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THE NATIONAL INITIATIVE FOR SUSTAINABLE AGRICULTURE (NISA): PROVIDING REASONABLE SOLUTIONS FOR THE CRANBERRY INDUSTRY

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Sustainable agriculture certainly is not new; in fact those still in the business of producing food are considered sustainable by nature. However, the interest in assessing sustainability from consumers and those in the value chain beyond the farm gate is relatively new and has proven resilient despite tough economic times.

Increasing food production, security and resiliency are critical to our planet's future. NISA efforts are inclusive of all production, regardless of scale, region or system. This holistic, non-competitive approach is needed to address global food demands.

We have two choices: we can let those outside agriculture determine what farm sustainability looks like, or we, as stewards of the land and rural America, can determine our fate. Producers need a voice in the sustainability discussion that ensures a reasonable way forward and gains credit for previous advancements. These efforts can't be cumbersome or redundant and need to respect the economic solvency of the producer. The producer-led NISA is working toward these goals.

What is the National Initiative for Sustainable Agriculture (NISA)?

NISA is a producer-led federation that will harmonize sustainability efforts within a common framework, regardless of cropping system, region or farm scale. The goal is not to judge the "sustainability" of agriculture but to provide producers with an opportunity to account for their advancements over time and communicate them broadly. We will develop a roadmap of farm management systems that will help producers to achieve verifiable sustainability outcomes, improve the environmental services and productivity of their farms, help their rural communities thrive, and satisfy sustainability expectations of the value chain.

These efforts will operate at the farm level; incorporate a framework of tools and technical information from a wide base of expertise and programs; and, with the support of regional and national experts, communicate sustainability management systems that are valid across crops and regions.

This sounds similar to other sustainability programs. Why is NISA necessary?

- **NISA is producer-driven and adaptable to changing times.** This bottom-up approach allows producers to be at the table in designing sustainability assessments that are regionally- and crop-appropriate, scaled to improve sustainability at the field level, founded on the best available science and balanced among the social, environmental and economic sustainability pillars. Such an approach also accounts for the diversity of agriculture, is neutral to production techniques, and won't competitively pit production regions or crops against each other. The alternative – those outside agriculture determining producers' fate – isn't appropriate or sustainable itself.

- **NISA is complementary to other sustainability programs, such as Field to Market and the Stewardship Index for Specialty Crops, and not redundant or overly cumbersome.** The assessment-based approach implemented by NISA will cover the gaps that currently exist in outcome-based programs. Several of these gaps exist because outcomes are difficult, expensive or invasive to quantify. The combination of assessment- and outcome-based data will create a holistic sustainability message. Sustainability assessments will not be overly cumbersome. Early test-runs with cranberry growers indicate that the survey tool can be completed in less than an hour.

- **NISA efforts will streamline sustainability efforts with customer expectations.** This approach will reduce redundant requests for sustainability metrics and provide a balanced way forward that includes producers in the developmental stage, thus ensuring that the process is not overly cumbersome. The request for such information continues to grow despite down economies, suggesting a resilient and long-term commitment by customers to developing such programs.

- **NISA will result in a communications conduit to customers and the general public that has been significantly missing for agricultural producers.** Industrial sustainability efforts have successfully focused on communicating improvements over time. Agriculture has yet to develop such a plan or communicate the gains already achieved by producers in typical sustainability parameters. The assessment-based approach, combined with appropriate outcome-based programs and a solid communications effort, will deliver a message of long-term commitment to sustainability by agricultural communities.

The NISA process is simple:

- Producers, in partnership with appropriate NGOs, academics and consultants develop a foundation, national level assessment tool for a given crop that abides by the producer-developed NISA guiding principles.
- The foundation tool is then shared with regional working groups that include producers, academics and consultants, adapted to be appropriate to local production, test-driven and revised as appropriate.
- The regionalized tool is supported by best management practice (BMP) workbooks that include the scientific basis for supporting production techniques.
- Assessment tool results are summarized regionally and nationally and used to communicate advancements in social, economic and environmental parameters over time and throughout the value chain.

Where do cranberries fit in NISA?

Cranberry production is unique compared to traditional row crops and varies regionally. A "one-size-fits all" sustainability solution isn't appropriate and existing assessment programs aren't a good fit. In response, we have drafted a cranberry assessment tool that is appropriate for the crop, can be adapted for production regions and has been reviewed and modified by cranberry producers. This assessment tool follows the NISA Guiding Principles and fulfills the appropriate expected outcomes such that results can be communicated to the public and throughout the value chain. While the assessment tool is customized to cranberry, "traveling in a flock" with the NISA producer-led federation will allow for harmonized communication and messaging among agricultural producer organizations.

The cranberry sustainability assessment tool will be tested with producers in spring 2012, with an anticipated industry launch after the 2012 harvest season.

VEGETATIVE OR REPRODUCTIVE – WHAT IS IN A CRANBERRY BUD?

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Background

Visual assessment of terminal bud status is utilized to predict yield of cranberry. With this approach, buds that are perceivably large and round are considered to be reproductive. Small and narrow buds, in contrast, are considered to be vegetative. Reproductive buds are assumed to bear flowers and fruit during harvest years, whereas vegetative buds only produce leaves. Biennial bearing is believed to contribute to the reproductive fate of buds, so that uprights fruiting one year will be less likely to set reproductive buds and fruit the following year (Eaton, 1978).

The use of bud external appearance when predicting yield is widespread, despite its large margin of error. Work in our lab has come to question the reliability and overall relationship between bud external appearance and reproductive status. As we seek to improve our understanding of yield, it is imperative that we also better understand cranberry bud development. Previous research on cranberry bud development has been valuable, but dates back to the early-to-mid 1900s (Goff, 1901; Lacroix, 1926; Roberts and Struckmeyer, 1943). With the release of new cultivars, which are reportedly higher-yielding and may circumvent biennial bearing tendencies, renewed investigations on bud development are needed. Moreover, technological advances in microscopy can enable researchers to gain a more comprehensive view of bud development.

The following is a progress report of a project initiated to address the deficits in our knowledge of cranberry bud development. The objectives of this project are threefold and include:

1. Characterize bud development and flower initiation throughout an entire growing season.
2. Compare bud development and flower initiation across several cultivars, including two recently released cultivars.
3. Determine the relationship of bud external appearance and the presence/absence of flower initials.

Materials and Methods

Approximately 100 uprights of the cultivars Stevens, Searles, Crimson Queen, and HyRed were randomly collected from a marsh near Wisconsin Rapids, Wisconsin. Collection of uprights occurred every two weeks and extended from 5 March to 7 Dec. 2011. After each collection date, uprights were divided into two groups – fruiting and nonfruiting. Buds from each group were dissected and the presence/absence of flower initials was recorded. Due to the small size of cranberry buds, scanning electron microscopy (SEM) was utilized to monitor the progression of flower development during the predicted time of initiation.

Preliminary Results

Current results show that, excluding 'Searles,' many of the assumed vegetative buds actually contained flower initials. Most of the terminal buds from 'Searles' were dead, which made sampling and subsequent analysis challenging. Recently released cultivars were more likely to form flower initials, regardless of fruiting status during the previous or current year. These initials were first visible by 29 July in all cultivars, excluding 'Searles.' Figures 1 and 2 show the dissected buds of 'HyRed' uprights, both of which contain flower initials. Similar images were collected from 'Stevens' and 'Crimson Queen' uprights. These images show that uprights have the capacity to form flowers, regardless of their current fruiting status. Future monitoring is needed to determine the fate of these flower initials.

Figure 1. Vegetative (nonfruiting) upright with flower initials visbile by 29 July 2011.

