

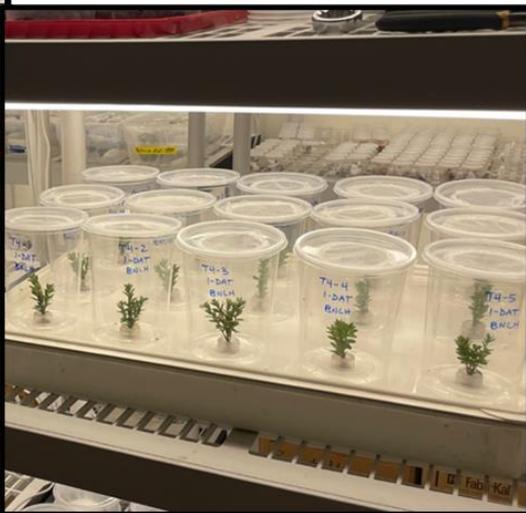
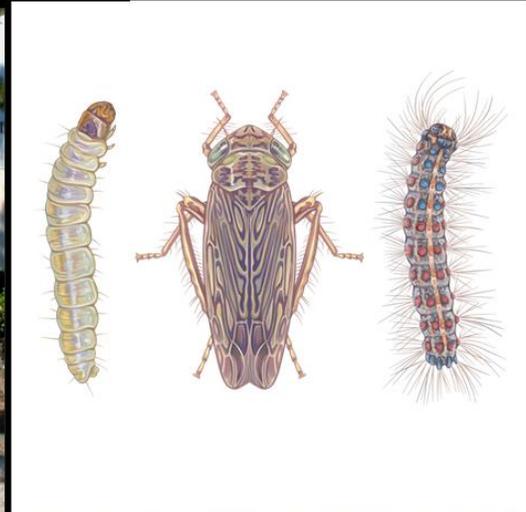
2026 Annual Winter Meeting of the American Cranberry Growers Association



Rutgers University
EcoComplex
Bordentown, NJ

Thursday
January 29, 2026

RUTGERS
New Jersey Agricultural
Experiment Station



Presentation Summaries

ACGA Winter Meeting Program

Thursday, January 29, 2026
Rutgers EcoComplex, Bordentown, NJ

8:00-8:30 Registration and Coffee

8:30-8:40 Welcoming Remarks– **Shawn Cutts, President, ACGA**
Treasurer's Report – **Shawn Cutts**

8:40-8:50 **Cranberry Statistics**

Bruce Eklund, National Agricultural Statistics Service, Trenton, NJ

8:50-9:10 **Current Approaches to Perennial Weed Control in Cranberry**

Thierry Besancon, Associate Professor & Extension Specialist, Department of Plant Biology, Rutgers University, P.E. Marucci Center, Chatsworth, NJ

9:10-9:30 **Call of the Wild: New Genetic Variation from Natural Cranberry Population Expeditions**

Jeffrey Neyhart, Research Geneticist, USDA-ARS, P.E. Marucci Center, Chatsworth, NJ

9:30-9:50 **Redirecting Genetic Gains in Rutgers Cranberry Breeding**

Gina Sideli, Assistant Professor, Department of Plant Biology, Rutgers University, P.E. Marucci Center, Chatsworth, NJ

9:50-10:10 **Can Interspecific Hybridization Mitigate the Effects of Temperature Shock?**

James Polashock, Research Plant Pathologist, USDA-ARS, P.E. Marucci Center, Chatsworth, NJ

10:10-10:25 **Break**

10:25-10:45 **Leveraging Loops, Lines, and Leaps: Copy Number Variation in Cranberry**

Joseph Kawash, Bioinformaticist, USDA-ARS, P.E. Marucci Center, Chatsworth, NJ

10:45-11:05 **Updates on Continued Fruit Quality Research**

Peter Oudemans, Professor, Department of Plant Biology, Rutgers University, P.E. Marucci Center, Chatsworth, NJ

11:05-11:35 **An Update on Cranberry False Blossom Disease and More**

Lindsay Wells-Hansen, Sr. Agricultural Scientist, Ocean Spray Cranberries, Chatsworth, NJ

11:35-12:00 **Cranberry Institute – An Update**

Katherine Ghantous and William Frantz, Cranberry Institute, Carver, MA

12:00-1:00 **Lunch**

1:00-1:30 **Water and Nutrient Translocation to Berries During Fruit Development**

Amaya Atucha, Professor and Department Chair, Department of Plant and Agroecosystem Sciences, University of Wisconsin-Madison, Madison, WI

1:30-1:50 **Results from 2025 Insecticide Trials**

Cesar Rodriguez-Saona, Professor, Department of Entomology, Rutgers University, New Brunswick, NJ, Robert Holdcraft, and Yahel Ben-Zvi, P.E. Marucci Center, Chatsworth, NJ

1:50-2:10 **Using Smart Drones for Detection and Mapping of Carolina Redroots in Cranberry Bogs**

Thanh Nguyen, Associate Professor, Department of Mathematics, Rowan University

2:10-2:40 **Pesticide Safety: Personal Protective Equipment (PPE)**

David Hlubik, County Agent III, Agriculture and Natural Resources Dept., Rutgers University, Westampton, NJ

2:40 **Adjournment- ACGA Board of Directors Meeting**

New Jersey Agricultural Statistics

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New Jersey cranberry producers expected to harvest 520 thousand barrels in 2025, down from the 588-thousand-barrel 2024 crop, according to the August 2025 survey. Total US production for the 2025 season was forecast at 8.13 million barrels, down 9 percent from the 2024 crop year. In Wisconsin, production was forecast at 5.30 million barrels, down 3 percent from 2024. Production in Massachusetts was forecast at 1.75 million barrels, down 22 percent from 2024.

