2007
NORTH AMERICAN CRANBERRY RESEARCH & EXTENSION WORKERS CONFERENCE

OCTOBER 1-3

P.E. MARUCCI CENTER FOR BLUEBERRY &
CRANBERRY RESEARCH & EXTENSION
RUTGERS UNIVERSITY CHATSWORTH, NJ

TUSCANY HOUSE, EGG HARBOR CITY, NJ

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BLUEBERRY & CRANBERRY
RESEARCH COUNCIL

AMERICAN CRANBERRY GROWERS association

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PROGRAM-AT-A-GLANCE

MONDAY OCTOBER 1, 2007

7:30-8:30 Registration (Florence Room)

8:30-8:45 Welcome, Dr. Mark Robson

8:45-9:30 Guest Speaker, Dr. Christopher Obropta

9:30-10:30 PAPER SESSION I

10:50-11:50 PAPER SESSION II

12:15 Bus Departs to Marucci Center

1:00-2:00 Lunch

2:00-5:00 LAB & FIELD TOURS

6:00-7:00 Poster Setup (Tuscany House Ballroom Lobby)

7:00-9:00 POSTER PRESENTATIONS AND WINE & CHEESE RECEPTION

TUESDAY OCTOBER 2, 2007

8:30-9:50 PAPER SESSION III

10:10-11:30 PAPER SESSION IV

11:45 Bus Departs to White's Bog

12:45-1:30 Lunch at White's Bog, Guest Speaker, Dr. Mark Ehlenfeldt

1:45-5:30 FARM TOURS

7:00-9:00 BANQUET (Venetian Room) – Guest Speaker, Ted Gordon

WEDNESDAY OCTOBER 3, 2007

9:00-11:00 WORKING GROUPS (Plant Nutrition/Physiology, Entomology, Pathology)

11:00-11:30 BUSINESS MEETING (Venetian Room)

PROGRAM

MONDAY OCTOBER 1, 2007

7:30-8:30 REGISTRATION (Florence Room)

8:30-8:45 Welcome, Dr. Mark Robson, Director of the New Jersey Agricultural Experiment Station and Professor of Entomology, Rutgers University

8:45-9:30 Guest Speaker, Dr. Christopher Obropta, Extension Specialist, Environmental Sciences, Rutgers University "*Water Issues Related to Cranberry Culture & Agriculture in New Jersey*"

9:30-10:30 PAPER SESSION I (15 min talks) – Peter Oudemans, Rutgers University, Moderator

AN EVALUATION OF IRRIGATION AUTOMATION SYSTEMS IN THE MASSACHUSETTS CRANBERRY INDUSTRY Brian Wick, Cape Cod Cranberry Growers' Association, 3203-B Cranberry Highway, East Wareham, MA 02538

IMPACTS OF NITRATE IN IRRIGATION WATER ON CRANBERRY GROWTH AND YIELD Beth Ann A. Workmaster and Kevin R. Kosola, Department of Horticulture, University of Wisconsin-Madison, 1575 Linden Dr., Madison, WI 53706

DISSOLVED ORGANIC NITROGEN POOLS IN CULTIVATED CRANBERRY BEDS Sarah Stackpoole, Beth Workmaster, and Kevin Kosola, Department of Horticulture, University of Wisconsin-Madison, 1575 Linden Dr., Madison, WI 53706

10:30-10:50 Coffee Break (Sponsored by Clement Pappas & Co., Inc.)

10:50-11:50 PAPER SESSION II (15 min talks) – Peter Oudemans, Rutgers University, Moderator

USING GROWER DATA TO DOCUMENT GROWER PRACTICES AND THE RELATIONSHIP BETWEEN FERTILIZER APPLICATION AND YIELD
Teryl Roper, Dept. of Horticulture, University of Wisconsin-Madison, 1575 Linden Drive, Madison, WI 53706

MANAGING FERTILIZER FOR PHOSPHORUS DEFICENT CRANBERRY BEDS Joan Davenport and Dan Schiffhauer, Washington State University, 24106 N. Bunn Road, Prosser, WA, 99350 and Ocean Spray Cranberries, Inc., Rte 563., Chatsworth, NJ 08019

PHOSPHORUS REDUCTION IN MASSACHUSETTS CRANBERRY PRODUCTION
Carolyn DeMoranville, UMass Amherst Cranberry Station, One State Bog Road, P.O. Box 569, East Wareham, MA 02538

11:50-12:15 Prepare for Bus Departure

12:15 Bus Departs to Marucci Center

1:00-2:00 Lunch (Sponsored by the American Cranberry Growers Association, NJ)

2:00-3:00 LAB TOURS (15 min rotations)

A CHEMICAL ECOLOGY LAB FOR BLUEBERRY & CRANBERRY ENTOMOLOGY
Cesar Rodriguez-Saona, Extension Specialist, Rutgers Entomology

WHAT'S NEW IN CRANBERRY HEALTH BENEFITS RESEARCH Amy Howell, Associate Research Scientist, Rutgers University

BIOLOGY AND CONTROL OF CRANBERRY PLANT PATHOGENS Peter Oudemans, Chris Constantelos, Jen Vaiciunas, and Donna Larsen Marucci Center for Blueberry and Cranberry Research and Extension, Cook College, Rutgers University, 125A Lake Oswego Rd., Chatsworth, NJ 08019

