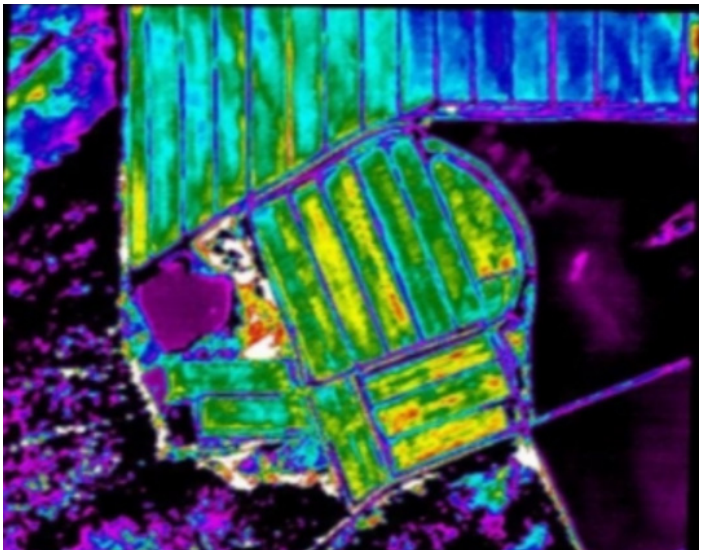

Finally, in August, the hot spot that remained in the thermal imagery showed up in the bed—it was early rot. This block of beds had received a light rate of fungicide, since they are newer plantings. No signs of disease were visible to the human eye until 6 weeks after stress was first noticed by the thermal imaging system.

Armed with the information that unexplained heat, picked up by thermal imaging, can indicate active plant pathogen presence even before human scouts can detect it, Wes went into the next season with a critical eye.

He identified some of the hottest conditions in areas of beds where leaves had collected after a spring bug & leaf flood, for example the northwest corner of the bed pictured here. He also noticed a bright white spot at the intersection where he piles his compost during harvest. Of course the heat generated by decomposition of the leaves causes the pile itself to be hotter than surrounding beds—but he also noticed a gradient across his beds. While some beds are 'hotter' than their neighbors because earlier varieties "warm up" sooner than later ones, other beds are hotter than their neighbors of the same variety. Even though you don't know the varieties Wes has on each bed, you can see a gradient: the closer the bed is to the leaf pile, the greater the plant stress—this could very well be caused by disease.

After just two years of exploration with a new technology, Wes found an action that he could take that might improve disease pressure on his marsh. In 2021, he will put leaves in a new pile, further from his production beds. And he will, of course, continue to monitor his vines and berries for yield and quality—but this could be the beginning of a new level of understanding.
Thanks to Wes and the Saddle Mound team for sharing their experience and knowledge!



# Wildflower Plantings Increase Bee Diversity on Cranberry Marshes

*By Nolan Amon and Christelle Guédot*

Cranberries are highly reliant on insect pollination to achieve optimal yield. Most growers ensure the delivery of pollination services through rented honey bee colonies, though recent population declines due to a combination of factors have called the sustainability of this practice into question. Wildflower plantings have been utilized in other cropping systems, including blueberry, almond, and strawberry to augment the wild pollinator community and ensure delivery of pollination services and increasing overall farm sustainability. Here we assessed how wildflower plantings affect the wild bee community in Wisconsin cranberry, to determine how the presence of a wildflower planting may affect bee visitation to cranberry flowers, and to evaluate how wild bee biodiversity and visitation affect cranberry yield.

## Bee diversity

| Family | 2018 | 2019 | 2020 |
|---|---|---|---|
| Apidae | 13 | 22 | 32 |
| Andrenidae | 5 | 19 | 21 |
| Colletidae | 0 | 3 | 3 |
| Halictidae | 32 | 43 | 46 |
| Megachilidae | 5 | 12 | 16 |
| Melittidae | 0 | 0 | 1 |
| **Total** | 55 | 99 | 119 |

Table 1. Number of bee species collected from each family every year

We found a higher Simpson diversity index outside of cranberry beds than within them, and higher within wildflower plantings than on conventionally-managed field edges (Figure 1). Simpson's diversity was not different between cranberry beds adjacent to wildflower plantings and those adjacent to conventionally-managed field edges. **These results suggest that pollinator gardens increased bee diversity on cranberry marshes but not yet in cranberry beds near pollinator gardens.**