For more details including acreage, yield, price, updated production, and value of production, USDA's National Agricultural Statistics will release the 2025 Non-citrus Fruit and Nut Final Summary May 1, 2026. We want to work with you to get the best data to accurately represent New Jersey cranberries. **Thank you for your help.**

Cranberry Disease Management

Peter Oudemans, Matt Hamilton, Ross Sousa, Chris Dib, Jaspreet Kaur, and
Christine Constantelos

Cranberry fruit rot was first described by New Jersey growers in the mid-1800s. At that time, the disease was so destructive that, without effective controls, it threatened the survival of the cranberry industry. Over the past century and a half, several generations of fungicides have been developed and successfully used to manage this disease complex. The current challenge is maintaining low levels of fruit rot in the face of increasing regulatory restrictions and the loss of broad-spectrum fungicides.

This presentation focused, in part, on ongoing efforts from the Rutgers Cranberry Breeding Program and the Plant Pathology program to develop sustainable fruit rot management strategies. Breeding efforts are producing advanced cranberry selections with improved genetic resistance, while pathology research is focused on integrated management programs that optimize fungicide use patterns for maintaining effective disease control.

Results from trials in “Bog 2” highlight several new fruit-rot-resistant selections, including second- and third-generation progeny that integrate multiple sources of resistance. These selections show strong promise for reducing fungicide inputs; however, precise fungicide timing remains critical for successful implementation of these systems.

In general, bloom-time applications remain the critical starting point for fruit rot management. For fruit-rot-resistant varieties, two well-timed fungicide applications may be sufficient to provide season-long control. This approach has significant implications for fruit rot management following the elimination of broad-spectrum fungicides and increases the feasibility of relying on site-specific materials. Under these systems, fungicide resistance monitoring becomes increasingly important, and identification of new modes of action is a high priority.

Evaluation of new fungicide chemistries using the lab-based FLEX bioassay has identified promising materials in FRAC groups 3, 7, 9, 11, 29, and P07. These materials are continuously being evaluated in field efficacy and use-pattern trials. Results from use-pattern trials conducted in Bogs 6 and 15 show several programs with considerable promise.

Cultural practices are also a critical component of fruit rot management. Stress reduction, particularly related to solar exposure can be managed using evapotranspiration methods and other canopy management strategies. Future cranberry fruit rot management programs will require the integration of host resistance, optimized fungicide timing, new chemistries, and cultural practices to achieve reliable control.

Product labeling is the next step before commercial adoption, with these efforts coordinated through registrants and IR-4. Field research continues to provide the data necessary to support these registrations.

Fairy ring was historically considered a minor cranberry disease during the first half of the 20th century. However, with increased production intensity and a greater emphasis on productivity, fairy ring has become a significant disease problem for cranberry growers in New Jersey and Massachusetts, with recent reports also emerging from Wisconsin.

The disease typically begins as a small area of weak or dead vines and expands uniformly in all directions, forming the characteristic ring pattern. Rings expand at a rate of approximately 30–45 cm per year, with some expanding up to 45–60 cm in radius annually. New rings may form at a rate of one to three per year, and the disease can spread into fields where it was previously absent. In severe cases, fairy ring can ultimately occupy more than 70% of a cranberry bed.

Fairy ring causes multiple negative impacts on cranberry production. The most immediate effect is direct yield loss from vine death along the expanding margin of the ring. As the interior of the ring recovers, canopy density is often reduced, resulting in fewer berries and increased fruit rot. These open areas also provide entry points for weed establishment and allow cranberry seedlings to emerge from seed deposited by rotted fruit. Plants arising from seed are genetically distinct, lower-yielding, and often more aggressive, spreading throughout the bed and reducing overall yield potential. The combined effects of ring expansion, vine death, weed invasion, increased fruit rot, and establishment of inferior genotypes significantly shorten the productive lifespan of cranberry beds and result in substantial economic losses.

A 2024–2025 survey of the New Jersey cranberry industry indicated that approximately 30% of producing beds contain at least one fairy ring. Current management recommendations emphasize early intervention. Fungicide applications should begin at bud break to rough-neck stages; applications made after hook stage are considerably less effective. Treatments should be applied to an area extending at least 10 feet beyond the active edge of the ring. Rings should be mapped the previous fall to clearly define treatment areas.

Fungicides must be applied in sufficient water volume to move the product at least six inches into the soil. Research indicates that approximately 0.2 gallons per square foot is generally adequate for typical sandy cranberry soils, although muck soils and older beds may require higher volumes. These drench applications often show variable results and typically require multiple years of treatment to achieve effective suppression.