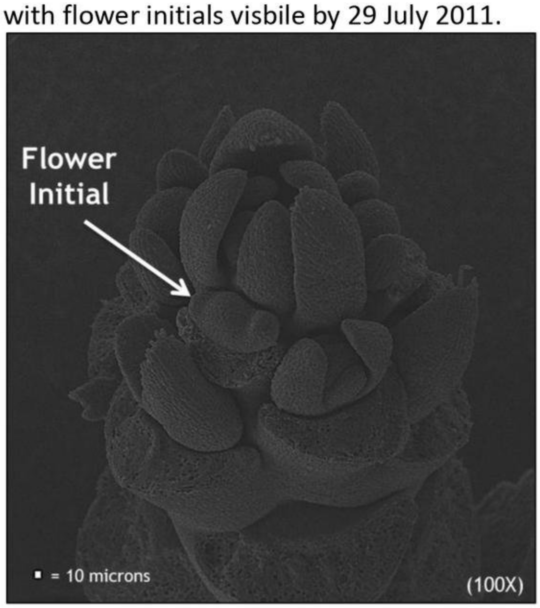
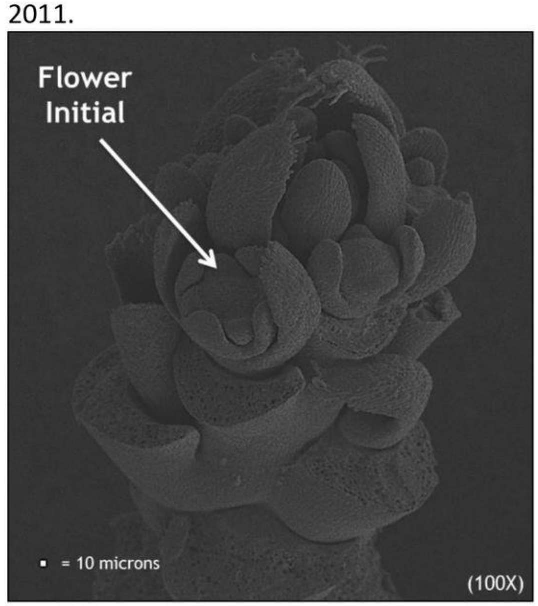


Figure 2. Reproductive (currently fruiting) upright with flower initials visible by 29 July 2011.



Future Work

This project is ongoing and sampling will continue during the 2012 season. Future work to be conducted includes:

- Determine the timing of floral initiation across cultivars.
- Relate floral initiation to growing degree day models (GDD).
- Assess the role of biennial bearing on floral initiation across cultivars.
- Further describe the relationship between bud external appearance and reproductive status.
- Reevaluate yield prediction models based on bud external appearance.

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PESTICIDE SCREENING FOR CRANBERRIES

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Objectives: The mission of the 201 1 program was to investigate fungicides, insecticides and herbicides for use in cranberry production. Objectives were to: I) Investigate pesticides currently registered for use in cranberries to refine their use patterns and to further identify their pest control spectrum; and, 2) Investigate pesticides not currently registered for use in cranberries for their potential to address existing pest problems.

Summary: In the 2011 growing season, thirty-three field trials were conducted on twenty-three Wisconsin marshes including 14 insecticide trials with a varying number of treatments at each site to evaluate treatments for 7 target pests and 9 fungicide trials on three marshes with 14 treatments conducted. Insecticide research focused on product evaluations for tipworm, fireworm, flea beetle, fruitworm, loopers and white grub control, as well as a refinement of recently registered insecticides. Fungicide evaluations focused on potential products for fruit rot control. The purposes of the 2011 herbicide trials were to investigate new post-applied products for possible uses in cranberries, seek control solutions for problem weeds (escapes), investigate Callisto on new plantings on high pH soils and continue to investigate herbicide candidates for dodder control.

INSECTICIDE TRIALS

Cranberry fruitworm, Sparganothis fruitworm, and black-headed fireworm are the primary insect pests in cranberries. Most acres are treated at least once per season for one or more of these pests. Tipworm, loopers/spanworms and flea beetles are secondary pests; in any given season some acres are treated for these pests. Cranberry weevil, cranberry girdler and white grubs are also occasional pests; there are no efficacious insecticides registered for the control of these soil pests.

Fourteen insecticide trials were conducted in 2011: four for fruitworms, two for fireworms, two for loopers, two for tipworms, two for flea beetle, one for leafhoppers and one for white grubs. The number of treatments evaluated varied with the pest and trial site. Recently registered insecticides, Assail, Knack, Rimon, Delegate, Belay, Intrepid, and several standards, Imidan, diazinon, Orthene, Lorsban, and several non-registered products were evaluated both alone and in tank mix combinations. Since trial sites were selected based on existing or developing insect populations all trials had moderate to heavy testable pest pressures.

All of the registered products performed much as expected. The older organophosphate products were broad spectrum across most test pests and were generally efficacious as long as the pest was present at the time of application. Controls ranged from acceptable to excellent. The newly registered products, particularly the insecticide growth regulators (IGR) were more pest-type specific. Lepidopteron pests were controlled well, the dipterans less so and the other pests mostly not controlled by the IGRs. Although all of the IGR products were generally equally efficacious. The timing of applications with these products was critical to performance; late egg-to-early instar applications were efficacious whereas applications *t*o later instars were significantly less effective - to be expected with these types of insecticides. Tank mixes of the newer products with the organophosphates lessened the necessity for precise timings of applications. Of the newly registered products Assail, Intrepid and Belay were efficacious. The currently registered rate of Belay (4 oz/a) provided good, but marginally acceptable control. The higher rates (6 and 8 oz/a) demonstrated improved efficacy. One of the candidate insecticides was a stellar product.

In commercial production systems concern has been expressed over the sometimes less-than-expected efficacy of Imidan. Imidan is subject to pH and the label recommends that tank solutions be buffered to pH 5.5. Six trials were conducted to determine the effect of solution pH on Imidan's efficacies. Imidan 3.0 lb/a was evaluated when applied in pH solutions of 6, 7 and 8. Imidan applied is a pH of 6 was most efficacious in the control of flea beetles, fruitworms and spanworms, less so when applied in a pH of 7 and significantly less so when applied in pH 8.

HERBICIDE TRIALS

New Post Product Trials

In our 2009 and 2010 trials three of the experimental products caused discernible crop response. For one, the crop response was detectable season long. For another, crop response was less long lasting but still unacceptable. Although the crop responses induced by either product did not result in significant yield reduction, the visual responses were unacceptable. The visual crop response induced by a third product was minor; however, several tested treatments of this product resulted in significant crop reductions.

In 2011 trials two experimental products demonstrated good promise for use in Wisconsin cranberries. The weed control spectrum for both of these products would make these great companion products for Callisto as they provide good control of weeds that are weaknesses of Callisto. One of these products provided good control of St. Johnswort, dodder and yellow loosestrife and demonstrated activity on maples. No crop responses were noted with either of these products.

Callisto on New Plantings on High pH Soils

Four small plot trials were established on cranberries planted in 2009 on high pH soils. Four rates (l, 2, 4, 6 oz/a) of Callisto with and without non-ionic surfactant were evaluated. Each rate was applied in early May when day and night temperatures were low and a separate set of the same treatments was applied in late May when day/night temperatures were more moderate. Two of the trials were conducted on Stevens cranberries and two on Grygleski GHI cranberries. Soils in the test sites had pH of 6.8,7.3,7.8, and 8.0.

No significant Callisto-induced crop responses were noted in any of the treatments in any of the four locations. Herbicide rate, surfactant and cold stress did not affect cranberry response to Callisto. Soil pH correction measures were applied to the entire bed and by late season cranberry stand establishment was in process.

