WISCONSIN CRANBERRY SCHOOL

2023 PROCEEDINGS

Photo by C. Guédot

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This publication was compiled and edited by:

Christelle Guédot
Fruit Crop Entomology and Extension Specialist
Department of Entomology
University of Wisconsin-Madison

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INTRODUCTION TO S.A.M.E. FOR CRANBERRY FRUIT ROT MANAGEMENT

LESLIE HOLLAND

Department of Plant Pathology, University of Wisconsin-Madison, WI

Fruit rot is identified as the most important research need of cranberry growers across all U.S. growing regions. Cranberry fruit rot (CFR) has been a major factor reducing yields since the first commercial beds were planted in the late 1800s. Even with appropriate implementation of a CFR management program, yield losses up to 30% or more are not uncommon in regions with high disease pressure. In historically lower disease-prone regions, such as Wisconsin, devastating levels of fruit rot tend to be sporadic and associated with climatic events.

A survey of North American cranberry growers conducted by Holland and colleagues in 2021-2022 found that 83% of growers experienced losses to fruit rot within the last 5 years. Less than half (46%) of the growers surveyed felt that the current fruit rot management practices were effective. Some of the top factors that growers felt contributed to increased fruit rot incidence included: weather conditions, retention of moisture in the canopy, susceptible varieties, and overheating.

Over the past decade, the fruit rot disease complex has become even more challenging to manage. Yield losses due to CFR of 50 to 100% have been reported. Consequently, growers apply 2 to 5 fungicides per growing season just to make sure their produce is marketable at harvest. Unwarranted fungicide application is a potentially unnecessary cost that reduces overall production efficiency, while simultaneously raising concerns about environmental impacts.

Why S.A.M.E.?

S.A.M.E. stands for Systems Approach for Managing the Expression of CFR. This 4-year, multistate, interdisciplinary project is seeking to address five important knowledge gaps and subsequent management strategies for fruit rot.

1. There are no predictive models to identify high risk conditions and growers are often caught off guard when higher incidences of CFR occur.
2. As broad-spectrum fungicides are lost, growers rely more heavily on at-risk fungicide chemistries.
3. Due to the endophytic nature of these fungi, it is assumed that most fruits are infected, however not all infections lead to the development of rot. Therefore, we propose that environmental stress factors may lead to the expression of fruit rot.
4. Current selections and germplasm of cranberry show enhanced fruit rot resistance, however, the mechanism for genetic resistance to fruit rot is unknown.
5. A better understanding of the trade-offs between CFR management practices and what best incentivizes growers to proactively manage CFR will lead to adoption of effective CFR control.

This project will dissect the components of the disease triangle (pathogen, host, environment) to enhance our understanding of the factors that contribute to cranberry fruit rot disease. Specifically, we will i) evaluate fungal pathogen diversity and response to fungicides, ii) determine how abiotic factors such as heat stress, solar radiation, and nitrogen fertilizer impact fruit rot development, iii) decipher the role of preformed compounds and tolerance to environmental stress in cranberry selections may confer resistance to fruit rot, iv) evaluate tradeoffs between different management practices, and v) develop predictive disease models that consider growing region, cultivar resistance, costs, etc. Findings of this

project will be shared with stakeholders and industry allies via webinars, newsletters, extension meetings, and online.

The long-term goals of the project are 1) optimized models that incorporate environmental conditions, cranberry phenology, cultivar, and disease pressure to deliver site (bed) specific management recommendations for CFR control, 2) adoption of integrated fruit rot management methods on commercial beds, 3) development of best management practices for fruit rot, and 4) reduction in fruit rot and increased fruit quality observed at receiving stations as management practices are implemented.

Co-Investigators on this project (Figure 1) include Drs. Amaya Atucha, Peter Oudemans, Jyostna Mura, Jeffrey Neyhart, Virginia Stockwell, Leela Uppala, Giverson Mupambi, Jill Fitzsimmons, Peter Jeranyama, and Juan Zalapa.

Figure 1. The S.A.M.E. Research Team including experts in Plant Pathology, Plant Physiology, Molecular Biology, Breeding & Genetics, Behavioral Economics, Predictive Modeling, and Extension.

Acknowledgements. We would like to thank the North American cranberry growers and processors for their letters in support of this project, and the numerous growers, researchers, and extension personnel serving on the Advisory Panel and Extension Network. This work is supported by the USDA National Institute of Food and Agriculture Specialty Crop Research Initiative Award no. 2022-51181-38322.

UNTANGLING THE BARREN AMERICAN CRANBERRY VINE: A SURVEY OF UNPRODUCTIVE GENOTYPES IN CENTRAL WISCONSIN

FRANK LAZAR and JUAN E. ZALAPA

Department of Horticulture, University of Wisconsin-Madison, WI
and USDA ARS, Vegetable Crops Research Unit, WI

The American Cranberry is one of Wisconsin largest staple crops with over fifty percent of the world's production coming from the state alone (Vorsa and Zalapa, 2019). Wisconsin is home to over twenty thousand acres of cultivated cranberry and over a billion dollars in revenue for the state. Currently, many of the growers in cranberry country (central to east central Wisconsin) have been experiencing yield decline due to vegetative genotypes popularly known as "Barren Berry" (Matusinec et al., 2022). The purpose of this study was to conduct a survey of barren genotypes in central Wisconsin, the largest growing region in the world. For this study, growers submitted 839 cranberry DNA samples of two phenotypes, a barren (n=646) or nonfruit-bearing, and productive or fruiting phenotype (n=193). We conducted genetic fingerprinting using nine SSR markers previously shown to differentiate cranberry genotypes (Fajardo et al., 2013; Vorsa and Zalapa, 2019; Matusinec, 2022).

This study identified a predominant barren genotype in central Wisconsin, denoted as "Barren Berry 1" accounting for over forty-three percent of all our barren samples. Due to its barren nature, this genotype may have a large effect on the sustainability of cranberry production worldwide. Additionally, a few other barren genotypes associated with the unproductive "Perry Red" genotype (Matusinec et al., 2022) accounted for nineteen percent of our barren samples, as well as many off types and unknown genotypes accounting for more than fifteen percent of our barren samples. An interesting finding was that most beds submitted for the study were vastly contaminated from the originally intended cultivar. Moreover, we identified over sixty-four different genotypes in beds which were supposed to be of only four cultivated genotypes (Stevens, Ben Lear, HyRed, or Searles beds).

Genetic purity is very important in relation to overall production and health of a cranberry bed (Jonjak and Zalapa 2022). Generally, the more contaminated a bed is with off types, or anything that is not a known cultivar, the less yield one can expect. Having an overall high genetic bed purity is very important as it will reflect high productivity and reduced long-term costs in terms of fertilizer and management efficiency. Fingerprinting techniques allow growers the ability to make better informed discissions to manage their plantings and plan future renovations. This study illustrates the importance of whole bed genetic purity for maintaining productivity.

In conclusion, the only productive cranberry vine is a true-to-type known cultivar, and no amount of management will make an unproductive genotype productive. Off-types, unknowns, and Perry Red are mostly unproductive, while Barren Berry 1 is completely barren, and all together these variants are a detriment to cranberry production. Finally, genetic contamination if left unaddressed will spread and could be very costly to growers in terms of a tremendous amount of time spent on management, which will result in reduced efficiency, and most importantly, money wasted.

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CRANBERRY SOIL HEALTH PILOT PROGRAM UPDATE

ALLISON JONJAK[1], JAMIE PATTON[2], ANDREW PAOLUCCI[4], and FRANCISCO ARRIAGA[3]

[1]Division of Extension, [2] Nutrient and Pest Management Program, [3]Department of Soil Science, University of Wisconsin-Madison, WI [4]USDA-NRCS, WI

When mankind began farming, soil physics was the most observable realm, and so soil physics was where we first developed a coherent theory of what makes "a good soil". In the last few centuries, our analysis and measurement techniques allowed us to understand soil chemistry—the nutrients present and available for our crops. From first being able to measure soil nutrients, to establishing baseline expectations for common soils, to finally understanding what nutrient application choices should be made based on our measurements, took many decades of iteration and exploration. As biological science matures, we stand on the frontier of understanding soil biology. A rich ecosystem of plants, animals, protists, nematodes, fungi, and more live in the soil that supports our cranberries— and we are beginning to be able to measure them. As we begin to learn what lives in our soils, it is likely we'll be able to have as many new "levers to pull" to improve cranberry production, as we discovered through our exploration of soil chemistry and plant nutrition. While biological traits of soils have been measured in row crops for more than a decade, no work on soil health in cranberry has been conducted yet.

Methods

As a pilot study, a first foray into soil health in cranberries—we began to explore soil health and soil biology in 5 production cranberry marshes. Because this is an exploratory project, we are comparing a "healthy" and a "poor" bed of similar treatment in each of our partner marshes. For example, a Wood County marsh will be comparing two HyRed beds, two beds apart, which were planted within a year of each other—but one bed always has >50 barrel/ac higher yields than the other. Our protocol will take a composite sample from the bed edge and a composite sample from the bed center of the "healthy" bed, and a composite sample from the edge and a composite sample from the center of the "poor" bed. Each of these samples received a battery of tests: the standard chemical analysis that growers use for their Nutrient Management Programs, as well as several "soil health tests" that have been developed over the last decade: cellulose decomposition, microbial respiration ("what is breathing in this soil?"), active carbon, potentially mineralized nitrogen and PLFA (phospholipid fatty acid) analysis ("what has cell walls in this soil?"), and others provided by the UW Sustainable Soil Management Lab. We are hoping to see whether there will be patterns or commonalities from each partner marsh's "healthy" bed samples in contrast with their "poor" bed samples. For 2021, sandy marshes in Tomah, Cranmoor, City Point, Exeland, and Manitowish Waters were sampled.

Fig 1. Soils from the "good" and "poor" beds in the first three sampled marshes.

Indicators included here: soil fertility, potential mineralizable nitrogen, active carbon, organic matter, gravimetric water content of soil at sampling time, and phospholipid fatty acids (PLFA) indicators. Analysis of soil physical indicators is on-going.

Fields from five growers were sampled, however, one grower site had to be excluded from the analysis since one field had a mix of cranberry varieties which were different to the other field within the same operation.

Analysis of variance was performed between less productive and more productive fields for soil fertility and PLFA indicators using grower as block. Means of specific indicators were considered significantly different when probability values were less than 0.10. Box plots indicating the maximum and minimum values, and the 75th, 50th and 25th percentiles were created to show the spread of data.

Results, Discussion and Conclusions

There are no significant differences between any of the soil health indicators included in this report (Tables 1 and 2). However, there was a strong trend of greater potential mineralizable nitrogen (P-value = 0.155) in less versus more productive fields (Table 1). The lack of significance between less productive and more productive fields can be attributed to large differences in indicators between growers (see appendix figures). For example, for most soil fertility parameters variability between farms contributed more than field productivity (0.0069 versus 0.468, respectively). There were significant differences between growers for CEC (0.059), Copper (0.053), Zinc (0.015), Manganese (0.011), Calcium (0.071), Potassium (0.007), Phosphorus (0.020), and soil organic matter (0.046). Similarly, there were strong trends indicating differences between growers for Mg (0.116), Iron (0.119), and PMN (0.184). Differences in soil fertility indicators between growers was generally greater than for PLFA. Only arbuscular mycorrhizae fungi (0.221) had a strong trend towards differences between growers. The probability for differences for grower versus field were 0.221 versus 0.476, respectively.

Soil fertility appears to contribute more to the difference between less productive and more productive fields than soil biological parameters. Potential mineralizable nitrogen contributions appear to be a possible factor, however these contributions might not be related to soil organic carbon content since there was no significant difference between field type. A larger sample pool to include more growers can help increase the sensitivity to detect differences between soil health indicators and reduce the

statistical variability between growers. Analysis of soil physical and hydrological parameters continue and might provide some indication of cranberry field productivity differences.

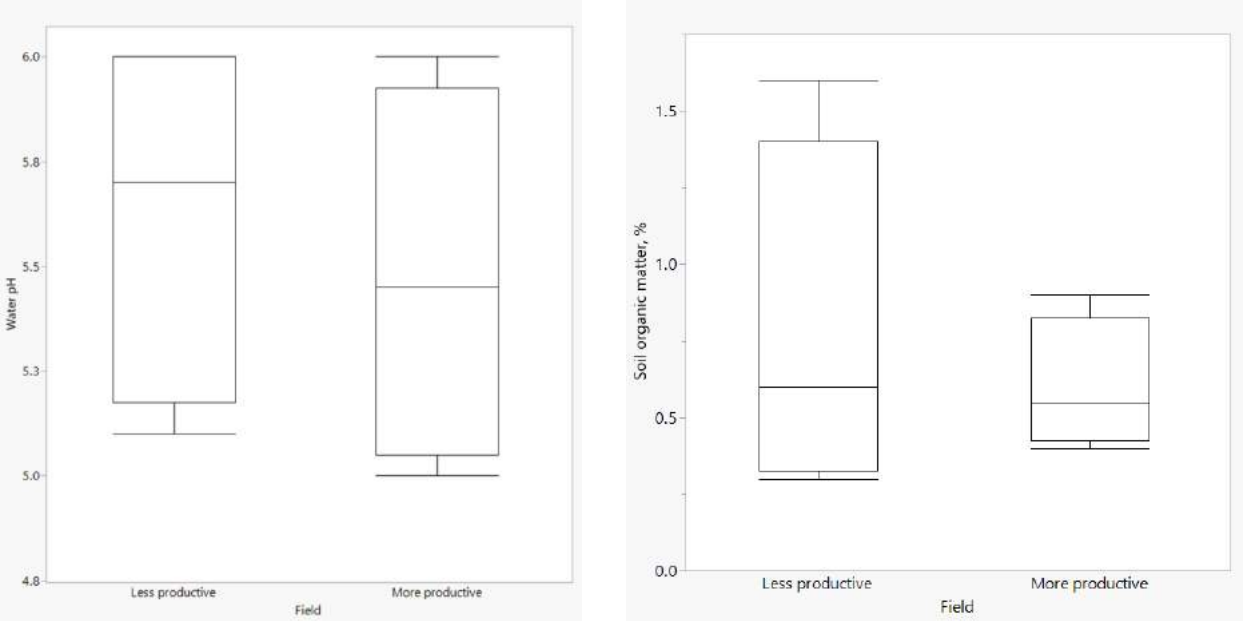
Table 1. Soil fertility and other soil health indicator mean values between less productive and more productive cranberry fields and associated probability significance value (P-value). A P-value greater than 0.10 signifies there is no statistical difference between fields. CEC – cation exchange capacity; PMN- potential mineralizable nitrogen; Active C – potassium permanganate oxidizable carbon; soil gravimetric water content measured at sampling time.

Indicator	**Cranberry Field Type**		**P-value**
	Less productive	**More productive**	
pH, water	5.63	5.48	0.679
Organic matter, %	0.78	0.60	0.468
Phosphorus, ppm	38.0	33.8	0.584
Potassium, ppm	56.0	57.3	0.835
Calcium, ppm	166.5	164.3	0.962
Magnesium, ppm	45.5	43.8	0.922
Sulfur, ppm	8.4	7.9	0.899
Copper, ppm	0.75	0.73	0.931
Iron, ppm	213.5	168.5	0.642
Manganese, ppm	1.8	2.0	0.727
$CEC_{est.}$, meq/100g soil	1.43	1.38	0.891
Base saturation, %	72.7	72.0	0.952
PMN, ppm	3.63	0.88	0.155
Active C, ppm	212.2	190.1	0.783
Gravimetric water content, %	24.5	21.5	0.794

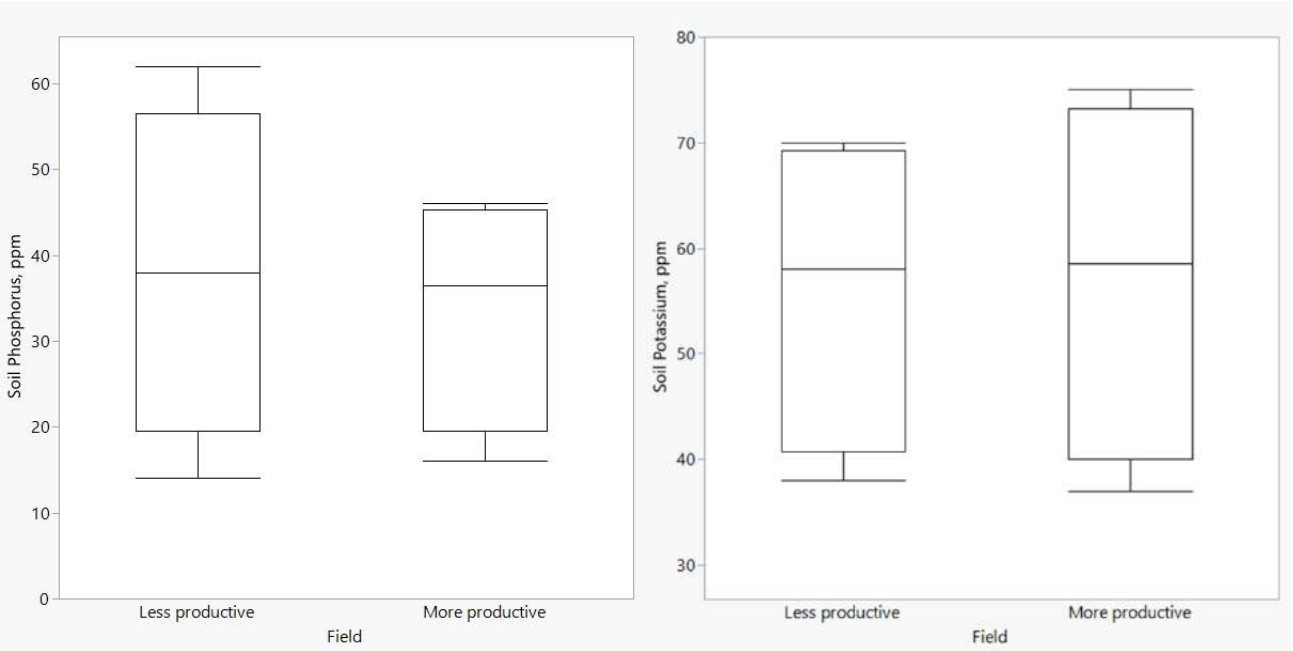
Table 2. Mean values of phospholipid fatty acids (PLFA) indicators of less productive and more productive cranberry fields and associated probability significance value (P-value). A P-value greater than 0.10 signifies there is no statistical difference between fields.

PLFA indicator	**Cranberry Field Type**		**P-value**
---- nmol/g soil ----	**Less productive**	**More productive**	
Total PLFA – microbial biomass	37,832.5	30,336.5	0.634
Gram negative bacteria	38.74	36.47	0.476
Gram positive bacteria	22.20	20.49	0.758
Gram+/Gram- ratio	0.85	0.83	0.919
Total fungi	24.35	28.87	0.662
Mycorrhizae fungi	2.45	2.16	0.545
Fungi/Bacteria ratio	0.47	0.60	0.586
Eukaryote	1.23	1.32	0.721
Actinomycetes	11.04	10.69	0.861

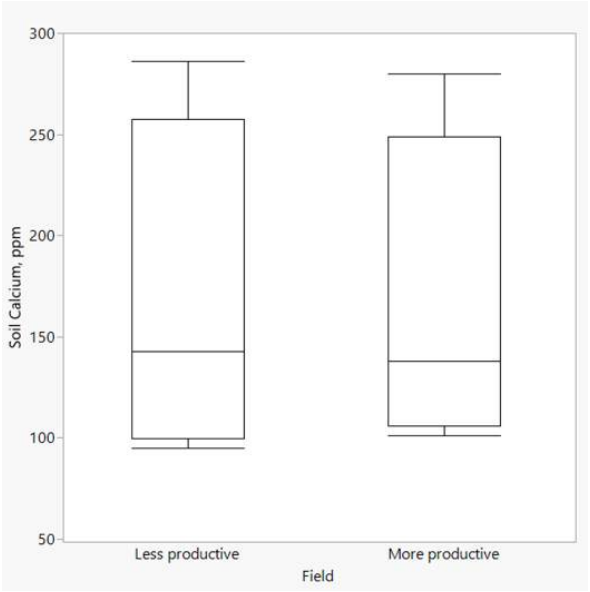
Appendices

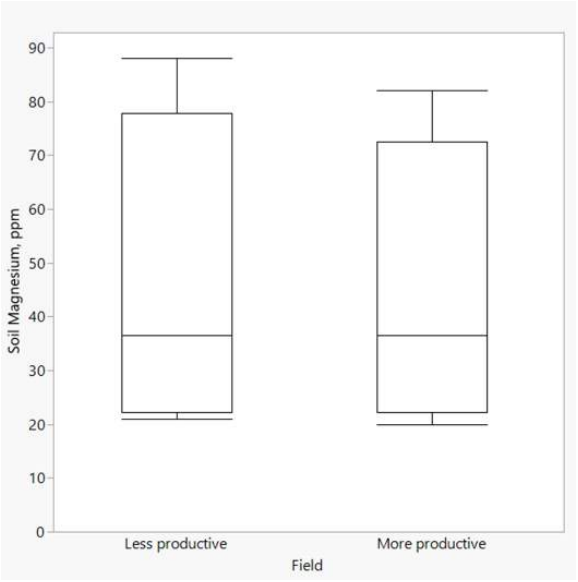


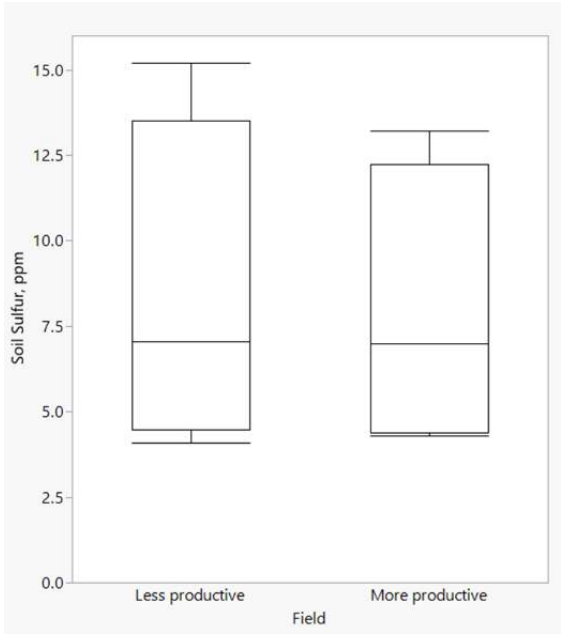
Appendix 1. Box plot of water pH and soil organic matter of less and more productive cranberry fields. Box plots indicate the maximum and minimum values, and the 75th, 50th and 25th percentiles.



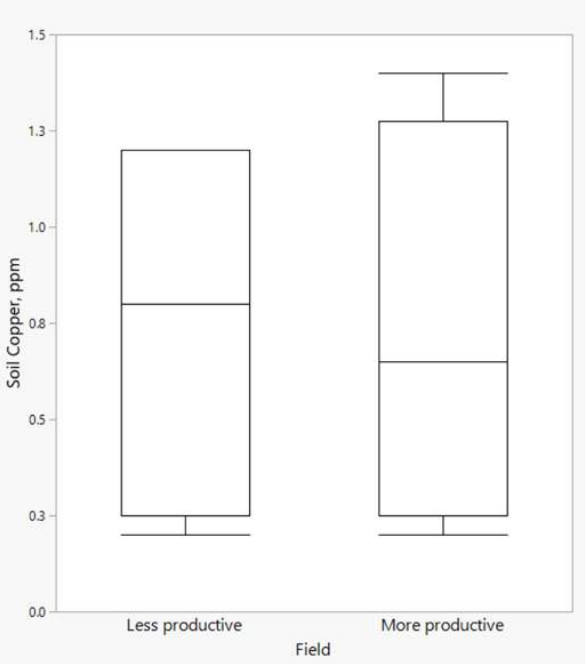
Appendix 2. Box plot of soil phosphorus and potassium of less and more productive cranberry fields. Box plots indicate the maximum and minimum values, and the 75th, 50th and 25th percentiles.

