2023 Annual Summer Meeting of the American Cranberry Growers Association

AMERICAN CRANBERRY GROWERS association

Rutgers University
Marucci Center

Chatsworth, NJ

Thursday
August 24, 2023

RUTGERS
New Jersey Agricultural Experiment Station

Presentation Summaries

American Cranberry Growers Association
2023 Summer Field Day

Thursday August 24, 2023
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

8:00–8:30 **Refreshments**

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

8:45–9:05 **Cranberry Germplasm Collection: Heart of the Breeding Program (Bog 1)**
Jennifer Johnson-Cicalese, Research Associate, *Sara Knowles* and *Thomas Spain*, Technicians, P.E. Marucci Center, Chatsworth, NJ

9:05–9:25 **Fruit Rot Management Beyond 2023 (Bog 2)**
Peter Oudemans, Professor & Extension Specialist, Department of Plant Biology, Rutgers University, *Matt Hamilton*, *Luke Mackara*, *Sophie DeCoite*, *Kristin Dana*, *Jennifer Johnson-Cicalese*, and *Christine Constantelos*, P.E. Marucci Center, Chatsworth, NJ

9:25–9:45 **Introducing Cifarelli Vacuum Harvester for Cranberry (Bog 3)**
Thierry Besancon, Associate Professor & Extension Specialist, Department of Plant Biology, Rutgers University, and *Wesley Bouchelle*, P.E. Marucci Center, Chatsworth, NJ

9:45–10:05 **Introducing H.A.R.V. – Hyperspectral Agricultural Research Vehicle (Bog 5)**
James Polashock, Research Plant Pathologist, *Joseph Kawash*, and *Lindsay Erndwein*, USDA-ARS, P.E. Marucci Center, Chatsworth, NJ

10:05–10:25 **New Phenotyping Technologies for Cranberry Breeding (Bog 5)**
Jeffrey Neyhart, Research Geneticist, USDA-ARS, P.E. Marucci Center, Chatsworth, NJ

10:25–10:45 **2023 Challenges & OSC Research Updates (Bog 19)**
Lindsay Wells-Hansen, Senior Agricultural Scientist, Ocean Spray, Chatsworth, NJ

10:45–11:05 **Overview of Entomological Research on Cranberries at Rutgers (Bog 19)**
Cesar Rodriguez-Saona, Professor & Extension Specialist, *Yahel Ben-Zvi*, *Haotian Liu*, Department of Entomology, Rutgers University, *Paolo Salazar-Mendoza*, and *Robert Holdcraft*, P.E. Marucci Center, Chatsworth, NJ

POLE BARN

11:20–11:30 **Cranberry Statistics**
Bruce Eklund, National Agricultural Statistics Service, Trenton, NJ

11:30–12:00 **Current Fruit Rot and False Blossom Research in Wisconsin**
Leslie Holland, Assistant Professor & Extension Specialist of Fruit Crop Pathology, *Ana Maria Vazquez-Catoni*, *Casey Trickle*, *Eithan Pozas-Rodriguez*, *Evan Lozano*, and *Fabian Rodriguez-Bonilla*, Department of Plant Pathology, University of Wisconsin-Madison, WI

12:00–1:00 **LUNCH**

1:00–1:30 **Resistance Management and the Pesticide Label – What You Need to Know**
Kate Brown, Program Associate—Commercial Agriculture, and *William Bamka*, Rutgers Cooperative Extension of Burlington County

1:45–3:15 **LAB TOURS**

- Jeffrey Neyhart – New tools for plant phenotyping
- James Polashock and Joseph Kawash – Improved phenotyping for cranberry fruit rot
- Cesar Rodriguez-Saona – An entomology lab for studying insect behavior and chemical ecology
- Jennifer Johnson-Cicalese – The Breeding Program at the Rutgers Marucci Center
- Peter Oudemans – The Pathology Program at the Rutgers Marucci Center
- Thierry Besancon – The Weed Science Program at Rutgers Marucci Center

Cranberry Germplasm Collection: Heart of the Breeding Program

***Jennifer Johnson-Cicalese,* Research Associate, *Sara Knowles and Thomas Spain*, Technicians, *Nicholi Vorsa*, Professor Emeritus, P.E. Marucci Center, Chatsworth, NJ**