Developing improved disease management is a critical part for achieving efficient and sustainable cranberry production in New Jersey. Convergent research efforts surrounding new varieties, horticultural methods, and robotics will become critical for plant pathogen management in the future.

Water and Nutrient Translocation to Berries During Fruit Development

Amaya Atucha, Pedro Rojas-Barros, and Beth Ann Workmaster

University of Wisconsin-Madison Department of Plant and Agroecosystem Sciences

Understanding fruit growth dynamics is essential for optimizing crop management strategies. In fleshy fruits, growth is driven by three main processes: cell division in early development, cell expansion fueled by water uptake through the xylem (which transports water and nutrients from the roots), and accumulation of sugars and other metabolites delivered through the phloem (which moves photosynthetic products). While we understand these general processes, little is known about the precise timing of nutrient movement into developing cranberries. This information could help growers optimize fertilizer applications and avoid wasteful late-season inputs.

We conducted a comprehensive two-year study (2022-2023) at the Cranberry Research Station in Black River Falls, collecting fruit and pedicels from 'Stevens' cranberries at ten time points from one week after full bloom through harvest. Our results reveal clear developmental patterns: fruit fresh and dry weight increase rapidly during early fruit development (Fig. 1), but the rate of growth slows dramatically once berries reach the blush stage, typically occurring in mid-to-late August. This growth pattern mirrors what has been observed in other berry crops, where early rapid expansion is followed by a slower maturation phase.

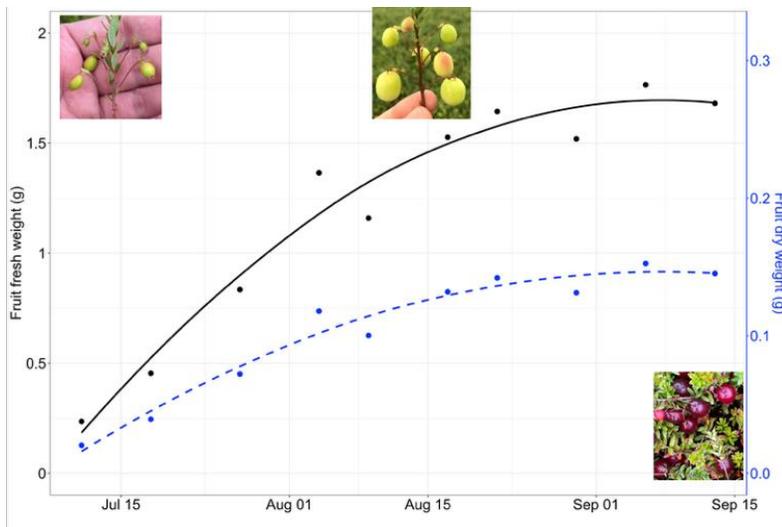


Figure1. Fresh and dry weight of 'Stevens' cranberry fruit during development.

Nutrient accumulation followed remarkably similar patterns to fruit growth. Potassium, which plays crucial roles in cell expansion and osmotic regulation, accumulated rapidly in early development but uptake nearly ceased by the blush stage (Fig. 2). Calcium and other macronutrients showed similar trends. The exception was phosphorus, which continued to accumulate through later stages of fruit development. This continued phosphorus uptake aligns with findings from grape and tomato research showing that phosphorus is closely linked to sugar

metabolism and phloem transport. As berries accumulate sugars during ripening, phosphorus continues to move into the fruit as part of sugar-phosphate compounds, even after other mineral nutrients have stopped accumulating (Fig. 3).

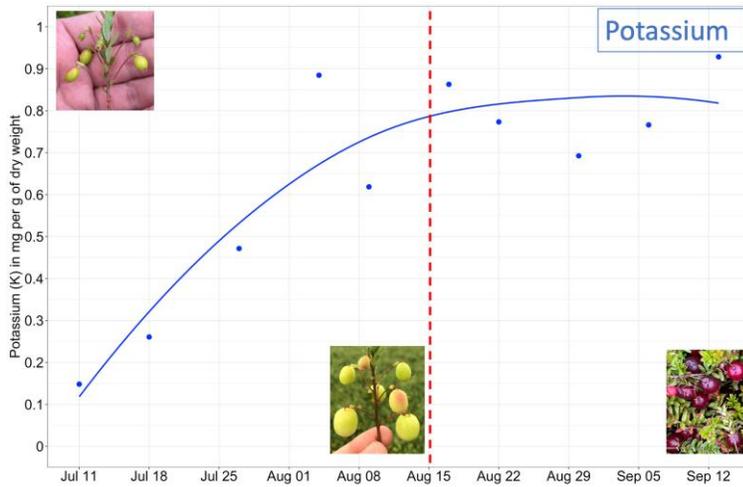


Figure 2. Potassium accumulation in 'Stevens' cranberry fruit during development.