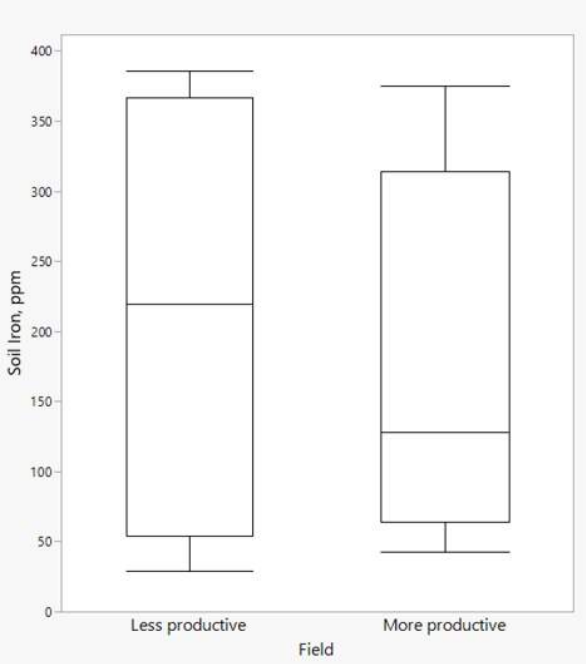


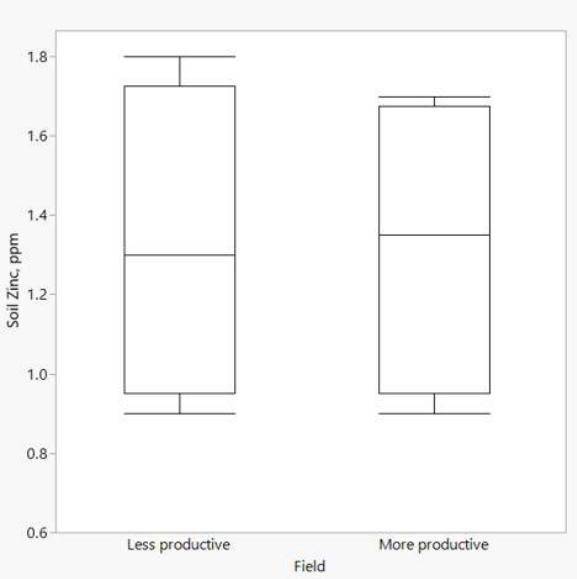




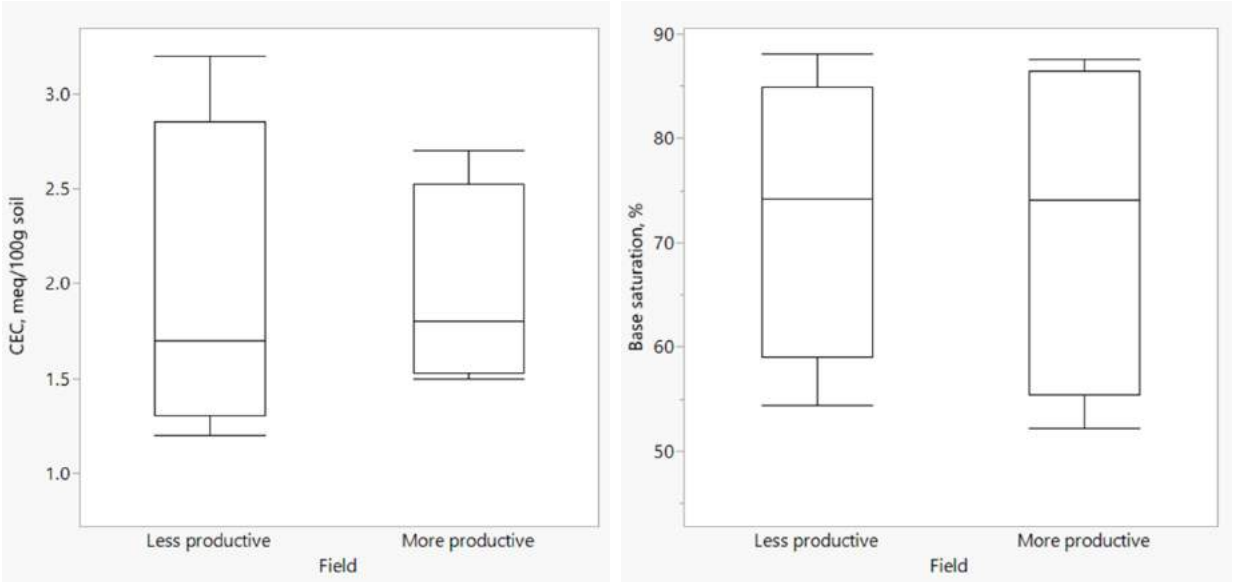
Appendix 3. Box plot of soil calcium, magnesium, and sulfur of less and more productive cranberry fields. Box plots indicate the maximum and minimum values, and the 75th, 50th and 25th percentiles.



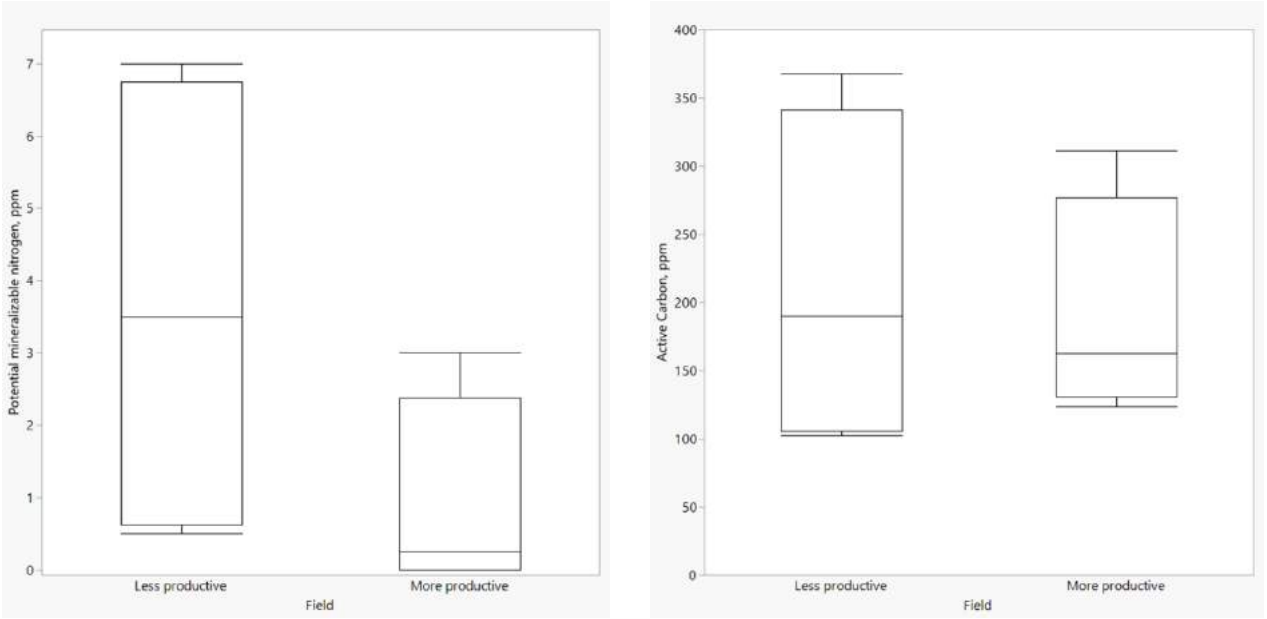




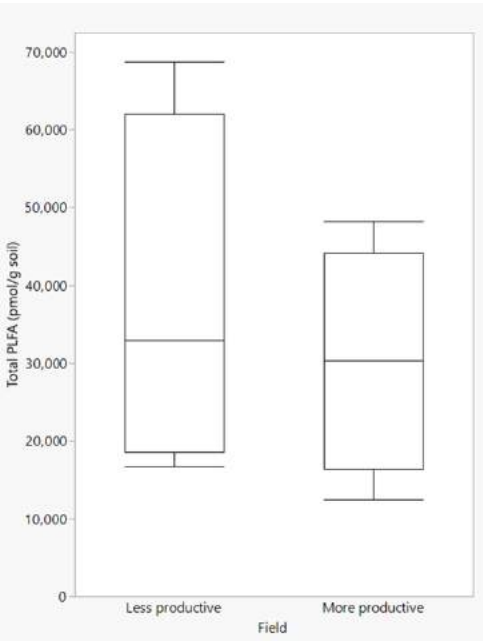
Appendix 4. Box plot of soil copper, iron, and zinc of less and more productive cranberry fields. Box plots indicate the maximum and minimum values, and the 75th, 50th and 25th percentiles.

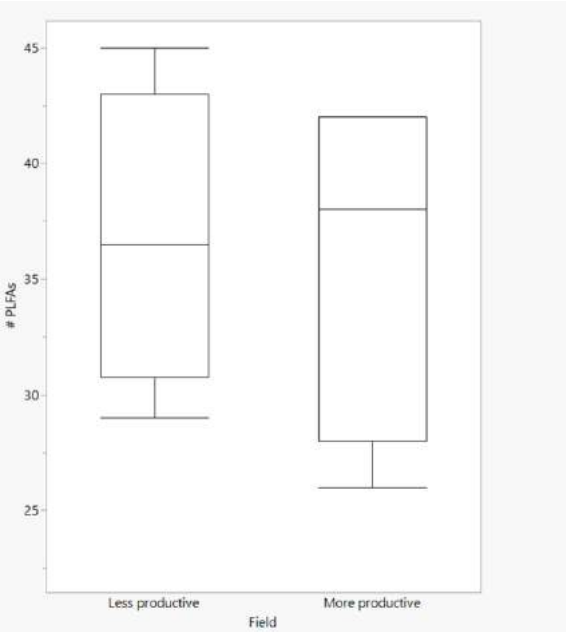


Appendix 5. Box plot of soil cation exchange capacity (CEC) and base saturation of less and more productive cranberry fields. Box plots indicate the maximum and minimum values, and the 75th, 50th and 25th percentiles.

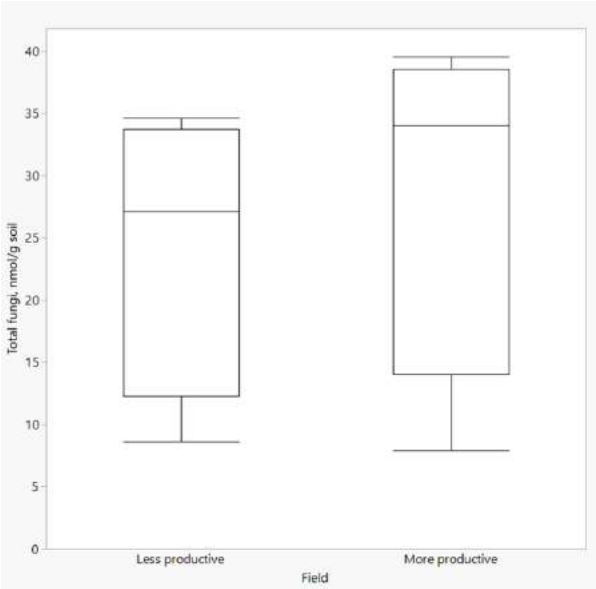


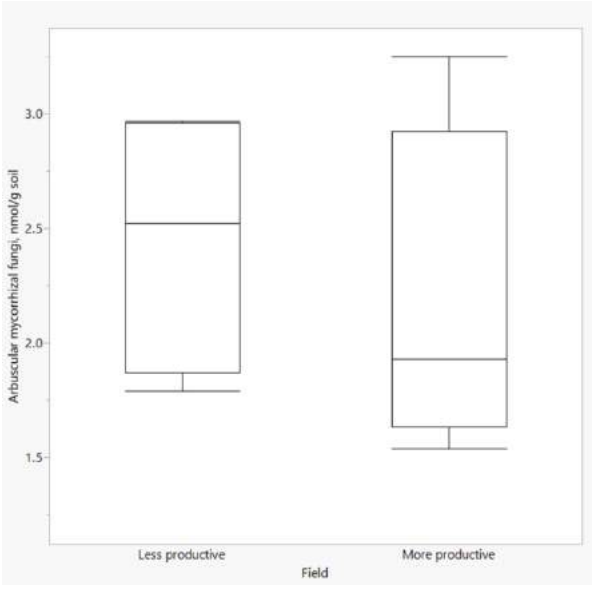
Appendix 6. Box plot of potential mineralizable nitrogen and potassium permanganate oxidizable carbon (active carbon) of less and more productive cranberry fields. Box plots indicate the maximum and minimum values, and the 75th, 50th and 25th percentiles.



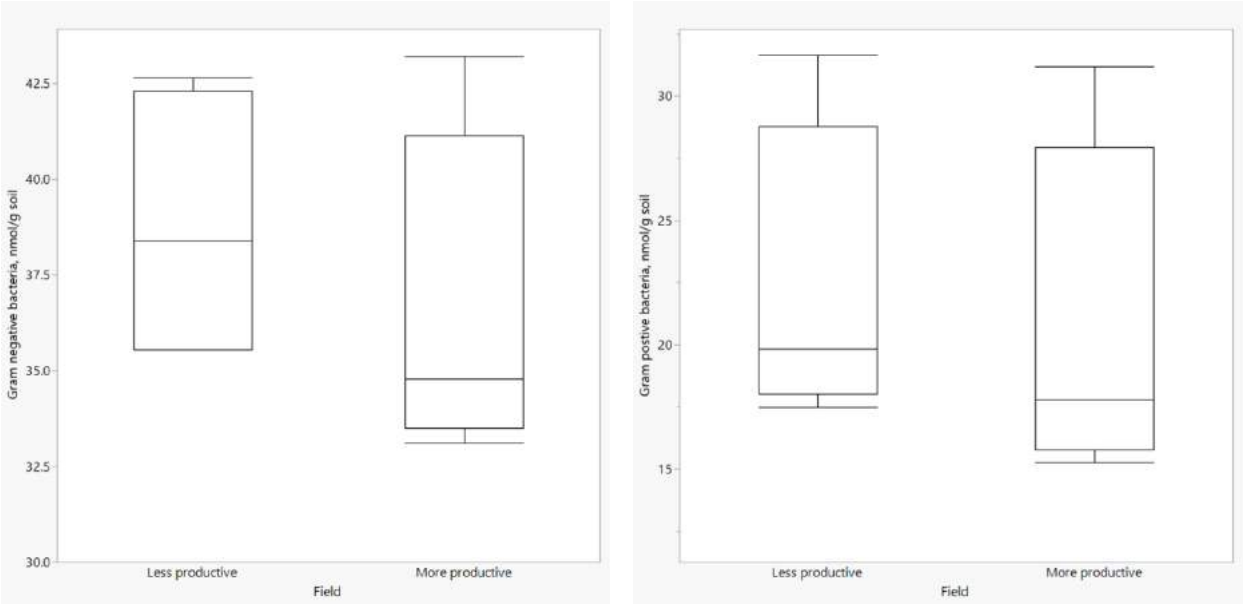


Appendix 7. Box plot of total phospholipid fatty acids (PLFA) found in soil and number of PLFA detected of less and more productive cranberry fields. Box plots indicate the maximum and minimum values, and the 75th, 50th and 25th percentiles.

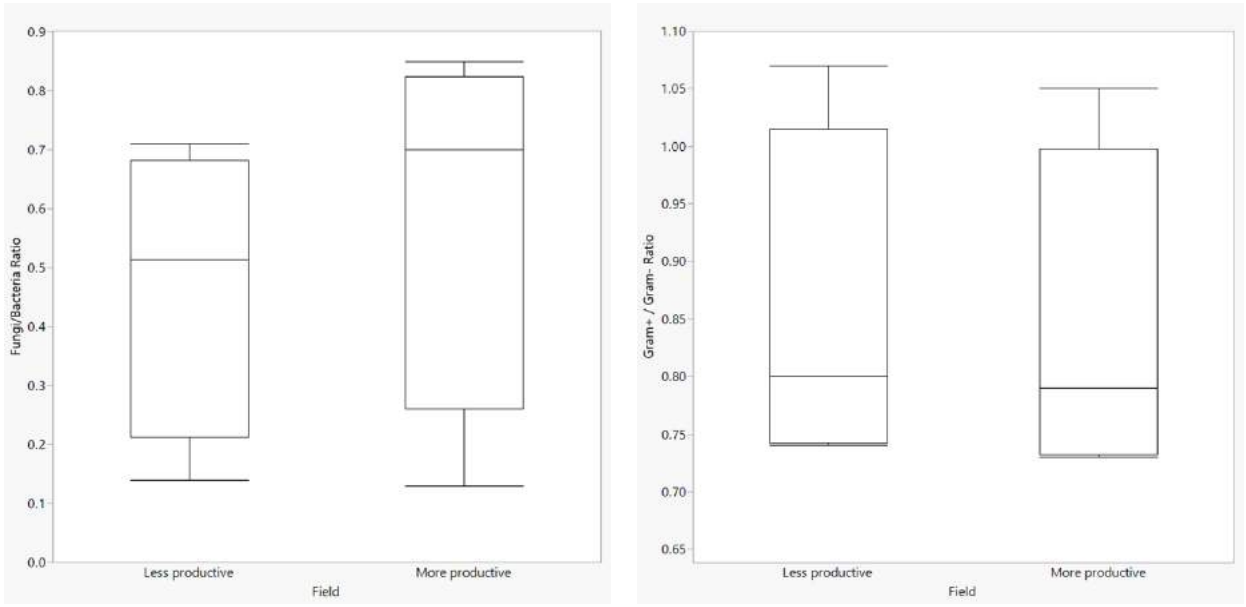




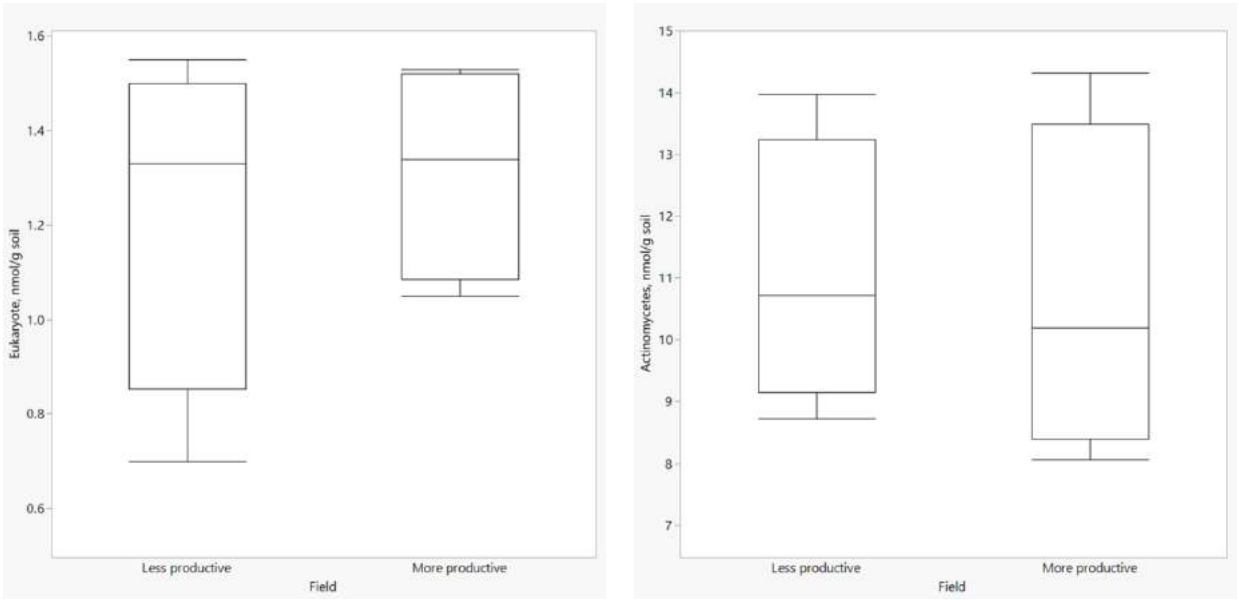
Appendix 8. Box plot of total fungi and arbuscular mycorrhizal fungi found in soil of less and more productive cranberry fields. Box plots indicate the maximum and minimum values, and the 75th, 50th and 25th percentiles.



Appendix 9. Box plot of Gram-negative and Gram-positive bacteria found in soil of less and more productive cranberry fields. Box plots indicate the maximum and minimum values, and the 75th, 50th and 25th percentiles.



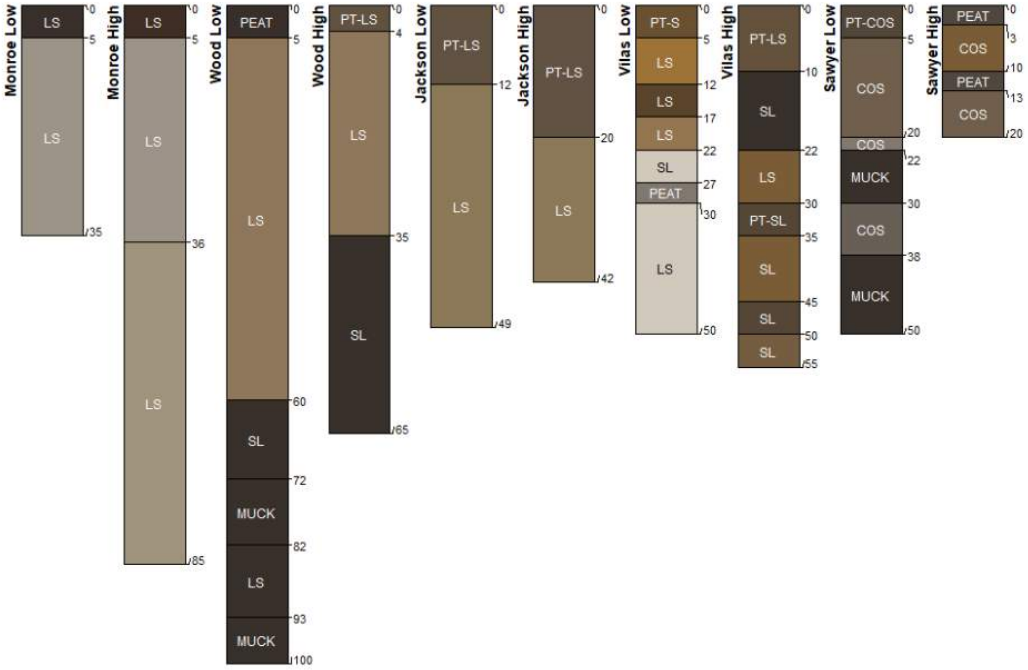
Appendix 10. Box plot of fungi to bacteria ratio, and gram-positive to gram-negative ratio in soil of less and more productive cranberry fields. Box plots indicate the maximum and minimum values, and the 75th, 50th and 25th percentiles.



