# 2025 Annual Summer Meeting of the American Cranberry Growers Association

AMERICAN CRANBERRY GROWERS association

**Rutgers University**
**P.E. Marucci Center**

Chatsworth, NJ

**Thursday**
**August 21, 2025**

RUTGERS
New Jersey Agricultural Experiment Station


Presentation Summaries

# American Cranberry Growers Association
# 2025 Summer Field Day

## Thursday August 21, 2025
## 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 (porta-potty) located at the Center's Pole Barn.

**CRANBERRY BOGS**

8:00–8:30 **Refreshments**

8:30–8:50 **Opening Remarks**
*Shawn Cutts*, President, American Cranberry Growers Association

8:50–9:20 **OSC Research Update 2025 (Bog 7)**
*Lindsay Wells-Hansen,* Senior Agricultural Scientist, Ocean Spray, Chatsworth, NJ

9:20–9:50 **Discovering New Traits for Pre-Breeding using High-Throughput Phenotyping (Bog 7)**
*Jeffrey Neyhart,* Research Geneticist, USDA-ARS, and *Breanne Kisselstein*, USDA-ARS Agricultural Science Research Technician, P.E. Marucci Center, Chatsworth, NJ

9:50–10:20 **From Field Layout to Automated Crop Phenotyping using HARV (Hyperspectral Agricultural Research Vehicle) (Bog 5)**
*James Polashock,* Research Plant Pathologist, *Joseph Kawash*, USDA-ARS, P.E. Marucci Center, Chatsworth, NJ, *Iman Dehzangi*, *Bobbi Zonin*, and *Malav Champaneria*, Center for Computational and Integrative Biology (CCIB), Rutgers University

10:20–10:50 **Fruit Rot Management 2025 (Bog 2)**
*Peter Oudemans,* Professor & Extension Specialist, Department of Plant Biology, Rutgers University, and *Matt Hamilton*, P.E. Marucci Center, Chatsworth, NJ

11:00–11:30 **Berry Metrics at Scale: High Throughput Phenotyping for Rapid Plant and Fruit Analysis (Breeding Headhouse)**
*Nicolas Jimenez*, Postdoctoral Researcher, and *Gina Sideli,* Assistant Professor, Department of Plant Biology, Rutgers University, P.E. Marucci Center, Chatsworth, NJ

11:30–12:00 **A Summary of 2025 Entomological Research (Entomology Greenhouse)**
*Cesar Rodriguez-Saona,* Professor & Extension Specialist, Department of Entomology, Rutgers University, *Hao-tian Liu*, and *Robert Holdcraft*, P.E. Marucci Center, Chatsworth, NJ

12:00–1:00 **LUNCH (POLE BARN)**

1:00–1:15 **Update on Cranberry False Blossom Disease Research**
*Lindsay Wells-Hansen,* Senior Agricultural Scientist, Ocean Spray, Chatsworth, NJ

1:15–1:45 **On Farm Safety: Pesticide and Road Safety**
*David Hlubik*, County Agent III (Assistant Professor), Agriculture and Natural Resources Dept., New Jersey Agricultural Experiment Station, Rutgers University

# Discovering new traits for pre-breeding using high-throughput phenotyping

***Jeffrey Neyhart**, Research Geneticist, USDA-ARS, P.E. Marucci Center, Chatsworth, NJ;*
*Taylor Bainbridge*, USDA-ARS Technician

### *Cranberry pre-breeding preliminary evaluation trial*

We established the first field trial for the USDA-ARS cranberry pre-breeding program in bog 7 in 2024. The trial is completely randomized with 437 different cranberry clones present, including new germplasm (wild clones and native selections) and offspring from crosses made in 2021 and 2022. These crosses were made to combine high yields and potential disease resistance, stress tolerance, and superior fruit quality from wild or unimproved clones.

| Type | Number of clones |
|---|---|
| Diverse germplasm | 80 |
| Elite x wild offspring | 59 |
| Elite x native sel. | 19 |
| Native sel. x native sel. | 117 |
| Native sel. x wild | 132 |
| Wild x wild | 30 |

We will use this trial to test new phenotyping technologies and breeding methods and to make selections for advancement or germplasm release.

