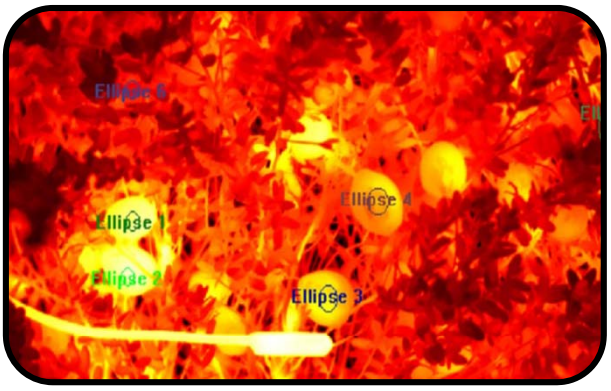
2016 Annual Summer Meeting of the American Cranberry Growers Association

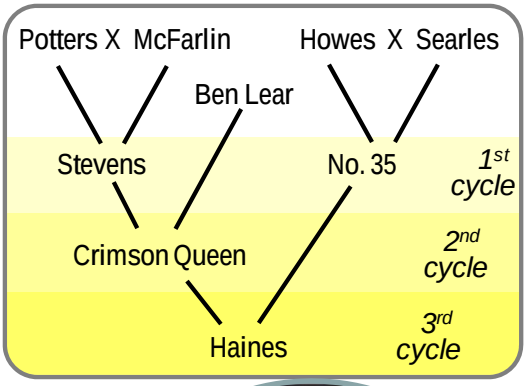
Rutgers University
Marucci Center

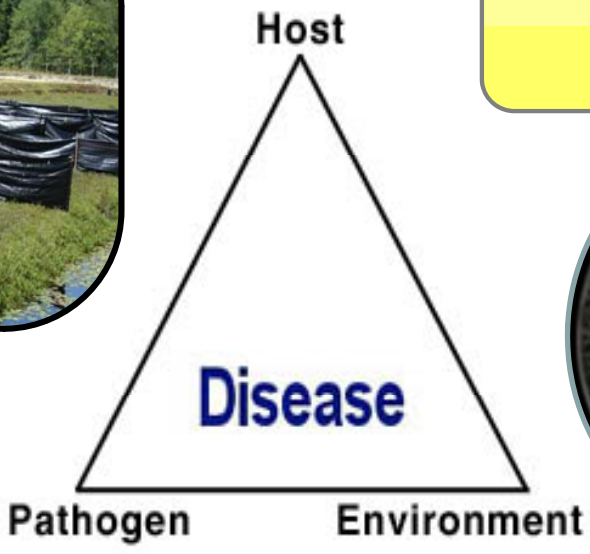
Chatsworth, NJ

Thursday
August 18, 2016

RUTGERS
New Jersey Agricultural Experiment Station







Presentation Summaries

American Cranberry Growers Association
2016 Summer Field Day
Thursday August 18, 2016
Rutgers University

P.E. Marucci Center for Blueberry & Cranberry Research & Extension,
Chatsworth, NJ

Parking will be available at the Center's shop (across cranberry bogs).
Transportation for tours will be provided at the Center.
Restrooms located at the Center, adjacent to Conference Room.

CRANBERRY BOGS:

8:30–8:45 **Opening Remarks**
Shawn Cutts, President, American Cranberry Growers Association

8:45-9:05 **Research on Sucking Insect Pests of Cranberries (Bog 19)**
Cesar Rodriguez-Saona, Department of Entomology, Rutgers University; *Vera Kyryczenko-Roth*, P.E. Marucci Center; *Robert Holdcraft*, P.E. Marucci Center; and *Dan Schiffhauer*, Ocean Spray

9:05–9:25 **Good fungi and bad viruses (Bog 18)**
James Polashock, Research Plant Pathologist, USDA-ARS

9:25–9:45 **Update on Breeding Cranberries for Fruit Rot Resistance (Bog 18 & 11)**
Jennifer Johnson-Cicalese, Guillaume Daverdin, and *Nicholi Vorsa,* P.E. Marucci Center for Blueberry & Cranberry Research & Extension, Rutgers University, Chatsworth, NJ

9:45-10:10 **Next Generation Cranberry Hybrids: 3rd Breeding and Selection Cycle (Bog 10)**
Nicholi Vorsa, and *J. Johnson-Cicalese*, P.E. Marucci Center for Blueberry & Cranberry Research & Extension, Rutgers University, Chatsworth, NJ

10:10-10:30 **Cranberry Fruit Rot Biology and Control (Bog 10)**
Timothy Waller and *Peter Oudemans,* Department of Plant Biology and Pathology, Rutgers University

10:30–10:50 **Understanding Scald and Heat Stress (Bog 9)**
Peter Oudemans and *Dave Jones,* Department of Plant Biology and Pathology, Rutgers University

10:50–11:10 **Show and Tell**
Cranberry growers

CONFERENCE ROOM:

11:20–11:30 **Cranberry Statistics**
Bruce A Eklund, State Statistician, U.S. Department of Agriculture | National Agricultural Statistics Service

11:30–12:00 **Assessing Host Plant Resistance to Insect Pests and Current Research on Honeybee Pollination in Cranberry**
Christelle Guedot, Assistant Professor and Extension Specialist, Department of Entomology, University of Wisconsin-Madison

12:00–1:00 **LUNCH** (Pole Barn)

1:00–1:30 **Farm Safety**
Ray Samulis, Cooperative Extension Agent, Burlington County Extension, Rutgers University

Research on Sucking Insect Pests of Cranberries (Bog 19)