Appendix 11. Box plot of eukaryote and actinomycetes found in soil of less and more productive cranberry fields. Box plots indicate the maximum and minimum values, and the 75th, 50th and 25th percentiles.

Grower	Field	AM Fungi	Gram Negative	Eukaryote	Fungi	Gram Positive	Actinomycetes	Fungi/Bacteria	Predator/Prey	Gram+/Gram-	Total PLFA (pmol/g soil)	# PLFAs
1	Less productive	2.99	35.54	0.70	34.63	17.47	8.73	0.71	0.013	0.74	16,804	29
1	More productive	1.94	34.95	1.53	32.39	18.17	11.02	0.65	0.029	0.84	28,488	42
2	Less productive	2.11	35.53	1.35	30.98	19.59	10.44	0.60	0.024	0.85	23,899	36
2	More productive	1.54	33.11	1.19	35.53	15.26	9.37	0.85	0.025	0.74	32,237	34
3	Less productive	1.79	42.65	1.31	8.61	31.67	13.98	0.14	0.018	1.07	68,731	45
3	More productive	1.92	43.18	1.49	7.91	31.18	14.32	0.13	0.020	1.05	48,209	42
5	Less productive	2.97	41.27	1.55	23.15	20.05	11.02	0.43	0.025	0.75	41,896	37
5	More productive	3.25	34.62	1.05	35.65	17.36	8.06	0.75	0.020	0.73	12,412	26

Appendix 12. PLFA raw data for each tested bed pair.



"High" indicates high producitivty or good crop health. "Low" indicates low productivity or poor crop health. Depths in cm
COS=coarse sand, LS=loamy sand, MUCK=muck, PEAT=peat, PT-LS=peat and loamy sand, PT-SL=peat and sandy loam, SL=sandy loam, S=sand

Appendix 13. Diagrams of soil profiles as identified in pedon descriptions.

CRANBERRY GROWTH AND PRODUCTION: IMPACT OF HIGH SOIL pH

JYOSTNA DEVI MURA

Department of Horticulture, University of Wisconsin-Madison, WI and Vegetable Crops Research Unit, USDA-ARS, Madison, WI

Soil pH is the primary determinant of nutrient availability and absorption by plants. It is known as the master variable because it regulates many chemical and biological processes in the soil system. Many soil characteristics are influenced by soil pH, including nutrient absorption, soil remediation, enzyme activity, microbes, decomposition, nitrification, and denitrification. When developing or assessing a nutrient management program for cranberry production, it is critical to understand the relationship between soil pH, soil properties, and nutrient availability.

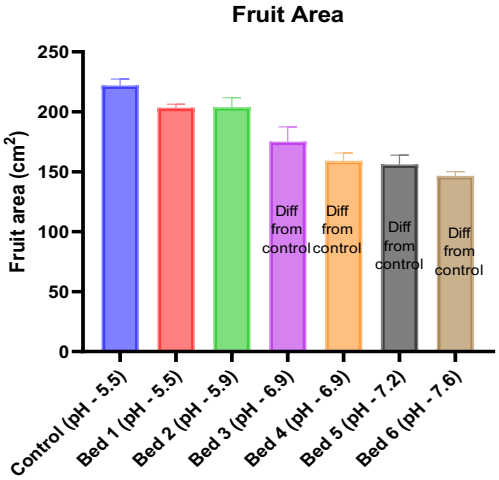


Fig 1. Effect of soil pH on the fruit area (cm^2) of plants grown in different soil pH conditions.

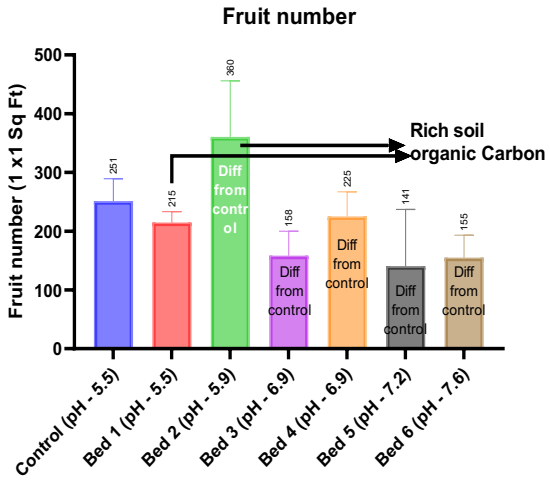


Fig 2. The number of fruits harvested from one square foot of plants grown in soils with varying pH levels.

The optimal soil pH range for the growth of cranberries is between 4.2 and 5.5, and the soil acidity level depends on the hydrogen (H+) ions present in the soil. Reasons for low soil pH include acidic parent material, leaching of cations, plant removal of cations, the addition of fertilizer, and plant root secretion of organic acids. Granular sulfur is a common soil amendment used to keep soil pH low. However, even with adequate granular sulfur addition, achieving optimum soil pH conditions is sometimes difficult due to high pH irrigation water, high calcium levels in the soil, and other factors.

In this preliminary study, we collected fruit and tissue samples from various beds with varying soil pH levels ranging from 5.5 to 7.6, as listed in Figures 1 and 2. We analyzed the fruit size, yield, and nutrient composition of the uprights collected under each pH condition. We found significant differences in fruit size and quantity between pH treatments. We observed a significant ($P<0.01$) reduction in the size of cranberry fruits collected from high soil pH beds as compared to optimal soil pH beds (Fig 1). Above a soil pH of 6, we observed a 30 to 35% reduction in fruit size. In addition, our results demonstrated that the number of cranberry fruits collected from optimal and high soil pH differed (Fig 2).

Even though bed one and bed two (Fig 2) received alkaline irrigation water, the fruit yield was greater ($P<0.01$) in bed two compared to the optimal pH bed (control). We discovered that bed one and bed two

had an abundance of soil organic carbon, which may be the reason for nutrient retention and absorption, so yield improvement. We found a significant increase in soil, stem, leaf, and fruit calcium and magnesium levels. In addition, we noticed a significant decrease in tissue micronutrients such as sodium, iron, manganese, and zinc levels, in high soil pH tissue samples compared to optimal pH samples. The pH of the soil affects the retention of base cations ($Ca^{2+,}$ $Mg^{2+,}$ and K^{+}) on exchange sites. When soil pH is high, most other nutrients (particularly micronutrients) tend to be less accessible, as we observed in our study.

IS METABOLIC HERBICIDE RESISTANCE THE STRAW THAT WILL BREAK WEED MANAGEMENT'S BACK?

JED COLQUHOUN

Department Of Horticulture, University of Wisconsin-Madison, WI

In a long-term tillage research project in Kansas, a Palmer amaranth population was identified that was resistant to six herbicide sites of action in individual plants. While that's challenging enough, here's the scariest part: in some cases the plants had evolved resistance to herbicides that had never been sprayed in the field (Shyam et al. 2021).

Similarly, in Illinois a waterhemp population was recently identified that's resistant to dicamba, yet the field had never been treated with dicamba or 2,4-D. The population was also resistant to five other herbicide sites of action, which may have been the source of resistance to the sixth herbicide site of action that includes dicamba (see https://aces.illinois.edu/news/first-dicamba-resistant-waterhemp-reported-illinois for an informative summary of this work).

Weeds that have become resistant to herbicides they've never been sprayed with may sound like something out of a CSI type show. The phenomenon is not new but is becoming more common. In fact, one of the potential causes – metabolic resistance – isn't even limited to plants. So how could this happen?

In a broad sense, herbicide resistant weeds can be divided in two groups: those with target site resistance, and those with non-target site resistance. In target site resistant weeds, the specific enzyme that the herbicide targets is either mutated so that the herbicide can't bind to it (think of pieces of a puzzle not fitting together) or the target enzyme is overproduced to the point that the herbicide can't effectively bind to all the sites.

Non-target site resistance can happen in a few ways: in resistant weeds the herbicide may not be absorbed or translocated (moved within the plant) as well, the herbicide may get sequestered in plant parts away from the target site, or the herbicide may get metabolized by the plant. The remainder of this article will focus on metabolic herbicide resistance because it likely has the greatest implications for production agriculture.

Herbicide metabolism involves the breakdown of the active ingredient into metabolites that are less mobile and less toxic to the plant, and then the "dumping" of the metabolites into plant parts where they are sequestered and not active. Enzymes cause the breakdown, and two of the most involved include cytochrome P450 monooxygenase (P450) and glutathione S-transferase (GST). P450s are among the most common enzymes in living organisms and have the ability to metabolize 11 of the 26 herbicide modes of action. GSTs are also common in living organisms and are responsible for some grass tolerance to herbicides and some observed cases of insecticide resistance (Rigon et al. 2020). Crop safety with many herbicides is based on metabolism by these broad enzymatic families.

Herbicide metabolism has been researched and observed over the past few decades with challenging grass weeds such as rigid ryegrass in Australian wheat production (Yu and Powles 2014). More recently, however, metabolic resistance has been reported among broadleaf weeds and close to home. For example, metabolic resistance to the herbicide S-metolachlor was reported in two waterhemp populations in Illinois (Strom et al. 2020). In this case the resistant waterhemp metabolized 90% of the S-metolachlor in less than 3.2 hours.

Metabolic resistance has sometimes been referred to as “creeping resistance” because of the way that it evolves in populations, where plants that can survive low herbicide doses by metabolizing some of the active ingredient produce seed, and subsequent generations are selected that can metabolize more and more herbicide until they are no longer useful for control. For example, waterhemp control with dicamba in the Illinois population noted above decreased from 80% to 65% over just a few years, and dicamba wasn’t even sprayed during that time.

So why is metabolic resistance so concerning compared to target site resistance that’s been addressed for years? Target site resistance is very specific to an herbicide active ingredient, the individual target site that it binds to, and a mutation that changes those puzzle pieces. In contrast, in metabolic resistance the enzymatic activity that breaks down the herbicides and other toxins is not specific. Once high metabolic activity is selected for, the plant can breakdown a broad range of herbicides across modes of action, potentially including active ingredients that have never been sprayed on that population before, and even herbicides that have yet to be discovered. For example, in the Kansas study mentioned above, the authors concluded that “these results suggest predominance of metabolic resistance possibly mediated by cytochrome P450 and GST enzyme activity that may have predisposed the KCTR Palmer amaranth population to evolve resistance to multiple herbicides” (Shyam et al. 2021). In practical terms, metabolic resistance adds tremendous unpredictability to weed management decision making and outcomes.

These metabolic enzymatic activities are also not specific to plants and herbicides, which makes for complex resistance scenarios. For example, Clements et al. (2018) reported that some of the fungicides commonly used for potato disease control can upregulate GST enzyme production in Colorado potato beetles, and that increase in enzymatic activity can negatively affect insecticide performance.

Additionally, not only is metabolic resistance more challenging to research than target site resistance, it’s also harder to observe in the field. For years growers and scouts have been told to keep an eye out for living target plants that normally would have been killed and that are among other dead weeds, and that stark contrast of living versus dead was often the smoking gun of resistance. In metabolic resistance, the selection pressure creeps along where target weeds may be injured but eventually recover enough to produce a few viable seeds, and the high metabolism selection cycle continues on until multiple herbicides are ineffective.

The increase in likely cases of metabolic resistance observations in recent years speaks to the dire need to develop practical and economical alternatives to herbicides – it’s simply not just about rotating herbicides anymore. In the short term, much effort is currently being directed to intervening in the seed production and dispersal step of the resistance selection cycle with mechanical tools like combine weed seed cleaners and collectors. Research is also underway to gain a better understanding of the complex metabolic interactions among pesticides and pests, and how that affects practical management decisions. In the longer term, alternative technologies like weed sensors and highly efficient robotic weeders need to be developed and available for adoption in reasonable and affordable ways.

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What makes a cranberry firm?
Understanding fruit ripening and its role in fruit firmness

PEDRO ROJAS-BARROS, BETH ANN WORKMASTER, and AMAYA ATUCHA

Department of Horticulture, University of Wisconsin-Madison, WI

In recent years, there has been an increased interest in fruit quality traits for cranberry. Usually, fruit quality is associated with fruit size and color, but fruit firmness has also become an important trait because of its relation to the production efficiency of sweetened and dried cranberries (SDC). However, although we speculate that higher fruit firmness is correlated with higher SDC production efficiency, this has not been systematically evaluated, and there might be other fruit traits involved in making a cultivar suitable for SDC production. Therefore, we are investigating the processes of fruit development and ripening in cranberry to identify changes in fruit quality that could maximize the production of SDC.

During fruit development in cranberry, maximum fruit weight (Fig. 1) and color (Fig. 2) are achieved just before harvest. However, maximum fruit firmness is achieved before the peak in fruit size and color and decreases steadily towards harvest (Fig. 3). This decrease in fruit firmness as ripening progresses, is associated with changes in the composition and structure of the fruit pulp.

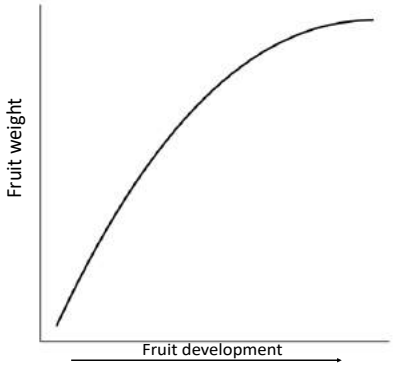

Figure 1. Cranberry fruit weight through fruit development

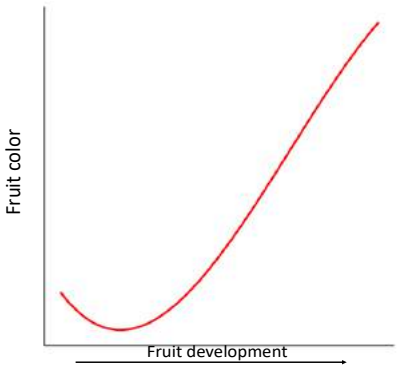

Figure 2. Cranberry fruit color through fruit development

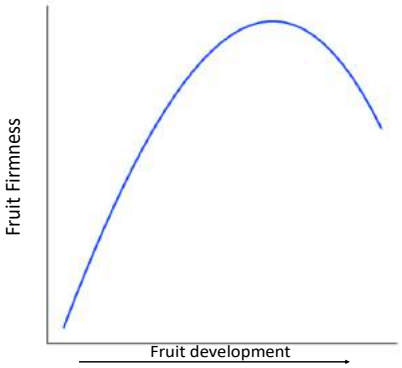

Figure 3. Cranberry fruit firmness through fruit development

Cranberry fruit pulp is composed of a type of plant cells with a cell wall. The cell wall of this type of cell is a complex structure that determines the cell size and form, but also how strong the cells are attached to each other (Fig. 4). As fruit ripening continues and harvest time approaches, pulp integrity is partially lost due to an increase in enzymatic activity that degrades the cell walls, negatively affecting the cell-to-cell junction, which leads to fruit softening. Calcium (Ca^{+2}) is well known to have an important role in fruit pulp integrity acting as a "glue" between cell walls. The presence of Ca^{+2} in the cell wall has been correlated with high fruit firmness and extended postharvest life in many other fruit crops.

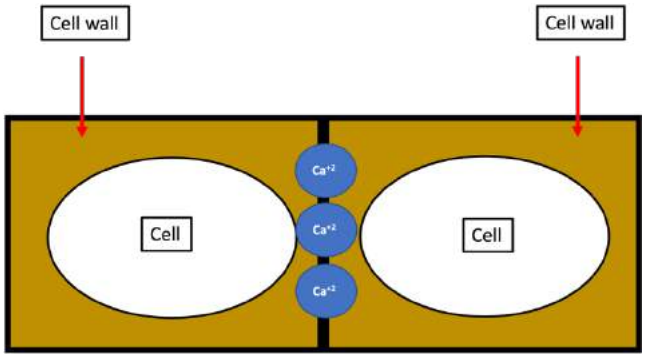

Figure 4. Diagram of plant cell and calcium association with the cell wall

Ca^{+2} is an essential macronutrient and its uptake by the plant occurs mostly through new root tips. Once in the plant, Ca^{+2} moves through the xylem towards actively transpiring organs (i.e., leaves and fruit). Thus, Ca^{+2} will accumulate preferentially in these organs, with more Ca^{+2} going to leaves rather than fruits. Once Ca^{+2} accumulates in an organ, it is completely immobile (i.e., Ca^{+2} will not translocate from leaves to fruit). Fruit Ca^{+2} accumulation occurs only at the beginning of fruit development because fruit transpiration decreases as the fruit develops, due to loss of xylem functionality and an increase in fruit cuticle thickness. In 2022, we initiated a study evaluating the Ca^{+2} accumulation in cranberry during fruit development. The study was established at the Wisconsin Cranberry Research Station near Millston, using the cultivar 'Stevens'. We collected weekly samples of fruit and measured their transpiration rate starting one week after full bloom until harvest. Preliminary data of shows that fruit transpiration rate decreases to zero within the first six weeks of fruit development (Fig. 5).

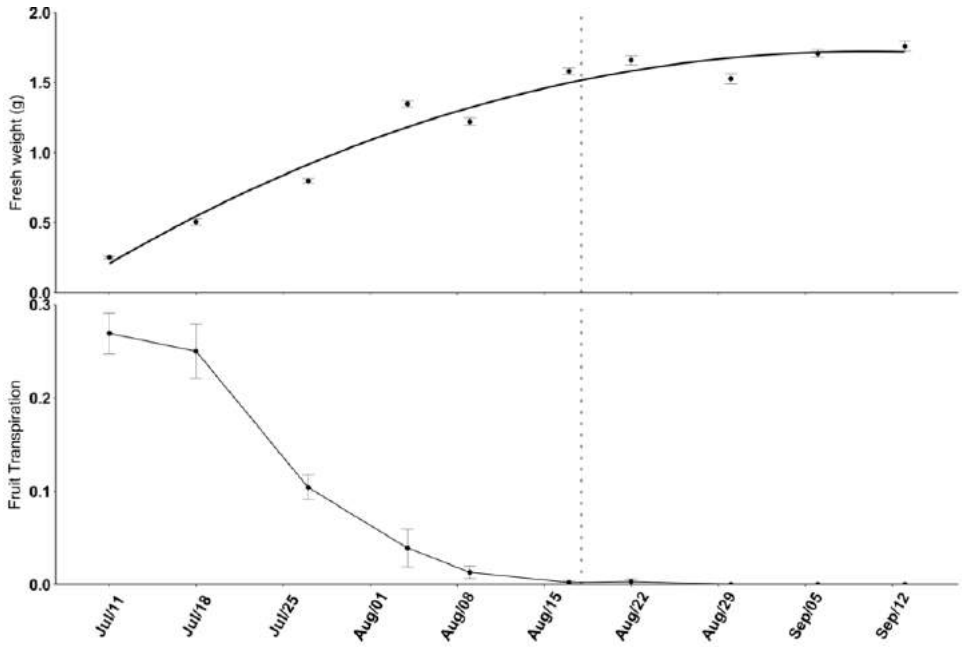

Figure 5. Fruit fresh weight and fruit transpiration through weekly sampling.

Similarly, when the Ca^{+2} concentration of fruit cell walls from two different cultivars were compared, the one with high efficiency in SDC production (Cultivar 1 in red) and another with low efficiency in SDC production (Cultivar 2 in blue), Ca^{+2} concentration decreased as the fruit develops (Fig. 6). As fruit size increases, there is a dilution factor affecting the fruit Ca^{+2} concentration, but once maximum fruit size is achieved close to harvest, Cultivar 1 has more Ca^{+2} associated with the cell wall

compared to Cultivar 2. Higher Ca^{+2} associated with the cell wall could be related to higher pulp integrity, but more analyses are needed.

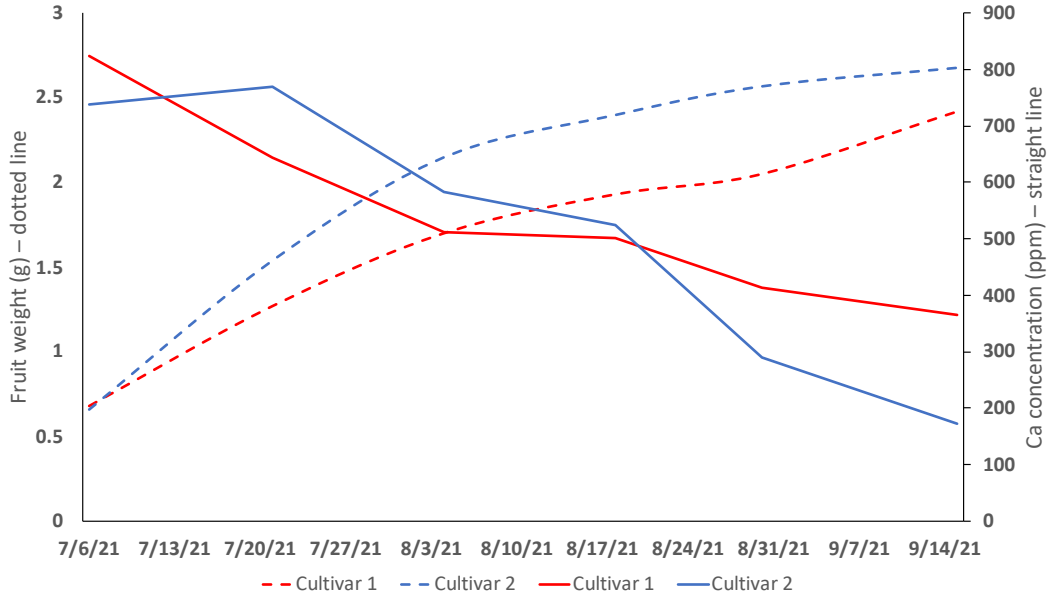

Figure 6. Fruit weight and calcium concentration of two different cultivars through fruit development in which cultivar 1 corresponds to a good or highly efficient sweetened and dried cranberry (SDC) producer, and cultivar 2 is a bad or low efficient SDC producer.

Since Ca^{+2} availability is limited by plant uptake and transpiration rates, supplemental foliar Ca^{+2} applications are used to increase fruit Ca^{+2} accumulation, with the goal to increase fruit firmness through direct absorption of Ca^{+2} at the fruit surface. For this reason, another study at the Wisconsin Cranberry Research station in 2022 involved applications of different Ca^{+2} concentration over four different phenological stages. The Ca^{+2} concentrations were 0 ppm (control), 750 ppm, 1500 ppm, and 3000 ppm, and all treatments were applied during the period of rough neck, 10% bloom, 50% bloom, and full bloom. Preliminary data have been collected and analysis is pending. The most effective treatments will be repeated, and additional locations/cultivars will be added in 2023.

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DISTRIBUTION AND DIVERSITY OF THE CRANBERRY FALSE BLOSSOM PHYTOPLASMA AND LEAFHOPPER POPULATIONS

CASEY TRICKLE[1,2], LESLIE HOLLAND[1], and CHRISTELLE GUÉDOT[2]

[1]Department of Plant Pathology and [2]Department of Entomology, University of Wisconsin-Madison, WI

Cranberry false blossom disease (CFBD) is a historically significant problem in Wisconsin, and an active problem in other areas of cranberry cultivation. Manifesting in both *Vaccinium macrocarpon* and *Vaccinium ocycoccos*, the bacterial phytoplasma colonizes the plant and parasitizes resources, causing symptom manifestation such as floral disfigurement, witches' brooming and increased vegetative growth. These plants may set a bud, but fruit is aborted or of significantly stunted size. Symptom latency for CFBD is unknown, due to the rate of colonization being difficult to determine, but could be 1-month to many years. During this time, plants may already be viable reservoirs for vectoring of the disease by the blunt-nosed leafhopper (BNLH; *Limotettix vaccinii*), a single generation insect that hatches in early May and goes through five molts before entering the sexually active and increasingly mobile adult stage before dying off in mid- to late-August.