Weed Escapes

Callisto has been used extensively in commercial production for several years. Several weeds that are not controlled by Callisto are now creating problems. Those weeds are sweet vernal grass, creeping red fescue, cinquefoil, Solomon's plume, trees (maples, willows, popples, oaks) and dewberry.

Sweet vernal grass Large infestations of vernal grass are occurring infrequently in ever-enlarging patches in some beds. One trial was conducted. Select, Select Max and Poast provided excellent control of vernal grass. Very early applications, multiple applications (if allowed by the label), maximum allowed rates and the use of an appropriate surfactant were keys to successful control. Callisto and two candidate products did not control vernal grass. Although a glyphosate wipe provided moderate control of vernal grass, satisfactory coverage was difficult to achieve.

Creeping red fescue Creeping red fescue is mostly a problem in the bed margins of new plantings. This grass is often used to stabilize dikes and problem grass is likely coming in off of the dikes by erosion or mis-applications during seeding. Two trials were conducted. By the end of the 2010 season, none of the tested treatments appeared to be adequately controlling creeping red fescue; a spring evaluation will be more definitive. Tested products are Casoron, Evital, Select Max, Poast and Callisto.

Cinquefoil. Solomon's plume Both of these weeds are becoming less problematic as Callisto is used more extensively. One trial on each of these weeds was conducted in 2011. The keys to the successful control of cinquefoil and plume are:

I. keep up a program of Casoron and Callisto early

2. use Callisto applied early (especially on plume), high rate, and with appropriate surfactant

3. expect it to take several years to achieve control

Maples, Willows, Poppies, Oaks Two trials per tree type were conducted in 2011. Callisto provided good control of willows, popples, and maybe oaks. The keys to good control with Callisto are high rates, use of a surfactant, and multiple applications beginning early in the season; mid-season applications are significantly less effective. Maples are more difficult to control. Callisto injures but does not kill them, as does one of the candidate herbicides. A combination of Callisto and the candidate product may prevent maples from successfully over-wintering. For all of these problem trees, a glyphosate wipe was efficacious though labor intensive.

Dewberry Two trials were conducted in 2011. None of the three non-registered products effectively controlled dewberry. Although two of these products had activity on dewberry they also had detrimental effects on the cranberries. The search for dewberry control continues.

Dodder Trials

In 2008 - 2010 there were successes with a non-registered product for the control of dodder. This product is pending registration for uses in cranberries. In 20 11 five trials were conducted in three marshes to investigate use patterns of the non-registered product (rates, application timing, tank mixes) for dodder control. Three of these trials at City Point, WI had heavy dodder infestations and valid trials were conducted.

The candidate product continued to be highly efficacious for dodder control; application timing of this product is critical to good control. Applications need to be made when the dodder strands first begin to appear in the cranberry canopy. It is likely that this timing coincides with dodder seed germination or just before the dodder vines abscise from the soil. Later applications inhibited dodder but did not prevent dodder vine matting. Callisto caused temporary chlorosis in the dodder but did not provide control. Combinations of the candidate product and Callisto did not provide enhanced control over comparable rates of either product alone. Two other candidate herbicides did not provided control of dodder.

FUNGICIDE TRIALS

In 2007-2009 late season fruit rots caused significant problems in Wisconsin cranberry production; in some marshes 30% of the harvested crop was lost to fruit rot. The 2010 growing season was conducive to fruit rot - warm with ample, periodic rainfall. Yield losses of 25-50% were experienced. This disease complex generally affects mature beds that are in full production. In 2009 isolated incidents of early rot were consequential problems; losses of 50 - 100% of the crop were experienced. In 2010 yield losses due to early rot were isolated but usually significant when they occurred. This disease and these losses generally occurred in 2-3 year old beds.

Fruit Rot

Three trials were conducted on two marshes that have experienced significant fruit rot problems in recent years. LeMunyon and Stevens were the subject varieties. Fourteen treatments were evaluated. Treatments included various timings of applications of the registered products Bravo, Abound, Evito and Indar. Three non-registered products were also included. Disease pressure was moderate-to-heavy in all three sites. '

Bravo, Evito and Abound were the most efficacious products. Indar was less effective. The current recommendation is for two applications of a fungicide at 50% bloom and at early post bloom. Additional applications at pre-bloom did not contribute significantly to enhanced disease control. There was a trend for improved disease control when later applications were made at late berry set. None of the three candidate fungicides was effective.

Early Rot

Two trials were conducted on two marshes that experienced significant early rot problems in 2010. Grygleski GH1 was the subject variety. Ten fungicide treatments were evaluated. Treatments included two applications of the registered products Bravo, Abound, Evito, Dithane and Indar. Five non-registered products were also included. Early rot disease pressure was light-to-moderate in both sites. Bravo and Dithane provided mediocre disease control. The other products were ineffective.

UTILIZING THE UW-MADISON PLANT DISEASE DIAGNOSTIC CLINIC

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The Plant Disease Diagnostic Clinic (PDDC) at UW-Madison is an excellent resource for growers and crop consultants looking to diagnose disease problems in their marshes. The clinic is run by Dr. Brian Hudelson, and over 1,500 samples are processed in the clinic annually. In 2011, we assisted the clinic with diagnoses and provided follow-up recommendations. In order to quickly and accurately determine the cause(s) of disease symptoms growers may be seeing, it is important for those working in the clinic to be provided with the appropriate information and types of plant or fruit samples.

General sample collection should include the collection of multiple, whole plants whenever possible. Dying plants are always better than dead plants for diagnosis, as dying plants provide diagnosticians with a better chance of identifying the disease(s) as it progresses throughout the plant tissue. When submitting a sample, providing additional information, such as symptoms seen in the marsh, environmental conditions, and management factors is especially important for diagnosis.

Submit the freshest samples possible. Wrap uprights, runners, and/or leaves in **moist** (not wet) paper towels immediately following collection, and place these samples into plastic bags for submission. Rotten fruit should be placed into a plastic bag containing a few air holes. Samples can be submitted in person or mailed to the clinic on the UW-Madison campus.

Once a sample is sent to the PDDC, it is processed either the same day or the day after its arrival. It is important to keep this in mind when submitting a sample; it is best if a sample arrives earlier in the week rather than on Friday afternoon or Saturday to ensure timely processing. A sample is first visually and microscopically observed for any obvious signs of disease. If necessary, the sample is incubated in a moist chamber (a container with high moisture and humidity) to induce sporulation, allowing for further symptom development. Fungal and bacterial pathogens are isolated on microbiological media to allow for identification. Generally, two weeks are required for a complete, accurate diagnosis. Once a diagnosis has been made, the results are sent to the submitter both via email and in a formal written letter. The cost for this sample processing is $25.00. If further testing is necessary for identification, the submitter will be contacted prior to the completion of such tests. Additional information for sample collection and contact information for the PDDC, as well as where to send your samples can be found on the web at http://pddc.wisc.edu/.

A summary of samples diagnosed from 2009 to 2011 is shown (Table 1). Main types of disease symptoms varied from year to year. In 2009 and 2011, dying uprights, primarily from younger beds, were the most common sample submitted. Pathogenic fungi were not consistently found to be associated with the dying uprights, and of the fifteen submitted in 2011, only two tested positive for *Phomopsis*, the causal agent of upright dieback. In 2010, fruit rots were the greatest concern. By the time many cranberry disease symptoms are visible, it is often too late to spray anything that will make a difference in the current year. However, a diagnosis can help to distinguish between problems caused by pathogens versus those caused by environmental factors such as heat stress or winter injury.