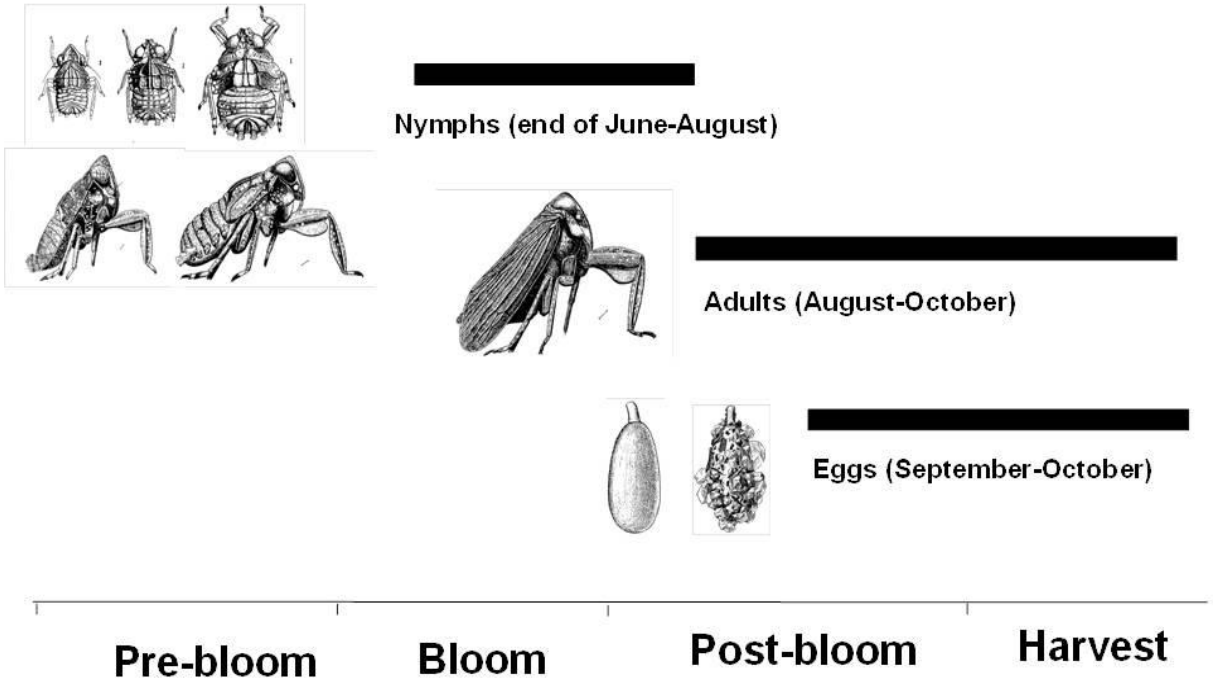
Cesar Rodriguez-Saona, Department of Entomology, Rutgers University; *Vera Kyryczenko-Roth*, P.E. Marucci Center; *Robert Holdcraft*, P.E. Marucci Center; and *Dan Schiffhauer*, Ocean Spray

There is concern among cranberry growers of a potential increase in secondary pests, such as the cranberry toad bug, *Phylloscelis atra*, because of recent changes in pest management strategies (e.g., adoption of new reduced-risk products and decreased applications of broad-spectrum insecticides).

The Cranberry Toad Bug

Although we had seen toad bugs in cranberry bogs in the past we had never seen them causing damage to the vines and fruit. Toad bugs are hemipteran insects (similar to blunt-nosed leafhoppers) but belong to the Family Dictyopharidae (planthoppers) (as opposed to leafhoppers, which belong to the family Cicadellidae). Toad bugs feed only on cranberries. This insect has a single generation per year. It overwinters as eggs. The nymphs appear by the end of June through August, and the adults from August through October. Eggs are laid from September through October. Feeding damage can be noticed in two stages. First stage feeding damage on vines causes closing in (towards the branch) of the leaves on the new growth. Second stage feeding causes changed in color (reddish to brown) of new growth. The damage can be seen from July until harvest. This damage will cause dying of the branch and the berries to shrivel up. Heavy infestation will result in dwarfed berries. Little information is currently available on the ecology, impact, monitoring, and management of cranberry toad bugs.

Life Cycle of the cranberry toad bug



Methods

Objective 1: Evaluate the efficacy of various insecticides against toad bugs

Field experiments were conducted to the toxicity of registered and non-registered insecticides on toad bugs. The following insecticides were evaluated: Diazinon, Sevin, Assail, Agri-Mek, Closer, Lorsban, Exirel, Beleaf, and Brigade. The experiment was conducted in an 'Early Black' cranberry bog located at the Rutgers PE Marucci Center for Blueberry and Cranberry Research and Extension in Chatsworth, New Jersey (see Figure). Plots were 16 by 20 feet, separated by a 3 foot tall silt fence to prevent movement of insects between plots. Treatment plots were arranged in a complete randomized block design with 4 replicates. Applications were made with a custom sprayer comprised of an 8 foot boom mounted on 26" wheels. The sprayer was calibrated to deliver 50 gal of volume per acre at 35 psi. Vacuum sampling was used to monitor nymph and adult toad bugs. Plots were sprayed on 5 August. Pre-spray samples were taken on 4 August, and post-spray samples were taken on 12 August. Numbers of toad bugs were counted (nymphs and adults were combined), with the aid of a dissecting scope.

Objective 2: Determine the effect of damage by toad bugs on cranberry yield

Little is known on the impact of damage by toad bugs on cranberry yield. This information is important for the development of treatment thresholds. We will determine whether toad bug feeding impacts cranberry fruit quality and health by characterizing feeding damage. This experiment started in July and ended in August. Randomly chosen single cranberry uprights were bagged (see picture). Treatments consisted of 0, 2, 5 or 10 toad bugs (20 terminals per treatment). At the end of the experiment, berries will be harvested by clipping uprights. To characterize damage, the number of damaged/undamaged uprights and dwarfed/healthy berries will be counted. All berries will be weighed.