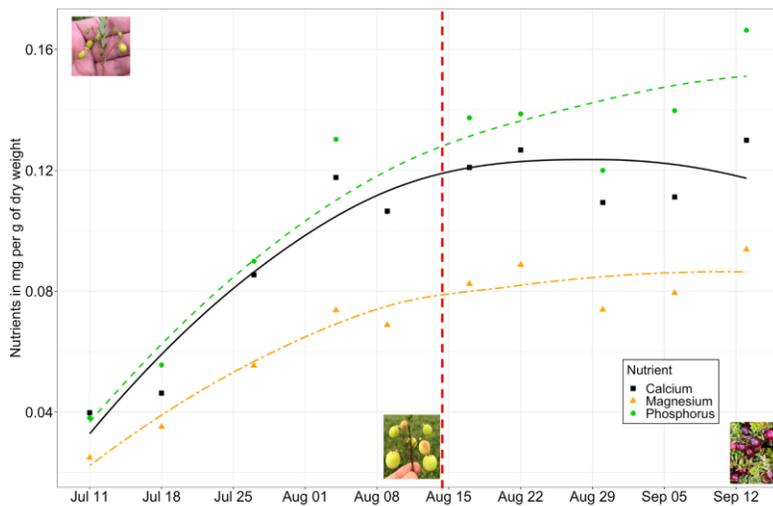


Figure 3. Accumulation of calcium, magnesium, and phosphorus in 'Stevens' cranberry fruit during development.

To understand the physiological mechanisms behind declining nutrient uptake, we examined the vascular tissue in fruit pedicels—the "pipeline" connecting fruit to the vine. Using microscopy techniques, we measured xylem vessel density and calculated hydraulic mean diameter, which indicates the capacity of the xylem to transport water. Our anatomical data revealed two important findings: first, xylem vessel density in the pedicel increased steeply until the blush stage and then plateaued or even declined toward harvest. Second, and perhaps more importantly, the hydraulic conductivity (i.e., the actual capacity to move water) was at its

maximum at fruit set and then declined continuously through harvest. This progressive loss of transport capacity has been documented in other fruit crops including grapes, tomatoes, and apples, where it's associated with fruit ripening and the transition from expansion to maturation.

The decline in hydraulic conductivity raised an important question: is the xylem still functional late in the season, or has it been completely blocked? To answer this, we conducted a dye tracer experiment that directly tested xylem function. We collected uprights with attached berries at each of our ten sampling dates and placed them in solutions containing red dye, exposing them to conditions promoting transpiration (wind and room temperature) for 20 minutes to mimic field conditions. We also tested detached fruit with pedicels still attached. The results were striking: at the beginning of the growing season, 100% of berries showed dye uptake, with red coloration visible throughout the fruit interior (Fig. 4). However, by late season, zero percent of berries took up any dye. The transition occurred around the blush stage, with uptake declining sharply during this critical developmental period.