Symptom type	2009	2010	2011
Root/runner rots	1	2	0
Leaf spots	2	3	1
Dying uprights	12	3	15
Fruit rots	5	27	7

Table 1. A summary of cranberry samples diagnosed from 2009 to 2011. Main types of disease symptoms varied from year to year.

FUNGICIDE EFFICACY ON HAIL-DAMAGED FRUIT

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Hail storms are a common occurrence in Wisconsin, with a few or many cranberry growers being affected every year. Fungicides are often applied immediately following hail storms to prevent fruit rot, despite the lack of research to support this practice. We conducted field trials in 2010 and 2011 to address the question of whether fungicide applications following a hail storm reduce fruit rot incidence (% rotten fruit), and if so, which fungicides are most effective. Trials were conducted throughout the growing season to determine if the stage of fruit development and/or extent of injury had any bearing on the effectiveness of these fungicides. Two trials each year were conducted in a Tomah marsh using cultivars 'GH2' in 2010 and 'GH1' in 2011. Fungicides were applied by the grower during bloom/fruit set at this site. Two trials each year were conducted in a Necedah marsh using cultivar 'Stevens' in 2010 and 2011. No fungicides were applied by the grower during bloom/fruit set at this site. Data was obtained from a total of seven trials; one trial was omitted because it did not contain enough damaged fruit to obtain meaningful data. Hail damage was simulated by shooting pea gravel into cranberry beds using a backpack mist blower, and the fungicides Abound (azoxystrobin) or Champion II (copper hydroxide) were applied to fruit immediately following this damage. In 2010 trials, approximately ¾ cup of pea gravel was applied to each 2ft. x 2ft. experimental plot. In 2011, the amount was increased to 1 1/3 cups to ensure an adequate amount of damage.

Fruit were collected from each field trial immediately following each simulated hail treatment to assess the initial damage to fruit as a result of this treatment (Figure 1). Fruit rot incidence was then evaluated in late September and early October. The simulated hail damage increased fruit rot incidence ($p \leq 0.05$) compared with the non-damaged control in six of seven trials (one trial illustrated in Figure 2). However, fungicides did not reduce fruit rot incidence ($p \geq 0.05$) in hail-treated plots compared to the non-treated control in six of seven trials (one trial illustrated in Figure 2). In one Tomah trial conducted on relatively immature berries, fruit rot incidence in hail-damaged plots treated with Abound was less ($p \leq 0.05$) than fruit rot incidence in hail-damaged plots treated with Champion II or no fungicide (Figure 3). It is unclear why Abound protected fruit in this trial but not in the other six. It is possible that due to the systemic activity of Abound, these immature berries were able to take the fungicide up more efficiently than were the older fruit.

Summary

In six of seven trials, neither Abound nor Champ 2 reduced fruit rot in simulated hail damaged berries. However, in one of seven trials, where berries were most immature, application of Abound, but not Champ 2 reduced fruit rot in simulated hail damaged berries. In general, results suggest that if cranberries are damaged by hail, it is unlikely that an application of fungicide will reduce the amount of fruit rot at the time of harvest. An exception may be very immature fruit (e.g. less than three weeks after bloom), in which case systemic fungicides such as Abound might provide some benefit.

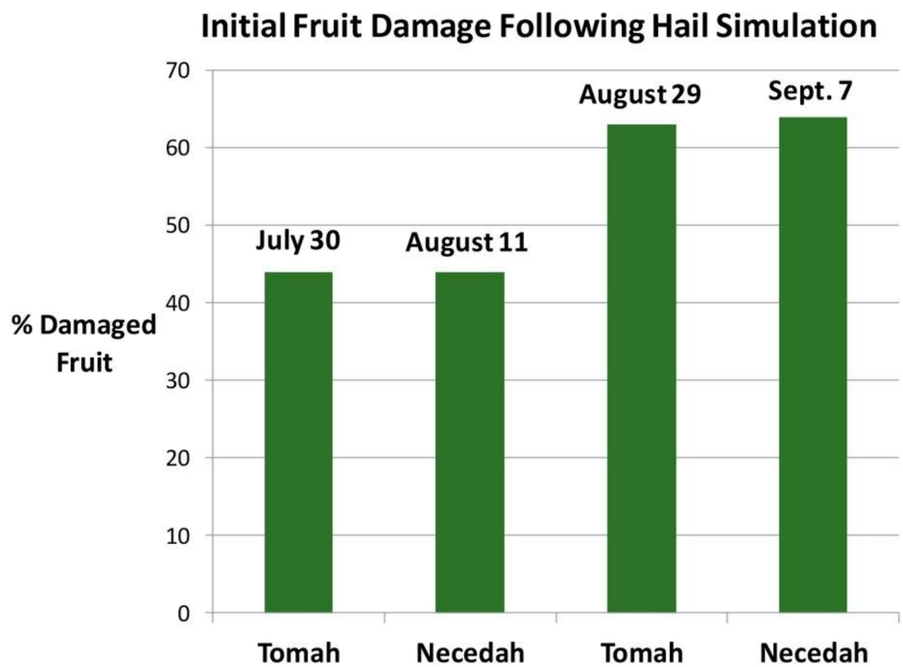

Figure 1. Initial fruit damage following hail simulation in 2011 at Tomah and Necedah marshes. Damage ranged from 44-64% in 2011, compared to 31-50% in 2010 (not shown). As fruit matured and increased in size, the percent of damaged fruit also increased. This difference may be a result of larger fruit having an increased chance at being hit, or a result of more mature fruit being more susceptible to damage. In 2011 trials, fruit more than doubled in size from July 30 to September 7.

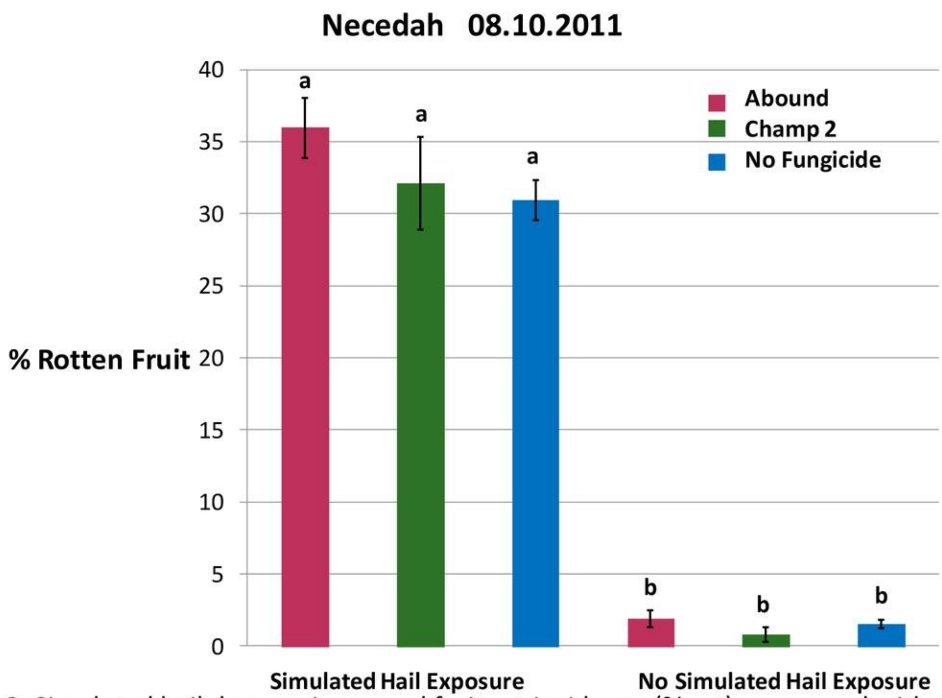

Figure 2. Simulated hail damage increased fruit rot incidence (% rot), compared with the non-damaged control in six of seven trials. Damaged berries had rot levels of 4 to 38%, whereas non-damaged berries had rot levels of <1 to 7%. Black bars are the standard error of the mean, a measure of variability. The percent rot resulting from treatments marked with the same lower case letter was not significantly different ($p = 0.05$).