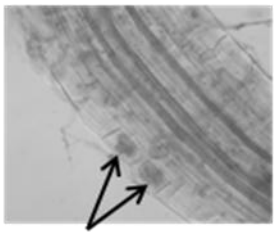
Good fungi and bad viruses (and Bacteria) (Bog 18)

James Polashock, Research Plant Pathologist, USDA-ARS

Mycorrhizae: beneficial fungi

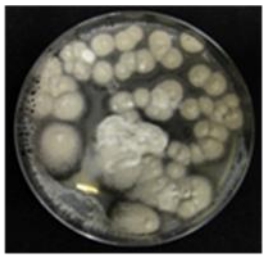
Fungi are generally thought of as harmful to cranberry production. Various fungal pathogens can cause fruit rot, upright dieback, blossom blast, root diseases etc. However, some cranberry colonizing fungi are beneficial to the plant. These fungi, collectively called mycorrhizae, can promote improved nitrogen utilization, increased water and stress tolerance, and increased disease tolerance. American cranberry (*Vaccinium macrocarpon*) is naturally colonized by ericoid mycorrhizae. In New Jersey, the two major species of ericoid mycorrhizae that colonize cranberry are *Rhizoscyphus ericae* and *Oidiodendron maius*. Although all cranberries are naturally colonized by these fungi, the species and strains are not equally beneficial and some can be detrimental. Our preliminary results from 2012 suggested that some locally collected isolates were beneficial to young plantings of Mullica Queen, but plot variation was high and statistical differences could not be demonstrated.

This year, the experiment size was increased to include two varieties (Mullica Queen and Demoranville) and a commercially available product (INOQ Rhodazo) was added, in addition to our locally collected isolates. INOQ Rhodazo is a dried mix of the ericoid mycorhizae, *R. ericae* and *O. maius*. The manufacturer (INOQ, Germany) claims that the product provides; better nutrition and growth of your plants, resistance to environmental stress like drought, some root pathogens and parasites, shock from transplanting etc., and improved uptake of essential elements. We will be closely monitoring the planting for growth and stress tolerance over the next few years.

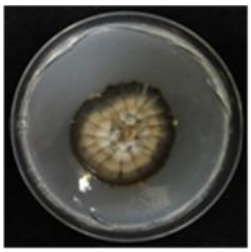


colonized root cells

INOQ Rhodazo



Oidiodendron maius



Rhizoscyphus ericae

Viruses: impact and prevalence

We know that Tobacco streak virus (TSV) and Blueberry shock Ilarvirus (BlShV) are infecting cranberry in New Jersey and incidence is increasing. TSV is currently much more common. Typical symptoms are scarring of the fruit. Viruses are systemic and as such, all of the fruit on a given upright and a given TSV/ BlShV infected runner tend to be scarred. TSV and BlShV symptoms are indistinguishable and detection is typically by ELISA. Spread is thought to be through thrips-mediated pollen transmission. Impact on yield is dependent on the extent of infection. Occurrence in the field is patchy and is reported more in newer varieties, however, TSV has been found in older varieties including Stevens. Fruit symptoms disappear the year after infection, but the long term impact is still unknown. Symptomless plants (i.e. recovered) are still thought to be infective. Chlorothalonil application is known to cause fruit scarring, but it tends to

be more superficial than the symptoms caused by virus infection. Also note that the damage caused by chlorothalonil tends to cause premature reddening where the scarring occurs, whereas this is not seen in TSV/ BlShV infection.

Symptoms of TSV infection in cranberry

Symptoms of chlorothalonil damage

Phytoplasma: a new one in cranberry

Phytoplasmas are bacteria that lack cell walls. Phytoplasma infection can cause distortion of the vegetative tissue as well as the flowers. The only phytoplasma reported to infect cranberry causes the disease known as false blossom. Last year we received two samples, one from Wisconsin and one from Massachusetts that had unusual double petals. These were tested and found to contain a phytoplasma. Further testing suggested the phytoplasma to be the same one that causes blueberry stunt. Although not yet reported in New Jersey, please be aware of the symptoms and alert us if you see it on your farms. Transmission is likely by a leafhopper.

Distorted flowers and fruit caused by blueberry stunt phytoplasma

Update on Breeding Cranberries for Fruit Rot Resistance (Bogs 18 & 11)

Jennifer Johnson-Cicalese, Guillaume Daverdin and *Nicholi Vorsa,* P.E. Marucci Center for Blueberry & Cranberry Research & Extension, Rutgers University, Chatsworth, NJ

In 2003, an intensive effort to develop cranberry cultivars with improved fruit rot resistance (FRR) began by screening our germplasm collection under intense fruit rot pressure. Four sources of FRR resistance were identified, two highly resistant accessions, Budd's Blues and US89-3, and two moderately resistant, Cumberland and Holliston. These resistant accessions were used in crosses and in 2009, 1624 progeny were planted in field plots at the Marucci Center, Chatsworth. The progeny were evaluated under reduced fungicide regimes (increased fruit rot pressure), and the best progeny were selected based on the best FRR, commercially viable yields, as well as berry size and color. Most of the top selections had Budd's Blues as a parent, a variety that has long been known to exhibit excellent FRR, but unfortunately very low yields. We were pleased to see that in these crosses many of Budd's Blues' progeny had good yields. For example, one BB x Crimson Queen (CQ) progeny had a 3-yr mean yield of 300 g/ft^2 under severe fruit rot pressure.

The top selections from the 2009 planting have been used in crosses with each other, combining multiple sources of resistance with hope of further enhancing FRR. The progeny of this next breeding cycle were planted in 5' x 5' field plots in 2014, 2015, and 2016, a total of over 4000 plots. This year, fungicides were withheld from the plots planted in 2014 and first evaluation of these progeny for FRR and yield will begin in a few weeks.