### *High-throughput phenotyping for trait discovery*

One goal of the pre-breeding program is **trait discovery**, which is the process of identifying novel characteristics that are valuable or favorable for developing new cranberry cultivars. These characteristics are also known as **phenotypes**. Traits may be discovered in two ways: 1) using traditional methods to record phenotypes in new breeding populations (e.g. finding new genetic sources of fruit rot resistance) or 2) applying new methods to record entirely new phenotypes (i.e. measuring heat stress resistance using thermal imaging). We are developing high-throughput systems for both methods of trait discovery.

#### *CranCart: proximal sensing cart*

We continue to use the *CranCart,* our **low-cost and lightweight** sensing cart to rapidly measure phenotypes on cranberry breeding populations in the field. The cart is equipped with a micro-computer that collects data from RGB sensors, a thermal sensor, and a GPS receiver, all of which is battery-powered. Using AI models and computer vision software, we can measure phenotypes from the sensor data, including:

1. Canopy temperature / heat stress
2. Fruit count and estimated yield
3. Flowering/bloom progress (% in/out bloom)


**Figure 1.** Visualization of traits that we can measure using the *CranCart*, including canopy temperature / heat stress (left), fruit count and yield estimation (middle), and flowering progress (right).

<u>*BerryBox: postharvest fruit imaging*</u>

To measure postharvest fruit quality phenotypes on breeding populations, we use our custom-made, low-cost (<$600) fruit imaging system. The system is composed of a lightbox to ensure consistent photographic conditions, a micro-computer to capture images from a DSLR camera, and a software pipeline that uses AI models and computer vision to identify fruit and measure their attributes. Using the *BerryBox*, we can measure phenotypes such as:

1. Fruit color (related to anthocyanin content)
2. Fruit size and shape
3. Uniformity of color, size, and shape

In our latest upgrade, we have trained an AI model to identify **rotten vs sound** fruit, and count the proportion of rotten fruit, from an image. This model distinguishes sound and rotten fruit with **97% accuracy.** This method enables more rapid measurements of fruit rot incidence than by traditional sorting, allowing for quicker identification of clones with greater fruit rot resistance.

**Figure 2.** The *BerryBox* system includes (top) a lightbox and (bottom) a microcomputer to capture images using a DSLR camera.

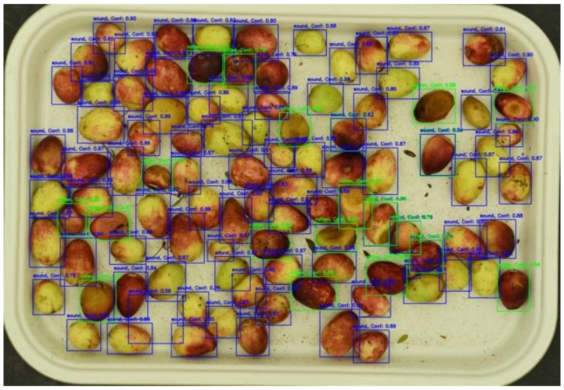


**Figure 3.** Example output of our AI model that can detect and count sound and rotten fruit in an image.

# FROM FIELD LAYOUT TO AUTOMATED CROP PHENOTYPING USING HARV (HYPERSPECTRAL AGRICULTURAL RESEARCH VEHICLE)

James Polashock and Joseph Kawash, USDA-ARS, Chatsworth, NJ

Iman Dehzangi, Bobbi Zonin, and Malav Champaneria, Center for Computational and Integrative Biology (CCIB), Rutgers University, Camden, NJ

We are programming our field robot, using Python, to meet the goal of accurate and efficient in-field automated phenotyping. The robot, which has a capacity to run for 8 hours on dual lithium batteries while hauling a 1000-pound load, is also being adapted to accurately layout new plot fields.