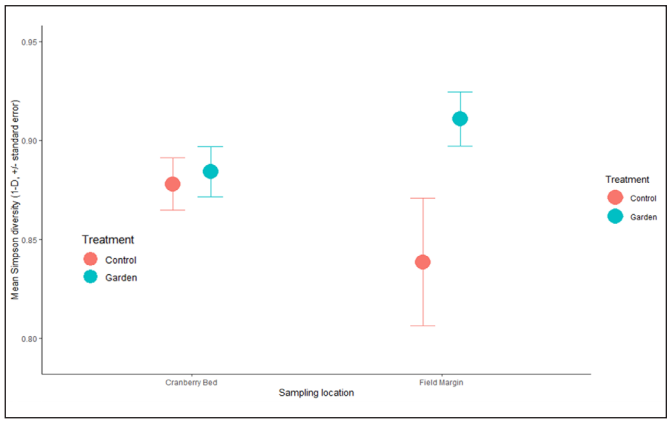



*Figure 1. Simpson's diversity of wild bee communities collected from within or outside cranberries, adjacent to wildflower plantings or conventionally managed field edges. Simpson's diversity values are +/- standard error.*

## Bee species richness and abundance

Looking at species richness (number of species collected) and abundance (number of bees per species) separately, we found no impact of the pollinator gardens on either of these metrics between cranberry beds adjacent to wildflower plantings and cranberry beds adjacent to conventionally-managed field margins, nor was it different between wildflower plantings and conventionally-managed field edges. Species richness increased every year in our study and wild bee abundance was higher outside of cranberry than within cranberry beds (Figure 2). **These results suggest that there is a larger abundance of wild bees on field margins that could be tapped into for cranberry pollination by fostering their populations with pollinator gardens and other pollination practices.**

## Bee visitation

Bee visitation to cranberry (Figure 3) was not significantly different between cranberry beds adjacent to wildflower plantings or conventionally-managed field edges. As growers stock honey bee hives to insure optimal pollination, it was not surprising to see that honey bees visited cranberry flowers more often than wild bees. **These results suggest that while pollinator gardens are not yet leading to wild bees spilling over into cranberry, they are also not drawing honey bees away from cranberry.**

## Yield metrics

Mean berry weight (Figure 4) was not different in cranberry beds adjacent to wildflower plantings or conventionally-managed field edges, was not affected by visitation rates from any bees, and was not different between years. **Wild bee species richness was positively correlated with increased mean berry weight, with every additional wild bee species adding approximately 0.01 grams of weight to fruit, thus emphasizing the importance to foster bee richness and diversity on cranberry marshes.**

Cranberry yield (Figure 5) was not different in cranberry beds adjacent to wildflower plantings or conventionally-managed field edges and was not affected by visitation rates from any bees. Yield was lower in 2019 than 2018 or 2020, and variations in yield were best explained by the marsh berries were collected from.

Wildflower plantings on cranberry marshes add an extra layer of support to the wild pollinator community and improve the overall resilience of pollination services to cranberry. The native floral resources afforded by pollinator gardens provide alternate means of forage for wild and honey bees. These resources may boost the overall health and resilience of honey bee colonies and may lead to greater sustainability of honey bee-mediated pollination.

## Recommendations

Our result support the recommendation that pollinator gardens increase the diversity of wild bees on cranberry marshes. We recommend planting at least ¼ acre pollinator garden but suggest that this is likely on the lower end of an optimal size to promote pollinators in cranberry. The mix of plants we used was well received by growers and we provided recommendations for site preparation, planting, and maintaining gardens as well as managing weeds in pollinator gardens at

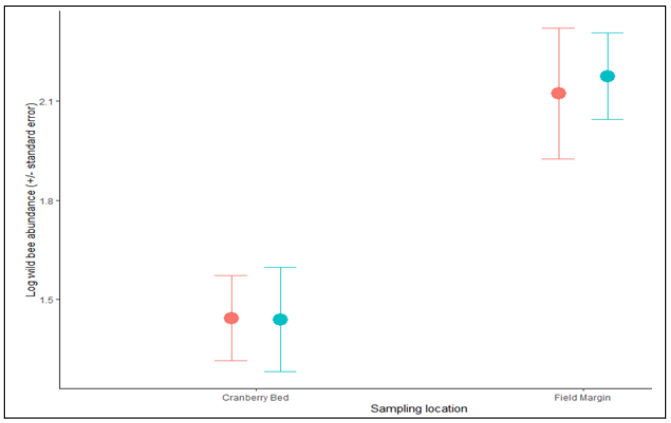



*Figure 2. Abundance of wild bee communities collected from within or outside cranberries, adjacent to wildflower plantings or conventionally managed field edges.*