The Rutgers cranberry germplasm collection represents the heart, the history, and the future of our breeding program. The germplasm of American cranberry, *Vaccinium macrocarpon* Ait., can be defined as varieties that have been domesticated from native populations over the last 200 years, and plant material that exists currently in native populations. Beginning in 1985, Nick Vorsa began assembling cranberry collections from 1) other State Agricultural Experiment Station programs in Massachusetts, Wisconsin, and Washington; 2) old cranberry beds around the country; 3) and wild germplasm from native populations across the geographic distribution of American cranberry, including NJ, DE, WV, PA, NY, MA, ME, MI, and WI in the United States, and NB in Canada. This valuable collection represents a considerable portion of the available genetic diversity of cranberry, and thus has been carefully maintained at the Marucci Center for the past 38 years, being replanted from fingerprinted stolons as needed. The collection is not static, but continually being increased with new varieties and wild accessions.

In 2003 and 2004, when the focus of our program turned to developing cultivars with improved fruit rot resistance, the collection was screened for resistance. Fungicides were withheld and severe fruit rot pressure occurred. Multiple sources of resistance were identified, including accessions from New Jersey, Massachusetts, Washington, and New Brunswick, Canada. These genetically diverse accessions were used extensively in crosses. Now multiple generations later and 1000's of progeny evaluated, we are close to meeting our goal of improved fruit rot resistance <u>and</u> high yield.

When we started a project to develop cranberries with lower acidity, we reviewed 1998 data on organic acids levels and identified an exceptionally low malic acid (3mg/g FW vs. normal levels of 6-8mg/g) and low citric acid (1mg/g FW vs. normal 8-11mg/g) accession. In 2005, we began making crosses with these accessions and have generated over 600 populations. Hundreds of seedlings from these populations have been screened for low citric and/or malic acid genotypes using KASP markers (Fong et al. 2020 and 2021). Fruit from these plants were also tested for titratable acidity (TA) and a wide range of values (0.60 - 2.97) were found. Progress has been made in lowering fruit acidity in cranberry; plants with TA below 1.5 are now being evaluated in field plots.

Cranberry fruit contains high levels of compounds associated with human health including anthocyanins, proanthocyanidins and flavonols. In a study measuring proanthocyanidin in our germplasm collection, a wide range of levels were found, with a few wild accessions having the highest levels. A recent survey of flavonols found considerable diversity, one accession had very high quercetin-3-galactoside, another with high quercetin-3-rhamnopyranoside, as well as high total flavonol (Fong et al. 2019)

Now, with sweetened dried cranberries (SDC) being such a large share of the market, new traits are being considered, such as fruit firmness and internal structure. In cooperation with Dr. Zalapa's program, these traits are being analyzed from 2022 fruit samples and will be analyzed again with fruit from this year.

Heat stress and 'sun scald' have been exacerbated by the warming climate, so the germplasm represents a potential source of stress tolerant accessions. Mullica Queen has shown greater heat tolerance, perhaps due to its recent development under NJ stress conditions. In addition, accessions with heavy epicuticular wax (ECW) on their fruit appear to have greater heat tolerance and a QTL associated with ECW has been identified (Erndwein et al., 2023)

With the development of an improved genome assembly for cranberry and new bioinformatic techniques, quantitative-trait-loci (QTL) continue to be identified, for fruit rot resistance, TAcy, Brix, TA, organic acids, flavonols, ECW, yield, fruit size, etc. (Knowles et al. 2021, Polashock et al. 2021). Each of these markers should facilitate our breeding efforts. Through breeding and selection, development of genotypes that are more resistant to current stresses offer the potential of better adapted varieties.