A MULTIFACTED APPROACH TO CRANBERRY IMPROVEMENT James Polashock, Research Plant Pathologist, USDA-ARS

3:00-5:00 FIELD TOURS

DOMESTICATED & NATIVE CRANBERRY GERMPLASM COLLECTION (*Bog 1 & 4*)
Nicholi Vorsa, Professor Plant Biology & Pathology, Jennifer Johnson-Cicalese, Research Associate, Karen DeStefano, Field & Greenhouse Technician, Rutgers University

ALTERNATIVE METHODS FOR CRANBERRY BED ESTABLISHMENT (*Bogs 3 & 5*)
Jennifer Johnson-Cicalese, Research Associate, Nicholi Vorsa, Professor Plant Biology & Pathology, Rutgers University

INHIBITION OF FRUITING TO IMPROVE CRANBERRY BED ESTABLISHMENT (*Bog 3*)
James Polashock, Research Plant Pathologist, USDA-ARS, Peter Oudemans, Plant Pathology, Rutgers University

MANAGEMENT OF CRANBERRY FRUIT ROT (*Bog 13*) Peter Oudemans, Donna Larsen, Chris Constantelos, Jen Vaiciunas Marucci Center for Blueberry and Cranberry Research and Extension, Cook College, Rutgers University, 125A Lake Oswego Rd., Chatsworth, NJ 08019

RUTGERS CRANBERRY VARIETY TRIAL: ADVANCED SELECTIONS AND VARIETIES (*Bogs 17 & 18*) Nicholi Vorsa, Professor Plant Biology & Pathology, Jennifer Johnson-Cicalese, Research Associate, Karen DeStefano, Field & Greenhouse Technician, Rutgers University

EVALUATION OF NEW INSECTICIDES AND ENTOMOPATHOGENIC NEMATODES (*Bog 19*) Cesar Rodriguez-Saona, Extension Specialist, Elizabeth Bender, Senior Laboratory Technician, Robert Holdcraft, Plant & Soils Technician, Rutgers University

5:00 Bus Departs to Hotel

6:00-7:00 Poster Setup (Tuscany House Ballroom Lobby)

7:00-9:00 POSTER PRESENTATIONS AND WINE & CHEESE RECEPTION (Sponsored by Ocean Spray Cranberries, Inc.) (Tuscany House Ballroom Lobby)

THE INFLUENCE OF NITROGEN NUTRITION ON CRANBERRY YIELD COMPONENTS John Hart, Bernadine Strik Oregon State University Department of Crop and Soil Science, and Department of Horticulture, Ag and Life Science Bldg Corvallis OR 97331 and Teryl Roper, University of Wisconsin-Madison 1575 Linden Drive Madison, WI 53706-1590

AFTERNOON SPRINKLER IRRIGATION REDUCES AIR AND CANOPY TEMPERATURE OF CRANBERRY BEDS Matthew Lippert and Teryl Roper, Wood County Extension, P.O. Box 8095, Wisconsin Rapids, WI 54495, and UW-Madison, Dept. of Horticulture, 1575 Linden Drive, Madison, WI 53706

RENOVATING CRANBERRY BEDS IN OREGON Linda White[1], John Hart[2], and Bernadine Strik[3]. 1. Oregon State University Extension Service, Coos and Curry County, 631 Alder St., Myrtle Point, OR 97458. 2. Oregon State University, Crop and Soil Science, 3045 ALS, Corvallis, OR 97331. 3. Oregon State University, Horticulture, 4017 ALS, Corvallis, OR 97331

PHENOLIC COMPOUNDS WITH POTENTIAL PEST-DETERRENT PROPERTIES FROM LEAVES OF EARLY BLACK CRANBERRY CULTIVAR (*VACCINIUM MACROCARPON*) Christine Dao[1], Michelle Botelho[2], Justine Vanden Heuvel[3] and Catherine Neto[1] [1]Department of Chemistry and Biochemistry, University of Massachusetts-Dartmouth, North Dartmouth, MA, [2]UMass Cranberry Experiment Station, Wareham, MA, [3]Department of Horticultural Sciences, Cornell University, Geneva, NY

ELICITATION OF INDUCED DEFENSES AS AN ALTERNATIVE TO CONVENTIONAL INSECTICIDES IN CRANBERRIES Cesar Rodriguez-Saona and Joseph Argentine, PE Marucci Center for Blueberry and Cranberry Research and Extension, 125 a Lake Oswego Rd., Chatsworth, NJ 08019

GENETIC VARIATION IN SELECT SPECIES OF THE NORTH AMERICAN CRANBERRY FRUIT ROT COMPLEX James Polashock, USDA-ARS, 125 a Lake Oswego Rd., Chatsworth, NJ 08019. Frank L. Caruso, UMass Cranberry Experiment Station, 1 State Bog Road, P.O. Box 569, East Wareham, MA 02538-0569**.** Peter V. Oudemans, Rutgers University, 125 a Lake Oswego Rd., Chatsworth, NJ 08019. Patricia McManus, Dept. of Plant Pathology, Univ. of Wisconsin, 1630 Linden Drive, Madison, WI 53706