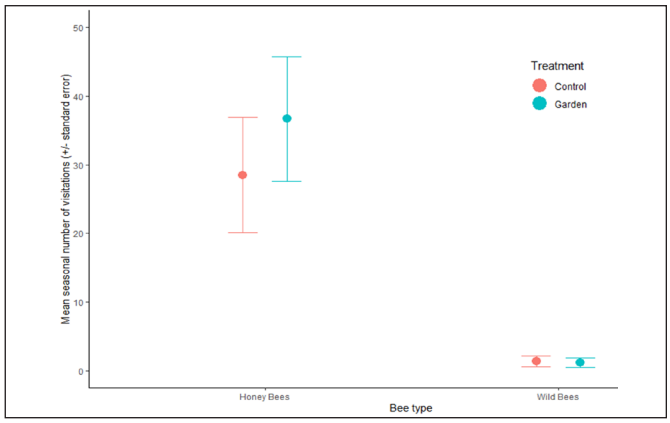



*Figure 3. Mean seasonal visitation to cranberry flowers by honey and wild bees, in cranberry beds adjacent to wildflower plantings or conventionally-managed field edges. Visitation numbers are +/- standard error.*

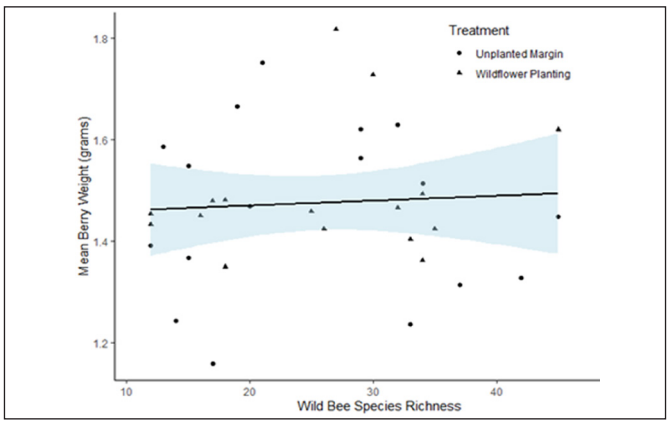



*Figure 4. Mean berry weight as a function of wild bee species richness. Shaded area represents a 95% confidence interval for the relationship between berry weight and wild bee species richness.*

different events. Other publications on protecting and promoting wild pollinators were provided to growers and are available as short and longer versions.

**Acknowledgments**

We would like to thank all the participating cranberry growers who established and maintained wildflower plantings, and allowed us to conduct research on their marshes, we could not do our research without you, your help, your knowledge, and insights! We would also like to thank the WCB and DATCP for funding this research.

Happy growing season!

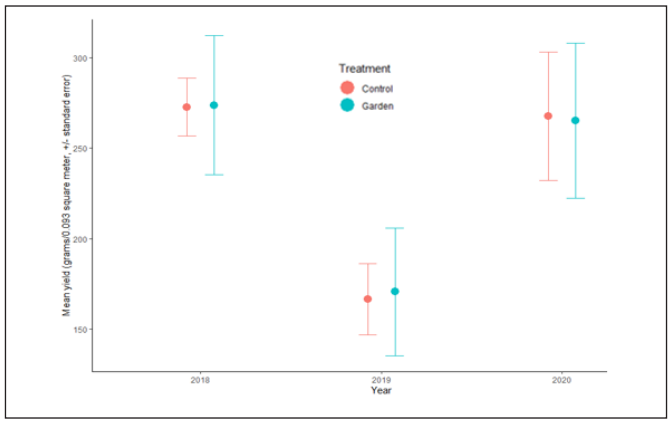



***Figure 5. Cranberry yield (average weight of 3 harvested 1 sq. foot transects) between beds adjacent to wildflower plantings and conventionally managed field edges, across years. Yield numbers given are +/- standard error.***