Citations

Erndwein L, J Kawash, S Knowles, N Vorsa, J Polashock. 2023. Cranberry fruit epicuticular wax benefits and identification of a wax-associated molecular marker. BMC Plant Biology 23:1812

Fong SK, Kawash J, Wang Y, Johnson-Cicalese J, Polashock J, Vorsa N. 2021. A low malic acid trait in cranberry fruit: genetics, molecular mapping and interaction with a citric acid locus. Tree Genetics & Genomes 17:4 https://doi.org/10.1007/s11295-020-01482-8

Fong SK, Kawash J, Wang Y, Johnson-Cicalese J, Polashock J, Vorsa N. 2020. A low citric acid trait in cranberry: genetics and molecular mapping of a locus impacting fruit acidity. Tree Genetics & Genomes 16: 42 https://doi.org/10.1007/s11295-020-01432-4

Knowles, S, J Kawash, J. Johnson-Cicalese, N. Vorsa. 2021. Relationships between fruit rot resistance and horticultural traits in American cranberry (*Vaccinium macrocarpon* Ait.). XII **Internat. Vaccinium Symposium, Halifax, Nova Scotia, Aug 30-Sep 1.**

Polashock JJ, JK Kawash, N Vorsa, J Johnson-Cicalese. 2021. Identifying epistatic loci for fruit rot resistance in cranberry using machine learning. XII International Vaccinium Symposium, **Halifax, Nova Scotia, Aug 30-Sep 1.**

Fong S, Y Wang, J Johnson-Cicalese, N Vorsa. 2019. Genetic and environmental variation for flavonol glycosides in American Cranberry Fruit. North American Cranberry Research and Extension Workers Conf., Vancouver, BC, Aug 19-21.

Fruit Rot Management Beyond 2023

Peter Oudemans, Matt Hamilton, Luke Mackara, Sophie DeCoite, Kristin Dana, Jennifer Johnson Cicalese and Christine Constantelos

Cranberry fruit rot was first described by New Jersey growers in the mid 1800's. The disease was so destructive that, without effective control, it would be the demise of the industry. Since then, several generations of fungicides have been used to successfully manage this disease complex. The challenge now is to maintain fruit rot at low levels despite regulatory challenges with fungicide labelling. The presentation today will focus on efforts from the Rutgers Cranberry Breeding Program for developing advanced selections with genetic resistance, and from the Plant Pathology program for developing integrated management programs to provide viable fruit rot management. The work in Bog 2 demonstrates some of the new fruit rot resistant selections, 2^{nd} and 3^{rd} generation progeny that integrate multiple sources of resistance, and the possibilities for minimizing fungicide applications. These new selections show significant promise although precise fungicide timing will be critical for this approach to be effective. In general, bloom time applications are most effective. Following the elimination of broad-spectrum fungicides, more site-specific materials will be implemented. As a result, fungicide resistance monitoring will become critical and new modes of action will be sought. Evaluation of new modes of action through the lab-based FLEX Bioassay have identified novel FRAC 3, 7, 9 and 29 materials that are now being evaluated in efficacy trials and tested here under various use patterns. Use pattern trials being conducted in Bog 5 and 15 show significant promise. Cultural methods for control are also critical for effective disease management. Stress reduction and specifically solar protection is actively being investigated using shade (Bog 15) and canopy management. Future cranberry fruit rot management programs will need to integrate several strategies to successfully manage this disease.

Introducing the Cifarelli Vacuum Harvester for Cranberry

***Thierry E. Besançon*, Associate Professor & Extension Specialist, Department of Plant Biology, Rutgers University, and *Wesley Bouchelle*, Rutgers P.E. Marucci Center, Chatsworth, NJ**

The Cifarelli V1200E is a vacuum for harvesting shell fruit. The light material (leaves or small stones) vacuumed together with the fruit is ejected from the tank thanks to a patented separation system. This vacuum harvester is used to collect quickly and effectively chestnuts, hazelnuts, walnuts, almonds, and acorns. This machine separates the product from leaves or other debris sucked in which are expelled through the air exit. Emptying the tank is simple with the machine on the shoulders pressing the proper level. To speed up collecting the harvest we recommend using the BL1200 blower or the air exit pipe of the vacuum itself to gather the product first. The machine is also suitable for intensive use, thanks to the powerful 5 HP two-stroke Cifarelli engine and professional carburetor. The suction hose consists of a flexible part and a rigid pipe that ensures better suction of the product.
A Cifarelli V1200E unit was purchased in summer 2022 by the Weed Science lab at the Rutgers P.E. Marucci center to help with harvesting cranberry research plots in a context of reduced manpower availability. On average, it took 3 to 5 minutes per ft^2 to harvest and unload fruits in paper bags using the vacuum harvester as compared to 10 to 15 minutes per ft^2 with traditional manual picking. No injury (bruising, slicing, or crushing) resulting from mechanical harvesting was observed on berries; thus, the vacuum harvester is not causing additional injurie that could interfere with the evaluation of pesticide treatments or new cranberry varieties. One other advantage of using the vacuum harvester was that harvested fruits dried during the harvesting process, allowing them to be stored immediately in paper bags and to start cranberry picking earlier in the morning when dew is still present. Cranberry trash (leaves, stems) or soil particles were easily separated from the berries during the harvesting process while no fruits were left on cranberry vines after 3 to 5 minutes of operation, depending on fruit load. Overall, the use of the Cifarelli V1200E vacuum harvester greatly improved the efficiency and flexibility of cranberry picking in research plots by reducing the time and workforce required for this operation.