The primary goal of this research is to characterize the seasonal phenology of both pathogen and vector to make informed decisions in the management of both pathogen and vector as they are present in Wisconsin cranberry. The project sought to build on the 2021 growing season findings and refine methods to answer our questions: 1) what is the distribution of CFBD within a Wisconsin cranberry marsh, within a cranberry plant, and what are reliable techniques for phytoplasma identification, and 2) what is the diversity and seasonal phenology of leafhopper species in Wisconsin cranberry.

Assess the seasonal phenology of BNLH in Wisconsin Cranberry

Expanding on 2021 data, we documented the seasonal phenology of BNLH in Wisconsin cranberry (Figure 1). Sampling was performed on a weekly basis from the beginning of May, through the end of August, with sample collection performed by sweep net over 20m long transect lines performed 1m from both the edge and center irrigation line of each bed. Collections began at three properties with known BNLH presence during the 2021 growing season. Two additional sites were added in early June due to applications of broad spectrum insecticide at two of the original sites. New farms were selected based on reported BNLH from IPM scouting agencies. The first occurrence of BNLH was on May 25, while the last capture occurred on August 30, suggesting that we were able to capture the BNLH seasonal phenology in its entirety. Nymphs were not positively identified to be BNLH as this will require expert identification not available at UW, but there is strong reason to believe they are based on the 2021 season adult abundance and the overwhelming majority of adults swept later in the season identified as BNLH (Figure 2). The 2022 season saw a two-week shift in BNLH phenology, reaching peak adult numbers two weeks later than in 2021 and persisting later into August. It should be noted that early season numbers appear inflated due to farms scouted possessing large populations likely carrying over from the 2021 season when no sprays were applied. Both farm managers feared potential repercussions on yield from not treating for BNLH, peaking at 630 and 898 individuals, respectively, in a single sweet set, and acted accordingly. Those sites were replaced with new sites confirmed to have BNLH but at much lower densities, causing charts to appear to have high early season presence through May 31 and then an apparent die off.

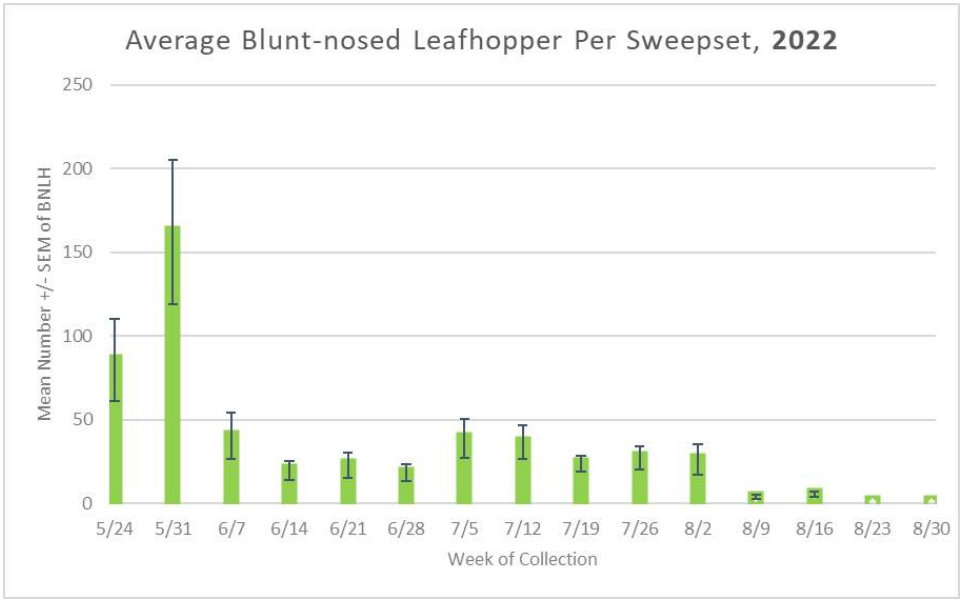


Figure 1. Seasonal phenology of BNLH in WI in 2022.

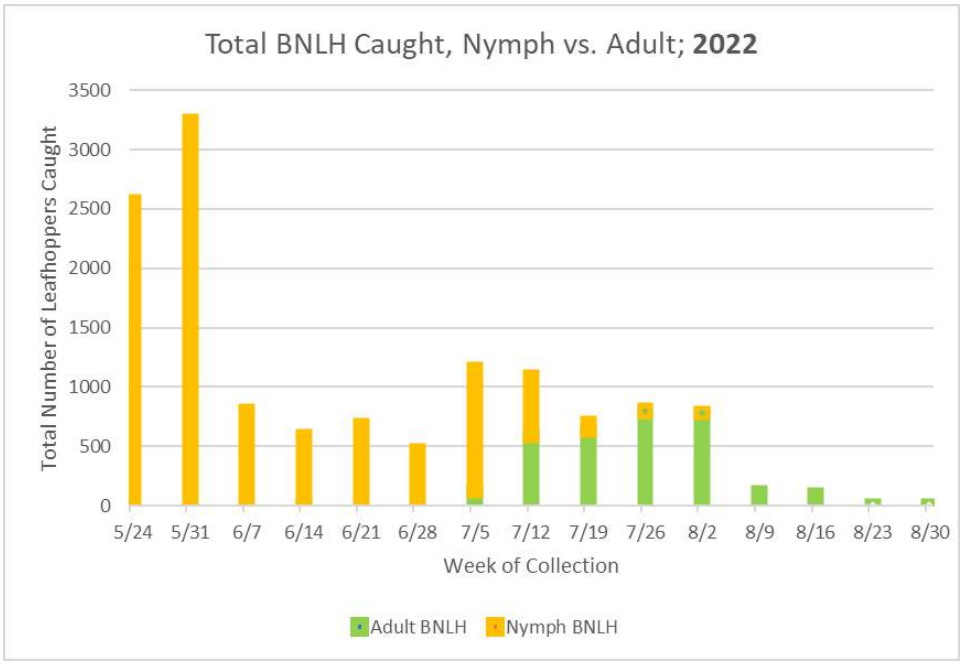


Figure 2. Seasonal phenology of BNLH in WI in 2022, separating nymphs (suspected to be BNLH) from adults

Determine the species composition of leafhoppers in Wisconsin cranberry

Repeating methods from the 2021 season and described in Obj 1, we wanted to characterize the composition of leafhopper species present in central Wisconsin cranberry to confirm that BNLH is the predominant leafhopper species in WI cranberry marshes. Swept adult leafhoppers were separated and

counted based on the 7 morphospecies groups identified in 2021. As seen previously in 2021, BNLH adults were the dominating species present at >80% of leafhopper species during the weeks of BNLH adult stage (Figure 3), strongly supporting the attribution of nymphs in Spring to BNLH.

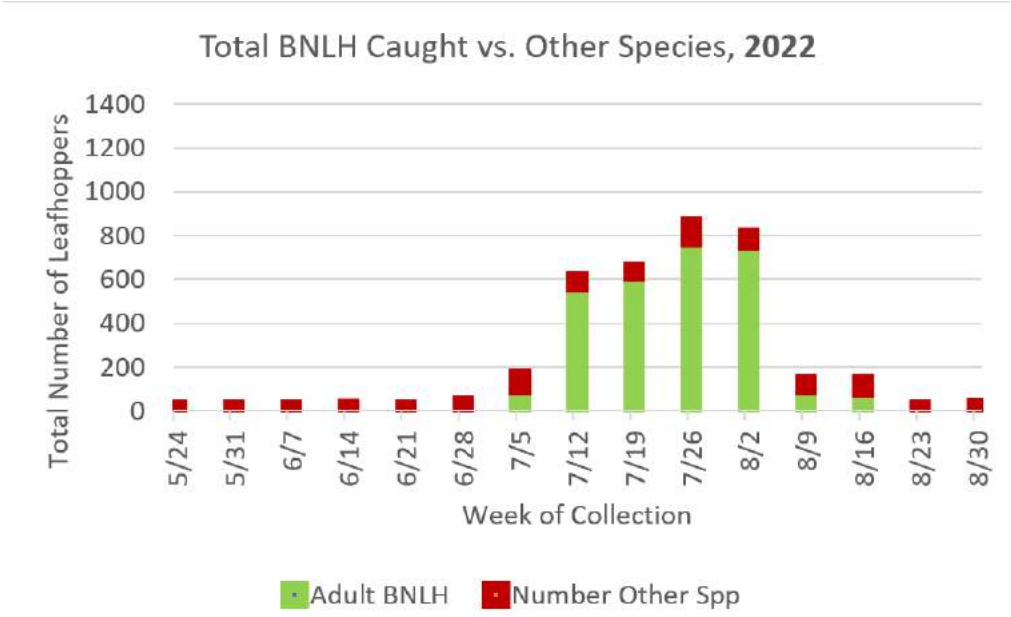


Figure 3. Seasonal phenology of adult leafhoppers vs. BNLH

Evaluate feeding injury by BNLH at different densities and different life stages

In this study, we designed a feeding assay for testing the potential impact of feeding from BNLH on upright health. This experiment was performed at the Walnut Street Greenhouse on the UW campus from late June until early August. Uprights were exposed to BNLH feeding for a total of 2 weeks and then observed for an additional 5 weeks, documenting potential feeding injury. Due to the timing of the nymphal and adult life stages, it is possible that young plant tissue is prone to lasting injury from nymphs that could affect yield. Methods of rearing BNLH were non-existent in the literature and attempts from industry researchers were unsuccessful. The 2022 feeding assay was a preliminary means of testing three things: can the insect be successfully reared, what are the necessary conditions for hydroponic rearing of cranberries, and is there discernible feeding injury from BNLH on cranberry leaves. BNLH were successfully transported and reared on cranberry uprights for two weeks in both the nymphal and adult forms, with 40% mortality overall at the end of the two week feeding period. Cranberry uprights were kept for 5 weeks beyond the feeding period, and a significant decline in upright health was observed at week 4. This objective will be performed with redesigned methods to allow for optimized feeding analysis. Alterations to growing conditions may be required, or the future assay may only persist through week 3 for observations. Additionally, uprights reared in a greenhouse setting, as well as a destructive sampling method for leaf injury counting will be employed to remove the potential for conflated injury assessments.

Evaluate the spatiotemporal dynamics of CFBD

Upright sampling was performed on a monthly basis from May to August except during bloom when frequency was increased to weekly. All collections in 2022 were from the same bed in central Wisconsin utilized for CFBD collections in 2021. Remnant symptoms from the 2021 season persisted post-winter, but symptoms were most apparent during bloom when floral organs express abnormal structure of both petals and pedicels. Additionally, vegetative growth expressed the symptom of witches' brooming, allowing for the testing of non-floral uprights. Each visitation saw the collection of 5 symptomatic uprights and 5 asymptomatic uprights. Uprights were dissected by organ type (root, stem, old leaf, new growth leaf, pedicel, flower/fruit) and each sample underwent DNA extraction for qPCR analysis and quantification. New qPCR techniques allow for quantification of total phytoplasma present, and these data offer the opportunity to characterize seasonal changes and total bacterial load (Figure 4). Additionally, these data provide strong evidence in support of a systemic infection of the CFBD phytoplasma throughout the plant, suggesting that less invasive cultural controls may be inefficient as a management tactic. Additional organ types (stem, old leaf, pedicel) are still being processed to further explore stratification of phytoplasma load within infected plants and allow for seasonal characterization of CFB phytoplasma reproduction and movement through vascular tissues, seen as disparity in phytoplasma levels in different organs. Asymptomatic uprights also need to be processed through qPCR. We hypothesize that these samples should yield negative results (no phytoplasma present), however positive results would strongly suggest a latency period of the phytoplasma in infected uprights with no symptom expression. A selection of both positive and negative samples will be sent off for sequencing of the pathogen present and confirmation that the CFB phytoplasma was being amplified.

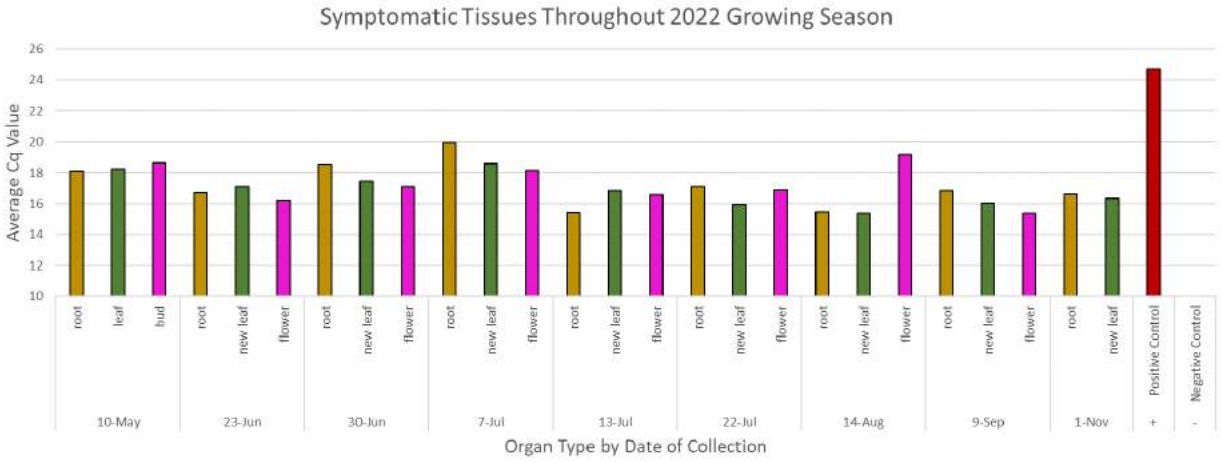


Figure 4. Spatiotemporal distribution of CFB phytoplasma in three plant organs; root, leaf, bud/flower; against a positive control phytoplasma (poinsettia) and negative control (water). Average Cq Value denotes the number of cycles of qPCR protocol needed before detection of CFB. Therefore, a low Cq value designates a higher amount of CFB phytoplasma present in the sample.

Next Steps

Distribution of CFBD within a Wisconsin cranberry marsh, within a cranberry plant

- Measuring bacterial titer in different plant organs throughout season
- Sequence extracted materials for positive identification
- Increase locational variability within the infected bed and in other positive beds to remove sampling bias due to proximity of selected uprights within potential clusters of infection

- Long-term: Contrast level of infection in plant organs and at different time of year

Diversity and Seasonal Phenology of LH

- Seasonal phenology with climate data to inform factors of insect hatch
- Determine level of concern over BNLH feeding at different life stages and in different densities
- Update feeding assay methods and repeat

Sites targeting BNLH control utilized pre-bloom sprays targeting the nymphal stage of BNLH in early June. Decisions to spray were informed by early season IPM efforts monitoring BNLH density for maximized efficacy, targeting the window post-hatch but pre-adult. These sprays were frequently able to overlap with other broad-spectrum applications targeting other insects in the early season. Effective chemistries for BNLH control are listed in the Cranberry Pest Management in Wisconsin Guide.

Recommendations

- Active early season scouting efforts, especially into early June, can maximize control
- Consider density of BNLH present in sweeps, even if chemical controls were used in the year prior
- Reach out with reports of leafhopper activity and/or cranberry false blossom presence at your marsh

Acknowledgement. Thank you to the Wisconsin Cranberry Board and Cranberry Institute for the funding and support provided to this project. Additionally, thank you to grower collaborators that allow our research to occur at their locations and to Dave Jones (Ocean Spray Cranberry) and Pam Verhulst (Lady Bug IPM) for the their help finding sites. Finally, thank you to Emma Mechelke, Fabian Rodriguez Bonilla and Morgan Weissner for their help in the lab processing samples and data.

FUNGICIDE SENSITIVITY OF A PRIMARY CRANBERRY FRUIT ROT PATHOGEN

EVAN LOZANO and LESLIE HOLLAND

Department of Plant Pathology, University of Wisconsin-Madison, WI

Cranberry fruit rot is a disease complex consisting of more than 12 phytopathogenic fungal species. Among those, *Colletotrichum* spp. are some of the most prevalent fungi observed in Wisconsin marshes. The genus *Colletotrichum* is well-studied in other fruit cropping systems, and work in these systems suggests that *Colletotrichum* species are at an increased risk for developing fungicide resistance mutations. Fungicide resistance develops when fungi are exposed to the same chemistries year after year, and the fungi mutate and are no longer sensitive to those chemistries. Reductions or losses in fungicide sensitivity is a concern in the cranberry industry because there are a limited number of fungicides approved for use, and they only span two FRAC groups. FRAC 11 fungicides such as Abound, Aframe, and Satori, are classified as high-risk for fungicide resistance development. The other class of fungicides commonly used are FRAC 3 fungicides, specifically, Indar and Proline and they are classified as medium-risk for resistance development. These fungicides have been used in cranberry for fruit rot prevention for 10-20 years, and there is growing concern for fungicide resistance development. Newer products such as Quadris Top also rely on active ingredients in FRAC 3 and 11, so the lack of diversity in fungicide mode of action for the Wisconsin cranberry industry puts strain on the longevity of these chemistries for fruit rot control.

To evaluate the fungicide sensitivity of *Colletotrichum* spp., fungal isolates were obtained from berries in a fungicide use pattern trial set up at a commercial marsh in central Wisconsin. In the trial, beds were treated with 0, 1, or 2 fungicide applications during bloom. A subset of six fungal isolates were used from these treatment groups and tested against three of the most used fungicides for cranberry fruit rot control: Indar, Abound, and Proline. Fungal isolates were also tested at two different growth stages: spores and mycelium. Spores are the inoculum source for most fruit rotting fungi and are typically introduced during bloom. It is therefore important to target spore germination with fungicides to prevent infection from taking place. Mycelium is an advanced growth stage of the fungus that can colonize infected berries and give rise to new spores; therefore, it is important to have a comprehensive view of the fungal life stages and their separate sensitivities to fungicides.

Fungicide sensitivity tests were performed using the spiral gradient dilution method on agar-filled Petri dishes, where fungicides are dispensed in a concentration gradient in a spiral pattern. The center of the agar plate contains the highest concentration, and the edge of the plate has the lowest concentration. We expected to see a reduction in fungal growth towards the center of the plate where the fungicide concentration is the highest. For mycelium-based testing, growth was compared to a control isolate grown on a plate free of fungicides, and measurements were taken using EC50 values. EC50 is the effective concentration to kill 50% of fungal growth. Using EC50 measurements is a standard protocol for *in vitro* trials of fungicide efficacy. Values were determined by first measuring the radial growth of the control plate (a) and multiplying this value by 0.5 to account for a 50% reduction in growth to give value (b). For spore germination, EC50 values were determined by measuring the length of the spore's germ tube 12 hours after exposure to fungicides. Our results indicate that all three fungicides are effective at reducing spore germination. Abound prevented spore germination in 5 of the

6 isolates, and Proline and Indar reduced germination in all 6 isolates, however the the EC50 varied across the isolates tested (Figure 1). Fungicide concentrations in this study were 10x lower than standard field rates, so effective control at higher concentratioins is expected.

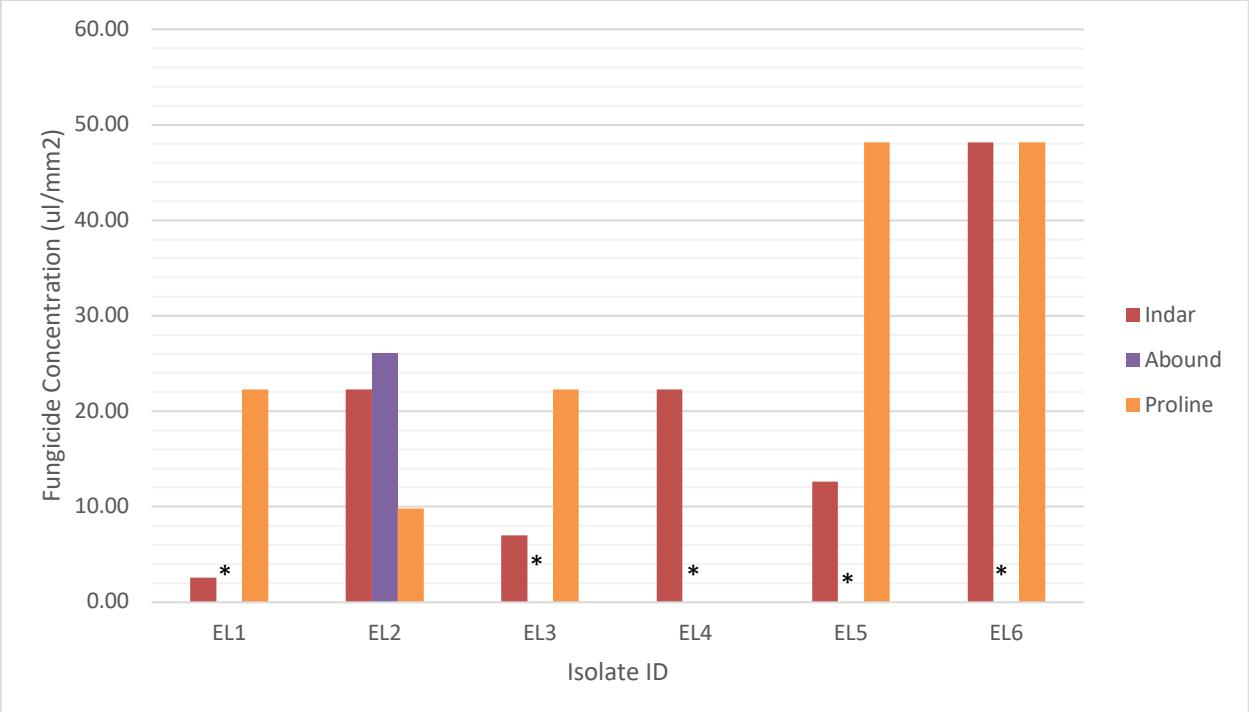


Figure 1. Spore germination of 6 *Colletotrichum* isolates vs. Indar, Abound, and Proline. Y axis represents fungicide concentration *in vitro*, not accurate to field rates. *indicates 0 germination.

In vitro tests of mycelium for this study are not shown due to contaminant growth on agar plates. However, preliminary results from a statewide collection of *Colletotrichum* isolates indicate that they respond differently to the three fungicides, with Colletotrichum isolates showing a strong rate response to Proline, less so for Indar, and no apparent rate response for Abound. Compared to the control, Abound, Indar, and Proline were all effective at suppressing mycelial growth (Figure 2).

Further studies will be completed to expand the number of isolates collected and to include Quadris Top active ingredients in the experiments. The results of this study confirm that Indar, Abound, and Proline are effective fungicides for managing a primary fungal pathogen in the fruit rot complex.

Figure 2. Growth of a single *Colletotrichum* isolate against Abound, Indar, and Proline.