These top selections were also planted in 2015 in large 10' x 20'plots, with 5 replicates of each selection in Bog 11. Establishment of the selections looks good so far. Crimson Queen is included in the trial as a high yielding but susceptible control. This trial will be evaluated for fruit rot, yield and fruit quality, under reduced fungicide input scenarios under the direction of P. Oudemans. Plots will be divided into subplots and receive a number of fungicide treatment regimens to determine minimum amount needed, and the optimal timing to achieve commercially acceptable low levels of fruit rot. These top selections were also planted in trials in Wisconsin and British Colombia. Depending on their performance, one selection may be considered for potential cultivar release.

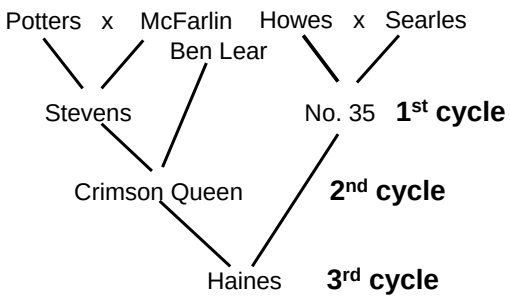
Multiple years are involved in making crosses, field plot establishment, and evaluating for fruit rot and yield. To potentially speed up this process, we are concurrently identifying genetic markers for resistance. DNA was extracted from large populations of progeny that were evaluated for FRR. DNA markers found only in the resistant progeny were identified through GBS (Genotyping by Sequencing). These FRR markers will now be tested on other populations. Future generations of progeny can be tested for these markers at the seedling stage, greatly reducing the number of progeny that need to be evaluated in the field. Eight FRR markers have been identified from Budds Blues. In addition, populations with resistance from Cumberland and US89-3 are currently being evaluated. Identifying markers for FRR genes, from different sources of resistance, facilitates future breeding by pyramiding genes for resistance, as well as potentially understanding the mechanisms of resistance. In 2016, we planted a large population of 219 individuals. The parents of this population were highly resistant, had good yield and offer three sources of FRR. This should be an excellent population for testing our genetic markers, identifying new markers, and gaining a better understanding of the genetic and environmental variability of progeny performance; AND potentially resulting in a fruit resistant cultivar with acceptable yields under reduced fungicide inputs.

Next Generation Cranberry Hybrids: the 3rd Breeding and Selection Cycle (Bog 10)

Nicholi Vorsa and *J. Johnson-Cicalese* P.E. Marucci Center for Blueberry & Cranberry Research & Extension, Rutgers University, Chatsworth, NJ

Bog 10 contains the most recent Rutgers cranberry selections resulting from the 3rd breeding and selection cycle. These include the four large plots (east half of Bog 10) of the most recently released cultivars Haines™ and Welker™, and selections CNJ99-52-69 and CNJ99-9-25. Haines and its full-sib CNJ99-9-25 are derived from a Crimson Queen x #35 cross. Welker and its full-sib CNJ99-52-69 are derived from the cross #35 x NJS98-34 (Ben Lear x Franklin). The west half contains a series of 3rd breeding and selection cycle crosses derived from 2nd generation cultivars Mullica Queen (MQ), Demoranville (D), Crimson Queen (CQ), Scarlet Knight (SK) and an unnamed selection NJS98-71 (Pilgrim x Ben Lear), and 1st generation cultivars, Pilgrim (P) and Stevens (S), and Ben Lear (BL). Over 1600 progeny were evaluated from these crosses during 2009-2012. In 2013, 17 selections exhibiting very high yield potential: MQxBL (2), MQxD (1), MQxS (1), PxMQ (3) and NJS98-71xMQ (4), were planted in Bog 10 to be evaluated for productivity, fruit rot susceptibility, season, vegetative vigor, establishment and fruit quality traits, e.g. TAcy, Brix, titratable acidity, phenolics, etc.

The **3rd breeding cycle cultivars' and selections' pedigrees are composed of genes from diverse array of native selections**. For example the Haines pedigree (see figure below) consists of: Howes (¼), Searles (¼), Ben Lear (¼), McFarlin (⅛) and Potter's (⅛). The MQxS selection's pedigree includes: Lemunyon (¼), McFarlin (⅛), Potters's (⅛), Ben Lear (⅛), Howes (3/16), Searles (⅛), and Early Black (1/16), and has a slight degree of inbreeding (<1.6%).



Background of 1st and 2nd cranberry breeding cycles: Genetic improvement of cranberry was initiated in 1929 with a cooperative effort between the USDA and State Agricultural Experiment Stations of New Jersey and Massachusetts. The breeding program was initiated in response to the 'false-blossom' disease with the objective of developing varieties which showed resistance to the spread of the disease (based on blunt-nosed leafhopper feeding preference assays), and would produce large crops and superior fruit. Crosses were made in Wisconsin, Massachusetts and New Jersey. Over 10,000 seedlings were planted and evaluated in Whitesbog, NJ. By 1940 1,800 seedlings fruited and 40 selections were made for a second test. From these, Stevens, Pilgrim, Wilcox, Franklin, Bergman and Beckwith cultivars were named. Another selection, known as #35, was likely selected for productivity, but never named because of poor color. These cultivars, e.g. Stevens, represent the **1st breeding and selection cycle** of the American cranberry. In 1985, Rutgers University/New Jersey Agricultural Experiment Station established a blueberry and cranberry breeding program. In 1988, 20 crosses were made with the first breeding cycle hybrids Steven, Pilgrim, Franklin and Wilcox, and Ben Lear and represent the **2nd breeding and selection cycle** in cranberry. From these crosses, 1466 seedlings were evaluated in the 1990's and the cultivars Crimson Queen® and Demoranville® were released. The selection criteria were based on early ripening, high TAcy, productivity and establishment vigor. The 1997 cross between #35 x 'Lemunyon' yielded the cultivar Mullica Queen®. Scarlet Knight® [Stevens x NJS98-37 (Franklin x Ben Lear)] was derived from a 1995 cross.