Picture 1. Cifarelli V1200E vacuum harvester

BDi Machinery
Mancungie, PA
(610)966-2444
https://bdimachinery.com/product/cifarelli-v1200e-vacuum-harvester

Picture 2. Cranberry research plot harvest with the Cifarelli V1200E vacuum harvester using an 18”^{2} quadrat.

Picture 3. Cranberry research plots harvesting operations with the Cifarelli V1200E vacuum harveste . a) vacuum sucking of the fruits; b) lever to open the tank containing harvested berries; c) berries unloading; d) berries harvested with the Cifarelli V1200E vacuum harvester

Introducing H.A.R.V. – Hyperspectral Agricultural Research Vehicle

James Polashock, Joseph Kawash, and Lindsay Erndwein

USDA-ARS, GIFVL, Chatsworth, NJ 08019

Rapid phenotyping in the field is a requirement for most breeding programs. Phenotyping cranberry traits in the field has thus far been labor intensive and time consuming. To alleviate this bottleneck, we have designed a lightweight mobile cart that integrates a high-speed rugged computer, a power source, and a rotating sensor mount. The cart is designed to carry a hyperspectral imager that serves a dual purpose; as a push broom type scanner in the lab for detailed work and utilizing a rotating stage for wider sweeps in field imaging. Ultimately a variety of sensor types and/or cameras can be attached tailored to specific wavelengths, focal ranges, or fixed or sweep angles. Testing shows that we can obtain detailed images of cranberry plots using H.A.R.V. with our hyperspectral imager attached. The next challenge is image analysis to classify target traits. We are developing a neural network-based classification model, based on lab data. These models are being adapted to utilize field- collected data.

Overview of Entomological Research on Cranberries at Rutgers

Cesar Rodriguez-Saona, Professor & Extension Specialist, Yahel Ben-Zvi, Haotian Liu, Department of Entomology, Rutgers University, Paolo Salazar-Mendoza, and Robert Holdcraft, P.E. Marucci Center, Chatsworth, NJ

The availability of broad-spectrum insecticides, such as organophosphates and carbamates, for use in cranberries continues to be under threat due to regulatory actions. To address this, new classes of insecticides have been registered, such as insect growth regulators, spinosyns, and diamides. Although these insecticides are selective, effective, and safe to the environment and human health, they do not control piercing-sucking insects (order Hemiptera) such as blunt-nosed leafhoppers. As a result, in the last 2 decades, we have seen increases in population size of this insect pest. Thus, it is imperative that new classes of insecticides are evaluated to ensure the availability of commercially acceptable controls to manage blunt-nosed leafhoppers in cranberries. This is particularly critical since chlorpyrifos (Lorsban), a key insecticide used for blunt-nosed leafhopper control, was recently banned for use in cranberries.

In 2023, research was conducted at the Rutgers P.E. Marucci Center to: 1) Study the seasonal phenology of blunt-nosed leafhoppers; 2) Evaluate new insecticides against blunt-nosed leafhoppers; 3) Determine the levels of resistance among old and new varieties against blunt-nosed leafhoppers and other insect pests; 4) Investigate the effects of fertilizer regime on cranberry/phytoplasma/blunt-nosed leafhopper interactions.

<u>Objective 1. Seasonal phenology of blunt-nosed leafhoppers</u>
In 2022, we initiated a study to determine the seasonal phenology of blunt-nosed leafhoppers in cranberries and develop degree-day models. This study was continued in 2023. Sweep net sampling was conducted from May until August in 4 beds at a commercial cranberry farm. The number and development stage of blunt-nosed leafhoppers was recorded.