# Check Out the VacciniumCAP Newsletter

***By Amaya Atucha***

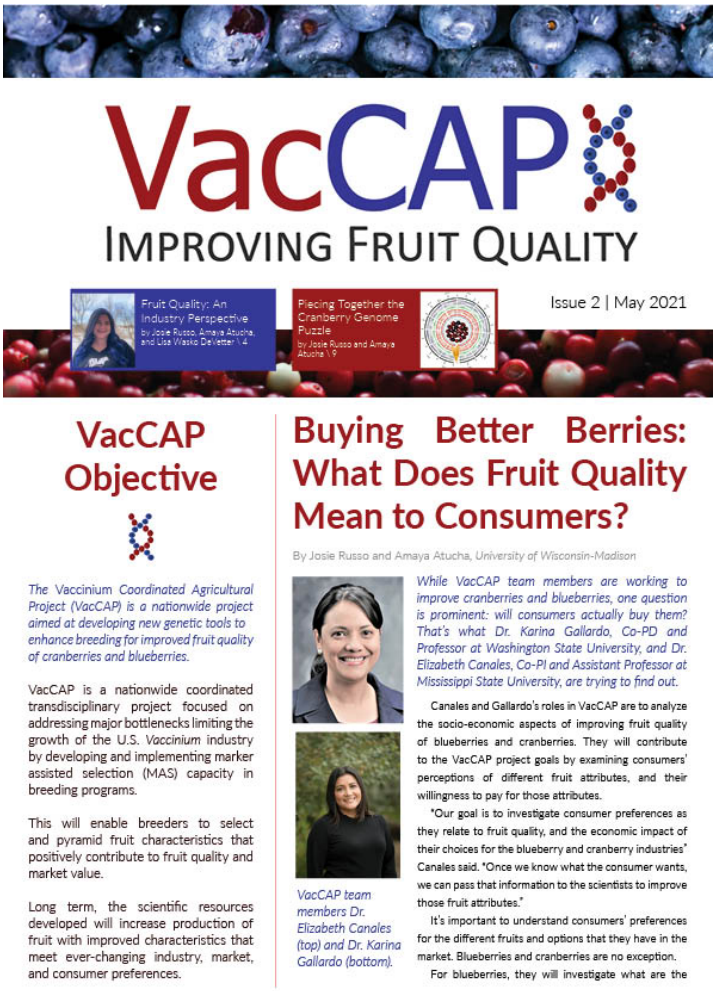
The Vaccinium Coordinated Agricultural Project (VacCAP) is a nationwide coordinated transdisciplinary project focused on addressing major bottlenecks limiting the growth of the U.S. blueberry and cranberry industry by developing and implementing marker assisted selection (MAS) capacity in breeding programs.

This will enable breeders to select and pyramid fruit characteristics that positively contribute to fruit quality and market value.

Long term, the scientific resources developed will increase production of fruit with improved characteristics that meet ever-changing industry, market, and consumer preferences.

Here's a link to the second edition of the VacCAP newsletter.

https://www.vacciniumcap.org/sites/default/files/inline-files/Newsletter%20Issue%202%20Layout_0.pdf


VacCAP

IMPROVING FRUIT QUALITY

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VacCAP Objective

*The Vaccinium Coordinated Agricultural Project (VacCAP) is a nationwide project aimed at developing new genetic tools to enhance breeding for improved fruit quality of cranberries and blueberries.*

VacCAP is a nationwide coordinated transdisciplinary project focused on addressing major bottlenecks limiting the growth of the U.S. *Vaccinium* industry by developing and implementing marker assisted selection (MAS) capacity in breeding programs.

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Long term, the scientific resources developed will increase production of fruit with improved characteristics that meet ever-changing industry, market, and consumer preferences.

Buying Better Berries: What Does Fruit Quality Mean to Consumers?

By Josie Russo and Amaya Atucha, *University of Wisconsin-Madison*

*VacCAP team members Dr. Elizabeth Canales (top) and Dr. Karina Gallardo (bottom).*

*While VacCAP team members are working to improve cranberries and blueberries, one question is prominent: will consumers actually buy them? That's what Dr. Karina Gallardo, Co-PD and Professor at Washington State University, and Dr. Elizabeth Canales, Co-PI and Assistant Professor at Mississippi State University, are trying to find out.*

Canales and Gallardo's roles in VacCAP are to analyze the socio-economic aspects of improving fruit quality of blueberries and cranberries. They will contribute to the VacCAP project goals by examining consumers' perceptions of different fruit attributes, and their willingness to pay for those attributes.