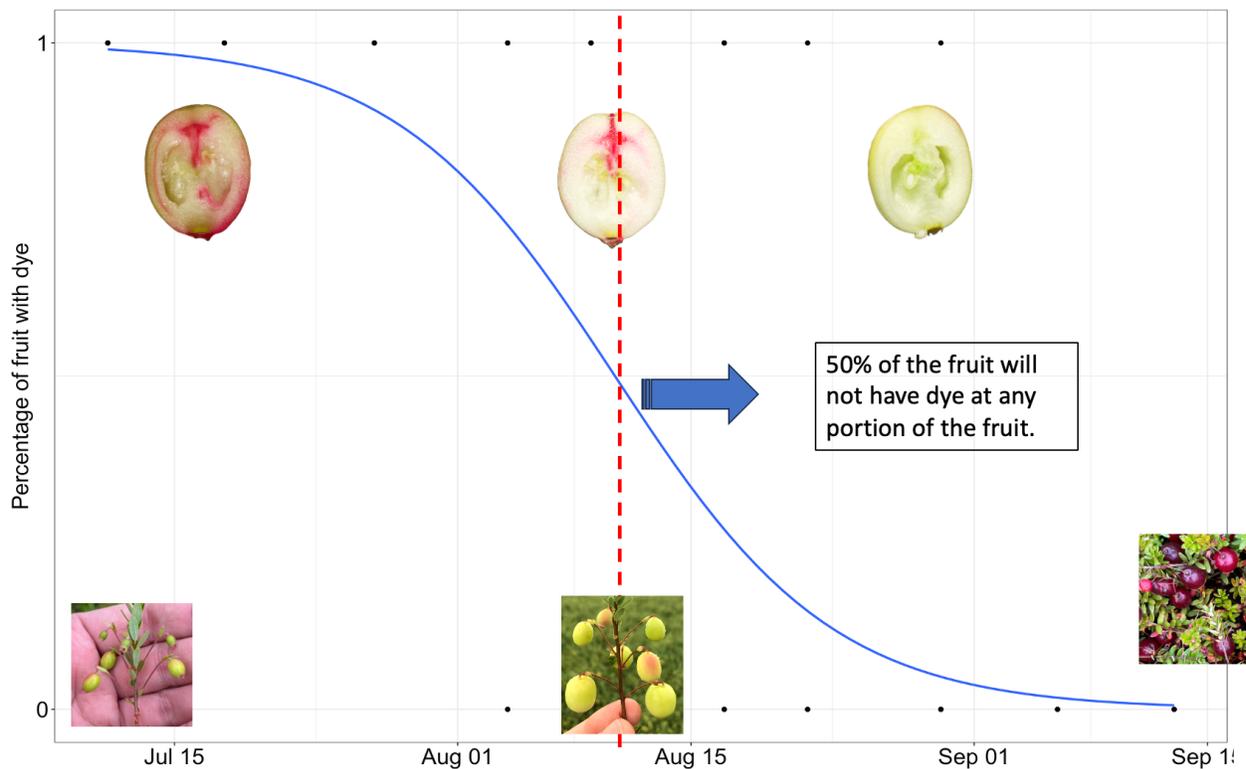


Figure 4. Functional xylem uptake in 'Stevens' cranberry fruit assessed by dye tracer experiment.

To understand what was causing this loss of xylem function, we conducted detailed microscopy of the pedicel-fruit attachment zone. Our observations revealed that beginning in early August, xylem vessels in this zone begin to break down structurally. We observed formation of an abscission-like layer where cellular connections were severed and vessel walls became disrupted. In dye experiments, we could actually see the red dye leaking out at this breakdown zone rather

than moving into the fruit. This anatomical disconnection explains the functional loss of xylem transport. Similar processes have been documented in other crops: in grape berries, xylem functionality declines at véraison (the onset of ripening), and in tomatoes, xylem backflow can occur as phloem pressure exceeds xylem pressure during ripening. The formation of an abscission-like zone in cranberry represents a particularly dramatic form of this disconnection.

Conclusions and Implications for Growers

Our study provides clear evidence that cranberry berries become physiologically isolated from the vine approximately four weeks before harvest. Water and nutrient movement through the xylem declines progressively as fruit develops, with the xylem becoming essentially non-functional by mid-to-late August. By the second week of August, 50% of fruits showed no dye uptake, and by harvest, the vascular connection was completely severed.

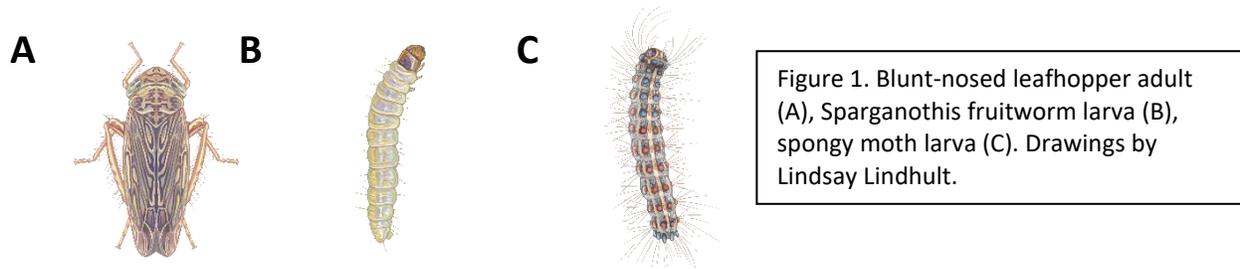
The practical implications for fertilization management are significant. Late-season applications of nutrients like potassium (often applied in August or September with the intention of increasing fruit size or improving quality) are essentially ineffective. Once the xylem has shut down, these nutrients cannot reach the developing berries. Instead, they are taken up by the vines and deposited in leaves and other vegetative tissues, where they contribute to vegetative growth and storage for the following season but provide no benefit to current-year fruit. While this vegetative uptake isn't necessarily harmful, it represents an inefficient use of fertilizer inputs and grower resources.

For optimal fertilization, nutrient applications targeting fruit development, particularly potassium, should be timed for early to mid-season, before the blush stage. This is when the xylem is fully functional and nutrients can actually reach the developing berries. Applications made after mid-August are too late to influence current fruit development. Understanding these developmental dynamics allows growers to time inputs more strategically, potentially reducing costs while maintaining or even improving fruit quality through better-targeted nutrition.

Results from 2025 Insecticide Trials

Cesar Rodriguez-Saona, Robert Holdcraft, and Yahel Ben-Zvi
P.E. Marucci Center, Rutgers University

The availability of broad-spectrum insecticides, such as organophosphates and carbamates, for use in cranberries continues to be threatened by regulatory actions. In response, new classes of insecticides have been registered, including insect growth regulators, spinosyns, and diamides. Although these products are selective, effective, and considered safe for the environment and human health, they generally do not control piercing–sucking insects (order Hemiptera), such as blunt-nosed leafhoppers. Consequently, populations of this pest have increased over the past two decades. Therefore, it is imperative to evaluate new insecticide classes to ensure the continued availability of commercially acceptable options for managing insect pests in cranberries. To address this need, insecticide trials were conducted in 2025 at the Rutgers Philip E. Marucci Center to evaluate control of three key cranberry pests: blunt-nosed leafhoppers, Sparganothis fruitworm, and spongy moth (Fig. 1).