Cranberry Fruit Rot Biology and Control (Bog 10)

Timothy Waller and *Peter Oudemans*, Department of Plant Biology and Pathology, Rutgers University

The world of pathology revolves around the disease triangle, being comprised of host plant, pathogen (fruit rot fungi) and the environmental conditions that both the host plant and pathogen are subjected to. Our research is focused on understanding the biology of cranberry fruit rot pathogens especially the response to stimulatory host plant signals produced during bloom on developing floral tissues and manipulation of the micro- and macro-environmental conditions in attempts at more efficient disease control strategies.

Cranberry fruit rot is caused by a complex of pathogenic fungi, each of which are more or less important in any given growing season. Two very common fruit rotting genera are *Coleophoma* (ripe rot) and *Colletotrichum* (bitter rots). These pathogens overwinter either in dormant floral buds from the previous season or plant "trash" left after harvest. During 'in-bloom' wetting events such as rain, prolonged dew or irrigation , these fungi infect the developing fruit where they remain quiescent until later in the season when fruit begin to ripen. As the fruit ripen the pathogens break dormancy and begin to rot the fruit.

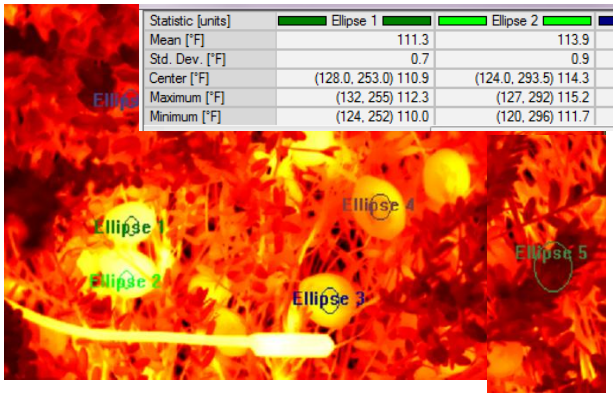
Our research has been focused on the stimulation of fruit rotting pathogens during the bloom period in regards to initiation of sporulation and the onset of disease epidemics. We have shown that components washed from flowers, with both water and chloroform, are extremely potent fungal stimulants. Floral compounds removed with water have been shown to initiate germination, secondary conidia production and appressoria or infection structures in *C. empetri, C. fioriniae* and *C. fructicola*. Recently this notion was taken to the field where rainwater runoff from flowers was shown to stimulate these same biological responses and further indicates that this phenomenon is happening in the field, not just the laboratory. We believe this rainwater contains dislodged, not dissolved, host waxes and other stimulants. Floral compounds removed with chloroform are generally non-polar in structure and are comprised of waxes, fatty acids/alcohols/methyl-esters, inhibitors and other non-polar compounds. Pure floral wax assays have shown that *C. fioriniae* is stimulated to form copious numbers of appressoria and a substantially lower number of secondary conidia when compared to water extracts. Isolation and identification of a long-chain fatty methyl-ester from floral extractions has yielded a definitive stimulant for appressorium formation *in vitro*. We have used this information to design field trials testing this compound in our fungicide programs. The hypothesis being that this material will synchronize pathogen germination (most vulnerable time of pathogens' life) thereby allowing the fungicide to have the highest level of efficacy. We have also included a short chain fatty acid that could interfere with the pathogens ability to recognize the host surface, if only for a few hours, would have dramatic effects on the amount of disease. Currently we are working on comparing surface components from various growth stages, cultivars and comparing water and chloroform extracts to each other to provide insight on other stimulants.

	Disease Triangle				
Phenology / Growth Stage	**Host**	**Pathogen**	**Environment**	**Key Points**	**Experimental / Questions**
Bud Swell / Break	Stressed, water debris present on surface of plant	**Dormant:** in overwintering forms ie. appressoria, conidia, hyphal fragments	Cool; periodic strong temperature fluctuations	**Overwintering locations**	**Where exactly do the pathogens overwinter and in what form?**
	Stimulatory compounds present	Within **floral buds**, scattered debris (from water) and canopy	Frequent rain and wetting events	**Cool temperatures**	
	Providing an **overwintering site** for pathogens (buds)				
Early floral development (up to 'Hook')	**Rapid increase in surface area**	*We believe* majority still dormant, some beginning to grow, spore/conidia release very low	Still cool and wet	**Surface area increase**	**Investigating stimulatory differences between surface compounds at this early stage and full bloom**
	Tender growth		Frequent rain and wetting events, dramatic temperature fluctuations	**Tender growth**	
		CRITICAL TIME FOR FUNGICIDE APPLICATIONS			
Bloom	**Fully open flowers create a water holding structure directly on developing fruit**	**Sporulation correlated to bloom**, signifying **fungal recognition** and reaction to plant cues	Frequent **rain** and **wetting events**	**Fungal response to floral compounds (*VLCF waxes, sugars, other compounds) in the form of sporulation and infection of ovaries (young fruit)**	**Fungicide trials** (new chemistry, replacement compound testing)
	Continued increase of surface area	Fungi are now forming **appressoria** and initiating the **infection process**	Dramatic temperature fluctuations		**Biocontrol trials** (antibiosis / competition / surface modulation)
	Floral surfaces comprised of stimulatory long chain fatty waxes	Polycyclic or **repeated infections** could be taking place	Average temperature dramatically higher, **optimum temperatures for pathogen development maintained**	**Rain and wetting conditions**	**Wetness reduction trials** (clay early in season and used as a sticker for Indar/abound sprays)
	Rain-water from flowers contains stimulatory **waxes, sugars and** other **compounds**	Microcyclic or **secondary conidiation while infecting**		**Temperature optimum**	Stimulatory based **'trapping trials', recognition disruption**
		*VLCF = very long chain fatty acids/alcohols/esters (waxes)			
Fruit Bearing	Believed **changes** in chemical structure of **surface compounds**	**Latent infections**	**Extreme temperatures reached**	**Changes in surface compounds**	**Protectant fungicide** applications
		Waiting for ripening signals or damage to fruit	Fruit stressed and scald associated rots prevalent	**Pathogen latent**	**Clay / thermal based assays**
				Extreme heat / scalding conditions	**Comparison of flower to fruit surface components**