"Our goal is to investigate consumer preferences as they relate to fruit quality, and the economic impact of their choices for the blueberry and cranberry industries" Canales said. "Once we know what the consumer wants, we can pass that information to the scientists to improve those fruit attributes."

It's important to understand consumers' preferences for the different fruits and options that they have in the market. Blueberries and cranberries are no exception.

For blueberries, they will investigate what are the

# Do You Grow a Pollinator-Dependent Crop? Please Take Our Quick Grower Survey!

***By Hannah Gaines Day***

The University of Wisconsin-Madison is conducting a survey of growers as part of a larger study examining the use of managed bees for crop pollination across the state.

This study is being conducted to understand where in the state crops may be most vulnerable to changes in honey bee availability. Your participation will help us gain a better understanding of where in the state honey bees are used for crop pollination (and where they're not). Participation is voluntary and will take less than 5 minutes. All information collected in this survey will be kept confidential.

If you have questions about this study, please contact Dr. Hannah Gaines Day (hgaines@wisc.edu). To complete the survey, please visit this link: https://go.wisc.edu/hc677v

# Update from the Wisconsin Cranberry Research Station

***By Wade Brockman***

Things are moving fast at the research station. First fungicide application is about to be made as some of the hybrids are about 20% in blossom. Last year's new plantings are also about 10% in blossom. Hopefully we get some rain soon as water tables are definitely dropping.

Last year's new plantings:

# Grower Updates

## Flying Dollar Cranberry

***By Seth Rice***

Growers around the central part of the state have been through a little heat wave but are still managing to carry on. Growers are on alert for drought as it can creep in when you're not watching. We were able to put down some applications of herbicides. Some growers were lucky to get most if not all of their applications on, while some did not. There are some bugs out on the marshes and across the area that we as growers were able to target and hopefully eliminate.

With this heat our degree growing days are sure climbing and we are seeing that, especially in our early varieties. Bloom is upon us and now we will start to see our beekeepers drop off their hives around the area marshes. It's always neat to see them work. We're always fascinated to see baby turkeys, ducks, cranes, and fawns around the marsh. I had one fawn scare me as I was fixing some irrigation in the bed and one jumped up from the ditch while I had my back turned and started to follow me around until I was not interesting anymore. Stay safe and try to fit some relaxing time for yourself into your busy schedule.

## Cranberry Lake

***By Karl Pippenger***

Window of application for first insecticide was mid-last week to mid-this week (June 2-9). It is important to be mindful of oil-based chemicals and adjuvants in the heat, or when tender growth is present. Stevens and GH1 varieties have 1½"-2" of growth with hooks pulling away from the stem. Some beds will be in full hook by the end of the week. It is still too early to apply fertilizer.

A note on fungicides. Research has shown that if only one fungicide is going to be applied, the best timing for control is during bloom. Personally, I do not like to make any type of pesticide application during bloom or when bees are present. If you plan on using fungicides, I recommend two applications; one application at full hook before the bees come in and one application at fruit set when the bees leave. While it may be counter intuitive to say it is more eco-friendly to make two applications as opposed to one, I believe in this case, it is. If I'm at a buffet and there is something disgusting in the food, I won't eat. Bees feel the same way, and while I cannot prove what the impact of spraying fungicides when the bees are flying is, it just seems like common sense to me to leave the bees alone when they're trying to make us money.

# Drought Monitoring Resources for Cranberry Crops in the Midwest—Through the Seasons

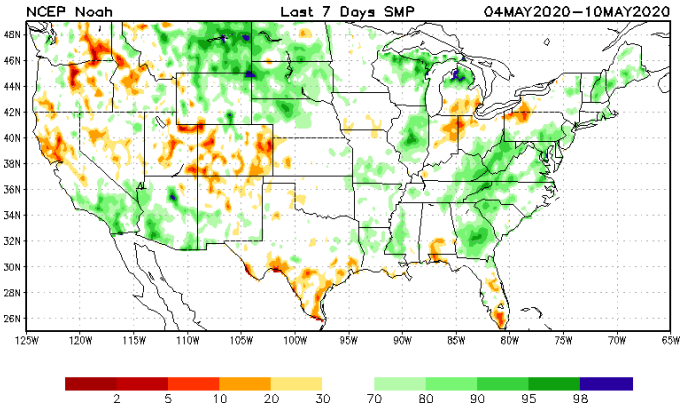
## Winter

Many cranberry crop producers depend upon winter precipitation for soil moisture and reservoir recharge., and upon snowfall to protect over-wintering vines from desiccation and large temperature swings.