THREE RUTGERS CRANBERRY VARIETIES: CRIMSON QUEEN, MULLICA QUEEN AND DEMORANVILLE Nicholi Vorsa, Jennifer Johnson-Cicalese, and Karen DeStefano, Marucci Center for Blueberry and Cranberry Research and Extension, SEBS College, Rutgers University, 125A Lake Oswego Rd., Chatsworth, NJ 08019

CRANBERRY PROANTHOCYANIDINS SENSITIZE OVARIAN CANCER CELLS TO PLATINUM DRUG Ajay P. Singh[1,3], Rakesh K. Singh[2], Satyan S. Kalkunte[2], Roger Nussbaum[1], Kyukwang Kim[2], Hong Jin[1], Monica S. Torres[1], Laurent Brard[2], and Nicholi Vorsa[1,3] [1]Rutgers, The State University of New Jersey. Department of Plant Biology and Pathology. 59 Dudley Rd. New Brunswick, NJ 08901, [2]Program in Women's Oncology, Department of Obstetrics and Gynecolgy, Kilguss Research Centre, Women and Infants Hospital, Brown University, Providence,RI, U.S.A. [3] Marucci Blueberry-Cranberry Research Center, Rutgers University, 125a Lake Oswego Road, Chatsworth, NJ 08019

TUESDAY OCTOBER 2, 2007

8:30-9:50 PAPER SESSION III (15 min talks) – James Polashock, USDA-ARS, Moderator

CRANBERRY GROWER PESTICIDE USE Joseph W. DeVerna, and William C. Frantz, Ocean Spray Cranberries, Inc., One Ocean Spray Drive, Middleboro, MA 02349

THE UTILITY OF HERBICIDE USE IN CRANBERRY BOG ESTABLISHMENT Bradley A. Majek, Rutgers Agricultural Research and Extension Center, Rutgers University, Bridgeton, New Jersey

GERMINATION PATTERNS OF SWAMP DODDER SEEDS PLANTED NEAR A COMMERCIAL CRANBERRY FARM Hilary A. Sandler and Katherine Ghantous, Univ. of Massachusetts-Amherst Cranberry Station, P.O. Box 569, East Wareham, MA 02538

ADVANCES IN CRANBERRY PEST MANAGEMENT Kim Patten and Chase Metzger, Washington State University Long Beach Research and Extension Unit. 2907 Pioneer Rd., Long Beach WA 98631

9:50-10:10 Coffee Break (Sponsored by Clement Pappas & Co., Inc.)

10:10-11:30 PAPER SESSION IV (15 min talks) – James Polashock, USDA-ARS, Moderator

CRANBERRY TIPWORM, *DASINEURA OXYCOCANNA,* AN INCREASING PEST IN BRITISH COLUMBIA CRANBERRIES Shannon Buckshaw, Debrah Henderson, and Brian Mauza, E.S. Cropconsult, Ltd. and Ocean Spray of Canada Ltd. respectively

CHEMICAL CONTROL STUDIES ON CRANBERRY TIPWORM IN WISCONSIN, 2006-2007 Daniel L. Mahr and Robert S. Perry, Department of Entomology, University of Wisconsin, 1630 Linden Drive, Madison, WI 53706

INVESTIGATION OF CRANBERRY DIEBACK DISORDER IN BRITISH COLUMBIA Sheila Fitzpatrick, Tom Forge, Siva Sabaratnam[1], Melissa Cook, Carol Koch, Anna Fronda and Anna Dicarlo[1], Agriculture and Agri-Food Canada, Pacific Agri-Food Research Centre, 6947 Hwy 7, Agassiz, British Columbia V0M 1A0; and [1]British Columbia Ministry of Agriculture and Lands, Abbotsford Agriculture Centre, 1767 Angus Campbell Road, Abbotsford, British Columbia V3G 2M3

INCIDENCE OF DISEASES IN WILD STANDS OF CRANBERRIES IN MASSACHUSETTS F.L. Caruso, University of Massachusetts, Cranberry Station, East Wareham, MA 02538

11:30-11:45 Prepare for Bus Departure

11:45 Bus Departs

12:45-1:30 Lunch at White's Bog (Sponsored by the Blueberry & Cranberry Research Council, NJ) – Guest Speaker, Dr. Mark Ehlenfeldt, Research Plant Geneticist USDA-ARS & President of White's Bog Preservation Trust "*History of Blueberries and Cranberries at White's Bog*"

1:45-2:30 Joe Darlington, Joseph J. White Inc., *Dry Harvest*

3:00-3:45 Abbott Lee, Integrity Propagation Inc., *Nursery Propagation*

4:00-5:30 William Haines, Pine Island Cranberry Co., Inc., *Welcome Reception & Farm Tour*

5:30 Bus Departs to Hotel

7:00-9:00 BANQUET (Venetian Room) – Guest Speaker, Ted Gordon "*The New Jersey Pine Barrens*"

WEDNESDAY OCTOBER 3, 2007

9:00-11:00 WORKING GROUPS (Plant Nutrition/Physiology, Entomology, Pathology)

11:00-11:30 BUSINESS MEETING (Venetian Room)

ABSTRACTS

PAPER SESSIONS

AN EVALUATION OF IRRIGATION AUTOMATION SYSTEMS IN THE MASSACHUSETTS CRANBERRY INDUSTRY Brian Wick, Cape Cod Cranberry Growers' Association, 3203-B Cranberry Highway, East Wareham, MA 02538

Like most cranberry farmers, Massachusetts growers are challenged with managing water resources, from both a conservation and vine health perspective. Also of importance is reducing operation costs. This need provided an opportunity for a USDA Conservation Innovation grant being awarded to the Cape Cod Cranberry Growers' Association for installing and evaluating automated irrigation systems on nine different farms. By automating irrigation pumps, growers have the opportunity to reduce water usage, while at the same time reducing fuel and related operating costs.