Understanding Scald and Heat Stress (Bog 9)

Peter Oudemans, Ph.D. and *Dave Jones*, Department of Plant Biology and Pathology, Rutgers University, PE Marucci Center for Blueberry and Cranberry Research and Extension

The Problem: Fruit temperatures can exceed canopy temperatures and lead to fruit loss.



Statistic [units]	Ellipse 1	Ellipse 2	Ellipse 3	Ellipse 4	Ellipse 5	Ellipse 6
Mean [°F]	111.3	113.9	105.4	102.0	89.0	94.2
Std. Dev. [°F]	0.7	0.9	1.0	1.0	2.5	0.7
Center [°F]	(128.0, 253.0) 110.9	(124.0, 293.5) 114.3	(283.0, 309.5) 106.4	(322.5, 238.5) 102.9	(512.5, 184.5) 87.7	(127.5, 156.5) 94.4
Maximum [°F]	(132, 255) 112.3	(127, 292) 115.2	(280, 316) 107.2	(325, 230) 104.6	(511, 167) 100.5	(127, 151) 96.6
Minimum [°F]	(124, 252) 110.0	(120, 296) 111.7	(289, 313) 103.4	(317, 244) 99.3	(512, 179) 86.7	(126, 159) 93.2

In this example, the canopy temperature is between 89F and 94F whereas the fruit temperatures are as high as ~115F . We know that fruit held at 108F for 2hrs. is irreparably damaged however, intermittent heating to these temperatures is unlikely to cause significant damage.

Risk Factors: During the growing season risk factors change. It is critical to understand what each of the risk indicators means and how they affect management decisions.

a) Fruit exposure. Fruit at the top of the canopy has the greatest exposure. Fruit within the canopy is mostly shaded.
b) Fruit load. Fruit exposed to the sun is at highest risk. Therefore a large crop on a thin canopy is at highest risk. An extreme example of this would be a young bed with incomplete ground cover and lots of fruit.
c) Fruit color. Since darker colors heat up faster ripe fruit represent a greater risk than lighter colored fruit.
d) Cultivar. Cultivars vary in both canopy structure as well as heat tolerance.
e) Solar radiation. The intensity and duration of solar radiation is the energy source that affects the extent of fruit heating.
f) Cloud cover. Shading can greatly impact fruit temperature. Clouds passing over fruit will immediately cause a significant change in fruit temperature. Therefore cloudy days are considered lower risk than clear days.
g) Relative humidity. It is likely that relative humidity can reduce the amount of solar radiation therefore very humid days pose a lower risk. On the other hand, on low humidity days lower water vapor in the atmosphere allows greater heating of fruit.
h) Time of day. The angle of incident radiation can affect the amount of incoming solar radiation and therefore the risk of overheating changes throughout the day.

Management of overheating: Management practices of fruit overheating should consider the following factors.

a. Evaporative Cooling (Irrigation) — Maximize evapotranspiration
    a. The application of water to the bog canopy, whereby evaporation of this water effectively cools the fruit by pulling heat out
    b. Effective evaporative cooling methods means irrigating only when the practice would be effective. This is mainly when:
        a. Scald Risk is HIGH
        b. Humidity is low
        c. Degree of cooling (wet bulb) are predicted to be greatest
b. Prediction and minimizing the risk, maximizing preventative measures (at the right time).
    a. This research could lead to Real Time measures of Scald Risk are sent to your phone accompanied by predictions of the maximum degrees of cooling that evaporative cooling will get you at any given time of the day.
    b. Programmed Alerts will tell growers when irrigation is strongly recommended
        1. Less irrigation guessing
        2. Peace of mind
        3. Better crop quality
c. Protection (kaolinite sunscreen, shade cloth) — Not likely to be practical but as a proof of concept may be useful.
d. Canopy structure —If size/shape is modified can we optimize the shading it provides? Can we identify a “Goldilocks” point of nitrogen fertilization.

Cranberry Statistics (New Jersey Agricultural Statistics)

Bruce A Eklund, State Statistician, NJ Field Office
U.S. Department of Agriculture | National Agricultural Statistics Service
Bruce.eklund@nass.usda.gov 503.308.0404

USDA's National Agricultural Statistics released the 2015 Noncitrus Fruits and Nuts Final Summary noon July 6, 2016. New Jersey growers were third nationally in acres harvested, barrels produced per acre, total production, utilized production, price received, and value of utilized production.

https://www.nass.usda.gov/Publications/Reports_By_Date/index.php

New Jersey producers were first nationally in accuracy of their crop forecasted last summer, within 2 percent of final production. The forecast for the 2016 crop was released noon, August 12. Thank you to New Jersey producers who contributed to an excellent participation rate for the survey producing those results.