CRANBERRY PEST MANAGEMENT PROGRAM – REVIEW OF 2022 FIELD TRIALS

ALLISON JONJAK[1], JED COLQUHOUN[2], CHRISTELLE GUÉDOT[3], and LESLIE HOLLAND[4]

[1]Division of Extension, [2]Department of Horticulture, [3]Department of Entomology, [4]Department of Plant Pathology, University of Wisconsin-Madison, WI

FUNGICIDES & DISEASES

2022 Disease Status— The 2022 growing season was characterized by a slow spring warmup, followed by an average bloom period (onset in mid-June and completed by mid-July) and average-to-dry conditions through the fruiting period. Growers throughout Wisconsin's three cranberry growing regions were not challenged by heavy disease pressures.

• Proline or a tank mixture of Abound + Indar are the industry standards for fruit rot management.

• In 2022, three fungicide efficacy field trials were conducted to evaluate control of early rot and fruit rot. All three were conducted on a 4-year-old Mullica Queen bed at the Wisconsin Cranberry Research Station in Millston, WI.

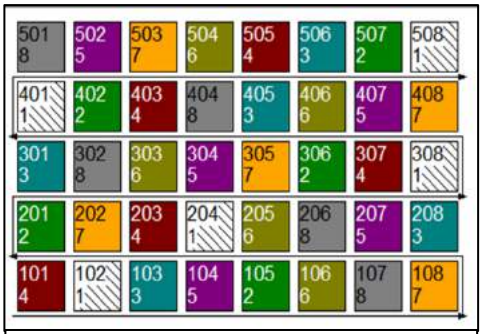


Fig 1. RCBD trial diagram of fungicide use patterns trial in fruit rot and early rot, for 2022.

• A use patterns trial compared the application of registered, grower-standard chemistries in various timings to compare the efficacy of 3 fungicide applications during bloom versus 2 applications during bloom. In this trial, treatments included fungicides applied at 20% and 80% bloom compared to fungicides applied at 20%, 50%, and 80% bloom, along with an unsprayed control.

• New fungicide products in the FRAC 7 group are nearing availability for use in commercial cranberry. To determine their best use fit among our existing chemistries, a FRAC 7 + FRAC 3 trial and a FRAC 7 + FRAC 11 trial were conducted. These trials matched grower standard chemistries in tank mixes as well as in serial applications with not-yet-registered FRAC 7 chemistries. Comparisons were made between grower standard (Indar + Abound) as well as an unsprayed control. All applications were made at 20% and 80% bloom.

• Very low disease pressure in 2022 resulted in little differences between unsprayed controls and treatments, so these experiments will be repeated in 2023 in hopes of gathering useful information.

Factors Influencing Disease Severity Three decision factors may be considered in determining the need for the number of fungicide applications for a season: 1) if April and/or May are frequently wet from precipitation and/or frost protection irrigation there may be an increased potential for diseases 2) if April and May are warm there may be an increased potential for diseases and 3) if the bed has a chronic history of disease.

INSECTICIDES & INSECTS

2022 Insect Review— Insect pressure in 2022 was within the normal range: cranberry fruitworm and sparganothis fruitworm were present and required control. Tipworm and fireworm were sporadic and individual producers managed them accordingly when present. Blunt-Nosed Leaf Hoppers (BNLH) were present in some regions of central Wisconsin in early-season sweeps, and growers in impacted areas applied pre-bloom treatments, which proved to be successful, as BNLH in post-bloom sweeps were rare. Flea beetles continue to be problematic at marshes where densities are high. Their long adult emergence widow precludes the use of several otherwise effective chemistries that have long pre-harvest intervals or handler restrictions. Additional options for flea beetle control are a top industry need.

• A pre-bloom BNLH trial was conducted in 2022, to determine the best treatment options for BNLH nymphs. Compared vs a nontreated control were 8 chemistries: 2 not-registered candidate products and 6 registered, of which 2 are approved for organic producers. A randomized complete block design trial with 5 replicates was performed at a Wood County cranberry marsh with BNLHs present and where no control measures were applied. Sweeps of BNLH were conducted 3, 7, and 10 days after the application. Fanfare and Orthene provided good control at 3, 7, and 10d post application, and Pyganic performed best among organic options, with good control 3d post application and low residual activity afterwards, as expected.

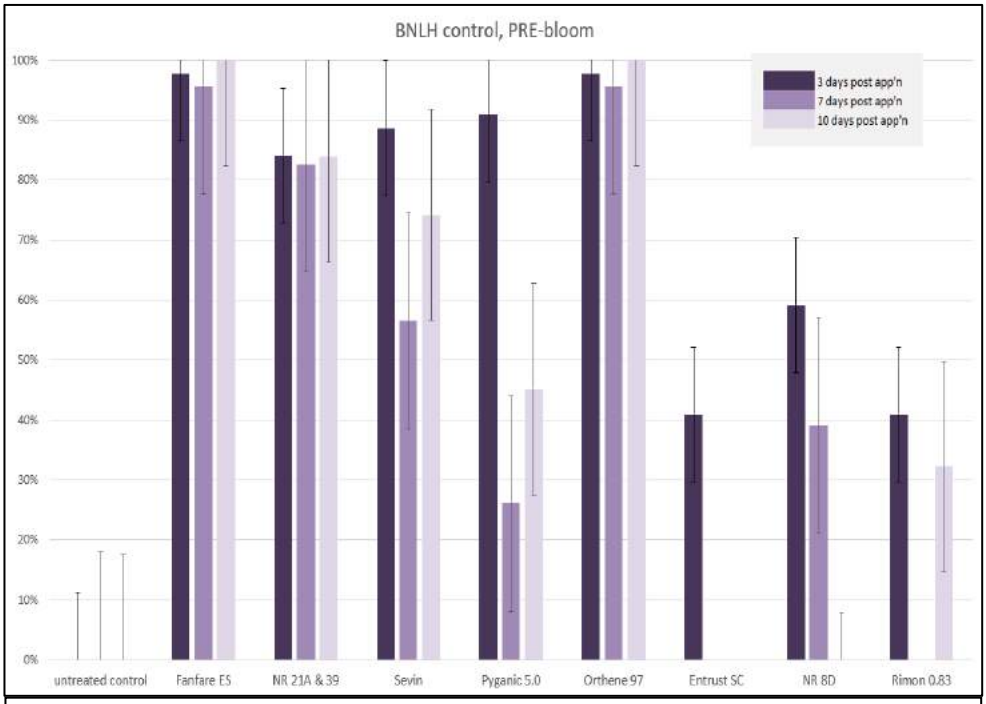


Fig 2. Percent control of BNLH nymphs, relative to untreated control, measured on 3, 7, and 10 days post application. This is a pre-bloom application targeting nymphs.

• A nearly identical trial was conducted post-bloom to determine the best treatment options for BNLHs in the adult stage. Post-bloom, 9 chemistries (7 registered of which 2 are OMRI approved and 2 not-registered) were applied, with control measured by sweeps at 3, 7, and 10 days following application. It

is evident that adult BNLH are more difficult to control than nymphs, and if nymphs are swept during scouting in the spring, it is important to prioritize controlling them when they are in their more vulnerable (nymphal) life stage.

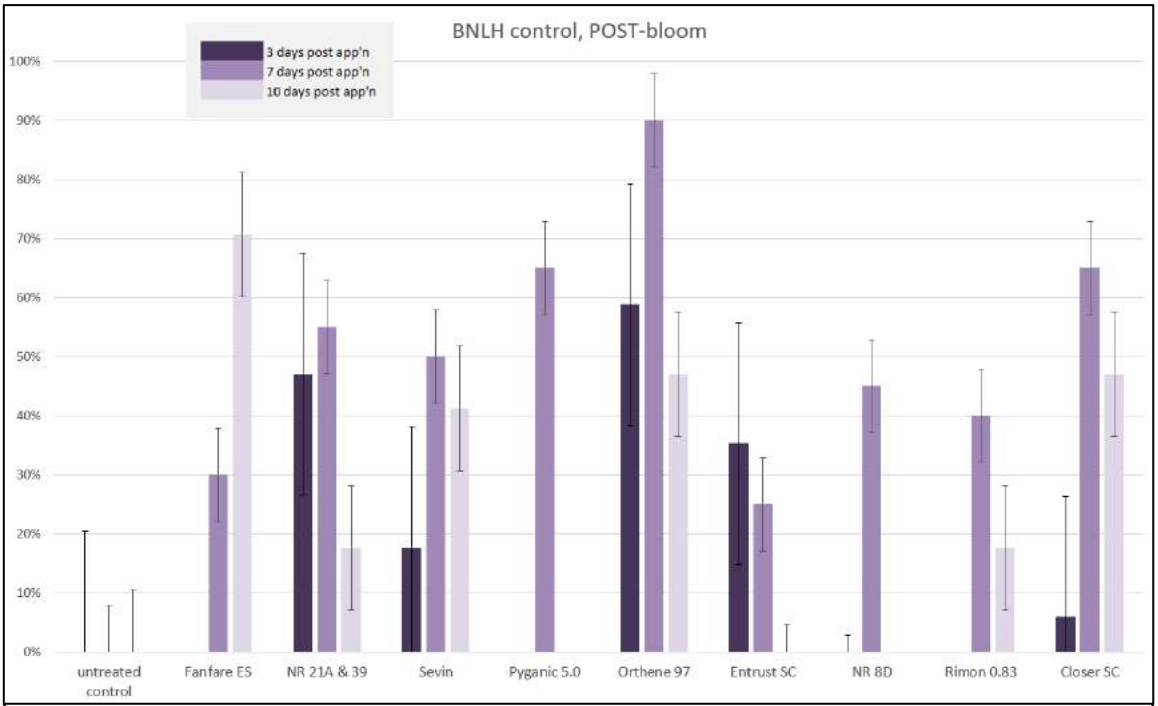


Fig 3. Percent control of BNLH adults, relative to untreated control, measured on 3, 7, and 10 days post application. This is a post-bloom application targeting adults.

• After 2021's trials displayed that small-plot work is poorly suited to evaluating control of the patchy-distributed flea beetle, a commercial marsh in northern Wisconsin volunteered large plots to evaluate possible control chemistries. Applications were made with the operation's boom sprayer, and evaluations of flea beetle were made at 3, 7, and 10 days following application as a mean of 3 subsample sweeps per treatment area.

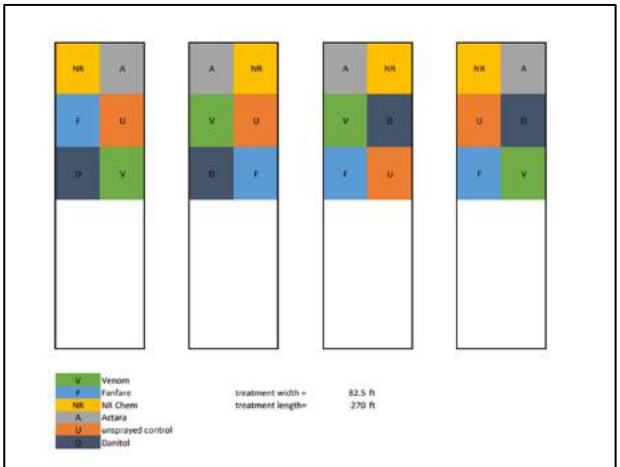


Fig 4. Trial schematic of large-scale flea beetle treatment area.

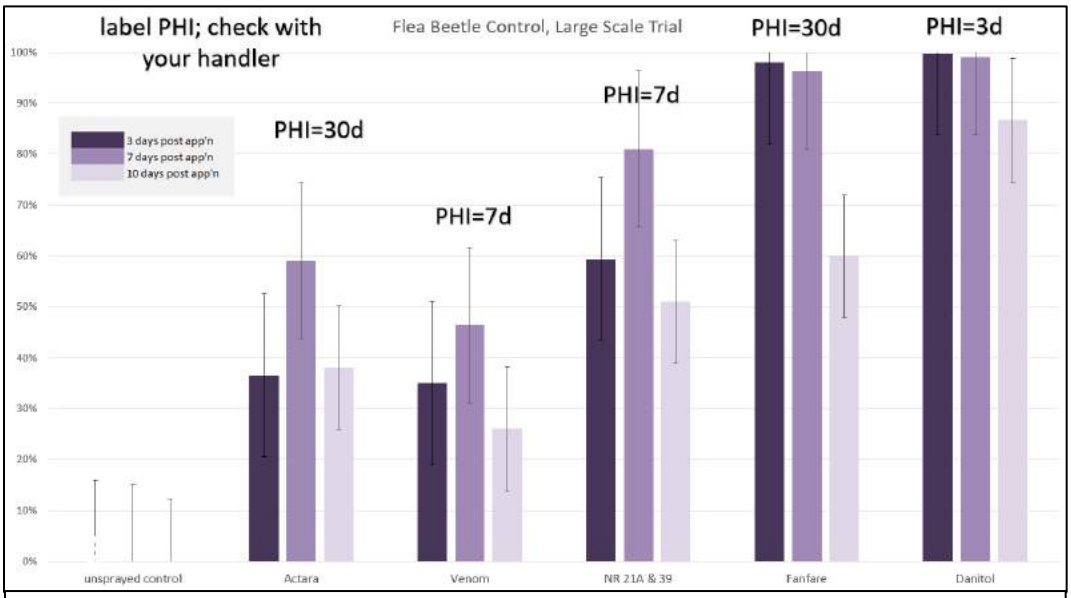


Fig 5. Control of flea beetle relative to untreated control, swept 3, 7, and 10 days after application.

New Insecticides
Three new insecticides will be evaluated in 2023 for their efficacy against BNLH and/or flea beetle.

WEEDS & HERBICIDES

2022 Weed Status— Weeds that are not being controlled by grower standard herbicide programs include maples, willows, popples, oaks, bristly dewberry, northern St. Johnswort, leatherleaf, poison ivy, and mosses.

• In 2022, a variety of not-yet-registered chemistries were tested at pre-emerge timing at the Wisconsin Cranberry Research Station to evaluate crop phytotoxicity. 6 chemistries (and two rates of one of these) were compared to a non-treated control, along with grower standards of dichlobenil (Casoron) and mesotrione (ie. Callisto). Proof of crop safety is required by product registrants to support registration of a product in cranberry.

• The same chemistries were evaluated at a cranberry bed no longer in production, to determine a spectrum of control. Using the same names as displayed in Fig. 6, examples of weeds controlled in this study include:
NR1: grasses, dewberry.
NR2: grasses, rushes, dewberry, spirea hardhack.
NR3: (haircap moss*), grasses, spirea hardhack. * moss not present at this site, but reports from Massachusetts indicate excellent moss control with this product.
NR4: grasses, bunchgrass, spirea hardhack
NR5: spirea hardhack
NR6: grasses
• Two timings of a post-emergent product (a relative of QuinStar) were applied at 4 rates at the WCRS and the non-production bed to evaluate phytotoxicity and control spectrum. More injury was seen in 2022 than had been seen in prior years, so future work will focus only on the post-bloom timing, a new

formulation will be evaluated, as well as in a wiper application. Control spectrum included maple, dewberry, sticktite, Labrador tea, leatherleaf, sedges, perennial grasses.

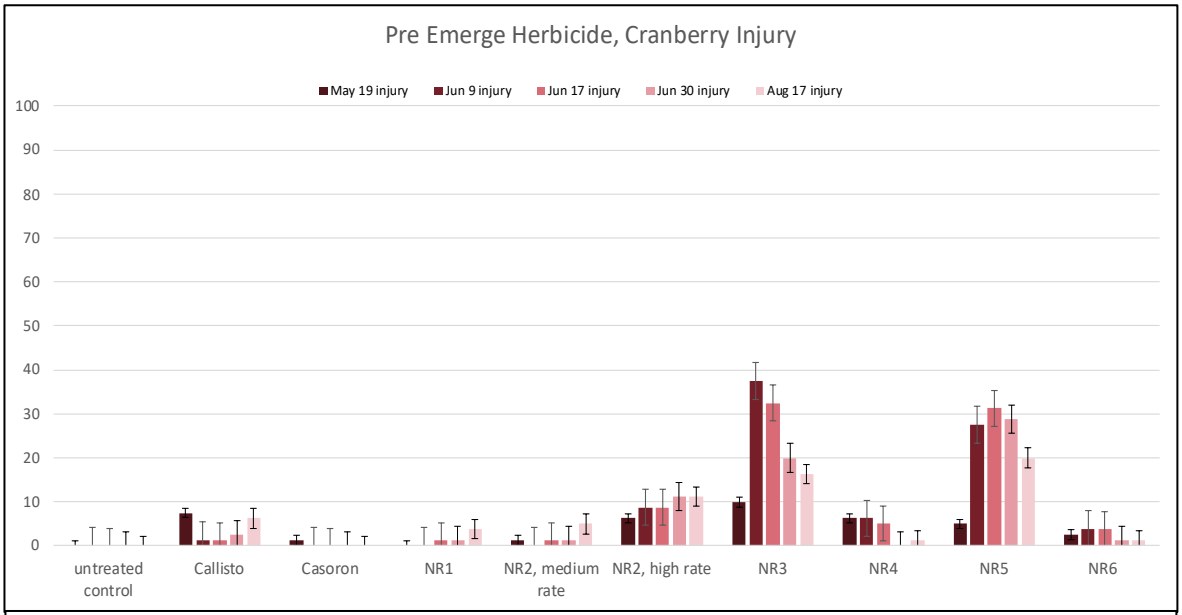


Fig 6. Cranberry phytotoxicity evaluated on several dates after application, to an established Stevens bed at Wisconsin Cranberry Research Station.

Fig 7. A not-yet-registered herbicide's control of maple and dewberry in cranberry production.

ALWAYS REMEMBER TO: 1) read the label and 2) check with your handler for approval to use pesticides.

Thank you to WCB and CI for the continued support for these trials, to chemical companies for donating products, and to collaborating growers and Wade Brockman at the Wisconsin Cranberry Research Station for helping with these trials.

CRANBERRY SCHOOL GROWER SURVEY 2023 RESULTS

ALLISON JONJAK[1], LESLIE HOLLAND[2], AMAYA ATUCHA[3], and CHRISTELLE GUÉDOT[4]

[1]Division of Extension, [2]Department of Plant Pathology, [3]Department of Horticulture, [4]Department of Entomology, University of Wisconsin-Madison, WI

ENTOMOLOGY

What was the main yield-reducing pest of the 2022 crop?

Insects	29	52%
Disease/Rot	13	23%
Weeds	14	25%

Was your insect pressure in 2022

Up from 2021	12	19%
Down from 2021	13	21%
Similar to 2021	37	60%

How many insecticide sprays did you apply in the 2022 growing season?

0	2	3%
1-2	14	24%
3-4	36	61%
5-6	7	12%
More than 6	0	0%

Was the flea beetle population on your marsh in 2022

Up from 2021	17	29%
Down from 2021	13	22%
Same as 2021	29	49%

How many sprays did you apply specifically for flea beetle in 2022?

0	17	28%
1	27	44%
2	13	21%
3	4	7%
4 or more	0	0%

What insecticide did you use for flea beetle control in 2022?

Assail	0	0%
Diazinon	32	70%
Rimon	0	0%
Altacor	7	15%
Actara	2	4%
Imidan	0	0%
other	5	11%

Did you notice flea beetle "suddenly switching" to feeding on fruit in 2022?

Yes	0	0%
No	46	84%
Maybe	7	13%
What are you talking about?	2	4%

How concerned are you about leafhoppers on your marsh?

Not concerned at all	17	29%
Slightly concerned	24	41%
Moderately concerned	14	24%
Very concerned	3	5%

How many times did you spray for leafhoppers in 2022?

0	43	81%
1	7	13%
2	3	6%
3 or more	0	0%

What do you plan to use in the <u>early season</u> instead of Lorsban to control insect pests?

Acephate (Orthene)	14	27%
Sevin (Carbaryl)	1	2%
A diamide (Altacor, Exirel, Verdepryn)	5	10%
A spinosyn (Delegate, Entrust)	16	31%
Phosmet (Imidan)	0	0%
A neonicotinoid (e.g., Actara, Venom, Assail, Admire Pro)	1	2%
Diazinon	6	12%
Other	9	17%

<u>CRANBERRY FORECAST</u>

The Cranberry Board funds the Cranberry Forecast each year. The cost is $8,900. Do you think the weather forecast is the best use of grower funds, if the same money could fund research or communications instead?

Continue with weather	55	90%
Fund other projects especially research	3	5%
Fund other projects especially communications	1	2%
No opinion	2	3%

Would you like to see the Cranberry Forecast all year long (not just during the growing season)?

I prefer growing season only ($8,900)	29	46%
I think it would be worth paying more to have a year-round cranberry forecast	30	48%
I think we should stop funding the Cranberry Forecast	2	3%
No opinion	2	3%

HORTICULTURE & PHYSIOLOGY

In the 2022 yields were:

Higher than average	29	44%
Lower than average	14	21%
Similar to previous years	23	35%

In 2022 fruit size was:

Bigger than average	10	44%
Smaller than average	34	21%
Similar to previous years	25	35%

In 2022, fruit firmness was:

Similar to previous years	47	71%
Better than in previous years	16	24%
Worse than in previous years	3	5%

In 2022, fruit rot incidence was

Similar to previous years	20	32%
Lower than in previous years	36	58%
Higher than in previous years	6	10%

Did you have yield losses due to cold damage during 2022:

Yes	11	18%
No	43	69%
I'm not sure	8	13%

Did you have yield losses due to the hail storm in early spring of 2022:

Yes	21	34%
No	37	61%
I'm not sure	3	5%

What kind of winter damage did you notice on your marsh?

Leaf drop on edges of bed	6	10%
Leaf drop on entire bed	9	15%
None	46	75%

When do you apply your first doses of N-P-K?

bud break	3	5%
before bloom	2	4%
at bloom	18	32%
50% bloom	8	14%
fruit set	10	18%
pinhead	13	23%
pea size	2	4%

When do you apply your LAST doses of N-P-K?

bud break	0	0%
before bloom	0	0%
at bloom	0	0%
50% bloom	0	0%
fruit set	2	4%
pinhead	1	2%
pea size	23	41%
full size	29	52%
red berry	1	2%

PATHOLOGY

Do you spray fungicides on your entire marsh for fruit rot control?

Yes, on all varieties	32	55%
No, only on modern hybrids	15	26%
No, do not use any fungicides on marsh	11	19%

How many fungicide applications did you make in the 2022 growing season to control fruit rot?

0	12	20%
1	13	22%
2	29	49%
3	4	7%
More than 3	1	2%

Over the last 3-5 years, have your fungicide practices changed for managing fruit rot?

Yes, I use more fungicide applications	10	19%
Yes, I use fewer fungicide applications	6	12%
No, I use the same number of fungicide applications	36	69%

What fungicides did you use this season for fruit rot management? (Select all that apply)

Abound + Indar	20	29%
Proline	20	29%
Quadris Top	3	4%
Satori or Aframe + Indar	15	21%
Other	2	3%
Did not use fungicides	10	14%

If you use fungicides, which treatment do you feel represents the most effective option for fruit rot control?

Abound + Indar	17	29%
Proline	13	22%
Quadris Top	2	3%
Satori or Aframe + Indar	8	14%
Other	2	3%
Did not use fungicides	9	16%
All fungicides are equally effective in my opinion	7	12%

Where do you get cuttings from? (Select all that apply)

Plugs from nurseries	6	8%
Licensed propagators	26	36%
I mow them from my own beds	36	50%
Other	4	6%

How long do you store the cuttings prior to planting?

Less than 2 weeks	14	25%
Between 2 to 4 weeks	19	33%
Over 4 weeks	5	9%
It will vary between years or within year	19	33%

How often do you assess potential diseases in propagative cutting material through a diagnostic service?