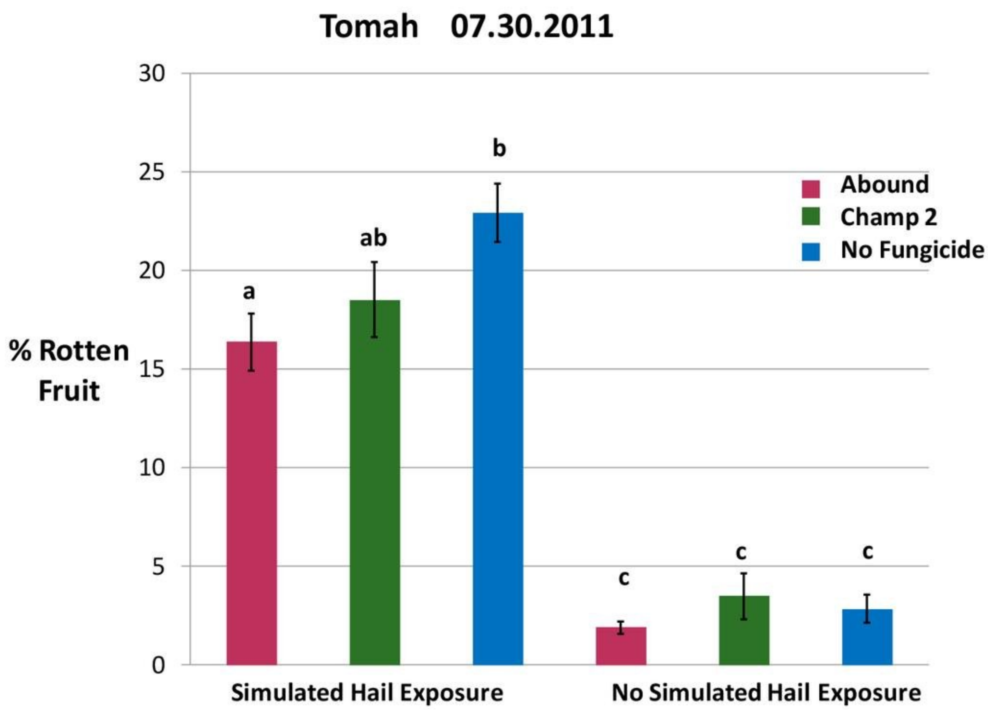

Figure 3. Tomah trial conducted on immature fruit on 07/30/2011. Simulated hail damage increased fruit rot incidence (% rot), compared with the non-damaged control. Abound significantly reduced the amount of fruit rot in damaged berries in this trial only. Champ 2 also reduced the amount of fruit rot in damaged berries, although it is not statistically significant. Black bars are the standard error of the mean, a measure of variability. The percent rot resulting from treatments marked with the same lower case letter was not significantly different (p = 0.05).

WORKER PROTECTION STANDARD (WPS)

LEROY KUMMER, OCEAN SPRAY CRANBERRIES, INC. AND JAYNE SOJKA, LADY BUG IPM

WPS Review

- Need to reaffirm that Worker Protection Standard are in place
  - New farms or changes in ownership of older farms
  - A quick refresher in things that we may have forgotten about
- Self Evaluation of What We Need To Improve Upon
- Things that may show up during an inspection
- EPA's Worker Protection Standard (WPS) for Agricultural Pesticides is a regulation designed to reduce the risk of pesticide related poisonings and injuries among agricultural workers (1995)
- Intended to protect @2.5 million Ag Workers and Pesticide Handlers working @600,000+ establishments (farms, nurseries, forest & greenhouses)
- WPS Addresses Requirements For:
  - Pesticide Safety Training
  - Notification of Pesticide Applications
  - Use of Personal Protective Equipment (PPE)
  - Restricted Re-Entry Periods (REI's)
  - Pesticide Decontamination Supplies
  - Emergency Medical Assistance

WPS – Who & What Are Covered

- WPS covers two types of employees:
  - Pesticide Handlers – those who mix, load or apply pesticides, those who clean or repair application equipment, or assist in the application of pesticides in other ways.
  - Agricultural Workers – those who perform task related to the cultivation or harvesting of crops or plants on farms, nurseries, forest or greenhouses
    - *Workers are defined as anyone who receives any type of compensation (including the self-employed) who perform agricultural production related duties….does not include office employees, truck drivers or mechanics*

WPS – Who must comply?

- Are pesticides with labeling that refers to the WPS, used on the establishment for the production of agricultural plants? YES /NO
- Does the establishment hire or contract workers to do tasks related to the commercial production of agricultural plants? YES/NO
- How many workers are employed? Workers Family Members
- Does the establishment hire or contract pesticide handlers or family members to do tasks related to the commercial production of agricultural plants? YES / NO
- If the answer to either 1 or more questions is yes, the employer must comply with the Worker Protection Standard.

WPS Basic Training Requirements

- The basic pesticide safety information must include the following concepts:
- Pesticides may be on or in plants, soil, irrigation water, or drifting from nearby applications.
- Prevent pesticides from entering your body by:
- Following directions and/or signs about keeping out of treated or restricted areas
- Washing before eating, drinking, using chewing gum or tobacco, or using the toilet
- Wearing work clothing that protects the body from pesticide residues
- Washing/showering with soap and water, shampoo hair and put on clean clothes after work
- Washing work clothes separately from other clothes before wearing them again
- Washing immediately in the nearest clean water if pesticides are spilled or sprayed on the body and, as soon as possible, showering, shampooing, and changing into clean clothes
- Further training will be provided within 5 days

WPS – Training

- WI Certified Pesticide Applicator Certification meets the WPS standards for employee training
  - Certified applicators can train others (workers) in pesticide safety
  - Training tools are available through companies such Gemplers – videos, handouts & certification cards
  - Online training classes as well

Summary of WPS Requirements

- Protection during applications – applicators are prohibited from applying a pesticide in any way that will expose workers or other persons. Workers are excluded from areas while pesticides are being applied.
- Restricted Re-Entry Levels – specified on all agricultural pesticide product labels. Workers are excluded from entering a pesticide treated area during the restricted re-entry period.
- Personal Protective Equipment – Protective Equipment (PPE) must be provided and maintained for handlers and early–entry workers.
- Worker Notification – Workers must be notified of treated areas so as to avoid accidental exposures.
- Decontamination Supplies – Workers and Handlers must have an ample supply of water, soap and towels for routine washing or in the event of emergency decontamination.
- Emergency Assistance – Transportation must be available to a medical care facility if a worker or handler should be poisoned or injured and all information provided about the pesticide to which the person may have been exposed.

What are auditors looking for?