<u>Objective 2. Toxicity of new insecticides against blunt-nosed leafhoppers</u>
In 2023, we compared the residual toxicity of a new insecticide (Insecticide A) and Danitol against blunt-nosed leafhoppers. In semi-field studies, Insecticide A and Danitol were applied to small (4-by-4 feet) cranberry plots. Toxicity was evaluated by placing leafhopper nymphs on field-weathered foliage residues collected 1, 3, and 7 days after treatment. On each of the sampling dates, five insecticide-treated uprights were inserted in florists' water picks, enclosed in a ventilated 40-dram plastic vial, and secured in Styrofoam trays. Each replicate consisted of five vials per treatment. Five nymphs were placed individually in a vial. Plants and insects were placed in the laboratory at 25°C. Mortality was assessed 1, 3, and 7 days after transfer.

<u>Objective 3. Resistance of old and new cranberry varieties against blunt-nosed leafhoppers and other insect pests</u>
Our main goal here is to better understand insect resistance among cranberry varieties and integrate this information into IPM recommendations if feasible. This study was initiated in 2022

and continued in 2023. We studied the effects of 12 cranberry varieties (Early Black, Howes, Ben Lear, McFarlin, Potter, Stevens, Franklin, Crimson Queen, Mullica Queen, Demoranville, #35, and Haines) on the performance of blunt-nosed leafhoppers (Fig. 1), Sparganothis fruitworm, and spongy (former gypsy) moth. We also analyzed the growth and chemical composition of these varieties to determine possible mechanisms. In greenhouse experiments at the Rutgers PE Marucci Center, insects were caged with an upright of one of the varieties in individual pots. Following, mortality and final weights of the insects were assessed after 7 days (spongy moth), 14 days (Sparganothis fruitworm), or 21 days (blunt-nosed leafhoppers).

Fig. 1. Greenhouse experiments to evaluate resistance of cranberry varieties on blunt-nosed leafhoppers.

<u>Objective 4. Effects of fertilizer on cranberry-phytoplasma-leafhopper interactions</u>

This study aims at better understanding resistance in cranberries against insect pests and diseases under variable nutrient levels. This work was conducted in collaboration with James Polashock (USDA-ARS). Two cranberry varieties (Crimson Queen and Ben Lear), either infected or not by the phytoplasma that causes false blossom disease, were propagated in the greenhouse and subjected to 4 different fertilizer rates. Following, we assessed plant growth, weight gain by blunt-nosed leafhoppers (vector) and gypsy moth (non-vector), levels of phytoplasma infection, leaf carbon and nitrogen concentrations, and levels of leaf proanthocyanidins (PACs).

New Jersey Agricultural Statistics

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New Jersey cranberry producers expect to harvest 550 thousand barrels in 2023, compared to 563 thousand barrels in 2022. NASS released the production forecast for the 2023 crop August 11, 2023.

Massachusetts production is forecast at 2 million barrels, down from 2.26 million barrels the year before. Oregon producers expect to harvest 470 thousand barrels, up from 400 thousand barrels in 2022. Wisconsin production is forecast at 4.6 million barrels, down from 2022 production of 4.835 million barrels. Total forecast for these four states is 7.62 million barrels compared to a realized 8.058 million barrels in 2022.

For more detail including acreage and value of production, USDA's National Agricultural Statistics released the 2022 Non-citrus Fruit and Nut Final Summary May 8, 2023 at: https://www.nass.usda.gov/Publications/Reports_By_Date/index.php.

USDA's National Agricultural Statistics will release the 2023 Non-citrus Fruit and Nut Final Summary in May, 2024 also at: https://www.nass.usda.gov/Publications/Reports_By_Date/index.php We want to work with you to get the best data to accurately represent New Jersey cranberries. Thank you for your help.

You can get e-mail alerts for New Jersey and Regional customized reports:

https://www.nass.usda.gov/Statistics_by_State/New_Jersey/index.php

Look under 'I want to' on the left.