Never	55	95%
Sometimes	1	2%
Frequently	2	3%

In the first few years of bed establishment, how often do you deal with Early Rot?

Never	17	29%
Sometimes	24	41%
Frequently	17	29%

How concerned are you about pathogen transmission through vegetative (cuttings) propagation of cranberry?

Not concerned	22	38%
Somewhat concerned	30	52%
Very concerned	6	10%

WEEDS

Do you have moss on your marsh?

Yes, but only in a few beds	40	68%
Yes, extensively across the marsh	13	22%
No moss on my marsh!	6	10%

Do you feel that your weed pressure impacts cranberry yield?

No impact	7	11%
Yes, by 10% or less	38	62%
Yes, by 11 to 25%	12	20%
Yes, by greater than 25%	4	7%

Do you use Casoron in your established beds:

Yes, I use it every year	30	55%
Yes, but not every year	21	38%
No, I don’t use Casoron	4	7%

How important is it to you that your herbicides control cranberry seedlings?

Not concerned at all	20	34%
Mildly concerned	24	41%
Moderately concerned	5	8%
Very concerned	10	17%

Have you had your varieties tested for purity in the past 5 years?

No	46	74%
On some but not all of my varieties	15	24%
On all my varieties	1	2%

For your weed control program in 2022, did you:

Use pre-emergent herbicides only	2	3%
Use post-emergent herbicides only	5	8%
Use pre- and post-emergent herbicides	50	83%
I didn't use any herbicides	3	5%

Do you use Stinger in your cranberries?

Yes, as a spot or wiper treatment only to needed areas	21	34%
Yes, as a broadcast application	0	0%
No, I don't use Stinger	40	66%

When considering surfactants with your pesticides:

I use the same surfactant product every year, if possible	34	60%
I use whatever the dealer delivers with the pesticide	10	18%
I'm not that concerned about which surfactant brand I use	13	23%

Are you concerned about the development of herbicide-resistant weeds on your marsh?

Very concerned	19	32%
Somewhat concerned	37	62%
Not at all concerned	4	7%

WISCONSIN STATE CRANBERRY GROWERS Association

2022 ANNUAL REPORT

WSCGA ANNUAL WINTER MEETING

January 18, 2023

AGENDA

- 1:00 PM - Call to Order — *Steven Bartling, WSCGA President*
- Minutes from the 2022 Summer Meeting — *Mary Sawyer, WSCGA Secretary*
- Report of the President — *Steven Bartling, WSCGA President*
- Report of Executive Director
- Report of Committees
- Election of Directors — *Mike Bretl, Board Development Committee*
- Other Business
- 1:30 PM - Adjourn

WSCGA SUMMER MEETING MINUTES

August 10, 2022

Wisconsin Cranberry Research Station

The 2022 Wisconsin State Cranberry Growers Association Summer Meeting was called to order by President Steven Bartling on Wednesday - August 10, 2022, at 1:30 PM at the Wisconsin Cranberry Research Station in Black River Falls, Wisconsin.

Bartling welcomed the growers in attendance and thanked the hosts and staff. Bartling also thanked the WSCGA staff, Tom Lochner, Alex Skawinski, and Crystal Johnston, as well as the WSCGA Education Committee and Associate Member Committee members for coordinating the Summer Field Day event.

INTRODUCTION OF BOARD

Bartling introduced the members of the WSCGA Board of Directors, including:

- Rocky Biegel, Vice President
- Jenna Van Wychen, Treasurer
- Mary Sawyer, Secretary
- Jim Bible
- Mike Bretl
- Kris Parker
- Karl Pippenger
- Rusty Schultz

SECRETARY'S REPORT

Bartling referred to the 2022 Virtual Winter Meeting Minutes printed on page 45 of the Summer Meeting & Field Day Program Book. Nodji Van Wychen moved, and Tyler Walker seconded a motion to approve the January 19, 2022 meeting minutes as printed. Motion carried.

RECOGNITION OF HOSTS

Bartling presented a Summer Field Day host plaque for the Wisconsin Cranberry Research Station and expressed the Association's appreciation and gratefulness for their efforts to host the event. Wade Brockman and Bill Wolfe made brief remarks and accepted the plaque on behalf of the Foundation.

SPECIAL GUESTS

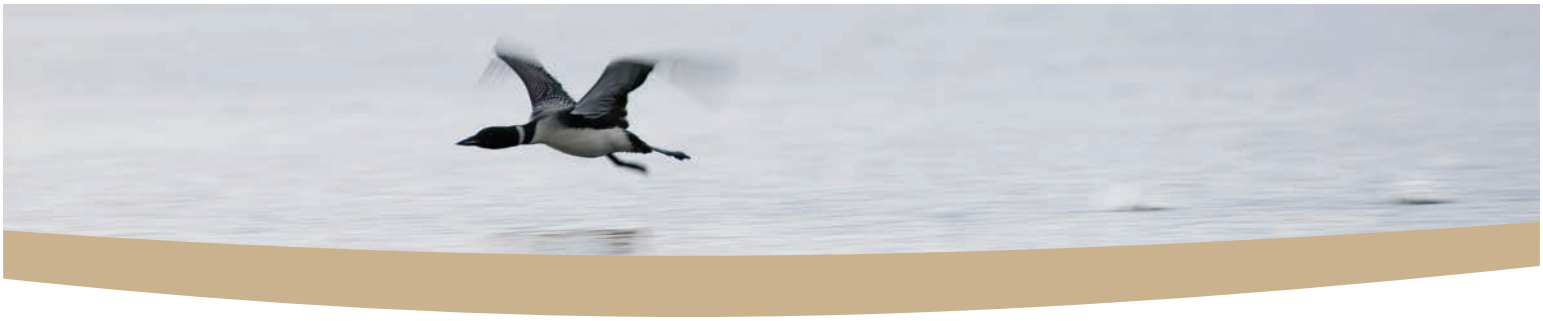
Bartling introduced the Summer Meeting special guests, including:

- Representative Nancy VanderMeer
- Dan Baumann, WDNR

RECOGNITION OF ANNIVERSARIES

Each year at the Field Day event, the WSCGA recognizes milestone marsh anniversaries of grower members. Bartling presented a recognition plaque for each of the following marshes:

- Walker Cranberry Company, Inc.- 75th Anniversary
- Hemlock Trails Cranberry Company, Inc. – 75th Anniversary
- Sherry Berry LLC- 25th Anniversary
- Bires Cranberry LLC- 25th Anniversary
- Ostrowski Cranberry LLC- 25th Anniversary



INTRODUCTION OF WISCONSIN CRANBERRY LEADERSHIP DEVELOPMENT CLASS VI

Alex Skawinski, Member Education and Communication Manager for the WSCGA, introduced the participants in the sixth class of the Leadership Development Program, including:

- Nickolas Belland, Manulife Investment Management Farmland Management Services
- Jamie Biegel, Dempze Cranberry Co.
- Daniel Bristow, Russell Rezin & Son, Inc.
- Ken Francl, Gardner Cranberry- Gordon Marsh
- Jaeke Gadsky, Manulife Investment Management Farmland Management Services
- Gabriel Gray, Manulife Investment Management Farmland Management Services
- Nick Hoffman, Dempze Cranberry Co.
- Allison Jonjak, UW-Madison Division of Extension
- Jeremiah Mabie, Manulife Investment Management Farmland Management Services
- Sean O'Brien, Arrow Cranberry
- Sarah Stauner, James Lake Farms
- Mathew Winter, Arrow Cranberry

PRESIDENT'S REPORT

Bartling made brief remarks as to the remarkable dedication of the Board and growers in the state, the excellent relationships between the industry and UW-Madison, ARS and legislators, and thanked staff and volunteers for their service.

EXECUTIVE DIRECTOR'S REPORT

Tom Lochner, WSCGA Executive Director, commented on the long-running and extremely successful Leadership Development Program, the 2022 Program Area Strategic Plan that the Association is currently implementing, the Association's recent relocation to a new office space, and thanked the staff, growers, and Boards that he works with, as well as his family for their support.

OLD BUSINESS

None

NEW BUSINESS

None

ADJOURN

There being no further business, Bartling entertained a motion to adjourn. Tyler Walker made a motion to adjourn the meeting. Mary Sawyer seconded the motion. All were in favor and motion carried. The Summer Meeting was adjourned at 1:49 pm.

ANNOUNCEMENTS

- The WCREF Sporting Clay Shoot is coming up on August 26, 2022
- The Association has moved to a new office at 3930 8th Street South, Suite 104 in Wisconsin Rapids
- There is not yet a host for the 2023 WSCGA Annual Summer Meeting, Field Day & Trade Show

Respectfully submitted,
Alex Skawinski on behalf of Mary Sawyer – WSCGA Secretary

FROM THE PRESIDENT

Taking time to reflect on the past year is an important exercise; what went well, what didn't go as expected, as well as what we can learn from and improve on for the future.

The year 2022 has been one of evolutions for myself, the grower community, and the WSCGA in many ways.

As we put the era of the covid pandemic further into the rearview mirror, the resets and restructuring of the greater world and our local communities have taken the forefront. This year at the Association, we are seeing the evolution of the staff involving some new and energetic people. At our upcoming Winter Meeting, we will have Board members retiring and we will be welcoming new Board members. Even down to the farm levels, we have seen an evolution of employees and leaders. To me, this is a very healthy and progressive atmosphere for all of us. As each and every new person on the team changes, like adding a new cog in a system of gears, each directly affects the outcome of all the cogs working together. It's time to make sure your personal cog is running in tip-top shape! It affects every system you are involved with.

The strategic planning structure the WSCGA adopted and updated last year is still alive and thriving. This is the guiding tool that the Board and growers community view as a "steadfast" objective that keeps us focused and aligned as an organization. The new WSCGA staff will bring energy and ideas on how to best accomplish this going forward.

Membership has continued to increase this year through farms that transitioned into new ownerships and found renewed value in the long-term membership structure of the Association. We welcome them. The more members the organization can represent, the stronger our voices and abilities are united as an industry.

After all the dynamic forces of the last couple of years, I strongly feel that our cranberry community is on a steady path forward. However, the evolutions are just beginning. The year 2023 is going to be one of new beginnings. With the new staff and leadership, we will devote our energy into fine-tuning and modernizing our plans and programs.

The current support in the community for the Association is very high. This is one of the most powerful things our state industry does in the favor of our farmers. We have a very connected and engaged cranberry community, and this is the biggest difference between us and other agricultural sectors. I feel this is the most valued aspect of what has brought us to where we are today and we will ensure this to be true for the future.

I am very excited to see what new advancements and programs our community will bring us over the upcoming years.

FROM THE EXECUTIVE DIRECTOR

Your growers association has completed another successful year in all of its program areas. The annual report details many of the successful grower-led programs developed and implemented this past year on your behalf.

The board and staff worked in late 2021 and 2022 to update a focused strategic plan for the organization. The process included member surveys developed by program committees. The plan adopted by the board was focused on the association's three core program areas: Education, Communications and Public Policy Advocacy. These programs are integrated to reach our ultimate mission which is to provide an environment that enables Wisconsin's cranberry growers to prosper. Since then, the board and committees have been working to implement the plan.

We also made minor adjustments to staff responsibilities and welcomed two new members to the WSCGA team.

Holly Herline joined us to fill the Communications Manager position. She started late in the year but has been working hard to establish relationships, orient herself to the programs and develop the Communication Plan for 2023. We are very excited to have her on board.

Crystal Johnston, who served as Clerical Assistant for the organization decided to retire after 17 years with the organization. She too was a valuable member of the team. With her departure, we reviewed the job responsibilities of the staff and created an Administrative Manager position, moving some of the Administrative Assistant duties to the new position. This allowed our Member Services Manager, Alex Skawinski to take on additional responsibilities in growing the member education and Associate Member programs. We were excited to be able to hire Kelsey McCauley for this role in September.

The year also saw us downsize our office space, relocating to 3930 8th Street South in Wisconsin Rapids. With all of these changes, we were able to focus management on the financial performance of the WSCGA and were very pleased by the resulting positive performance that allowed us to operate with a positive cash flow and to build back reserves that were used during the difficult economy the industry faced.

With all of our success comes the recognition that it would not be possible without a strong and active membership. The financial support of the payment of your dues is critical, but even more important is your participation in the organization, its board, committees and programming. We can only say thank you for that support and wish all of you the best for 2023.

WSCGA ANNUAL REPORT

The Wisconsin State Cranberry Growers Association was formed in 1887 to serve the state's newly emerging cranberry industry. Some 136 years later, the organization continues to work to meet its mission of providing quality programs for members in an effort to enable the industry to prosper.

WSCGA is organized as a non-profit, non-stock corporation governed by a nine-member Board of Directors. The board is advised by a number of committees and working groups on topics ranging from Public Policy and Promotion to Grower and Public Education. The association employs professional staff and consultants. The board, committees, staff and consultants work together as a team to develop and implement programs and policies for the organization.

The 2022 Annual Report highlights activities by the association on behalf of its membership throughout the course of the year. These successes are due to the hard work of the grower and associate members who volunteer their time and talent to work with the association's professional staff and contractors to advance the mission of the organization. We hope all growers and members of the industry will thank those who continue to work on their behalf and to join the WSCGA in these efforts.

WSCGA SERVICE TO INDUSTRY AWARD

The WSCGA Board of Directors presents the Service to Industry Award to individuals or groups who have provided outstanding service to the industry and association. The award is the highest recognition that the WSCGA provides. This year the Association is pleased to provide recognition to:

MIKE MOSS

Mike and his wife Diane are 3rd generation cranberry growers at Elm Lake Cranberry Co. in Cranmoor, WI. Elm Lake was founded in 1901 and has a long tradition of being a family-run and community-focused business. Mike was born and raised in Wisconsin Rapids and received a degree in Instrumentation from Mid-State Technical College. After getting married in 1983, Mike and Diane decided to join the family farm and began the process of taking over the marsh from Diane's parents, Jerry and Sue Wirtz.

When he moved there, Elm Lake was a 75-acre marsh consisting mostly of Searles, Ben Lear and Stevens varieties. Mike has grown the farm into a flourishing marsh of 150-acres that is full of modern hybrids. In his time on the farm, Mike has renovated or planted every single acre of cranberries on the property. From planting cutting edge UW-Madison varieties, to establishing test plots with Nick Vorsa at Rutgers, he has always been an early adopter of new hybrid varieties. Mike has collaborated with many industry researchers at those universities and Ocean Spray and has supported a continuous stream of research projects ever since he started.

Mike was on the WSCGA Board of Directors for 10 years, from 2007-2016 and served as President in 2010 & 2011. He served on the WSCGA Research Committee for many years, and through his time on the WCREF Board, he was a big supporter of the new research station.

Elm Lake currently has 4 generations of family members living on the farm and at the end of 2022, Mike & Diane will transition the business to the next generation of the family: John & Melissa. Mike is very grateful for the opportunities the cranberry industry has afforded him and extremely honored to have been able to work side-by-side with the cranberry growers of Wisconsin to build a better future.

STEVE GEBHARDT

Steve is a 4th generation cranberry grower and has been growing cranberries for more than 45 years. He is currently farming 300 acres of cranberries with his wife Betty and children Heather, Nick and Nathan, along with their families, in southeast Jackson county. Steve founded Gebhardt Manufacturing in the early 80's to manufacture and supply specialized cranberry equipment to the industry. He also added an irrigation company to supply irrigation systems specific to the cranberry industry. He sold those companies later on to devote more time to raising a family and growing cranberries. Steve has served on numerous boards in the community, with the latest being the WCREF Board. He has passion for improving all things cranberry, whether it be equipment, new varieties, or research on better and more efficient ways to grow cranberries.

WSCGA ADVOCATE AWARDS IN MAJOR PROGRAM AREAS

In 2022, the WSCGA Board of Directors created additional recognition for members who have provided leadership and support in our major program areas. The board is proud to present these awards to the following individuals who have stepped up this year in the areas of Public Policy, Education, Communications and Research. The board has also selected an associate member to recognize for their support this year.

EDUCATION ADVOCATE - DAVID S. JONES

Dave is originally from Middleton, WI., and spent many happy hours (and days) at family farms in the southeastern part of the state growing up. After starting college at UW-Stevens Point and developing a love for all things central/northern Wisconsin he transferred to the UW-Madison to finish his B.S. in Horticulture, completing internships with focus on fruit production at both the UW-West Madison Agricultural Research Station and the UW-Peninsular Agricultural Research Station. During this time, he worked with wine grapes, apple, tart cherry, raspberry, and sweet cherry. After finishing his undergraduate degree, he went on to graduate school at the UW Department of Plant Pathology, earning his M.S. in plant pathology while studying the relative resistance of modern cold-hardy wine grapes to key economic pathogens. After finishing graduate school, Dave worked for several years with Michigan State University Extension as a fruit researcher and extension educator, serving the growers of west Michigan and working in both research and extension with apple, pear, peach, sweet cherry, tart cherry, and several other local fruit crops. Cranberries called him back home to Wisconsin in early 2020, and he considers himself very fortunate to serve in research and extension for Wisconsin's cranberry industry as the Senior Agricultural Scientist for Ocean Spray in the Midwest. Dave lives in Wisconsin Rapids with his wife Abby and their two children Isabel (3) and Charlie (1), where they enjoy gardening, trips to the park, and local rec sports. On, Wisconsin!

COMMUNICATIONS ADVOCATE - MICHAEL S. GNEWIKOW

Mike Gnewikow has been involved in the cranberry industry for over 30 years. Mike works together with family members, Jim, Nodji and Henry VanWychen to operate the Wetherby Cranberry Company and VanKow Cranberries. Mike and his wife Tonya raised four boys who are part of Wetherby's fifth generation of cranberry growers and they have a one year old granddaughter who has now begun the 6th generation. These long time family cranberry roots are the main reason why Mike has such a strong passion for the cranberry industry.

Mike began his cranberry life in High School when he started working summers and breaks pulling weeds, mowing dikes and dumping bags of fertilizer. He attending UW-Eau Claire and obtained an Advertising Degree with an Economics Minor while continuing to work on the marsh whenever he could. After college, Mike and Tonya got married and Mike ran a small printing and advertising business in Tomah while working part-time on the marsh. After a few years he put the printing business behind and began working at Wetherby full time. Mike and his brother-in-law, Henry VanWychen, began VanKow Cranberries over fifteen years ago and they currently help run both companies. Mike continues to use his advertising background as he helps promote their companies as well as the entire cranberry industry through many different channels. Mike was a participant in the inaugural Wisconsin Cranberry Leadership Development Class and has used the information and skills he obtained in that class to give many interviews and tours to individuals, groups, schools and media personalities through the years. Mike has volunteered in the cranberry booth at the Wisconsin State Fair multiple years where he also did several TV and social media interviews. Additionally, he has volunteered at the Birkebeiner race and the Crazy Legs races and other Badger events where the WSCGA has been a sponsor through the years.

Mike currently serves on the Wisconsin Cranberry Board, is an alternate for the Cranberry Marketing Committee and is on the WSCGA Public Relations Committee and Research Committee. Outside of the cranberry industry, Mike also serves his community by sitting as the current President of the Tomah School Board, the President of the Tomah Gridiron Club and is a member of the Warrens Lions Club. He also is a past board member for the Warrens Cranberry Festival.

When discussing his cranberry career and the industry Mike stated the following. "I absolutely love talking about cranberries. There are so many fascinating things in our industry. The decades of family heritage have so many amazing stories to tell. We use so many unique techniques and machinery that are so intriguing to everyone I talk to. I can have a wonderful conversation with school kids as I explain how cranberries float and then turn around and have an in depth discussion with an engineer the next moment where they are so interested in how we operate. I think one of the greatest things about our industry is the wide array of career opportunities we offer. We have opportunities and interactions with everyone from our weed pullers, through managers, and even with people that help represent our industry across the globe. Being a part of such a dynamic industry makes me want to continue to help it grow and thrive more than ever. I can't imagine doing anything other than growing cranberries and look forward to sharing all this information with the next generations as long as I can."

RESEARCHER OF THE YEAR - LESLIE HOLLAND

Leslie Holland received a B.S. in Biology (2013) from New Mexico State University, a M.S. degree in Plant Pathology (2015) from Washington State University, and a PhD in Plant Pathology (2020) from the University of California, Davis. She joined the department of Plant Pathology at UW-Madison as an assistant professor and extension specialist in fruit crop pathology in 2020. Her research focuses on the biology, epidemiology, and management of pathogens affecting fruit production in Wisconsin. The goal of her extension program is to optimize and deliver integrated disease management approaches that support the productivity and sustainability of fruit crop production. Her research in cranberry pathology centers on two important diseases, cranberry fruit rot and cranberry false blossom. Cranberry pathology research in her lab has received funding from the Wisconsin Cranberry Board, the Cranberry Institute, Ocean Spray, USDA Specialty Crop Block Grants Program, and USDA Specialty Crop Research Initiative.

ASSOCIATE MEMBER OF THE YEAR - NUTRIEN AG SOLUTIONS

Craig Raha is a crop consultant for Nutrien Ag Solutions, the largest agricultural retailer in North America. Nutrien Ag Solutions provides full-acre solutions through a global network of trusted crop consultants, of which Raha is part of. Raha is based in Galesville, WI – one of more than 1,700 global locations. He helps growers achieve the highest yields with the most sustainable solutions with a focus on Nutrien Ag Solutions' specialty cranberry and ginseng markets. Raha is responsible for providing crop protection products, solutions and recommendations to growers in his region.

Prior to joining Nutrien Ag Solutions in 2013, Raha was working for a different agriculture company in a similar capacity.

Due to his passion and success in the field, Raha was recently selected by Nutrien Ag Solutions and Farm Journal Magazine to participate in a docuseries focused on the cranberry market, which can be viewed on YouTube.

THE TEAM – WSCGA BOARD OF DIRECTORS 2022

STEVEN BARTLING, PRESIDENT

Steven and his family own and operate Bartling's Manitowish Cranberry in Manitowish Waters. Steven is the WSCGA President, and serves on the Executive, Education, and Research Committees, as well as the Technology Subcommittee. He also worked as the WSCGA representative on the Strategic Planning Committee. Steven participated in the inaugural class of the Wisconsin Cranberry Leadership Development Program in 2012-13, and was elected to the Board in 2016.

ROCKY BIEGEL, VICE PRESIDENT

Rocky Biegel is part of Dempze Cranberry Co. in Wisconsin Rapids and Cranberry Cove in Tomah. Rocky joined the board in 2017 and became the WSCGA Vice President in 2020. Rocky serves on the Executive, Board Development and Education Committees.

MARY SAWYER, SECRETARY

Mary is part of Saratoga Cranberry in Wisconsin Rapids. Mary was elected to the Board of Directors in 2020 and serves as the WSCGA Secretary. Mary also serves on the Executive, Board Development, Public Relations, and Research Committees. Mary participated in the inaugural class of the Wisconsin Cranberry Leadership Development Program in 2012-13.

JENNA VAN WYCHEN - TREASURER

Jenna joined the Board in 2017. Jenna is part of Van Kow Cranberries and Wetherby Cranberry in Monroe County. Jenna is the WSCGA Treasurer and chairs the Associate Member Committee. Jenna also serves on the Executive Committee and participated in the 2013-14 Wisconsin Cranberry Leadership Development Program.

JIM BIBLE

Jim is part of Brockway Cranberry and Rock Creek Cranberry in Black River Falls. Jim was elected to the Board in 2020 and serves as chair of the Education Committee.