Initially, for automated travel, we started with a robot-mounted RGB Camera that recorded video from the field that was stored in a binary file containing all metadata, including GPS RTK corrections, focal length, disparity view, and other necessary details (Fig. 1). We then performed segmentation of crop and soil to train a model for robot movement, developing this technology on each frame from the recorded video (Fig. 2).

Although the robot can be accurately GNSS/RTK guided, we found that field irregularity makes automated travel through research plots unreliable. To solve this issue, we fitted the tractor with an RGB depth camera. This became a turning point in our approach. The depth sensor allowed us to capture accurate distance values for every pixel, enabling us to generate heatmaps that were both spatially and visually informative. In these heatmaps, paths ahead were colored differently from nearer crops, creating clear visual separation. This depth-enhanced mapping made it easier for the robot to identify safe navigation routes. Once all frames were processed into heatmaps, we trained a Convolutional Neural Network (CNN) consisting of multiple convolutional layers for feature extraction, pooling layers for dimensionality reduction, and fully connected layers for decision-making. This architecture enabled the robot to interpret heatmaps effectively and navigate autonomously in different fields.

The robot can carry an integrated array of sensors, such as our hyperspectral imager that can 'see' and record features such as cranberry fruit rot in field plots. In addition, the robot can be fitted with implements such as sprayers, compost spreaders and cultivators. Together, the advancements we implemented in custom programming and depth sensing in color will allow us to take another step in in the direction of automated field plot layout and phenotyping of important traits.

Figure 1. Unprocessed field of vision of robotics forward camera. The camera takes in a standard RGB image of the terrain in front of the robot. The software will take into account the plot locations, the paths on the side of the plots, and move forward as directed while avoiding travel on the vegetation.

Figure 2. Using machine learning and segmentation analysis, the robot is trained to recognize vegetation areas (green) that should not be traveled on and potential paths (red) that can be traveled on. Additionally, breaks between vegetation segments, combined with GPS coordination, will denote specific plot locations where measurements will be taken.

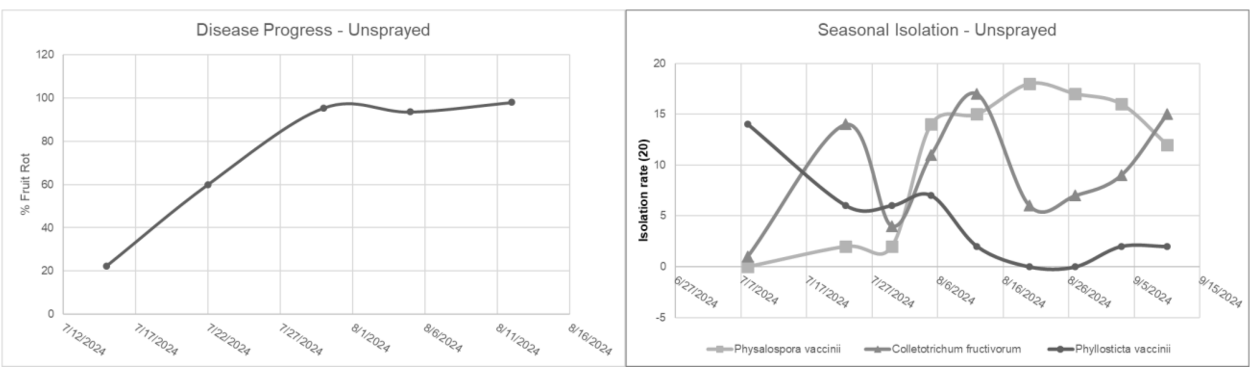
## CRANBERRY FRUIT ROT (CFR) MANAGEMENT UPDATE

*Peter V. Oudemans, Matt Hamilton, Luke Mackara, Chris Dib and Christine Constantelos*
*PE Marucci Center for Blueberry and Cranberry Research and Extension, New Jersey Agricultural Experiment Station, Rutgers, The State University*

Cranberry fruit rot (CFR) remains one of the most important challenges for cranberry growers. The disease directly reduces yield and quality, and once incidence passes a certain threshold, entire loads can be rejected. Losses are most severe in the Northeast but can also be significant in the Midwest and Pacific Northwest. In New Jersey, unsprayed plantings or research plots can suffer up to 100% losses. Without fungicides, North American cranberry production could be reduced by about 20% (Rice-Mahr and Moffitt, 1994).