Current Fruit Rot and False Blossom Research in Wisconsin

<u>Leslie Holland</u>, Ana Maria Vazquez-Catoni, Evan Lozano, Casey Trickle, Eithan Pozas-Rodriguez, Fabian Rodriguez-Bonilla

The UW-Madison Fruit Crops Pathology program investigates two destructive diseases of cranberry - cranberry fruit rot (CFR) and cranberry false blossom disease (CFBD). Both diseases represent significant threats to the industry and with increasing reports of fruit rot and the re-emergence of false blossom, efforts to further explore pathogen biology and management are warranted. Current areas of research include:

Evaluating the movement of fruit rot fungi in propagative cuttings. Unlike many other vegetatively propagated crops, cranberry cuttings used to establish new beds are not treated for diseases prior to establishment. In 2023, vegetative cuttings were collected from seven commercial marshes in central and northern Wisconsin from a variety of cultivars. Cutting collection occurred at three sampling points: immediately after mowing, during storage, and just before planting. Fungal pathogens associated with propagative cutting materials were identified by isolating them from leaves, runners, and uprights. Regardless of the sampling point, cranberry fruit rot pathogens including *Colletotrichum*, *Phomopsis*, *Coleophoma*, *Godronia*, and *Phyllosticta* were identified from all plant tissues, suggesting that propagative material may harbor latent (non-symptomatic) infections of these pathogens.

Utilizing heat as a pre-planting approach to reduce fruit rot fungi. The use of heat or steam as a pre-planting treatment has been shown to reduce pathogen presence and plant mortality in strawberry, citrus, grape, and peach propagation systems. The aim of this work is to determine the efficacy of pre-planting heat treatments to control fruit rot pathogens present in cranberry cuttings. In vitro studies were completed with isolates of fruit rot pathogen, *Colletotrichum acutatum* to determine the range of temperatures needed to kill spores. This study revealed survival of *C. acutatum* spores depends on the duration of heat exposure, with higher mortality rates observed at higher temperatures for shorter exposure periods. Cranberry cuttings were collected from two popular varieties, Stevens and Mullica Queen. Cuttings were exposed to a range of temperatures for 15- or 30-minutes, then planted in the greenhouse to monitor growth and survival. Preliminary results indicate that 8 weeks after heat treatment, approximately 75% of the Stevens cuttings displayed root and shoot growth, with no significant differences in mortality between heat treatment groups. Mullica Queen cuttings after 4 weeks show approximately 93% survival rate, with mortality observed at temperatures above 47°C. The results of these experiments demonstrate that cranberry plants can establish and grow following heat treatments, suggesting that heat treatments prior to planting have the potential to reduce losses due to pathogen infection while still maintaining plant viability.

Fruit rot fungi infection development. Over 15 fungal species are known to be associated with cranberry fruit rot infections. To better understand the prevalence and distribution of CFR fungi this work is taking place across the major cranberry producing states in the U.S. Samples will be collected from cranberry beds cv. 'Stevens' and 'Mullica Queen' throughout the growing season.

This research is in the early stages, but preliminary findings suggest that fruit rot fungal diversity appears low early in the growing season, and as fruit begin to develop a shift in fungal populations is observed.

Re-investigating cranberry false blossom disease in Wisconsin. Cranberry false blossom disease (CFBD) is caused by the cranberry false blossom phytoplasma. This bacterial pathogen is transmitted by the blunt-nosed leafhopper (BNLH). The origin of CFBD has been traced back to propagative cuttings from Wisconsin in the early 20th century, leading to the spread of the pathogen in other production areas in North America. Through a combination of cultivar breeding and chemical controls, CFBD and its vector were no longer a threat to the cranberry industry. However, the recent discovery of CFBD and outbreaks of the BNLH in Wisconsin, have raised concerns among growers. During the 2021, 2022 and current 2023 growing seasons we collected both symptomatic uprights, displaying characteristic symptoms such as stunted foliar growth and floral abnormalities and discoloration, and non-symptomatic uprights from the same bed of plants known to have CFBD. The collected uprights were dissected according to plant organ type and processed for the molecular detection of the phytoplasma. The CFBD phytoplasma was detected in all plant organs from symptomatic uprights, suggesting a systemic infection. The findings of this study provide valuable insights into the seasonal patterns of the causal phytoplasma.