Using an automated system, growers can start their pumps remotely with an Internet connection or via a radio frequency. Additionally, these automated systems can start based on pre-set temperature thresholds for frost protection. The pumps can then cycle on and off as the temperature fluctuates during the night, in some cases decreasing water use and fuel expenditures by 60%. Many growers are reporting a minimum of two hours run-time savings on frost nights. Automated systems also allow growers to start all of their pumps simultaneously or to turn on only when the optimal temperature is met at that particular location. Prior to automation, large and mid-size growers would need to turn on their pumps earlier than necessary in order to have enough time to start all of their pumps before the frost event began. Growers can also program their irrigation schedules, allowing for automatic turn-on for irrigation. Additional savings discovered included improved chemigation efficacy and ease of use, employee safety and a probable increase in pump longevity.

Many obstacles needed to be overcome in order to achieve a grower comfort level with this new technology. More work is needed to further refine the systems and gain additional grower implementation. Additional research is needed to qualify the success (or failure) of cycling on frost bights under a variety of weather conditions. Future technology considerations include integrating soil moisture into automated systems, automating gate valves, and inline irrigation sensors for pinpointing problem areas.

IMPACTS OF NITRATE IN IRRIGATION WATER ON CRANBERRY GROWTH AND YIELD Beth Ann A. Workmaster and Kevin R. Kosola, Department of Horticulture, University of Wisconsin-Madison, 1575 Linden Dr., Madison, WI 53706

Many Wisconsin growers with high nitrate levels in their irrigation water have observed patterns of excess vine growth around joints in the irrigation line and next to sprinkler heads. Given that excess nitrogen decreases cranberry fruit yield, estimated potential yield losses due to this phenomenon could reach 5%-10%, even in well-managed marshes.

We have been testing the influence of water and N inputs on cranberry growth and yield at a marsh using two different water sources for irrigating different sections of the marsh. The water sources differ in nitrate concentration. Grab samples of water from the high-N water source varied in concentration between 1 to 9 ppm, and were constant at approximately 1 ppm from the low-N water source. We used ion exchange resin columns mounted below funnels to capture sprinkler inputs of irrigation water N, and ion exchange resin in mesh bags to capture N inputs from drainage at irrigation line joint gaskets. Current season vine growth was correlated with cumulative growing season nitrate inputs. Nitrate-N inputs were highest in the spring collection periods. We plan to quantify the volume of water lost from draining joint gaskets with siphoning lysimeters this fall, allowing us to better estimate total N inputs from this route.

Cranberry leaf tissue sampled next to sprinklers and joints had elevated natural abundance ^{15}N, as compared to tissue sampled at the drier locations in between. Nitrogen in the irrigation water is the most likely source for this enrichment in ^{15}N, as fertilizer N matches atmospheric ^{15}N ratios and mycorrhizal acquisition of organic N leads to ^{15}N-depleted tissues. We will analyze ^{15}N in irrigation water N captured with ion exchange resin columns to provide an integrated estimate of irrigation water ^{15}N inputs. This may provide an integrated check for effects of irrigation water N inputs on vine growth with less labor than required for installation and analysis of ion exchange resin columns and bags.

We are currently investigating management options for growers to reduce the impact of irrigation water N inputs. Growers that have elevated irrigation water N are trying different management options to reduce patches of excess water inputs, such as high-uniformity sprinklers, buried irrigation lines, non-draining joint gaskets, and low-pressure line drains.

DISSOLVED ORGANIC NITROGEN POOLS IN CULTIVATED CRANBERRY BEDS

Sarah Stackpoole, Beth Workmaster, and Kevin Kosola, Department of Horticulture, University of Wisconsin-Madison, 1575 Linden Dr., Madison, WI 53706