CFR is not caused by a single fungus but rather a complex of species. Traditionally, we have managed this complex as one disease, but, with improved detection tools and increased dependence on site-specific fungicides there will be an increasing need to target the different categories of fruit rot separately. In addition, each of these pathogens respond differently to different fungicides, especially site-specific fungicides, so future management will require more tailored strategies.

- **Early Rot** (*Phyllosticta vaccinii*) is most common in new plantings and causes losses in July–August, but symptoms are rarely visible at harvest.
- **Field Rot** (*Physalospora vaccinii, Colletotrichum fructivorum, Coleophoma empetri*) show symptoms later in the season and strongly affect fruit quality at the receiving station.
- **Field rot with other symptoms:** *Phomopsis vaccinii* causes upright dieback, as well as fruit rot and both stages can result in significant loss.



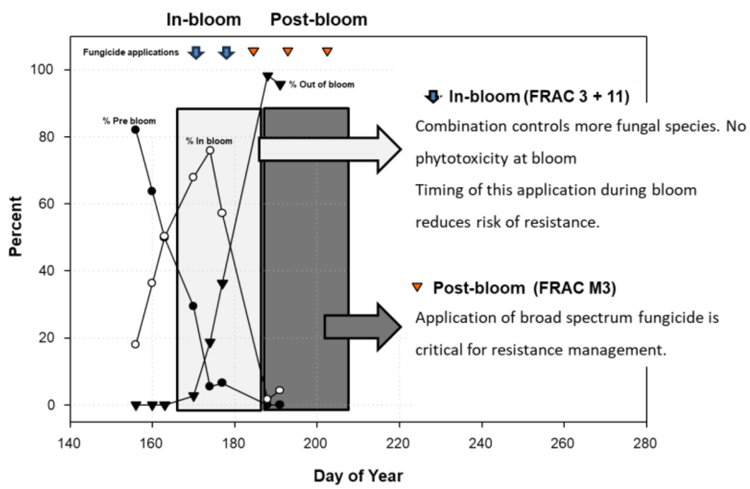

Graphs showing fruit rot symptom expression in untreated plots (left) and fungal incidence (right). Note how *Phyllosticta* early rot incidence declines as the season progresses while *Physalospora* and *Colletotrichum* increase.

## Fungicide Programs and Resistance Management

Broad-spectrum, surface-acting fungicides such as **chlorothalonil** and **mancozeb** have been the backbone of CFR control for decades. They protect against all major pathogens and help prevent resistance. However, with chlorothalonil deregistration, growers will rely heavily on other FRAC groups. The long-term impact of this shift on disease populations is not yet clear, but changes in species composition are possible.

Effective control depends on **both timing and sequence** of applications:

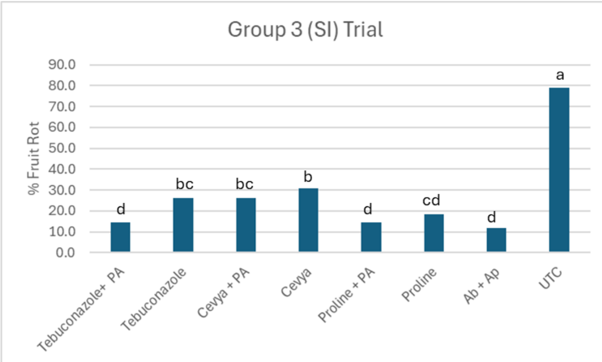
- Most infections occur during **flowering and early fruit development**, making early sprays critical.
- Chlorothalonil provides strong protection but is phytotoxic during bloom, so it is best used **after fruit set**.
- Our research shows the **60% out-of-bloom stage** is a tipping point—waiting beyond this significantly reduces control.