MIKE BRETL

Mike serves as the Wisconsin Region Manager for Manulife Investment Management- Farmland Management Services, based out of Wisconsin Rapids. Mike joined the Board in 2019 and is the chair of the Research Committee. He also serves on the Board Development Committee and took part in the inaugural class of the Wisconsin Cranberry Leadership Development Program, in 2012-13. Mike earned the Accredited Farm Manager designation from the American Society of Farm Managers and Rural Appraisers in 2017. In 2018, he became a Wisconsin Certified Crop Advisor and Sustainability Specialist, qualified through the American Society of Agronomy.

KRIS PARKER

Kris is the Project Manager at Cranberry Creek Cranberries in Necedah. In 2020, Kris was appointed to the Board and soon after was elected to the Board. Kris participated in the 2013-14 Wisconsin Cranberry Leadership Program and serves on the Education Committee. Kris's education is in surveying. His surveying background has led to his growth in equipment GPS leadership. Kris has also served in township board capacity and serves as a volunteer First Responder and Firefighter for the local township.

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KARL PIPPENGER
Karl is part of the team at Cranberry Lake Cranberries in Phillips and owns and operates his own small cranberry marsh, "Pip's Cranberries". He participated in the 2013-14 Wisconsin Cranberry Leadership Development Program. Karl joined the Board in 2015 and serves as the chair of the Public Policy Committee.

RUSTY SCHULTZ
Rusty joined the Board in 2018 and is part of Russell Rezin & Son and Jay Creek Cranberries in Monroe County. He participated in the inaugural class of the Wisconsin Cranberry Leadership Development Program in 2012-13. Rusty is the chair of the Public Relations Committee.

WSCGA COMMITTEES

EXECUTIVE COMMITTEE
Charge: The committee is delegated certain board authorities to act between board meetings and provide strategic direction for the board in relation to the operation, finances and structure of the WSCGA.

Steven Bartling, President
Rocky Biegel, Vice President
Mary Sawyer, Secretary
Jenna Van Wychen, Treasurer
Bill Hatch
Mark Mahoney

PUBLIC POLICY COMMITTEE
Charge: The committee is responsible for the development of recommendations on policy related to issues of state and federal regulatory and legislative actions that arise as part of the public policy advocacy program. The committee works to mobilize growers on issues to implement policy, and works to develop relationships with elected officials to help them understand the concerns of Wisconsin cranberry growers.

Karl Pippenger- Chair
Asa Bennett
Amber Bristow
Stephen Brown
Jenna Dempze
Karen Doers
Fawn Gottschalk
David Hansen
Nicole Hansen
Bill Hatch
Leroy Kummer
Andy Reitz
Seth Rice
Doug Rifleman
Russ Rifleman
Ben Ryner
Scott Schultz
Craige Scott

EDUCATION COMMITTEE

Charge: The main emphasis of the WSCGA mission is education, both for growers and the general public on cranberry growing. A large portion of this responsibility is assigned to the Education Committee, making it one of the key committees in the association. The committee meets with UW Extension faculty and others during the year to review and plan the various education programs for the association, including the Wisconsin Cranberry School, early season workshops and the Summer Meeting and Field Day.

Jim Bible- Chair
Christelle Guedot- Cranberry School Program Chair
Steven Bartling
Stephanie Bennett
Rocky Biegel
Jim Bielmeier
Alex Billman
Jeremy Eichhorn
Steve Hahn
Nicole Hansen
Jason Hatch
Allison Jonjak
John Moss
Kris Parker
Andy Reitz
Russ Sawyer
Sara Schmitt
Jayne Sojka
Pam Verhulst

TECHNOLOGY COMMITTEE

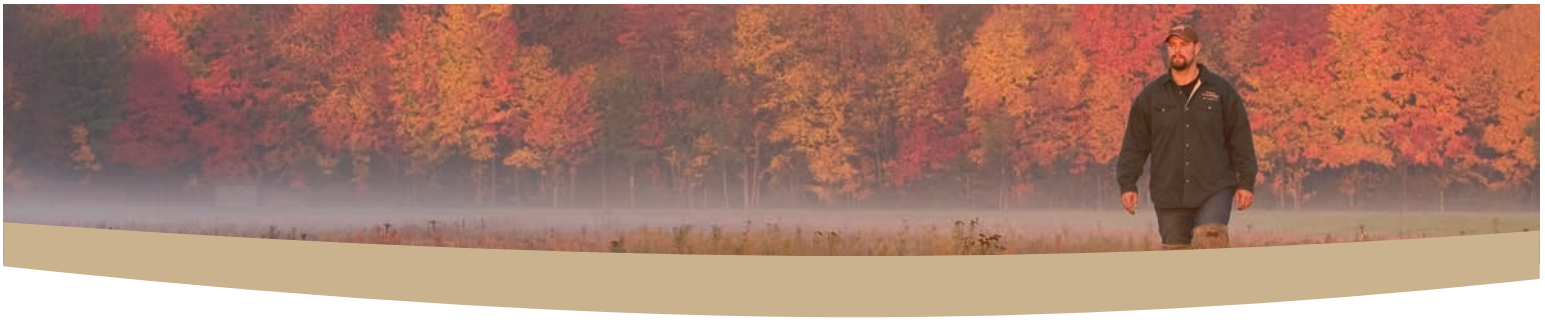
Charge: The Technology Subcommittee is a subset of the Education Committee. The subcommittee is tasked with assisting the Board of Directors and WSCGA committees on an as-needed basis in matters such as information technology, adoption of new technologies by the industry, identifying solutions to the technological needs of the association, etc.

John Moss – Chair
Steven Bartling
Russ Sawyer
Pam Verhulst

PUBLIC RELATIONS COMMITTEE

Charge: The Public Relations Committee is responsible for development and implementation of the communications plan for the Association. The objectives of the WSCGA communications program are twofold. First, to promote the general knowledge of cranberry growing in Wisconsin to enhance the image of growers and the industry; second, to inform consumers and the public about cranberries and cranberry products to enhance and promote the consumption of fruit and increase overall demand for cranberry products.

Rusty Schultz– Chair
Amber Bristow
Robert Detlefsen
Jeremy Eichhorn
Amy Gebhardt
Mike Gnewikow
Fawn Gottschalk
Rochelle Hoffman
Leroy Kummer
Gabriella Liddane
John Moss
Beth Oemichen
Jessica Rezin
Greg Schwartz
Mary Sawyer
Nodji Van Wychen



RESEARCH COMMITTEE

Charge: The Board of Directors established the committee to provide growers with a forum to discuss research needs with University of Wisconsin research faculty and the cranberry research community on a national basis. The committee works cooperatively with the Wisconsin Cranberry Board, Inc. (WCB), The Cranberry Institute (CI), and others to identify grower research needs, coordinate projects to avoid duplication, and to help establish priorities.

Mike Bretl – Chair
Suzanne Arendt
Steven Bartling
Alex Billman
Amber Bristow
Stephen Brown
Robert Detlefsen
Mike Gnewikow
Fawn Gottschalk
Ed Grygleski
Jeff Habelman
Nicole Hansen
Rochelle Hoffman
David Jones
Gabriella Liddane
Mark Mahoney
John Moss
Doug Rifleman
Ben Ryner
Dustin Sawyer
Mary Sawyer
Russ Sawyer
Scott Schultz
Jayne Sojka
Pam Verhulst
Bill Wolfe

ASSOCIATE MEMBER COMMITTEE

Charge: The Associate Member Committee provides input on WSCGA Associate Membership benefits, Summer and Winter Trade Shows, NEWS advertising, Program Book & Buyers Guide publication advertising, sponsorships, mailings and evaluations.

Jenna Van Wychen - Chair
Tom Altmann
Nicki Anderson
Amy Boson
Derek Johnson
Casey Koback
Paul Roberts
Dawn Ruiter
Jay Weidman

BOARD DEVELOPMENT COMMITTEE

Charge: The Board Development Committee functions to identify paths of leadership for potential leaders and develop their skills. The Committee is responsible for Board recruitment, orientation, board and director self-assessment, continuing education, and board management in addition to serving as the Nominating Committee

Mike Bretl
Kris Parker
Jenna Van Wychen

WSCGA STAFF

TOM LOCHNER, EXECUTIVE DIRECTOR

Tom Lochner was named the first WSCGA Executive Director in 1988. Since then, the association has grown into a well-respected voice for the Wisconsin cranberry grower.

As the chief staff person, Tom serves as the lead spokesman for the organization and represents WSCGA in interactions with University Research and Extension faculty and administration, as well as with Federal, State and local governmental organizations. He is also responsible for coordinating the activities of staff and various consultants who assist with communications and public policy programs. He serves as a liaison with industry groups, such as the Cranberry Institute and the US Cranberry Marketing Committee.

Over the course of his career, Tom has worked with the Board and committees on growing the programs and membership of the association. He believes in a team approach to program planning and development. This approach has resulted in active committees, an engaged and high performing board, and high grower participation in WSCGA programs.

ALEX SKAWINSKI

Alex joined the WSCGA in December 2015 as the Administrative Assistant. Following the 2019 strategic planning project, Alex shifted into the role of Member Education and Communications Manager. Staff restructuring in 2022 has transformed Alex's role to focus on Member Services to grow the Education and Associate Member programs.

As the Member Services Manager, Alex works closely with the Executive Director, the Education Committee, and the Associate Member Committee to develop and implement industry education and communication plans. She also manages membership benefits, programming, and education, as well as develops content for and manages the membership side of the wiscran.org website. Alex coordinates the production of WSCGA publications and maintains the Association's Oral History Project.

Alex continues to provide support to the WSCGA, WCREF and WCB through the preparation of materials and maintenance of records for Board and Committee meetings, as well as project support for the various organizations. Additionally, Alex works with the WCREF Development Fund Committee to plan and hold the annual Cranberry Open Golf Outing and the Sporting Clays Shoot.

KELSEY MCCAULEY

Kelsey joined the team in September of this year as the Finance and Administration Manager for the Grower's Association. Her main responsibilities include maintaining monthly financial reports and journals, recording and preparing deposits, processing payment of accounts payable, processing bi-weekly payroll and all applicable payroll taxes and forms, completing monthly reconciliation of bank statements, filing of necessary tax forms with state and federal agencies, and coordinating and assisting with annual audits. She is also crucial for implementing and maintaining financial controls for all organizations.

Kelsey has additional responsibilities managing the databases for the membership, serving as back-up for staff support, assisting at meetings and WSCGA events, and serving as office manager in purchasing supplies and equipment for the association.

Additionally, she manages the assessment forms, filings, and bookkeeping for the Wisconsin Cranberry Board, Inc. As well as completing all bookkeeping tasks for the Wisconsin Cranberry Research and Education Foundation, including but not limited to, recording accounts receivable, processing accounts payable, tracking grant receipts and expenditures, monthly reconciliation of bank statements, scheduling preparation for and assisting with annual audit.

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HOLLY HERLINE

Holly joined the WSCGA in October 2022 in the role of Communications Manager. The association reorganized staff duties as part of the implementation of the strategic plan adopted in 2018. In the plan, growers supported increased communication and public relations efforts as well as continuation of the quality education programming provided by WSCGA. The new staffing structure is designed to accomplish these goals.

Holly leads the WSCGA communication and promotion programs aimed at educating the public about cranberry growing in Wisconsin, maintaining a strong reputation for the industry and promoting the consumption of Wisconsin cranberries. She joined WSCGA after completing nine years of service with the United States Navy, as a mass communication specialist. She has a background in community outreach, public affairs, journalism and content creation and management.

In this role, Holly works with the Executive Director and Public Relations Committee to develop an industry public relations and communications plan. She is responsible for implementing the plan and managing various communications and marketing initiatives. She also manages the public-facing side of the wiscran.org website and the Wisconsin Cranberries social media channels, to include content development and strategic advertising. She also writes and edits various communications materials, including newsletter articles, annual reports, news releases, pitch letters, talking points, articles and blog posts.

In addition, Holly conducts media relations efforts on behalf of industry, managing reactive and proactive news opportunities. She also maintains WSCGA's partnership/sponsorship program, including logistics and contract negotiations. Holly is responsible for coordinating and marketing the Made with Wisconsin Cranberries program.

ASSOCIATION CONSULTANTS

Dewitt, LLP is a full-service law firm based in Madison, WI. DeWitt has experienced attorneys in virtually all areas of law practice and has offices in Brookfield, Madison and Minneapolis, Minnesota.

The DeWitt Government Relations team is led by **Attorney Jordan Lamb**, a partner in the Madison office, who also serves as WSCGA's legislative counsel. **Jordan Lamb's** expertise in environmental regulation is a particular asset to WSCGA and our members, as they navigate the interplay between state and federal regulations and running a successful business. She is a consistent and trusted voice for us in the development and current rewrite of the State non-point source pollution program in NR 151 and ATCP 50. In prior legislative sessions, she played a key role in Wetland Reform Legislation, the development of a protocol for dealing with cranberry floodplain and consistently provides leadership on issues related to groundwater, drainage, artificial and navigable water bodies and business issues that affect our members.

Laughlin Constable, Communications and Public Relations

Laughlin Constable (LC) is a multi-faceted and full-service agency. The LC team is made up of a group of talented and creative public relations professionals with a wide variety of backgrounds. LC provides access to expertise for communications, public relations, advertising, influencer marketing and social media programs for WSCGA and its members and partners.

Kris Naidl, *APR,* began working with WSCGA in 1994 and she has assisted the cranberry industry with a number of efforts, including strategic communications work to affect change in state regulations, branding, publicity and media relations, issues management, digital strategy and more. She heads up LC's PR team and has earned her national accreditation from the Public Relations Society of America (PRSA). Kris and the LC team have been honored on numerous occasions by PRSA for its communications work to support Wisconsin's cranberry industry.

Katie Whitlock, *APR,* has worked with WSCGA for more than 5 years, assisting the industry with communication efforts, including strategic planning, public opinion research, media relations, issues management, event and sponsorship coordination, crisis communications, social media and more. She has earned her national accreditation from the Public Relations Society of America (PRSA).

WSCGA PROGRAM ACTIVITIES

PUBLIC POLICY ADVOCACY

WSCGA PUBLIC POLICY ADVOCACY PROGRAM OVERVIEW

POLICY STATEMENT OF WSCGA PUBLIC POLICY ADVOCACY PROGRAM

The WSCGA's Public Policy Advocacy Program strives for state and federal legislative outcomes that allow Wisconsin growers to farm in an environmentally and economically sustainable manner. The position statements and activities of the Public Policy Program are weighed against this goal:

Wisconsin cranberry growers support legislation, rules and policies that balance the conservation of important natural resources and the stewardship of resources by growers against the economic needs and benefits of cranberry growing in Wisconsin.

The following are priority areas for the WSCGA Public Policy Advocacy Program:

ENVIRONMENTAL POLICY AND REGULATION

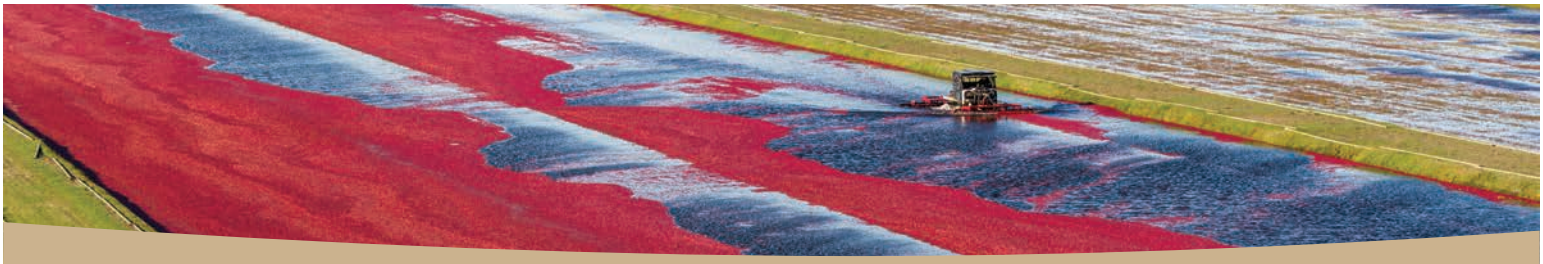
The greatest threats – and opportunities – for the industry in public policy are in the area of environmental regulation. Whether it pertains to water access and quality, wetlands or the chemicals for crop production that growers use, WSCGA members expect their Association to represent their interests.

WATER ACCESS

An abundant and high quality water supply is the key to the success of cranberry growing in Wisconsin. As such, the highest priority for the WSCGA is to maintain and protect growers' ability to access surface and groundwater for their farming operations. Conducting normal farming operations to maintain and enhance water use and conservation must be protected and must continue to be allowed with limited regulation.

WATER QUALITY

Cranberry farming practices face increasing scrutiny as to their impacts on water quality. WSCGA has led efforts with UWEX, USDA NRCS, DNR and DATCP to address Best Management Practices to protect water quality. Maintaining the definition of return flow from irrigated agriculture as a non-point source is a priority for the WSCGA. Changes to the state water regulatory program need continuous monitoring. TMDL development for cranberry waters and the Statewide Nutrient Management Strategy are also priorities for WSCGA.



FEDERAL/STATE LINKAGE

In many cases with environmental regulation, there is a strong and important relationship between Wisconsin and federal laws and regulation. This is the case with the Clean Water Act and floodplain regulation. As changes take place in federal programs, they impact the state as the delegated authority to administer those programs. At the same time, attempts to reform or revise state regulatory programs require federal approval. WSCGA and its Legislative Counsel continue to be vigilant in these areas.

With these identified priorities, WSCGA staff and leadership will closely communicate with the WSCGA Legislative Counsel to evaluate issues as they arise, assess risk and threats to the industry, and then determine the level of activity that is required to meet the organization's goal and mission.

FEDERAL LEGISLATIVE UPDATE

The WSCGA maintains a targeted Federal Legislative program that has developed a working relationship with all of the members of the Wisconsin Congressional Delegation. Bill Broydrick assisted the Association in these efforts which resulted in major benefits to growers this past year and a half.

The Association also worked with the WCREF to secure additional funding for the USDA ARS Cranberry Research Program in Wisconsin. These funds were used to create a new Food Science position, add a Cranberry Plant Physiologist and to enhance the operation of the Research Station. Additional support was also provided to the Genetics and Genomics program as well as the Entomology Program. Funds were secured to support the operation of the Wisconsin Cranberry Research Station.

The Association also works with other grower and handler groups on issues such as pesticide registrations, MRLs, research funding and USDA purchases.

STATE LEGISLATIVE UPDATE

By Jordan Lamb, DeWitt LLP

Attorney Jordan Lamb serves as the WSCGA's legislative counsel. Successful management of state governmental issues for the WSCGA depends on our comprehensive approach to the unique challenges ranging from environmental to business issues that are faced by Wisconsin cranberry growers. Our approach to each issue depends on a combination of legal analysis, statute and rule design, constituency involvement, political action, and media management.

The Wisconsin State Legislature is currently "out of session" until January 3, 2023, when they will convene for the 2023-24 legislative session. They adjourned the 2021-22 session in March 2022 in order to focus on the November 2022 elections.

Wisconsin has reelected Democratic Governor Tony Evers for his second four-year term, which will begin in January 2023. At the same time, the State Assembly and the State Senate will have very strong Republican majorities when the legislative session begins. With a Democratic governor and a Republican legislature, Wisconsin will have "divided government" in the state legislature again for the upcoming 2023-24 legislative session. In January 2023, the Governor will immediately begin work on the next biennial budget bill, which he will deliver to the Legislature on February 15, 2023. The legislature will begin the session working on numerous legislative issues from tax reform to school choice before moving to review the Governor's budget proposal. We are just beginning to identify emerging issues in the 2023-24 session that may arise and affect our membership.

The following are the issues that our state advocacy team worked on while the legislature was out of session during 2022.

DATCP NITROGEN OPTIMIZATION PILOT GRANT PROGRAM

The WSCGA worked with our colleagues from across agriculture last session to pass 2021 Wisconsin Act 223, which created a farmer-led commercial nitrogen optimization grant program. This program, which is funded with $1.6 million in this fiscal year, provides grants of up to $50,000 to farmers to engage in nitrogen conservation research projects on their farms working with UW System researchers. This farmer-led conservation is critical to driving improved cropping and fertilization agricultural innovation. The goal of the pilot program is for agricultural producers to "collaborate with University of Wisconsin System (UWS) scientists to conduct research projects that enhance the understanding of and refine new methods that optimizes nitrogen applied to agricultural fields and decreases nitrogen loss to atmosphere, groundwater, and surface water." Applications for grants are open through January 31, 2023, and we are supporting all interested WSCGA growers who are interested in engaging in a grant-funded research project.

DWD OPENS RULE TO ADDRESS MIGRANT WORKER ISSUES – DWD 301

The Wisconsin Department of Workforce Development (DWD) has opened a Scope Statement to potentially revise Wis. Admin. Code s. DWD 301 to "make revisions that are necessary to better align its requirements with federal law." One issue that has come up recently as a potential conflict between federal and state law relates to the insurance requirements imposed on those who transport migrant labors to and from the farms. Specifically, current Federal regulations do not require redundant liability insurance for workers if they are covered by an appropriate Worker's Compensation plan.

WSCGA is monitoring this rulemaking based on concerns about farm labor transportation contractors operating in Wisconsin being required to provide insurance coverage at levels that exceed federal requirements, at great additional expense. A number of contractors have already discontinued operations in Wisconsin as a result because they can operate without this additional financial burden in almost any other state. We are monitoring this rulemaking closely and will participate as opportunities arise.

REVISIONS TO SOIL AND WATER RESOURCE MANAGEMENT RULE ARE UNDERWAY - ATCP 50

DATCP is working with agriculture industry stakeholders, county staff, state agencies, the legislature, Governor, and the general public to update Wis. Admin. Code ATCP 50: Soil and Water Resource Management Program. ATCP 50 is the administrative rule that covers soil and water resource management grants to counties, county resource management planning, cost-share requirements for landowners, conservation compliance for farmland preservation tax credits, local ordinances, nutrient management, and other conservation practices. Rulemaking will consider options, including the conservation practices necessary, to implement the Silurian bedrock agricultural performance standards promulgated in 2018 by the Wisconsin Department of Natural Resources (DNR) in Wis. Admin. Code NR 151.075, as authorized under Wis. Stat. s. 281.16(3). The rulemaking will also assess options to update, simplify, add to, and clarify existing rule provisions related to implementation of existing agricultural performance standards, soil and water conservation on farms, county soil and water programs, grants to counties and cost-sharing for landowners, standards for soil and water professionals, and standards for cost-shared practices. DATCP is currently holding stakeholder meetings to collect input on the rulemaking. We continue to participate and monitor this rulemaking for any potential effects on our growers.

WISCONSIN INITIATIVE FOR AGRICULTURAL EXPORTS (WIAE)

Also in 2022, the Wisconsin Initiative for Agricultural Exports was created as a part of 2021 Wisconsin Act 92 through support from WSCGA and other agricultural organizations. This initiative, which invests up to $5 million over five years, aims to increase the export of dairy, meat, crop, and other agricultural products by 25 percent by June 2026. During the fall of 2022, DATCP accepted applications for ag export expansion grants. These grants were funded through the WIAE. The grants were intended to accelerate the growth of Wisconsin dairy, meat, and crop exports and were provided to not-for-profit organizations, located in Wisconsin, and currently serving or have the ability to serve Wisconsin agribusinesses.