The objective of this research project was to create a nitrogen budget for cultivated cranberry beds in Wisconsin. The budget accounted for nitrogen inputs (precipitation, irrigation, fertilization, floodwater, and net mineralization) and outputs (harvested berries), as well as what is held in the plant and the soil. One key factor of this budget was that we measured extractable dissolved organic nitrogen in the soil. Interestingly, we found that dissolved organic nitrogen was the largest component of the extractable soil nitrogen pool, ranging between 5-25 lbs acre^{-1}, while ammonium (0 – 2 lbs acre^{-1}) and nitrate (< 1 lb acre^{-1}) values were much smaller. From the samples collected at the end of the growing season, August 2005 and September 2006, we found that cranberry plants stored on average 293 lbs N acre^{-1} ± 89.46 in live plant material, and about 31.5% is held in aboveground biomass, such as leaves and stems. On average 68.5% of the nitrogen is held in belowground biomass, such as roots and belowground stems. We also measured changes in above and belowground biomass and nitrogen content throughout the growing season. Growers reported that inputs from fertilizer ranged from 15 – 45 lbs N acre, while we measured that inputs from irrigation, fertilization, and harvest floods ranged between 7 – 19 lbs N acre^{-1}. Average net mineralization rates contributed less than 1 lb N acre^{-1}. For outputs, on average about 12 lbs N acre^{-1} ± 6.12 was removed with the cranberry harvest. By creating a budget, we can demonstrate the relative sizes of nitrogen pools and inputs in the cranberry agroecosystem. This information may be a useful addition to nutrient management plans.

USING GROWER DATA TO DOCUMENT GROWER PRACTICES AND THE RELATIONSHIP BETWEEN FERTILIZER APPLICATION AND YIELD

Teryl Roper, Dept. of Horticulture, University of Wisconsin-Madison, 1575 Linden Drive, Madison, WI 53706

In 2005 I gained access to a substantial body of grower data that included year planted, soil OM, CEC, last sanding, soil pH, soil P & K, tissue test data, fertilizer application rates, and yield for Stevens vines over five years. Simple correlations were run between all parameters and yield. Soil test P and tissue test K were insignificant predictors of yield. N application and tissue N were positively correlated with yield, but were not strongly correlated. Tissue test P was not a strong predictor of yield. Both tissue and soil test K were negatively correlated with yield. This may simply be a salt effect from applied K fertilizer. Soil test K was not related to tissue test K. Thus adding more K fertilizer did not lead to higher tissue K. The amount of K fertilizer applied was correlated with soil test K, but not strongly so. Better predictors of soil test K included cation exchange capacity and soil organic matter, and these two factors were tightly related. While these data showed interesting correlations between grower practices and yield they do not establish cause and effect relationships. Weaknesses with the data set include no zero fertilizer control treatments. The correlations would be easier to interpret and would be more meaningful if 'zero' data were included. Also, applications of N, P, and K do not vary independently of one another. Growers typically apply complete fertilizers so application of one element is inherently related to application of another. Correlations between fertilizer applied and yield are suspect. Despite the weaknesses in the data we can extract meaningful kernels of information that can help us work with growers to refine their fertilizer practices, especially to show where relationships don't exist.

MANAGING FERTILIZER FOR PHOSPHORUS DEFICENT CRANBERRY BEDS Joan Davenport and Dan Schiffhauer, Washington State University, 24106 N. Bunn Road, Prosser, WA, 99350 and Ocean Spray Cranberries, Inc., Rte 563., Chatsworth, NJ 08019

In the early 1990's, tissue testing revealed that cranberry plantings throughout the state of NJ were low in phosphorus (P). Increasing annual rates of P application, through blended fertilizers, using supplemental triple-superphosphate, or using foliar P additives over a five year period, did not increase cranberry leaf tissue P to the low end of the adequate range. In 2001, fertilizer P source was shifted from calcium based P forms to the use of similar rates of P applied using monoammonium phosphate (MAP) as a source for both nitrogen (N) and phosphorus. This presentation will show how shifting P fertilizer sources has lead to increasing tissue P into the adequate range.

PHOSPHORUS REDUCTION IN MASSACHUSETTS CRANBERRY PRODUCTION
Carolyn DeMoranville, UMass Amherst Cranberry Station, One State Bog Road, P.O. Box 569, East Wareham, MA 02538

Cranberries are grown in wetland settings. Environmental concerns have led to a need for nutrient management planning by cranberry farmers. In particular, phosphorus (P) has been identified as a potential environmental pollutant in cranberry systems discharging to inland water bodies. Most growers apply fertilizers that are a complete blend of N-P-K, basing the application rate on the amount of N required. Depending on the N:P ratio of the chosen fertilizer, this can result in the application of P rates that may be in excess of plant needs. Previous research has indicated that the recommended rate for P in cranberries with tissue tests above the critical value (0.1% P) should be ~20 lb P/a/season (~45 lb P_2O_5). Recent field trials have explored the relationship of P rate (in the range of 0-30 lb P/a) to yield. The results have not supported increasing the recommended P rate. As part of a water quality study, MA growers reduced P inputs in bogs paired with standard practice bogs (no P reduction). Significantly reduced P fertilizer inputs did not suppress yield and were associated with marked improvement in water quality (P load in flood discharges). A 40% reduction in P over a 3 year period at one study site resulted in a decrease in average total P concentration in flood discharge from 0.377 to 0.097 mg/L. During that same period, yield increased at that site. After 2 years of reduced P, net P discharge from this bog system was reduced by more than half. Based on these studies, MA growers have begun to adopt fertilizers with lower P:N ratios. A popular current choice is an 18-8-18 formulation, along with slow release products such as 15-15-15 and 10-12-24 (IBDU). Previous standard materials were 5-15-30 and 12-24-12 formulations. The focus of nutrient management for MA cranberries in the future will be on the implementation of reduced P plans evaluated through the testing of leaf tissue and through careful monitoring of yield trends.