Insecticide trial against blunt-nosed leafhoppers

This experiment evaluated the efficacy of Venom (dinotefuran), Aza-Direct (azadirachtin), Avaunt (indoxacarb), Fanfare (bifenthrin), and four unregistered insecticides for controlling blunt-nosed leafhopper in cranberries. The study was conducted in a ‘Haines’ cranberry bed at the Rutgers P.E. Marucci Center for Blueberry and Cranberry Research and Extension in Chatsworth, NJ. Applications were made using an R&D CO₂-powered backpack sprayer equipped with a 1-L plastic bottle, calibrated to deliver 50 gal/acre at 30 psi through a single TeeJet VS 110015 nozzle, corresponding to 1.58 fl oz of spray solution per plot.

Cranberry uprights were collected from the center of each plot approximately 4 h after treatment (0 days after treatment, DAT) and again on 6 June (3 DAT). Four uprights per treatment were inserted into florist’s water picks with open bottoms and enclosed within ventilated 32-oz plastic deli cups (Fig. 2). Each cup had a hole in the bottom through which the water pick was fitted snugly, and lower leaves



Figure 2. Experiment setup.

were removed before insertion. Water picks were placed in trays containing water to maintain turgidity. Five bioassay containers (replicates) were prepared per treatment for each sampling date (0 and 3 DAT). Each container held five field-collected blunt-nosed leafhopper nymphs (2nd–3rd instars). The number of live and dead nymphs was recorded 1, 3, and 6 days after exposure and expressed as percent mortality. Moribund or missing nymphs were classified as dead.

At 0 DAT, Avaunt and the new unregistered insecticide A produced moderate mortality (<40%) one day after exposure but caused high mortality (>90%) by six days (Fig. 3). In contrast, Fanfare and Venom provided rapid knockdown, achieving 100% mortality within one day. Aza-Direct showed low toxicity. By 3 DAT, Avaunt and the new unregistered insecticide remained highly effective, maintaining 100% mortality six days post-exposure. Fanfare and Venom again produced complete mortality within one day, whereas the remaining insecticides exhibited limited activity (<50%).

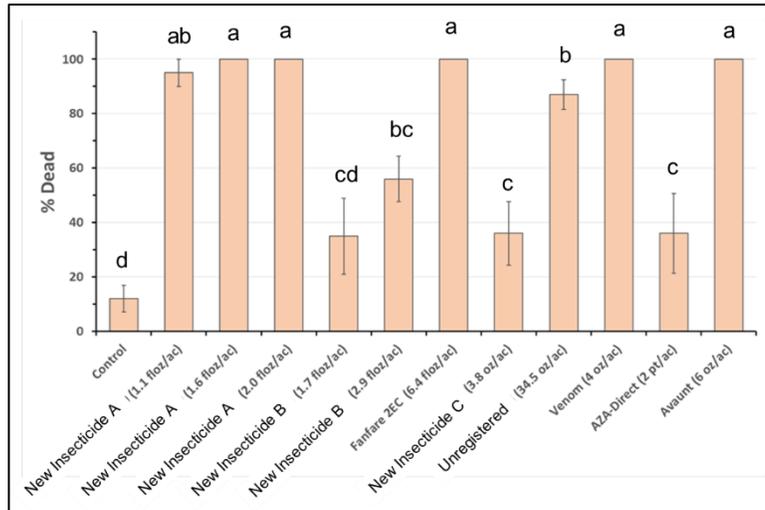


Figure 3. Toxicity of tested insecticides on blunt-nosed leafhopper nymphs at 0 DAT and 6 d after exposure. Different letters indicate significant differences among treatments.

Insecticide trial against Sparganothis fruitworm

The objective of this experiment was to compare the efficacy of a new unregistered insecticide with the grower standard Delegate (spinetoram) for controlling first- and third-instar Sparganothis fruitworm in cranberry. The study was conducted in a ‘Haines’ cranberry bed at the Rutgers P.E. Marucci Center for Blueberry and Cranberry Research and Extension in Chatsworth, NJ. Treatments were applied using an R&D CO₂ backpack sprayer equipped with a 1-L plastic bottle calibrated to deliver 50 gal of solution per acre at 30 psi through a single Teejet VS 110015 nozzle, providing an output of 1.32 fl oz per plot. Treatments were applied on 18 July.

Cranberry uprights were clipped from the central portion of each plot approximately four hours after application (0 days after treatment, DAT) and again at 3 and 6 DAT. For laboratory assays, three to four uprights were inserted into florist’s water picks with open bottoms, and the upper portions (with leaves) were enclosed in ventilated 32-oz plastic deli cups with a hole in the bottom to fit the water pick securely (Fig. 2). Prior to insertion, leaves were removed from the cut ends of uprights, and the water picks were placed in water-filled trays to maintain turgidity. Five containers were prepared per treatment. For first-instar assays, three newly hatched larvae were introduced per container. For third-instar assays, two larvae were used. Mortality was assessed seven days after exposure for first instars and after six days for third instars. The percentages of live and dead larvae were recorded.

The new unregistered insecticide caused high mortality of first-instar larvae, often exceeding the efficacy of Delegate. Mortality remained above 60% for at least 6 DAT. Similarly, the new insecticide provided strong control of third instars, achieving over 88% mortality and outperforming Delegate (Fig. 4).