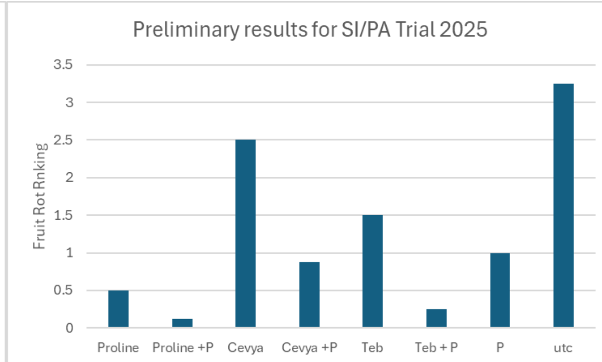



Control of cranberry fruit rot is achieved by proper timing and sequence of fungicide applications. In-bloom sprays are the critical starting point for fungicide applications. Our research suggests that the 60% out of bloom stage is an important tipping point after which control declines rapidly. Typically, combinations of FRAC 3 and 11 fungicides provide excellent disease control. For post-bloom applications chlorothalonil or mancozeb is used. In general, for New Jersey, fungicide applications begin in mid-June and are complete by late-July.

## Fungicide Groups for CFR management

- **Group 3 (Proline, Cevya, Quadris Top):** Moderately systemic, moderate resistance risk, variable efficacy across CFR species. Work well when combined with Group 11 or P07 fungicides.
- **Group P07 (Phosphorous Acid):** Induce plant resistance, highly systemic, low resistance risk, but weak alone against fruit rot. Provide improved control when paired with Group 3 fungicides.
- **Group 11 (Abound):** Translaminar, high resistance risk (already reported in MA), effective in combination with Group 3 or some Group 7 fungicides.
- **Group 7:** Not yet registered for cranberry, but some materials are under IR-4 review. Medium to high resistance risk. Combine well with Group 11.
- **Group 29:** Also pending registration through IR-4. Low resistance risk but nonsystemic and short-lived on plant surfaces.

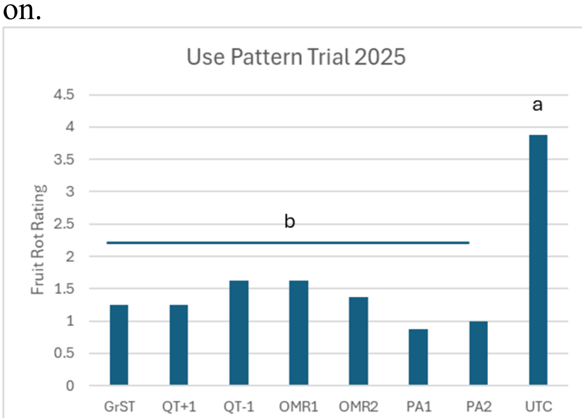



Results showing impact of adding a phosphorous acid (P07) product with a FRAC group 3 fungicide. Graph on the left shows harvested fruit results from 2024 and the graph on the right shows preliminary results for 2025 using a fruit rot rating.

## Developing New Use Patterns

Over the past several years, we have tested a range of programs using both registered and candidate products. Several new sequences provided control equal to or better than current standards. The challenge now is to refine these into sustainable programs that growers can rely on.




Preliminary results on the 2025 use pattern trial showing a grower standard (4-spray) on the left and an untreated control on the right. Of the six use patterns shown there was no broad spectrum fungicides used.

## Next Steps: Registration and Implementation

Progress depends on new fungicide registrations. IR-4 and product registrants are critical partners in this process, with strong support from the Cranberry Institute. Once products are registered, larger-scale testing will be needed to fine-tune use patterns and monitor for unexpected outcomes.