Assessing Host Plant Resistance to Insect Pests & Current Research on Honeybee Pollination in Cranberry

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Host plant resistance

The cranberry industry is continuously looking for ways to improve sustainability and to incorporate more Integrated Pest Management (IPM) strategies into growing practices. Host plant resistance (HPR) is an important component of IPM that has not been extensively studied in cranberries. HPR refers to heritable properties in plants that improve their natural resistance against insects and other pests. This resistance can be due to physical properties of the plant such as leaf toughness or chemicals in the plant that deter insect feeding and oviposition or impair insect development.

In this study, we investigated host plant resistance in cranberry. First, we measured field population densities of the three most economically important pest insects in Wisconsin: cranberry fruitworm, sparganothis fruitworm, and blackheaded fireworm in five commonly grown cranberry varieties, i.e. 'Stevens,' 'Ben Lear,' 'GH-1,' 'Mullica Queen,' and 'HyRed'. This study was carried out in the summers of 2013 and 2014. We used five different sites at commercial marshes in central Wisconsin. Population densities of male moths of all three species were assessed using pheromone traps in beds of the different cranberry varieties in commercial marshes in central Wisconsin. Each bed was adjacent to at least one bed of the same variety, and the traps were placed between the two beds to minimize the likelihood of moths flying in from beds of other varieties. Traps were checked weekly from June through August. For each variety, damaged cranberries were collected, and the number of damaged berries and larvae feeding within berries were compared among varieties. We walked 100 m transects along the bed edges collecting all red, damaged berries within a meter width. The red berries were returned to the lab and damaged berries were counted, then dissected and the larvae inside were counted and identified to species. More than 99% of larvae collected were cranberry fruitworm. 'Mullica Queen' and 'Ben Lear' had significantly more damaged berries

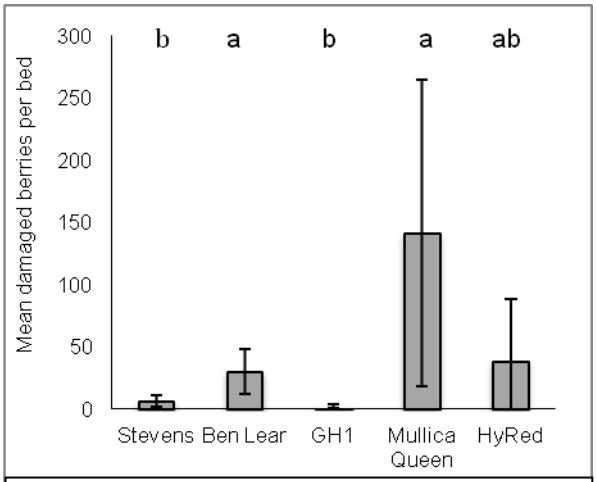

Fig 1. Mean number of damaged berries collected in each variety.

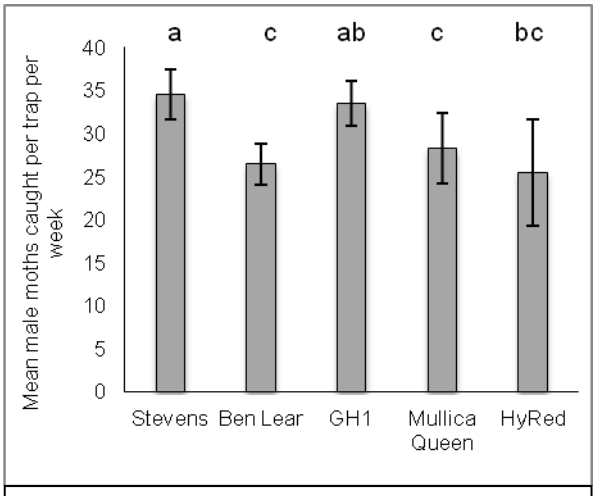

Fig 2. Mean number of sparganothis fruitworm adults caught per trap per week for each variety.

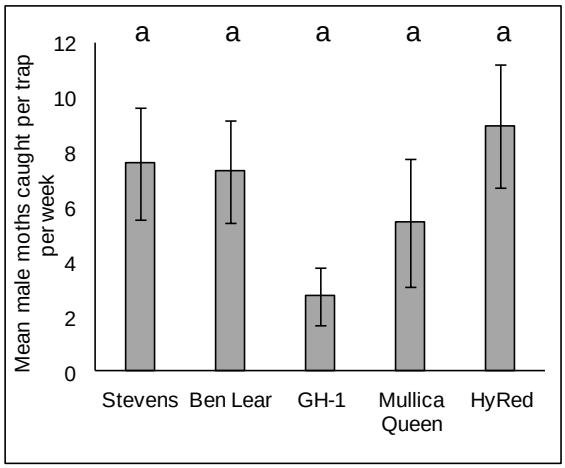

Fig 3. Mean number of blackheaded fireworm adults caught per trap per week for each variety.

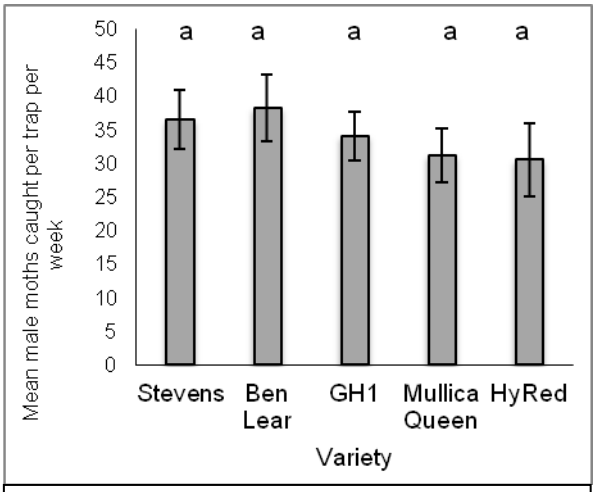

Fig 4. Mean number of cranberry fruitworm adults caught per trap per week for each variety.

than 'Stevens' or 'GH-1', and had more larvae than 'GH-1' (Fig 1). Conversely, fewer adult male sparganothis fruitworm were found in 'Ben Lear' and 'Mullica Queen' beds than in beds of 'Stevens' or 'GH-1' (Fig 2). Adult populations of blackheaded fireworm (Fig 3) and cranberry fruitworm (Fig 4) were not different among varieties. Our findings provide evidence of different levels of resistance in common cranberry varieties, which may help inform future plantings and breeding programs.