### Soil Moisture Maps of the U.S.

(www.cpc.ncep.noaa.gov/products/Drought/Monitoring/smp_new.shtml)

These maps show how soil moisture in different layers of the soil column differs from normal. The soil moisture data account for regional differences in soil moisture field capacity. Yellow and orange colors indicate where there is less soil moisture than normal for that time of the year, while green colors show that the soil conditions are wetter than normal. The user can view current conditions as well as the past week or month.

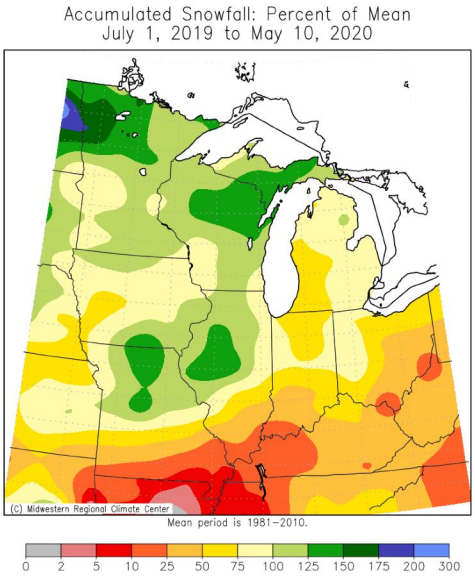



### Midwestern Regional Climate Center's Climate Watch

(mrcc.illinois.edu/cliwatch)

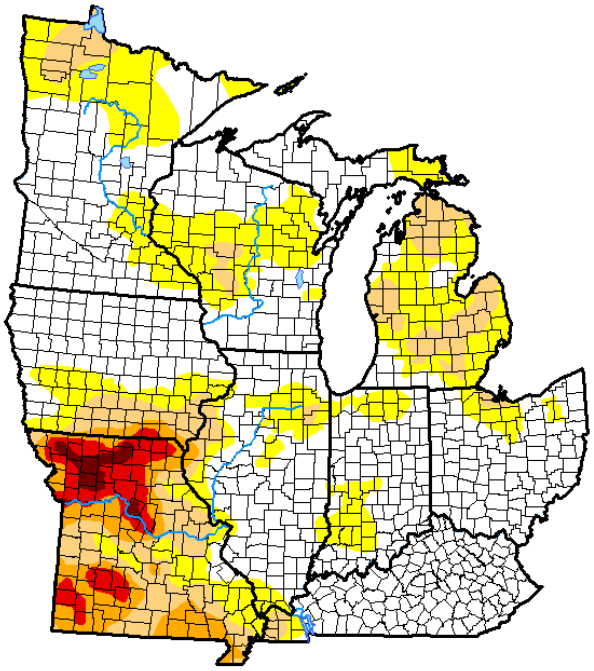
"Seasonal Maps - Winter" tab

"Percent of Normal" maps show how current snowfall compares to the 30-year normal. Areas in green/blue have received more snow than normal, while areas in orange/red have received less snow than normal. These maps can provide an early indicator of soil conditions come spring.



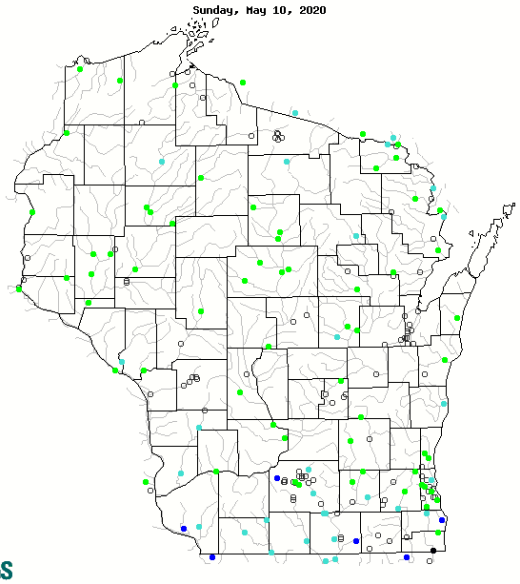
# Summer/Autumn Hydrological Concerns

During the summer and autumn, growers may be keeping an eye on the availability of water reserves for harvest and the winter flood. While the U.S. Drought Monitor can provide a general snapshot of conditions, a few other monitoring tools focus more specifically on groundwater and surface water levels.