Insecticide trial against spongy moth

The objective of this experiment was to compare the efficacy of a new unregistered insecticide with the grower standard Delegate (spinetoram) in controlling third-instar spongy moth larvae on cranberries. The study was conducted in a ‘Haines’ cranberry bed at the Rutgers P.E. Marucci Center for Blueberry and Cranberry Research and Extension in Chatsworth, NJ. Applications were made using an R&D CO₂ backpack sprayer equipped with a 1-L plastic bottle, calibrated to deliver 50 gal per acre at 30 psi using a single Teejet VS 110015 nozzle. Each plot received 1.32 fl oz of spray solution. Treatments were applied on 18 July 2025.

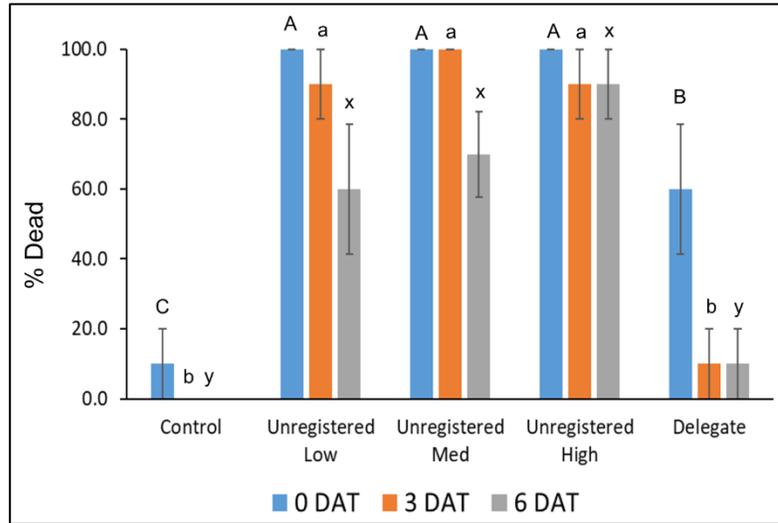


Figure 4. Toxicity of tested insecticides on Sparganothis fruitworm larvae at 0, 3, and 6 DAT. Different letters within each DAT indicate differences among treatments.

Approximately 4 hours after application (0 DAT), treated cranberry uprights were clipped from the central portion of each plot.

Additional samples were collected at 3 and 6 DAT. Three to four uprights were inserted into florist’s water picks with open bottoms. The upper portion of the uprights, containing leaves, was enclosed within ventilated assay containers made from 32-oz plastic deli cups, with holes cut in the bottom to fit the water picks snugly (Fig. 2). The stripped ends of the uprights were placed in water-filled trays to maintain turgidity. For each treatment, five assay containers (replicates) were prepared. Two 3rd larvae were placed per assay. Mortality was evaluated 5 days after larvae were introduced. The number of

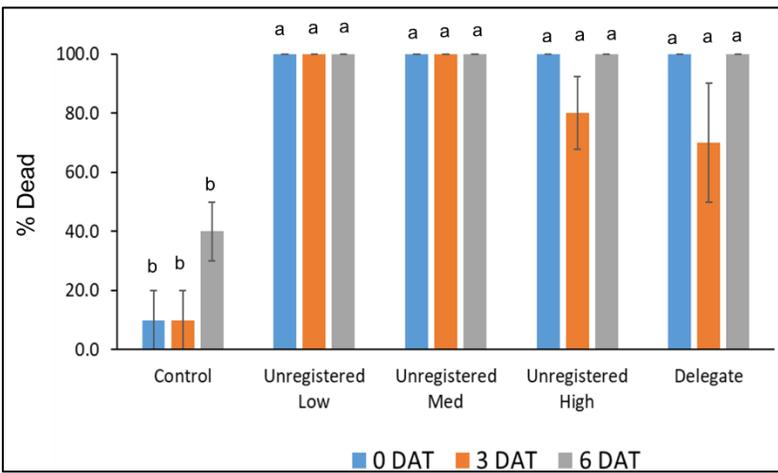


Figure 5. Toxicity of tested insecticides on spongy moth larvae at 0, 3, and 6 DAT. Different letters indicate significant differences among treatments.

larvae alive, dead, or missing was recorded, and percent mortality was calculated, considering missing larvae as dead.

Both Delegate and the new unregistered insecticide provided high ($\geq 70\%$) mortality, with residual activity lasting at least 6 DAT (Fig. 5).

Acknowledgements. We thank Aurora Gill, Vera Kyryczenko-Roth, and Jennifer Frake for their assistance during the experiments. This work was supported by funding from Syngenta, the New Jersey Cranberry Research Council, the Cape Cod Cranberry Growers Association, the Cranberry Institute, and Ocean Spray Cranberries.