- Proper posting of pesticide signs during the application period
- Worker Protection Central Posting Area
  - WPS posters
  - Record of pesticide applications & REI's
  - Emergency Medical Information
  - Record of Training (pesticide certifications or other records showing proof of training) – 5 years

WPS – Audit Keys

- Notification and posting of pesticide application
- Application and entry restrictions
- Personal protective equipment and pesticide handling equipment
- Pesticide safety training - 5 year
- Pesticide safety information
- Decontamination supplies
- Emergency assistance

WPS Central Posting Area

- Pesticide Safety Posters Must Be Displayed
- Emergency Medical Information
- Chemical Information – REI's & Areas Treated

Emergency Medical Information

- Provide Location of Nearest Medical Center
- Emergency Contact Numbers – Fire, Police, Medical
- Include: Name, Accident Location,
- Type of Emergency, Any Pesticide Information (Material, EPA Registration)

WPS – Required Sign

- This sign must be posted 24 hours or less prior to and during the application period
- Kept up until the REI expires and must be removed within 3 days of the REI expiration
- Size 14"x16"
- Some materials require WPS signs & oral notification

WPS Decontamination Kit

- Soap
- Water (1 gallon for worker or 3 gallons for a handler)
- Towels (single use towels)
- Change of clothes (handler)
- Emergency eyewash (minimum 1 pint for handlers)

EPA Website: Printable Publications By Title

- http://nepis.epa.gov/EPA/html/pubindex.html

CRANBERRY POLLINATION

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Honey bee decline

In the past couple decades, honey bees have experienced drastic declines due to mites, disease, and more recently, Colony Collapse Disorder (CCD). When a colony suffers from CCD, the worker bees disappear from the hive, abandoning otherwise healthy brood and their queen. CCD was first documented in 2006 and since then has resulted in an annual loss of 30-90% of colonies for some bee keepers (Pettis and Delaplane 2010). While scientists have not identified a specific cause for CCD, it is likely due to a combination of biotic and abiotic factors affecting the colonies simultaneously including the Varroa mite, new strains of Nosema fungus, Israeli Acute Paralysis Virus, poor diet, insecticide exposure, and stress. Recently, scientists have also identified a parasitic fly that attacks bees and causes them to abandon their hives and become disoriented, much like the behavior observed in CCD (Core et al. 2012). This fly has been documented across the United States and has the potential to cause significant damage to the honey bee population over the next few years.

Each year, cranberry growers spend thousands of dollars on honey bee rentals to ensure that their marshes receive sufficient pollination to produce a good crop. With the continuing decline in honey bees, the availability and quality of hives may decrease. In the past five years, 20% of Wisconsin cranberry growers have already noticed a decline in availability and 15% have noticed a decline in quality of hives (Gaines, unpubl. data). California almond growers have seen prices of hive rentals reach nearly $200/hive (Lifsher 2012), a 400% increase since 2003, and if the decline continues cranberry growers can expect to see increases in rental prices as well.

Use of managed bees in Wisconsin cranberry

While 89% of Wisconsin cranberry growers use honey bees and 21% use bumble bee colonies (instead of or in addition to honey bees) (Gaines, unpubl. data) on their marsh every summer, the stocking rate varies greatly. Based on the results from my grower survey, stocking rates range from 1 to 9 hives per acre for honey bees and 1 to 8 colonies per acre for bumble bees (Gaines, unpubl. data). Not surprisingly, one of the most common questions I get from growers is “How many hives per acre should I stock on my marsh?” More specifically, growers want to know whether increasing their hives per acre will increase their yield (fig. 1).

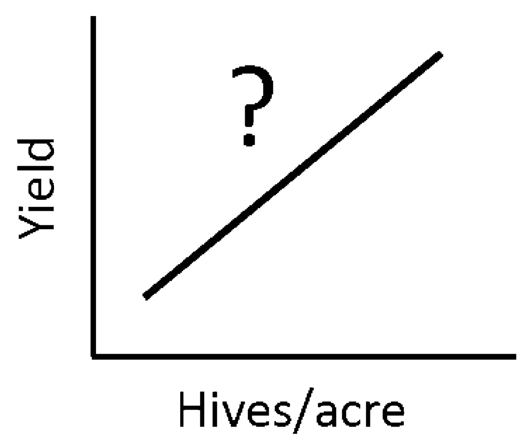

Figure 1. Growers are interested in whether their yield will increase if they stock more managed bees on their marsh during bloom

According to the literature, the recommended stocking rate for cranberry pollination is 2-3 hives/acre of honey bees or 2 colonies/acre of bumble bees (McGregor 1976). These recommendations are based on a review of publications spanning from the early 1900s to the 1960s. While all of these studies are related to bees and cranberry yield, most were based on data collected at one or two farms from one or two years and were not scientifically rigorous. Additionally, the recommendations from these papers were highly variable, ranging from 0.2-10 hives/acre. Since marsh to marsh and year to year variation in yield can be so great, basing recommendations on such a small sample is not especially reliable. Given the huge variation in current stocking rates by Wisconsin cranberry growers and the lack of any rigorous studies on the topic, we are currently collecting records from the past 11 years on yield and stocking rates from as many marshes as possible. From this data we hope to clarify the relationship between stocking rate and yield.

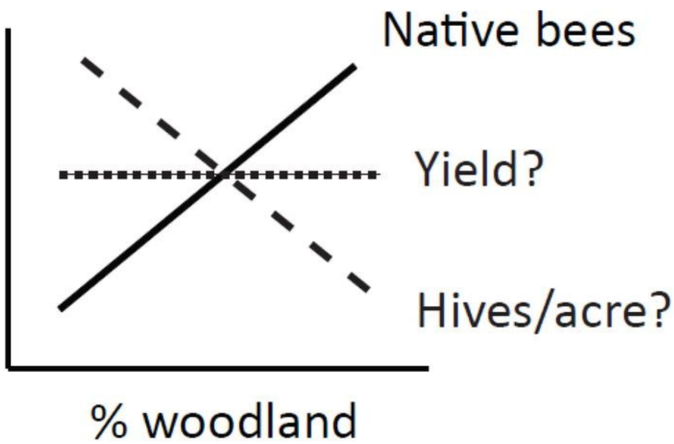

Figure 2. The required number of managed bees on the marsh may vary depending on the surrounding landscape.

One possibility, however, is that the recommended stocking rate will vary on a marsh to marsh basis. We hypothesize that the number of bees required at a marsh may vary as a function of (a) local management practices and (b) the surrounding landscape. The reason we think this may be true is that previous research has shown that native bees, naturally present in the landscape, are influenced by these two factors. Native bees are often more efficient pollinators than honey bees and are more willing to fly in cooler, damper weather. So a marsh with a high population of native bees may require fewer managed bees while a marsh with a low population of native bees may require more managed bees (fig. 2).

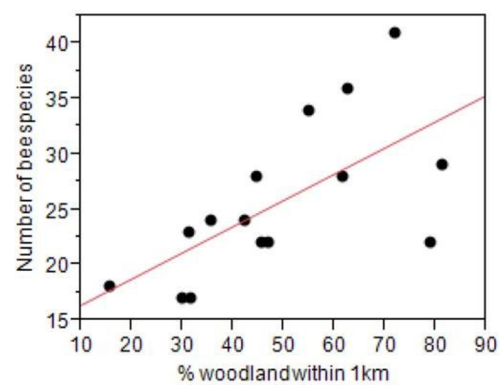

Figure 3. As the percent woodland increases in the landscape surrounding Wisconsin cranberry marshes, native bee diversity also increases.

Native, wild bees

Native bees provide valuable crop pollination services to many crops but are often overlooked. In Wisconsin there are about 500 different species of native bees, most of which are solitary and do not make honey. Since 2008, we have collected approximately 4500 specimens representing 176 species of bees in Wisconsin cranberry marshes. Our work has shown that as the area of the surrounding landscape composed of wooded habitat increases, native bees also increase (fig. 3).

Several ways for growers to protect and encourage bees on their marshes are (1) to reduce chemical use when bees are active, (2) provide additional floral resources for bees when cranberry is not in bloom, and (3) provide nesting habitat for native bees. Additionally, the increasing availability of Insect Growth Regulators allows growers to select pest control options that are less toxic to bees. For more information on how to create foraging and nesting resources for bees on your property, visit the Xerces Society for Invertebrate Conservation website (www.xerces.org) or contact me.