## U.S. Drought Monitor
(droughtmonitor.unl.edu)

Areas in yellow are experiencing abnormally dry conditions that could develop into drought or are recovering from drought but are not yet back to normal. Areas in darker tan and red colors are currently experiencing moderate to extreme drought, indicating where it may be difficult to recharge soil moisture or reservoir levels before the growing season begins.




USGS

## WaterWatch
(waterwatch.usgs.gov)

The U.S. Geological Survey produces these maps of real-time streamflow conditions, generally updated on an hourly basis. Colors represent streamflow conditions compared to historical streamflow, with red and orange colors representing below-normal streamflow, green representing normal streamflow, and blue and black colors representing above normal streamflow.

**Climate Information Needs of Midwest Specialty Crop Growers** is a project of the National Drought Mitigation Center and the University of Wisconsin, with the U.S. Department of Agriculture Midwest Climate Hub and the National Integrated Drought Information System. We are grateful for the participation of advisors representing Iowa State University, the Iowa Winegrowers Association, University of Missouri Extension, University of Wisconsin-Madison Extension, Wisconsin Potato and Vegetable Growers Association, and Wisconsin State Cranberry Growers Association. The project was funded by the National Oceanic and Atmospheric Association Sectoral Applications Research Program.

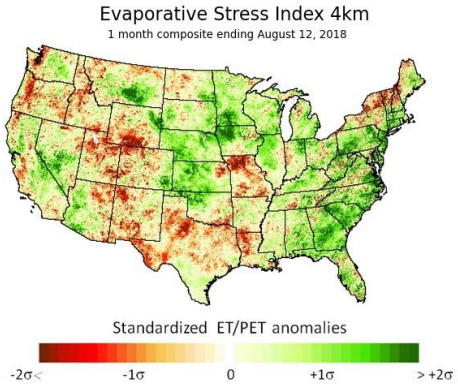
# Spring/Summer Evapotranspiration Concerns

Drought can develop quickly in the spring and summer when the atmospheric evaporative demand is higher than normal. This can be caused by warmer temperatures, sunnier skies, low relative humidity, and strong winds and can desiccate plants in the spring and lead to fruit scald in the summer. It is important to keep an eye on tools that can alert growers to emerging drought conditions.

Satellite-based monitoring tools track vegetation health with high spatial resolution, showing the cumulative impact of elevated evaporative demand and dry soils. These tools monitor relatively fast changes in vegetation conditions, and can act as an "alarm" of rapidly developing drought.

## Evaporative Stress Index (ESI)

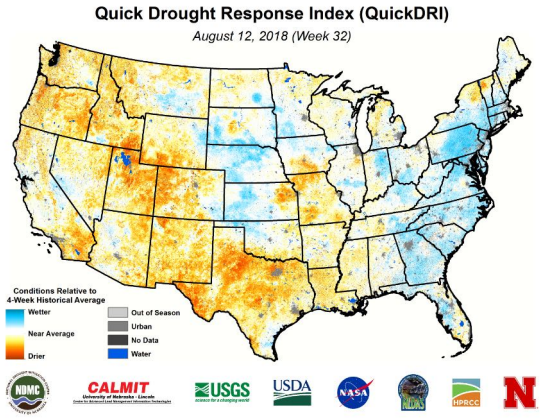
(hrsl.ba.ars.usda.gov/drought/index.php)




Orange-to-red colors indicate plant stress due to abnormally high evaporative demand. Green colors show areas where the vegetation is healthy.