CRANBERRY GROWER PESTICIDE USE Joseph W. DeVerna, and William C. Frantz, Ocean Spray Cranberries, Inc., One Ocean Spray Drive, Middleboro, MA 02349

U.S. and Canadian cranberry industry pesticide usage was estimated in 2003 and 2005 by sampling submitted grower's pesticide use forms. Form submission and approval by Receiving Stations is required prior to harvested fruit delivery. Submitted forms are reviewed to make sure that they comply with state and federal regulations and any handler restrictions for pesticide use. Pesticide use forms include information concerning which pesticides were applied, the rate and date of application, the method of application and the particular Bog ID's to which the applications were made.

All data was analyzed using SAS (SAS Institute Inc., Cary, NC) version 9.1.3, primarily using the SAS procedures Means, Rank and Tabulate. Individual pesticide types were grouped according to active ingredient (A.I.). Summary statistics were generated for a range of traits including, by growing area and across growing areas: the percent of contracts using each pesticide, acre-applications by pesticide type, average applications per contract, pounds of A.I. applied per application as well as total A.I. applied, acre-applications by method, and the date of application.

Grower pesticide use results will be discussed in terms of which pesticides are most widely used and changes in use patterns from 2003 to 2005. This data will also be discussed in terms of residues commonly observed in cranberry products and how these two together may impact the export of cranberry products. Last, all results will be discussed in regards to research priorities to reduce residues including the identification of new low-risk chemistries.

THE UTILITY OF HERBICIDE USE IN CRANBERRY BOG ESTABLISHMENT
Bradley A. Majek, Rutgers Agricultural Research and Extension Center, Rutgers University, Bridgeton, New Jersey

Studies were established in bogs planted with cranberry 'Stevens' cuttings in April of 2003 and 2004. Herbicides were applied in late spring, about four weeks after planting, or in the summer, two to three months after planting. Weed growth was heavy in both establishment years, creating a canopy over the cranberry vines by mid summer. The most prevalent weeds were false nutsedge, slender rush, blackgrass, marsh St. Johnswort, large crabgrass, and meadow beauty. When applied four weeks after planting, napropamide suppressed or controlled false nutsedge, slender rush, and large crabgrass, but did not control blackgrass or meadow beauty. The experimental herbicides, BAS 514, DPX 6025, and ZA 1296, applied with nonionic surfactant, controlled all the weeds except marsh St. Johnswort when applied four weeks after planting, but were less effective when applied two to three months after planting. The studies were treated annually for three years, until a measurable yield could be harvested from at least some treatments. Napropamide, BAS 514, and ZA 1296 did not injure the cranberries. The DPX 6025 treatment applied annually in late spring appeared to cause slight temporary stunting, and caused some shoot tip chlorosis in 2004. The bog planted in 2003 was harvested in 2005 and in 2006. The bog planted in 2004 was harvested in 2006 and in 2007. All the herbicides applied improved cranberry growth and vigor. The highest yields were observed in cranberries treated annually for three years with BAS 514 or ZA 1296 at 0.5 and 0.2 lb ai/A respectively.

GERMINATION PATTERNS OF SWAMP DODDER SEEDS PLANTED NEAR A COMMERCIAL CRANBERRY FARM Hilary A. Sandler and Katherine Ghantous, Univ. of Massachusetts-Amherst Cranberry Station, P.O. Box 569, East Wareham, MA 02538

Dodder (*Cuscuta gronovii*) is a serious weed pest in commercial cranberry that is typically controlled with preemergence herbicides, such as Casoron (dichlobenil) or Kerb (pronamide). Successful management is tied to proper timing of herbicide to recently germinated seedlings. This study was initiated to gather information on the germination patterns of dodder to facilitate timely applications.

Utilizing a simple system of simulated bogs constructed in plastic containers, the germination pattern of MA dodder seed has been monitored for 9 years. In 1997, 8 cm of peat was placed in the bottom of a 5-gallon container, covered by 10 cm of sand, which was then covered with 13 cm of 50:50 sand:peat mix. In the fall of 1997 and 1998, one set of 10 containers was prepared in this fashion. On 8 Dec. 1997, 150 cc of unscarified dodder seed was placed on the top layer and incorporated into the top 1 cm of mixture. A second set of containers was inoculated (with 15 cc of seed) on 7 Dec. 1998. Pots were monitored in early spring for first germination. Seedlings were counted and removed daily and less frequently during high and low germination periods, respectively.

Seeds most recently added to the seedbank (Year 1 of either study) produced the greatest number of seedlings (relative to subsequent years). Dodder seeds apparently have a definitive peak of germination in the initial year after planting. Peaks can still be seen in subsequent years, but they are less definitive and much lower in absolute numbers. Over the course of this 9-year study, the peak germination period occurred later each year. The delay of peak germination may contribute to the difficulties growers have in managing dodder. As new seed is introduced into the system each year, its peak germination period may be different from dodder germinating from the seedbank. Since most herbicides targeting dodder can only be efficacious for a specific window of time, a portion of the population may always escape preemergence control and provide enough viable seedlings to cause substantial infestations in the vine canopy.