Future Research Plans

In 2012 my research will focus on better understanding the relationship between bees and cranberry yield. I am currently collecting past data on yield and the use of managed bees from as many marshes as possible. In the summer of 2012 I will be conducting several experiments looking at the contribution of native bees and other abiotic factors to cranberry yield.

Acknowledgements

Thank you to all of the growers who allowed me to conduct research on their properties and responded to my grower survey. Thanks to Jayne Sojka and Dan Mahr for helping me find field sites. Funding for this research has been provided by a UW Hatch grant to Claudio Gratton and from a Sustainable Agriculture, Research, and Education (SARE) grant to H. Gaines.

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Further information on pollinator conservation

The Xerces Society for Invertebrate Conservation
Toll Free number: (855) 232-6639
Website: www.xerces.org

EARLY-SEASON FLOODING FOR INSECT PEST CONTROL

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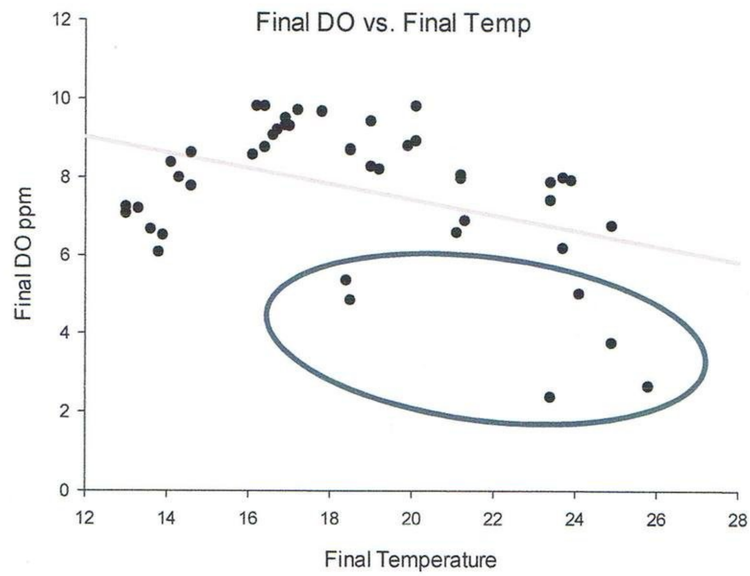
For over 100 years, the cranberry industry has been interested in the potential for spring floods to suppress arthropod populations. One critical element of this strategy is the trade-off between lethality for insects and harm to the cranberry plant. The basic question underlying our research, therefore, was the following: Can a late spring flood effectively suppress arthropod pests without harming the cranberry harvest? If so, under what conditions?

In collaboration with Wisconsin pest management consultants and growers, we set up a large-scale experiment in central Wisconsin in 2011. This work involved 23 pairs of flooded/unflooded beds (46 beds total, among 11 commercial growers), and we included not only arthropod metrics (Sparganothis fruitworm, cranberry fruitworm, and black-headed fireworm densities), but also plant metrics (chlorophyll, upright growth, flowers/upright, harvestable crop) and surface water metrics (temperature, dissolved oxygen, and pH).

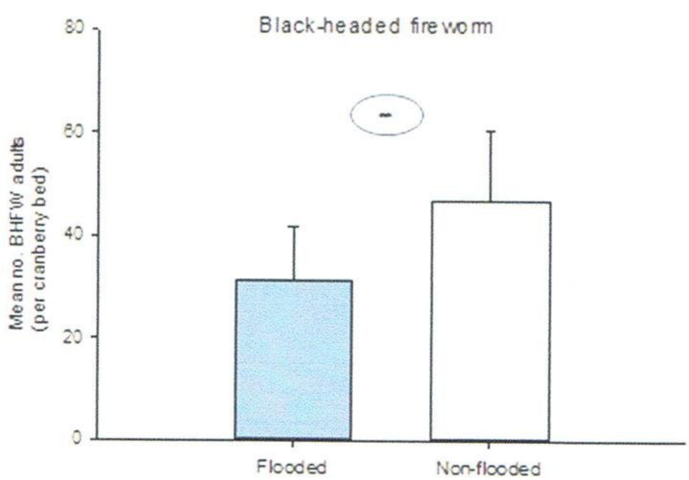
In parallel, we conducted a submergence tolerance study in a greenhouse setting, where we could concurrently manipulate the effects of water temperature (cool, warm regimes) and submergence duration (0, 48, and 96 hrs) on three different cranberry varieties ('Stevens,' 'Ben Lear,' and 'GH1').

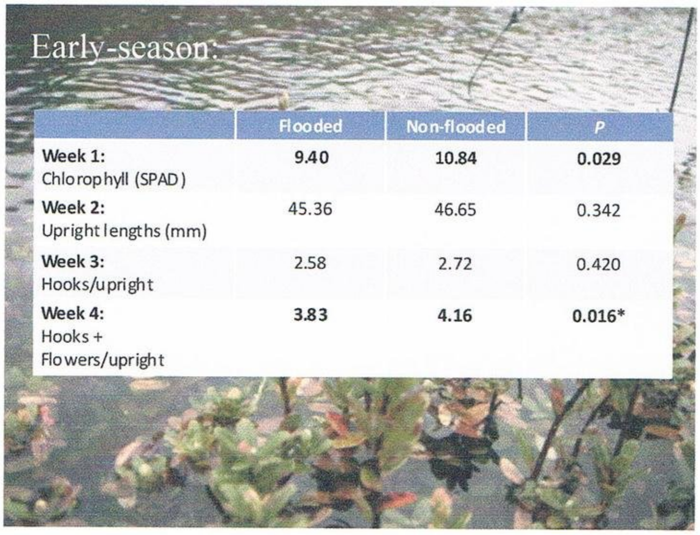
From our field data, we showed that springtime surface waters in Wisconsin were generally well-oxygenated and cool (8.2 ppm at flooding, and then 7.7 ppm as water drained; 64-65°F). As water temperature rose, dissolved oxygen (DO) declined. At the majority of the marshes, DO levels were not worrisome, although there was some evidence of hypoxia (see blue circled data points below), and we suspect this is due to elevated microbial oxygen demand in older beds.



After 30-40 hours of flooding, the floodwaters warm up and lose dissolved oxygen. At week-2 post-flood, black-headed fireworm trap-catch (pheromone-baited traps) was significantly lower in flooded beds than in the non-flooded beds. Sparganothis fruitworm and cranberry fruitworm trap-catch numbers in flooded versus non-flooded beds (which received insecticide treatments) were equivalent, suggesting that the effects of the flood were similar to that of insecticide treatments alone.

Pheromone-based trapping



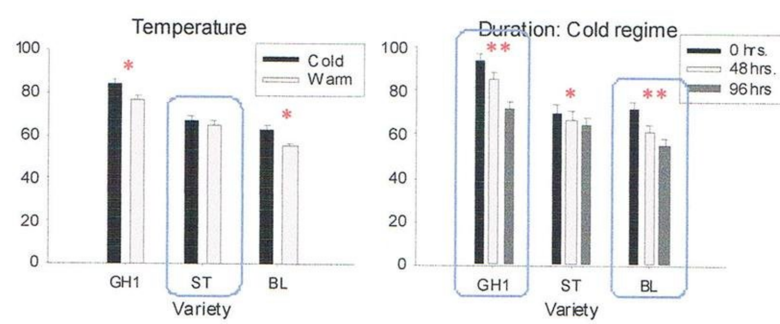


	Flooded	Non-flooded	P
Week 1: Chlorophyll (SPAD)	**9.40**	**10.84**	**0.029**
Week 2: Upright lengths (mm)	45.36	46.65	0.342
Week 3: Hooks/upright	2.58	2.72	0.420
Week 4: Hooks + Flowers/upright	**3.83**	**4.16**	**0.016***

In terms of the cranberry plant, there was evidence of flood-induced stress. By week-1, chlorophyll was reduced in the leaves of flooded beds, and by week-4, flowers per-upright were significantly fewer in the flooded beds: 3.83 flowers per-upright in flooded beds vs. 4.16 flowers per-upright in non-flooded (see table below). By harvest, however, there was no difference in harvestable crop between flooded (204.3 grams/sq. ft.) and non-flooded beds (203.0 g/sq. ft.).