Cranberry pollination

Wisconsin cranberry growers who use pollination services rely primarily on honeybees for optimal fruit set. On average, $140 to $210 per acre is spent on pollination services. Therefore ensuring that cranberry flowers are successfully pollinated is imperative to cranberry growers. Wisconsin growers have reported observing honeybees fly off the marsh, presumably to forage on other flower resources. Previous studies have shown a lot of variability in honeybee cranberry pollination and this variability could be due to weather conditions, varying needs of the colony, proximity to additional resources, and hive placement on the marsh. In this study, we investigated whether honeybee hive placement on the marsh impacts the foraging efficiency of honeybees on cranberry. Three hive placements were evaluated (1) near wild habitat, (2) near a water reservoir, and (3) near the center of the marsh. We expected that water and surrounding cranberry beds may not provide off-farm foraging sources unlike hives near wild habitat.

We assessed honeybee fidelity to cranberry across different hive locations using pollen morphology analyses and conducted floral assessment surveys to identify the diversity and frequency of flowering plants on the marsh and in wild habitat (wooded and open landscapes). We collected honeybees returning to hives with pollen at the 3 different locations at five marshes (A-E). Back at the lab, using a hemocytometer slide, we quantified cranberry versus non-cranberry pollen grains using pollen grain morphology. The current results show that on a particular day, contribution of cranberry pollen to honeybee hives vary from 0-96% cranberry pollination (Fig 5A). We also found that there was no difference based on location, with on average, two-thirds of all bees foraging on cranberry, regardless of hive location (Fig 5B).

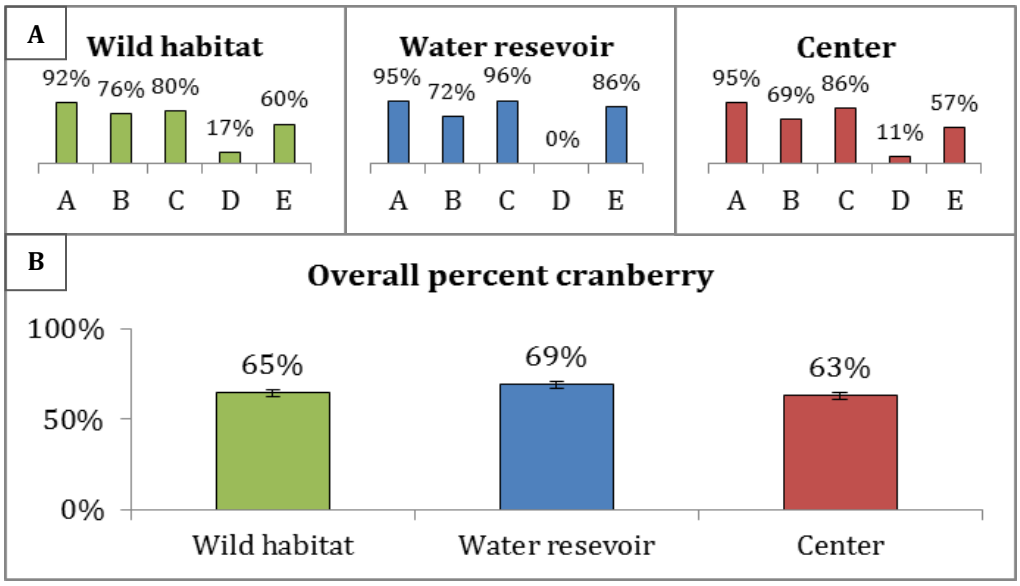

Fig 5.
(A) Percent cranberry pollen per site (A-E) for each hive location.
(B) Overall percent cranberry pollen per location.

From the floral assessment, we have compiled a list of the most common flowering plants on the marsh and off the marsh (Fig 6). Previous studies have also found that cranberry pollination varies greatly from day-to-day and across colonies. In our study, cranberry pollen contribution was variable from site to site but bees were collected on a single day during full cranberry bloom. Contrary to our expectations, there was no difference in honeybee fidelity to cranberry across hive placement locations (near water reservoir, wild habitat, and center). Some of the variability could be due to management practices, landscape type, and availability of alternate flower resources on the marsh and in the surrounding landscape, as well as abiotic factors such as weather. In this study, we sampled each marsh on a single day providing a snapshot on where bees are foraging during cranberry bloom. In 2015, we expanded this study to sample on multiple days on 11 different marshes; however the data is still being processed.

Off the marsh: open	**On the marsh: dikes**
swamp dewberry	white clover
canada thistle	sheep sorrel
cranberry	orange hawkweed
wild strawberry	canada thistle
broadleaf plantain	broadleaf plantain
steeplebush	common cinquefoil
goldenrod	wild strawberry
birdsfoot trefoil	yellow woodsorrel
common cinquefoil	yarrow
Off the marsh: wooded	
wild strawberry	orange jewelweed
bittersweet nightshade	cranberry
blueberry	bog birch
chokeberry	narrowleaf hawkweed
yellow woodsorrel	

Fig 6. Floral assessment showing most common plants on the marsh (dikes) and off the marsh (open and wooded).

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