**Berry Metrics at Scale: High Throughput Phenotyping for Rapid Plant and Fruit Analysis**

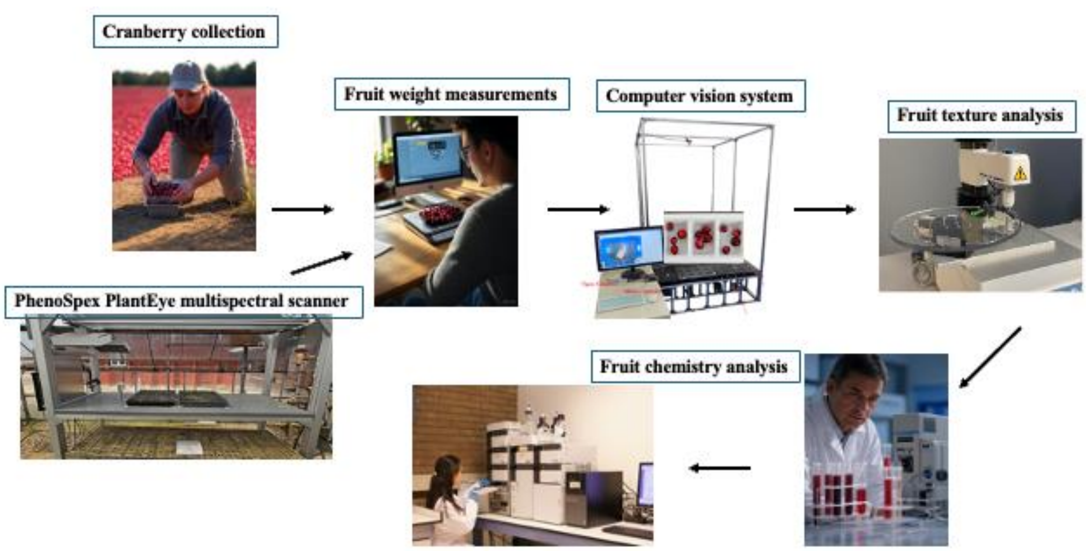
*Gina Sideli,* Assistant Professor, *Nicolas Jimenez*, Postdoctoral Associate, *Sara Knowles*, Lab Technician, *Jeremy Simon*, *Caisey Neil-Martino*, *Caitlin Dwight*, Seasonal workers, Department of Plant Biology, Rutgers University, P.E. Marucci Center, Chatsworth, NJ

Rutgers cranberry breeding program has implemented a comprehensive, automated phenotyping system that integrates multiple technologies for efficient data collection across fruit and vegetative traits. The workflow begins with barcode tagging of individual plants and berry clamshells, enabling sample collection and tracking through automated scanner input reducing errors.

Real-time data collection is facilitated through iPad interfaces, while fruit phenotyping is automated via several specialized systems: an automated scale captures precise fruit weight measurements, a computer vision system equipped with a fixed camera captures standardized fruit images, fruit texture field penetrometer and texture analyzer. Custom algorithms process these images to quantify color parameters, fruit size dimensions, and rot assessment. Fruit texture analysis is performed using a dedicated texture analyzer to measure firmness and related mechanical properties.

For vegetative growth monitoring, we have employed a Phenospex PlantEye automated imaging system that captures time-series plant images and spectral data. This system provides continuous monitoring of plant development with integrated analysis of morphological measurements and spectral signatures over the growing season.

This integrated workflow significantly increases the amount of fruit and plants that can be measured while maintaining data quality and traceability, enabling more efficient selection decisions in our breeding program through comprehensive quantitative trait assessment.



## A SUMMARY OF 2025 ENTOMOLOGICAL RESEARCH

**Cesar Rodriguez-Saona, Professor & Extension Specialist, Department of Entomology, Rutgers University, Hao-tian Liu, and Robert Holdcraft, P.E. Marucci Center, Chatsworth, NJ**

In 2025, research at the Rutgers P.E. Marucci Center focused on three main objectives: 1) evaluating a new insecticide against various insect pests; 2) understanding the timing of phytoplasma acquisition and transmission between leafhoppers and cranberry plants; and 3) investigating the effects of different fertilizer regimes on the interactions between cranberry plants, phytoplasma, and insects.

Objective 1. Evaluate new insecticides against cranberry pests.