2022 COMMUNICATIONS & MARKETING HIGHLIGHTS

The beginning of 2022 continued to mark a slight return to "normal" for WSCGA's communications program following the pandemic. WSCGA remained flexible with its outreach efforts and was able to continue moving back into some live events and promotions. With the departure of Isaac Zarecki, the communications manager position was gapped from April until October of this year. Nonetheless, the PR Committee, WSCGA Board and staff, and Laughlin Constable came together to remain flexible and involved, allowing the program to execute effectively and accomplish what can certainly be called a successful year of outreach and harvest coverage.

PARTNERSHIPS AND SPONSORSHIPS

WSCGA's 2022 **Wisconsin State Fair** activation produced solid educational opportunities and community engagement. While booth sales were down considerably this year, feedback from onsite staff remained positive regarding community excitement surrounding booth activations.

The Wisconsin Cranberries booth again featured the popular mini-marsh with vines and floating berries, marsh photo opp, educational displays and an educational video. The mini-marsh was a huge hit with kids and people of all ages enjoyed taking their photo in the marsh photo opp.

Growers remain a huge asset to WSCGA's presence there. Low grower participation this year resulted in "Meet A Grower" occurring two days during the Fair - Tuesday, Aug. 9 and Saturday, Aug. 13. While the public enjoyed having the opportunity to speak with a real cranberry grower, having more opportunities and days to feature growers would have capitalized on the varying Fair attendance through the week and greater opportunities to engage with the public.

Products this year included the Cranberry Cake Pop, Cranberry White Chocolate Chunk Cookie. Unfortunately, sales for all products this year were low (perhaps due to declining attendance at the Fair in general). Cranberry cookies, bottled juices and dried cranberries were of more interest to fairgoers.

As a whole, media interest was lower than usual this year, with less media entities focused on the fair. On Tuesday, Aug. 9, we partnered with TMJ4's Morning Blend feature show on a 5-minute live segment from the Wisconsin Cranberries booth as well as a Facebook live video. This segment was well-received and garnered welcome attention.

WSCGA partnered with the **American Birkenbeiner** in February of 2022, an event that marked the return of the in-person Birkie expo. As in year's past, this expo was very popular with event attendees. WSCGA staff and grower volunteers distributed juice, SDCs and written material. A new part of the promotion, the cranberry photobooth was made available to the public on the Saturday following the expo. WSCGA will again partner with American Birkenbeiner in February and June 2023 for the ski race and bike expo.

As part of the association's partnership with UW Badgers Sports, we conducted a sampling event at the 2022 CrazyLegs Classic as part of a make good from a 2020 canceled event. Continuing our partnership with them for this year, we participated in exit giveaways at the UW Women's Volleyball and Hockey games. The crowd was receptive and very excited to see us again! This is a good chance to get cranberries in their hands ahead of the holiday season. We will also be sampling at the 2023 CrazyLegs Classic.

SOCIAL MEDIA

As social media continues to be a primary and economical way for WSCGA to routinely reach the public, there has been a renewed effort in content creation and branding. We encourage our grower's to continue to use the platforms, as we source some of our best content from you! Facebook remained WSCGA's primary platform with a total reach of 1,029,843, more than triple last year's reach, and 32.1k followers. Instagram's reach was 42,983 with an engagement rate two times greater than last year.

VIDEOS

The winter sanding video (can be found by searching "Wisconsin Cranberries Winter Sanding") was released in January. This video was one of our highest performing association produced videos. It reached 665,800 people and garnered 2,013 reactions.

SPECIALTY CROP BLOCK GRANT

The WSCGA promotions program was awarded an $83k Specialty Crop Block Grant from the Wisconsin Department of Agriculture, Trade and Consumer Protection in 2021. The project timeline began in March 2022 and will continue through June 2024.

The first portion of the grant is dedicated to a video project being created in partnership with Don't Blink media services, an organization that has created much of our best performing content. The project is a three-part video series that will feature the past, present and future of the cranberry industry in the state of Wisconsin. The documentary will include the natural history of the fruit and its use by indigenous groups, the commercialization of the industry, expansion and evolution of growing regions and harvest techniques, and growth of the industry to become and stay the world's top producer. All filming has been completed and we appreciate our grower's time and involvement in making that possible! The series is being edited now and has an expected release date to the public near the timing of harvest season 2023.

The final component of the Specialty Crop Block Grant is a public opinion survey to assess the efforts of the Public Communications Program. This survey will be a follow up to the public opinion survey conducted in 2019 and 2022 and is slated to be conducted in March/April 2024 . The information gained in this survey will help gauge effectiveness of current efforts and direct the program for the following 3-5 years.

FALL HARVEST EFFORTS

Due to staffing, WSCGA scaled back harvest coverage this year, but still managed to coordinate media visits to marshes and organize interviews with growers. That being said, harvest coverage numbers were up significantly this year!

As in past years, WSCGA provided support to the Warrens, Eagle River and Stone Lake Cranberry Festivals in the form of educational materials and display materials. These events are organized and operated by each community with input from growers in each respective area. These are great opportunities for members of the industry to be cranberry ambassadors as members of the public actively seek information about growing cranberries.

A continuing new component of WSCGA's media outreach this year was a media open house at the Wisconsin Cranberry Research Station. We continue to see success from this event as it generates a number of positive stories about the industry, condenses media attention to a singular day at a controlled location, and continues to showcase the new developments at the Research Station. The follow on media coverage was also a benefit this year. We had a reporter from Fox news return the week of thanksgiving and give multiple live coast to coast news broadcasts on cranberries. Growers who participate in media events during harvest are a huge benefit to our industry.

We partnered with Travel Wisconsin on two harvest familiarization events. They brought groups of food and travel writers to Habelmans's and Dempze Cranberry/Rooted in Red Co. We saw a lot of great influencer content created from those events throughout the harvest season and into the holidays, with a healthy amount of reach. We also had two follow up requests that resulted in additional content creation– at no cost to us. Partnerships with this organization have historically been and continue to be quite beneficial. Working with them includes combined outreach efforts with their team of staff at Turner PR and we see residual outreach and follow on requests for information for months.

Wisconsin cranberries generated more than 1.5 billion impressions across online, print, and broadcast outlets between August and November. This is a historically large number and was due to a rising Thanksgiving inflation story garnering nearly 600 million views as it ran across a wide variety of well known local and national sources. Cranberries were featured in the positive paragraph of the story with little to no change in price this year! There was a good mix of research, tradition, information and recipe stories, a majority of which were positive and educational.

RESEARCH PROGRAMS

RESEARCH COORDINATION AND ADMINISTRATION

Although the WSCGA does not have a direct research program, it does provide administrative services to the Wisconsin Cranberry Board, Inc. Under this agreement, WSCGA provides the staffing services that the WCB needs in order to operate. This allows WCB to maximize its investment in research, education and promotion programs on behalf of the Wisconsin growers and minimize administration costs.

As part of this service, the WSCGA also works with other cranberry groups to coordinate research activities to avoid duplication and to create synergies and partnerships to maximize the investments by growers.

WSCGA also provides similar services to the WCREF under a contract. Working together, all three organizations developed an industry wide strategic plan in 2018 and began implementation in 2019. Progress has been made to restructure programs, reassign responsibilities and provide an efficient and coordinated effort on behalf of Wisconsin growers.

2022 saw the transition of the Research Station to operations as the major renovation projects to convert the property to a research farm were completed. The WSCGA also managed the project to upgrade and replace the water control structure at the station and improvements to the emergency spillway.

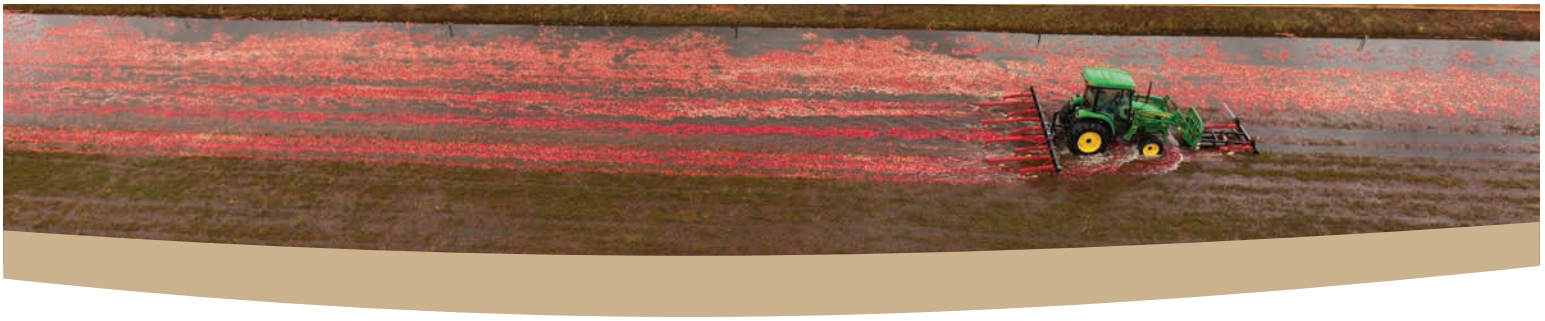
EDUCATION PROGRAM HIGHLIGHTS

Education is a major component of the WSCGA Mission. The Member Services Manager works with the WSCGA Education Committee to develop and implement high quality and innovative education programs for cranberry growers and members of the public. The Committee coordinates grower education program planning with UW Faculty from CALS and the Division of Extension, with the joint goal of allowing growers to operate their farms in an economically and environmentally sustainable manner.

The Association continued offering virtual events this year, based on the successes seen in 2020 and 2021. Virtual meetings will continue for some events, based on the benefits seen in regards to traveling, scheduling, accessibility, etc. The Association will explore hybrid meeting options going forward depending on the event, location, audience, etc.

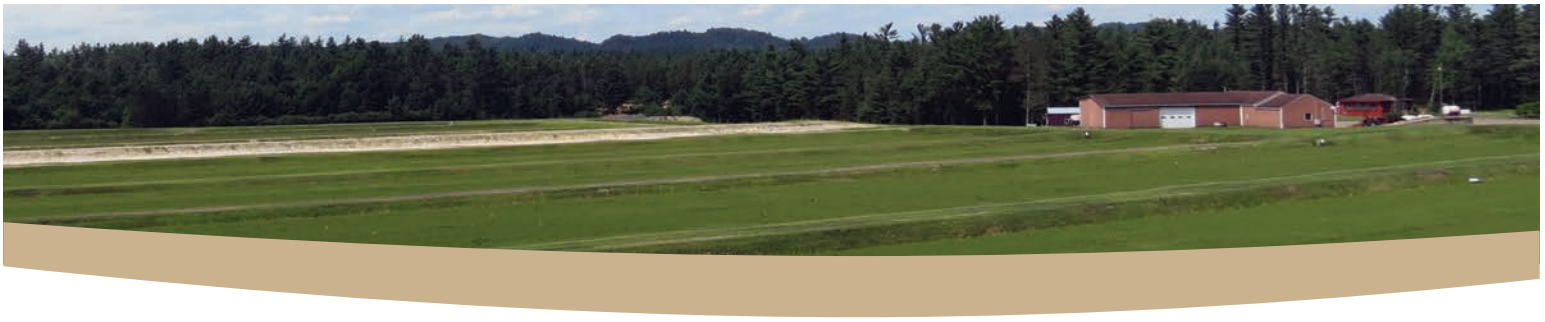
The partnership with Allison Jonjak, the UW-Madison Division of Extension Cranberry Outreach Specialist, strengthened this year through collaboration on educational topics, events, and outreach. Working with Jonjak, the Education Committee identified topics of interest to the grower member community and delivered programming that focused on information that was both timely and applicable, in formats that were convenient for both farm owners and workers.

Early in the year, the Education Committee created a program plan consisting of monthly events based on quarterly themes. The education program plan was piloted in 2020 and provided a successful framework to offer growers continued learning opportunities throughout the year.



2022 EDUCATION PROGRAM

MONTH	EVENT	QUARTERLY THEME	ATTENDANCE
January	Virtual Cranberry School Pesticide Applicator Trainings	Business Management	259
February	Navigating Labor Shortages Brown Bag Nutrient Management Training		31
March	Supply Chain Insight Brown Bag		43
April	Spring Mini-Clinics	Growing Season	89
May	Worker Protection Standards & Nematodes Brown Bag		33
June	Herbicide & Fungicide Brown Bag		36
July	Fertilizer & Frost Protection Brown Bag	Pre-harvest/Harvest	47
August	Summer Field Day Mini-Clinics		150
September	Off		
October			
November	Nationwide Research- Biological Controls Brown Bag	Research and Out-of-state networking	27
December	Nationwide Research- IrrigationBrown Bag		30



WISCONSIN CRANBERRY SCHOOL

The 2022 Wisconsin Cranberry School was held virtually on January 19-20, sponsored as a collaborative effort of the Wisconsin Cranberry Research & Education Foundation (WCREF), the WSCGA and the UW-Madison Division of Extension.

The WSCGA Education Committee originally planned for an in-person event, but due to COVID-19 concerns the event was quickly transitioned to virtual. The virtual event mirrored the in-person agenda, providing two full days of programming.

There were over 250 registrants for the virtual event, and programming ranged from horticultural topics like fruit rot disease, pollination and weed management, to crop protection topics, to genetic research, and more. Popular in-person events were continued virtually, including the live grower survey on management practices and grower panels focused on variety specific management and operational efficiency.

Attendees heard industry updates on the state level including the Wisconsin Cranberry Research & Education Foundation, the Wisconsin Cranberry Board, the Association's advocacy program, a state-wide look at the agricultural economy and a presentation on workforce retention and upskilling. On the national front, updates were given by the Cranberry Institute and the Cranberry Marketing Committee, as well as a review of cranberry health research.

NUTRIENT MANAGEMENT TRAINING

The WSCGA, UW Extension, USDA NRCS and the Wisconsin DATCP held an in-person training session on February 1, 2022 for cranberry growers to qualify and re-qualify to write nutrient management plans for their farms. This training is part of the ongoing industry effort to assist growers in implementing sustainable management practices and complying with state regulation of nonpoint source pollution.

The training was designed to help cranberry farmers write their own nutrient management plans to meet DATCP requirements. Wisconsin DATCP also requires that farmers complete a department-approved training course at least once every four years to maintain their qualification.

Presenters included Mike Stanek, NRCS; Andrea Topper, DATCP and Allison Jonjak, UW-Madison Division of Extension. Since the start of the program, more than 400 growers have participated in the training to become qualified to write a nutrient management plan for their farm.

SPRING MINI-CLINICS

The WSCGA and UW-Madison Division of Extension co-sponsored the annual Spring Mini-Clinics on April 21. Allison Jonjak, Cranberry Outreach Specialist, and the WSCGA Education Committee worked to successfully implement a new hybrid format for the event. There were two attendance options, in-person at the Wisconsin Cranberry Research Station or 3 different livestream locations at marshes across the state. A total of 89 people attended the 2-hour meeting.

The Spring Mini-Clinics event is held annually to update growers on new management practices, strategies for the growing season, review of winter impacts, new crop production tools, and informal discussions on the upcoming growing season.

This year's topics included pollinators, frost watch, research conducted at the station, several research project updates, and spring observations and updates from Research Specialists, Crop Consultants and Field Scientists.

VIRTUAL CRANBERRY BROWN BAG SEMINARS

Building on the success of the "brown bag" seminars in 2020 and 2021, the Education Committee worked with Allison Jonjak, Cranberry Outreach Specialist, to continue the Virtual Brown Bag Seminars in 2022. The seminars were held virtually once a month over the lunch hour, providing growers the opportunity to catch up on seasonal updates without having to set aside significant time during the workday. The Education Committee helped to develop topics and plans for the seminars, and Jonjak hosted and facilitated the meetings.

- February: Business Management- Navigating Labor Shortages
- March: Business Management- Supply Chain Insight
- May: Growing Season- Worker Protection Standards & Nematodes
- June: Growing Season- Herbicide & Fungicide
- July: Pre-harvest/Harvest- Fertilizer & Frost Protection
- November: Nationwide Research- Biological Controls
- December: Nationwide Research- Irrigation

MID-STATE TECHNICAL COLLEGE WORKFORCE ADVANCEMENT TRAINING GRANT

Prior to the Covid-19 pandemic, Mid-State Technical College (Mid-State) and the Wisconsin State Cranberry Growers Association (WSCGA) began discussing ways to partner to assist the WSCGA membership. From meetings with the Education Committee, came a training plan that would provide a wide variety of skills to assist the existing workforce.

Mid-State then applied for a Workforce Advancement Training (WAT) grant to assist with the Association with the training development and delivery costs. Since 2005, the Wisconsin Technical College System (WTCS) has provided WAT grants to support employers in their efforts to retain and advance the skills of their existing workforce. The state sets aside $4 million annually to support these customized training plans. The funds are not equally distributed however, and the grant process is very competitive between the 16 technical colleges in the state.

Mid-State was successfully awarded the WAT grant award for WSCGA's training plan in the 2021-2022 cycle. This allowed Mid-State and WSCGA to begin the process of developing and delivering the following courses:

- Large Equipment Maintenance
- First Aid & CPR
- Digital Marketing Basics
- Professional Skills

A total of 34 people attended the courses, representing 14 Grower and Associate Member companies. In total, 480 hours of continuing education were provided through the courses. The Association partnered with Mid-State again and successfully received a training grant for the 2022-2023 cycle.

SUMMER MEETING

The 2022 Summer Meeting, Field Day, and Trade Show was a historic occasion for the Wisconsin cranberry industry as the debut event for the Wisconsin Cranberry Research Station. The Wisconsin Cranberry Research and Education Foundation hosted the event on August 10th at the station in Black River Falls. Participants had the opportunity to take a variety of tours, attend Mini-Clinics on the Marsh, visit the trade show, and socialize with fellow Grower and Associate members.

The marsh that has become the station, formerly Robinson Creek Cranberry, was purchased in September 2017 from the Bible family. Renovations to the marsh began in 2018 and include productive acreage, variety trials, and research beds, as well as replacement of the water control structure on Robinson Creek and construction of the Research and Education Center. The Foundation has had a busy 4 years!

The Foundation Board, along with Marsh Manager Wade Brockman, WSCGA staff and Cranberry Outreach Specialist, Allison Jonjak worked to plan the logistics of the Field Day. Three tours were offered, giving attendees opportunities to see the many unique features of the station. Handouts were provided for each tour; containing background information to guide attendees.

Marsh Tours
This tour route traveled the marsh, passing various points of interest including the remaining original beds, the newly renovated beds, a pollinator garden, the water control structure, the variety trial research bed, and the replicated trial beds.

Hydro Dam Tours
Completed in July 2022, the original dam dating to the 1930's was replaced, and an emergency spillway was constructed. The station can generate electricity from a hydro unit installed by the Bible Family as an alternative energy project funded through a program with the WSCGA and USDA NRCS.

Research and Education Center Tours
Completed in June 2021, the Research and Education Center provides a basic laboratory, storage and maintenance areas, three offices, the Thomas Lochner Education Center- a space to hold educational programming for growers as well as other groups, and the Donor Wall recognizing the many contributors that helped to make the station a reality.

The location provided a unique opportunity to modify the traditional Mini-Clinics to showcase the work taking place at the station. The WSCGA Education Committee and UW Extension Faulty developed a new format to combine the marsh tours with the Mini-Clinics, becoming "Mini-Clinics on the Marsh". Attendees were transported by bus to several stops on the marsh. At the various stops they heard in-field presentations by researchers including:

- Disease protection trials- Leslie Holland, UW-Madison/ Allison Jonjak, UW-Madison Division of Extension Cranberry Outreach Specialist
- Variety Trial bed- Juan Zalapa, UW-Madison/ USDA-ARS
- Replicated beds- Amaya Atucha, UW-Madison
- Cran-Cam and physiology work- Jyostna Mura, UW-Madison/ USDA-ARS
- Herbicide testing- Jed Colquhoun, UW-Madison

The area south of the Research and Education Center was created with trade shows and parking in mind. This space worked perfectly as the location for the Summer Trade Show which had 44 exhibitors. These exhibitors are strong supporters of the industry as WSCGA Associate Members. Their inviting displays and information on new products and services were enjoyed by all.

At the WSCGA Annual Summer Meeting, President Steven Bartling proudly presented plaques to recognize the event hosts and 2022 marsh anniversaries.

WSCGA NEWS

Each month, members of the WSCGA are provided with up-to-date information on the cranberry industry, news, activities and anything that would be of interest to the growers of Wisconsin's number one fruit crop. WSCGA coordinates the publication of the newsletter and solicits articles from a cross-section of organizations and individuals. The NEWS is distributed in both print and electronic form with over 600 people on the subscription list.

WEATHER FORECASTING

The Wisconsin Cranberry Board, Inc. has provided funding for weather forecasting services for decades. WSCGA administers the program for the industry. Working with forecasters from Great Lakes Weather Services, daily forecasts are available online and via a toll free number. The forecasts are specific to cranberry farms and are an important tool for growers as they make decisions about management practices such as frost protection. The forecasts are available April 15 through October 31.

ASSOCIATE MEMBER PROGRAMS

The WSCGA has an active program for the businesses that support the Wisconsin cranberry industry. Associate Membership in WSCGA allows these companies to participate in a wide variety of marketing opportunities. The most popular are the Winter and Summer Trade Shows. The Association's advertising program offers opportunities in the WSCGA NEWS as well as the Summer Meeting publications. Associate members are also actively involved in industry events such as the annual Cranberry Open Golf Outing and the Sporting Clays Shoot.

A Committee of the Associate membership works with WSCGA Staff to develop and conduct these programs. Highlights for 2022 include:

VIRTUAL WINTER TRADE SHOW — CRANBERRY SCHOOL SPONSORSHIPS

The annual Winter Trade Show is traditionally held in conjunction with the Wisconsin Cranberry School and the WSCGA Winter Meeting. In 2022 these events took place virtually on January 19-20 and the quick transition to an online event did not allow for a virtual trade show. Association staff created a robust sponsorship program for the virtual Cranberry School. The online sponsorships provided the opportunity for WSCGA Associate Members to maintain their presence at the event with logo placement on the conference website and in-session recognition. A total of 21 Associate Members sponsored the event.

SUMMER TRADE SHOW

The annual Summer Trade Show is held in conjunction with the WSCGA Summer Meeting and Field Day. The event was held on August 10, 2022 at the Wisconsin Cranberry Research Station in Black River Falls. Over 500 people attended, taking part in the Summer Trade Show as well as a busy program of marsh tours, educational mini-clinics, and the WSCGA Annual Summer Meeting. Cranberry growers and their families had the opportunity to renew connections and build new relationships with the 44 exhibitors who provided inviting displays and shared information on new products and services.

WCREF FUNDRAISING ACTIVITIES

The Wisconsin Cranberry Research and Education Foundation hosts annual fundraising activities including the Cranberry Open Golf Outing and the Sporting Clays Shoot. The Associate Membership of the WSCGA has a strong history of supporting these events through participation and sponsorships, as well as monetary and raffle donations.

Proceeds from past events have been used for scholarship funds at UW-Madison, UW-Stevens Point, UW-La Crosse, UW-River Falls, WWTC Foundation, and provided support for the Wisconsin Cranberry Discovery Center, WCREF and UW Koller Fund for Graduate Studies.

WSCGA MISSION

The Wisconsin State Cranberry Growers Association enables Wisconsin cranberry growers to prosper by providing growers with information, championing responsible environmental stewardship, advocating for sound governmental policies and leading effective public communications and outreach.

WISCONSIN STATE CRANBERRY GROWERS Association