ADVANCES IN CRANBERRY PEST MANAGEMENT Kim Patten and Chase Metzger, Washington State University Long Beach Research and Extension Unit. 2907 Pioneer Rd., Long Beach WA 98631

Weed control trials: Multi-year trials on false lily-of-the-valley (*Maianthemum dilatatum*) control using 3, 4, and 5% acetic acid as an early spring soil drench were conducted. Efficacy and crop damage were not consistent on peat or muck soils, while on sandy soils good control with only moderate crop damage was observed. Multi-site three-year comparisons of Casoron and Callisto were conducted. Callisto had superior efficacy against numerous perennial weeds, and better vine health and crop production. For more recalcitrant weeds, efficacy of Callisto was improved by modifying spray volume and surfactant. Herbicides trials for yellow loosestrife were conducted using Balance, Outlook, Chateau, Matrix, Paramount, KSU12800, Resource and Callisto. Paramount provided the best efficacy without phytotoxicity.

Insect control trials*:* Blackvine weevil adulticides (broadcast sprays and baits) and larvicides (insecticide and nematodes) were compared. A beet-based cryolite bait and Actara were better adulticides than Venom, Belay, and commercial baits. A combination of bait and spray adulticides were necessary to totally suppress adults. Summer applications of Nemasys L nematodes were a better larvicide than Admire, Venom and Belay. The efficacy of broadcasted and chemigated rynaxypyr, flubendiamide, metaflumizone and diazinon for blackheaded fireworm was evaluated. All products were effective with broadcast applications, but comparative efficacy of all products, except Diazinon, was reduced with chemigation. Season-long efficacy of rynaxypyr, flubendiamide, metaflumizone, spirotetramat, and diazinon for tipworm was evaluated. Spirotetramat and Diazinon were the most effective, but spirotetramat resulted in some phytotoxicity.

Fruit rot: Treatments were made at four sites for three years to compare traditional grower fungicide applications (Bravo at fruit set followed by Maneb in 14 days) against earlier and more aggressive applications of fungicides (Bravo & Abound) with and without excess nitrogen. Overall there was no significant treatment effect on fruit rot or yield across all sites. However, there was a trend for reduced rot with Bravo application during bloom, without any effect on yield. Fruit rot comparisons were also made with three applications each of Bravo, Pristine, Cabrio and Omega. No major differences have been observed.

CRANBERRY TIPWORM, *DASINEURA OXYCOCANNA*, AN INCREASING PEST IN BRITISH COLUMBIA CRANBERRIES Shannon Buckshaw, Debrah Henderson, and Brian Mauza, E.S. Cropconsult, Ltd. and Ocean Spray of Canada Ltd. respectively

Cranberry tipworm has been noted in British Columbia cranberries for a long time but in recent years the population has affected production of cranberries. Two on-farm populations have been tracked for the last two years to help understand the life cycles in our mild climate. Known susceptible varieties such as Ben Lear appear to be worse affected, but increasingly fields of Bergman and Stevens are being infested to a level that by early August nearly 100% of vegetative tips are dead. Treatments with currently registered pest control products have had variable results. Trials with alternative products are underway.

CHEMICAL CONTROL STUDIES ON CRANBERRY TIPWORM IN WISCONSIN, 2006-2007 Daniel L. Mahr and Robert S. Perry, Department of Entomology, University of Wisconsin, 1630 Linden Drive, Madison, WI 53706

In 2006, 16 registered and unregistered products were evaluated for activity against cranberry tipworm in small field plots replicated 4 times, in a commercial cranberry bed mowed in the spring of 2006, and with heavy tipworm pressure. Three applications were made at two week intervals in July and August (the exception being Rynaxypyr, which was applied only twice (applications 2 & 3). Twenty terminals from each plot were microscopically examined about two weeks after the third application. Condition of terminals was rated as to being killed, damaged but alive, and undamaged. Results, presented in ascending order as mean number of live terminals per 20, include untreated (4), Tesoro (4.25-4.75), Orthene (5), Rimon (6.5), PreVam (6.5), Neemix (7), Imidan (8.75), Lorsban (9.75), Provado (11), Esteem (11.75), Guthion (13.25), Diazinon (14.5), Sevin (16.25), Capture (18.25), Clutch (18.75), Danitol (18.75), and Rynaxypyr (19).

Plots were marked through the winter and fruit counts were taken on 11 July 2007 after fruit set. Data were taken by arbitrarily tossing four 4" internal diameter hoops into the plot, avoiding the edge 1 ft of each plot. Hoops were gently shaken and pushed into the canopy. All fruiting uprights within the hoop were counted, as well as the total number of fruit over ¼” diameter. Data from the 4 subsamples from each plot were pooled. The following data are in ascending order of average berry count per plot: Rynaxypyr (5), untreated (17), Orthene (18), PreVam (20), Tesoro (27-27), Lorsban (26), Provado (27), Imidan (29), Rimon (30), Sevin (33), Guthion (37), Neemix (40), Diazinon (42), Esteem (71), Clutch (75), Capture (75), Danitol (91). The two synthetic pyrethroids ranked 2 & 4 in terminal protection and 1 & 2 in yield. Rynaxypyr ranked 1 in terminal protection but last in yield (an enigma). Clutch tied for second in both terminal protection and yield.