In 2025, we evaluated the residual toxicity of a new, unregistered insecticide against blunt-nosed leafhopper nymphs, Sparganothis fruitworm larvae, spongy moth larvae, and toad bug adults in small-plot and laboratory assays at the P.E. Marucci Center (Fig. 1). Insecticide applications were made to 4-by-4-foot cranberry plots. Toxicity was assessed by exposing insects to field-weathered foliage residues collected at different intervals after treatment. On each sampling date, insecticide-treated uprights were inserted into florists' water picks, enclosed in ventilated 40-dram plastic vials, and secured in Styrofoam trays. The plants and insects were then held in the laboratory, and insect mortality was recorded after transfer. For each assay, the number of larvae or nymphs alive, dead, or missing was documented.

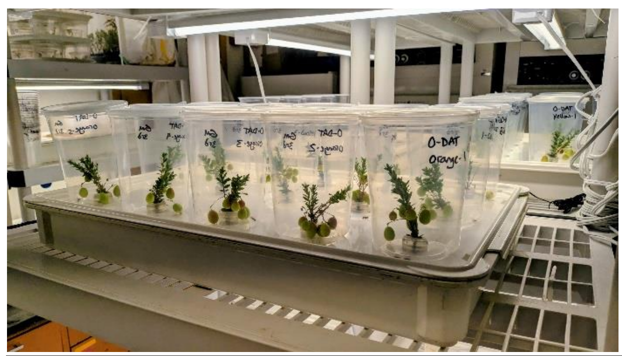


Fig. 1. Small plot/lab experiments evaluated toxicity of a new insecticide on insect pests of cranberries.

Objective 2. Understand the timing of acquisition and transmission of phytoplasma between leafhoppers and cranberry plants.

The objective of these studies is to determine the timing of acquisition and transmission of the phytoplasma that causes false blossom disease by blunt-nosed and sharp-nosed leafhoppers. This work is being conducted in collaboration with Dr. James Polashock (USDA-ARS).

For the **acquisition** studies, five nymphs or adults were placed on phytoplasma-infected or non-infected (control) plants. Insects were removed after 1, 3, or 5 days of feeding and tested for phytoplasma using methods developed in Dr. Polashock's laboratory. Each insect × stage × time combination was replicated five times (i.e., five plants per treatment).

For the **transmission** studies, five nymphs or adults were placed on phytoplasma-infected plants. After 5 days of feeding, insects were transferred to non-infected plants. As a control, five nymphs or adults were placed on non-infected plants and then moved to a second set of non-infected plants after 5 days. Plant material was collected 5, 10, and 20 days after insect feeding to test for phytoplasma presence. Each treatment (infected-to-non-infected and non-infected-to-non-infected) × time interval combination was replicated five times. All studies were conducted in growth chambers under controlled environmental conditions.

In addition, a **long-term transmission** study was initiated. Adult blunt-nosed and sharp-nosed leafhoppers were placed on infected 'Ben Lear,' 'Crimson Queen,' and 'Stevens' cranberry plants. After 5 days of feeding, they were transferred to uninfected plants of the same variety. Plant samples are being collected every 10 days to quantify phytoplasma titer.

<u>Objective 3. Investigate the effects of fertilizer regime on cranberry, phytoplasma, and insect interactions.</u>

These studies aim to evaluate cranberry resistance to insect pests and diseases under varying nutrient levels. The research is being led by PhD student Hao-tian Liu in collaboration with Dr. James Polashock (USDA-ARS). Phytoplasma-infected and uninfected 'Crimson Queen' plants were propagated in the greenhouse (Fig. 2) and subjected to four fertilizer rates. In 2025, we examined the effects of these treatments on blunt-nosed leafhopper feeding behavior and oviposition through a series of choice experiments. To investigate potential mechanisms, plants from the same treatments were also used for volatile collection and hyperspectral imaging analyses.

Fig. 2. Greenhouse experiments evaluated the effects of phytoplasma infection and fertilizer rates on blunt-nosed leafhopper feeding and oviposition behavior.