## Quick Drought Response Index (QuickDRI)

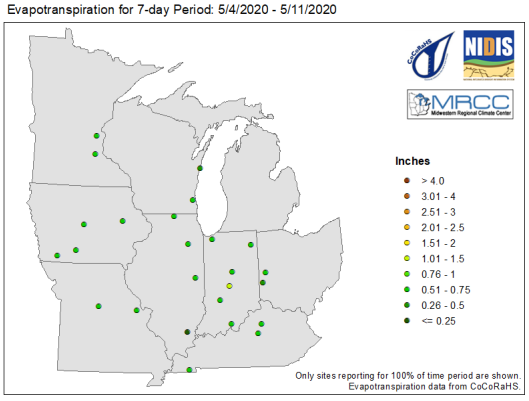
(quickdri.unl.edu)




Regions in yellow-orange-red are rapidly becoming drier while regions in blue shades are rapidly becoming wetter.

## Evapotranspiration and Water Balance Maps

(mrcc.illinois.edu/cliwatch/drought/drought.jsp)



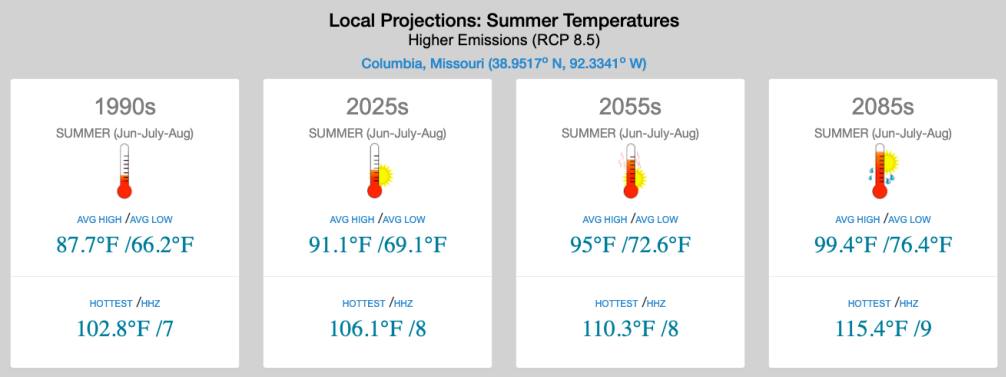

While many growers of irrigated high-value crops have in-field monitoring equipment, there are some tools that can help monitor daily evapotranspiration rates. Use of these tools can improve the efficiency of variable rate irrigation, and help the grower conserve water when possible while protecting plant health and yield. These of course tend to be very specific to conditions at the station location and will not provide anything close to the spatially continuous, high-resolution data provided by satellites and models.

# Annual/Inter-annual/Longer Term

Cranberry growers make decisions that will affect their operations for many years to come, including locating crops for optimal health and productivity, and planting under circumstances that get vines off to a strong start. Future climate decision-support tools can inform these long-term strategic decisions by demonstrating how precipitation, temperature, evapotranspiration demand, and growing seasons might change over the next few years to over decades.

## Future Climate Dashboard

(climatetoolbox.org/tool/future-climate-dashboard)

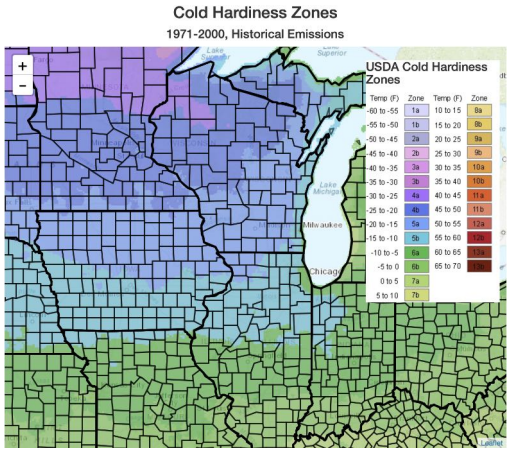



This tool displays a dashboard of projected future climate information for any location in the contiguous US. This tool is useful for evaluating how an individual climate variable is projected to change in future 30-year periods at a set location. The dashboard compares what was normal for 1971–2000 with projections derived from an ensemble of downscaled climate model projections using multiple future emissions scenarios.

## Future Cold Hardiness Zones

(climatetoolbox.org/tool/Future-Cold-Hardiness-Zones)

This tool visualizes contemporary and future cold hardiness zones, also known as the USDA Plant Hardiness Zone. Cold hardiness zones can help growers determine which perennial crops and plants are most likely to tolerate their winter temperatures. The cold hardiness map is based on the average coldest single overnight temperature of the winter. Users can also map the potential geographic range under current and future climate from a number of perennial crops based on their hardiness zones.

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