Detection, Mapping, and Spot Spraying of Carolina Redroot in Cranberry Bogs using AI & Smart Drones

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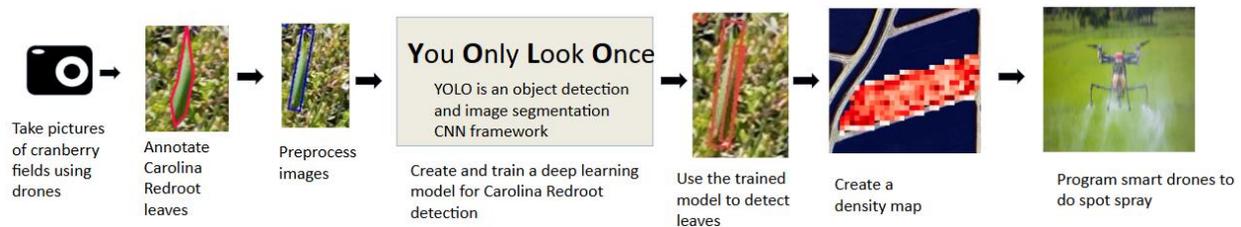
Motivation and research goal

Carolina redroot is a problematic weed in cranberry bogs due to its aggressive growth, which competes directly with cranberry plants for essential resources like water, nutrients, and sunlight. Carolina redroot also spreads through rhizome propagation, during which underground roots spread out and create new nodes that will grow above the surface. Through these processes, Carolina redroot easily crowds out cranberry vines and reduces crop yields. Managing Carolina redroot is not only labor-intensive but also financially burdensome for cranberry growers.

Our project proposes a more efficient and affordable method for controlling Carolina redroot in cranberry bogs. We develop an intelligent and autonomous drone system which can:

- automatically detect the weed in cranberry bogs
- create a Carolina redroot density map, and
- perform spot spraying.

The workflow of the proposed autonomous Carolina redroot detection & mapping system:



Development phases

The development of our Carolina redroot detection system is outlined in the above figure. It includes three phases:

Phase 1: Development of an artificial intelligence model for detecting Carolina redroot in cranberry bogs. This phase includes several steps: (1) collecting images and videos of Carolina redroot in cranberry fields; (2) manually annotating Carolina redroot leaves from the collected images; and (3) building, training, and evaluating the performance of AI-based Carolina redroot detection models.

Phase 2: Apply the trained AI-based models to images and videos collected from cranberry bogs and create Carolina redroot density maps to assist farmers in the weed management process.

Phase 3: Program autonomous drones to perform spot spraying. Using the density map created in Phase 2, the autonomous drones are programmed to fly to the areas with high density of the weed and perform spot spraying. The drones can also perform a real time detection to confirm the presence of the weed before spraying.

Achieved Results

Image annotation & Carolina redroot detection models: In the summers of 2023-2025, our project team collected more than 370 GB of images and videos of Carolina redroots in different times (May, June, July, and September) from cranberry bogs in Pine Island Cranberry fields. The project team has performed several rounds of image annotation to provide training data sets for the AI-based Carolina redroot detection models. So far, more than 35,000 Carolina redroot leaves have been annotated



Annotations of Carolina redroot leaves

Two different Carolina redroot detection models have been developed. Both of them were built based on the same deep learning architecture but trained on two different data sets. The first data set contained aggressively-annotated Carolina redroot leaves, meaning that we annotated all areas in the images that we thought Carolina redroot leaves, even if they are not very clearly visible. The second data set contained conservatively-annotated leaves only, meaning that we only annotated leaves which are visibly clear. Our best model was able to detect about 72% of the Carolina redroot leaves that we manually annotated.

The following figures show examples of detected Carolina redroot leaves in collected images.

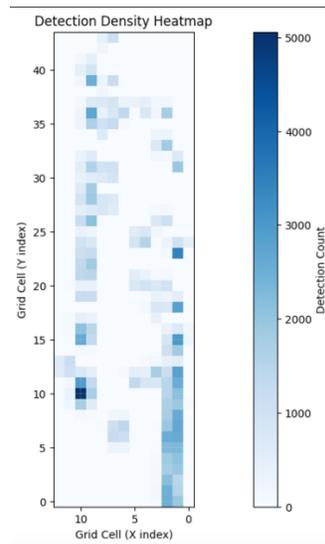


Carolina redroot leaves detected by the model



Carolina redroot leaves detected manually

Density map: To create a density map of the Carolina redroot in a cranberry bog, a drone flew along a pre-programmed path to collect videos. Then, video frames were extracted and fed into the Carolina redroot detection. The detection results were then used to create a Carolina redroot density map of the bog. The density map is color-coded. The below figure shows a density map created by our program.



Drone programming & spot spraying: A drone control software package has been developed. With this package, a drone is set to fly to a series of preselected GPS locations and perform spot spraying at each location. A drone simulation package has been developed to illustrate how the drone spot spraying works.

Future work

We plan to deploy our technology in summer 2026 on different cranberry farms to assess its performance in mapping out Carolina redroot. We also plan to implement the drone control software on our customized drones to test their spot spraying mechanisms.

Acknowledgements

The project is supported by the New Jersey Department of Agriculture through the Specialty Crop Block Grant program. It was also partially supported by Rowan University department of Mathematics, College of Science and Mathematics. We would like to thank Pine Island Cranberry Farm (Chatsworth, NJ) for allowing us to collect images and videos of their cranberry bogs for this project.