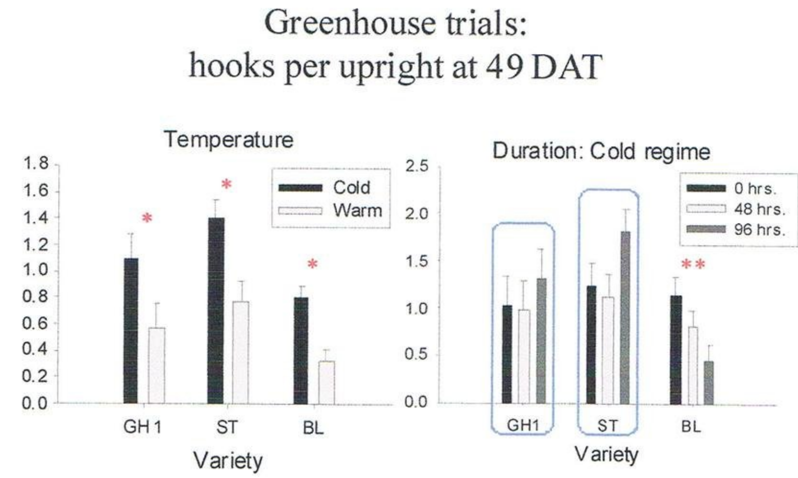
In the greenhouse trials, we learned that over the long term, cranberry sods can sustain complete submergence for 96-hrs, whether the water is cool or warm, as long as dissolved oxygen levels remain above approximately 40% saturation (~5 ppm). However, 7 days after treatment (see figure below; Greenhouse trials: upright length at 7 DAT), there were significant differences between controls (0 hours submergence) and 96 hours of submergence. For each variety, being submerged for the longer duration significantly reduced the growth of uprights. After 7 weeks, though, this trend was no longer evident. The response of both 'Stevens' and 'GH1' were similar among the 0, 48, and 96 hour submergence duration regimes (see Greenhouse trials: hooks per upright at 49 DAT).

Greenhouse trials:
upright length at 7 DAT

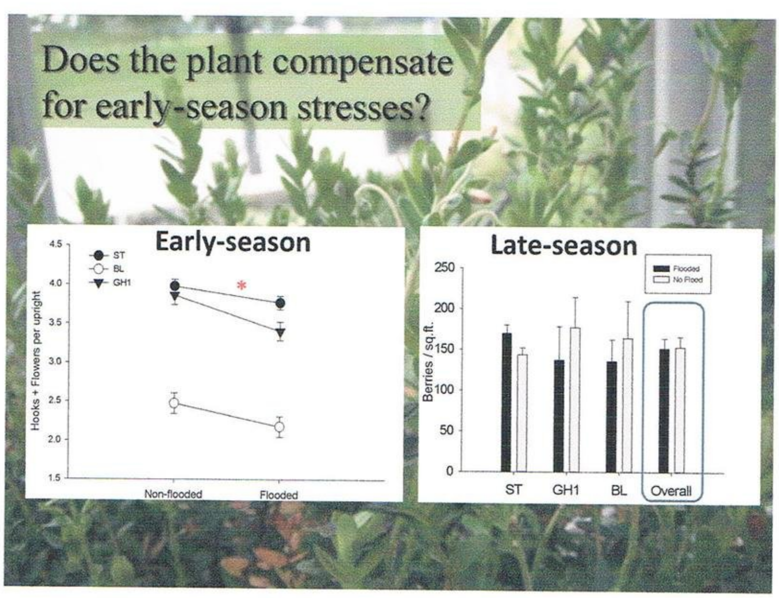


Notably, there was a significant difference between cold and warm effects, where warm water caused a greater reduction in upright growth 49 days-after-treatment (DAT). Interestingly, the *'Ben Lear'* sods suffered much more, even in the cold water regime, but this can be explained by the markedly depleted oxygen levels in the *'Ben Lear'* water. Here we suspect there was elevated microbial activity reducing available oxygen.

For the 'Stevens' and 'GH1' sods, the cold water regime was quite similar to water temperatures and dissolved oxygen levels in the field. This allowed us to focus on the cold water regime in the greenhouse to assess how well these plants could sustain prolonged submergence. After being submerged for 96 hrs and then being allowed to grow under natural conditions for 7 weeks, there was no difference (in terms of hooks or flowers per upright) between these plants and those that had not been submerged at all. This suggests that as long as dissolved oxygen levels are not too low (< 40% saturation), cranberry sods ('Stevens' and 'GH1') can remain submerged for prolonged periods (48-96 hrs) in the springtime without suffering significant injury.

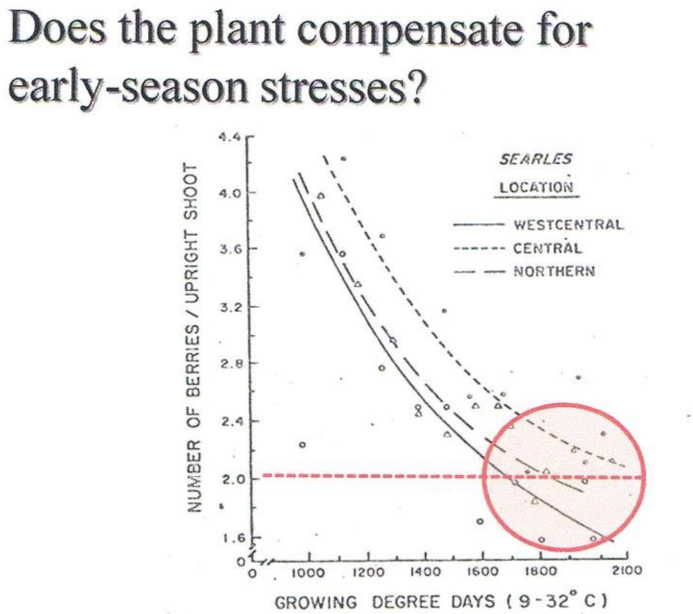


In the field, we observed a similar trend in which there was early evidence of flood-induced plant stress, yet by harvest (Sept/Oct), the difference between flooded and non-flooded beds was non-existent. Note in the figure below that early in the season (left panel, "Early-season"), there were fewer hooks and flowers per upright, but by harvest (right panel, "Late-season") there was no significant difference between flooded and non-flooded beds.



Why might this be? Does the plant possibly compensate by re-allocating resources? An old study done in Wisconsin (using '*Searles*') shows how cranberries are "shed" all season, eventually reaching about 2 fruit/upright by harvest (see figure below, from Hawker & Stang 1985).

What this suggests is that stressors, like spring flooding, might reduce flowers/upright early in the season (from an average of about 4/upright to 3/upright), but this may have little bearing on harvest because the sods will only mature approximately 2 berries/upright. Thus, as long as spring flooding does not reduce the number of berries/upright to fewer than 2, there may not be a significant problem with early-season flooding.



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