Two sets of trials are being conducted in 2007 – screening trials and timing trials. Screening trials were applied as in 2007, and included Actara, Pyganic, Delegate, Danitol, Capture, Rynaxypyr, Esteem, Hero, and Assail. Timing trials evaluated 2 and 3 applications of Danitol, Capture, Rynaxypyr, Clutch, Esteem, and Assail to determine optimum timing for following season fruit production.

INVESTIGATION OF CRANBERRY DIEBACK DISORDER IN BRITISH COLUMBIA

Sheila Fitzpatrick, Tom Forge, Siva Sabaratnam[1], Melissa Cook, Carol Koch, Anna Fronda and Anna Dicarlo[1], Agriculture and Agri-Food Canada, Pacific Agri-Food Research Centre, 6947 Hwy 7, Agassiz, British Columbia V0M 1A0; and [1]British Columbia Ministry of Agriculture and Lands, Abbotsford Agriculture Centre, 1767 Angus Campbell Road, Abbotsford, British Columbia V3G 2M3

In recent years, numerous growers in British Columbia (BC) have begun reporting expanding patches of dead and dying vines that are symptomatically different from those associated with known insect pests and diseases in BC. In order to identify possible causes of this dieback disorder, we initiated a survey of BC cranberry beds in the spring/summer of 2007. Of the 51 beds visited, 32 had areas of dieback that could not be readily explained by herbicide or cranberry girdler damage. Symptoms at these sites usually included patches of dead vines surrounded by stressed vines with burgundy to grey-coloured leaves. Vines around the periphery of these dieback patches often appeared to have poor root systems, and could be pulled up like a blanket. We also observed vines that were well-rooted, but had blackened areas on runners, often at rooting points or upright branching points.

Upright, runner and root samples taken from symptomatic plants from 29 beds with dieback were analyzed for the presence of fungal, oomycete, bacterial and viral pathogens. Soil samples taken from 40 symptomatic and non-symptomatic beds were analyzed for plant-parasitic nematodes and *Phytophthora*. These *Phytophthora* analyses included direct extraction of DNA from soil and nested PCR using primers for oomycetes or *Phytophthora,* followed by amplification with a primer specific for *P. cinnamomi*. In addition, duplicate 5 g subsamples of each sample were subjected to lupine baiting; after baiting, the lupine roots were plated directly on PARPH media and subjected to nested PCR as for the soil samples.

Identification of the pathogens isolated from symptomatic plant tissues is ongoing. *Phytophthora cinnamomi* was detected in soil from several of the beds with dieback. This is the first report of *P. cinnamomi* on cranberry in British Columbia. Several potentially damaging genera of plant-parasitic nematodes have also been found. Of particular interest, *Paratrichodorus* spp. (stubby-root nematodes), were found in approximately 2/3 of all symptomatic beds. However, population densities at the time of sampling were generally lower than those observed to cause growth reductions of cranberry in greenhouse experiments, and the role of *Paratrichodorus* nematodes as a primary cause of the dieback is unclear. Future research will attempt to determine if these nematodes are functioning as part of a disease complex including *Phytophthora spp.* and other pathogens.

INCIDENCE OF DISEASES IN WILD STANDS OF CRANBERRIES IN MASSACHUSETTS F.L. Caruso, University of Massachusetts, Cranberry Station, East Wareham, MA 02538

Wild stands of cranberry vines located in the Cape Cod National Seashore in Provincetown and Truro and on the Sandy Neck barrier beach in Barnstable have been visited since 1990 during the growing season. General observations were made on plant health and conditions of the different sites. Observations of symptomatic plants were also compiled and flowers, berries, uprights, leaves, and roots sampled for isolation of causal agents of different diseases. Several stands have a significant incidence of false blossom disease, caused by a phytoplasma and vectored by the blunt-nosed leafhopper, a disease absent from commercial cranberry beds. Other stands have significant areas of upright dieback, caused by *Phomopsis vaccinii*. Several stands in one area of Sandy Neck had areas of dead vines killed by *Phytophthora cinnamomi*. Although fruit rot is largely lacking in these stands, *Phomopsis*, *Fusicoccum*, *Physalospora* and *Botryosphaeria* are regularly cultured from rotted and healthy berries. *Coleophoma* and *Phyllosticta* are hardly ever isolated from berries. Occasionally, leaf spots caused by *Protoventuria* and *Pyrenobotrys* are observed. Fairy ring disease, red shoot, red leaf spot and rose bloom have never been found. The incidence of insect injury has also been noted during the duration of this study. These wild cranberry stands serve as a model area to study the incidence of diseases in the absence of pesticides and fertilizers, and in swales that are often flooded for long periods of time.

POSTER
SESSION

THE INFLUENCE OF NITROGEN NUTRITION ON CRANBERRY YIELD COMPONENTS John Hart, Bernadine Strik Oregon State University Department of Crop and Soil Science, and Department of Horticulture, Ag and Life Science Bldg Corvallis OR 97331 and Teryl Roper, University of Wisconsin-Madison 1575 Linden Drive Madison, WI 53706-1590

The goal of most cranberry growers is to produce as many berries as possible with the least inputs and costs thus maximizing return on investment. Achieving this goal requires management that transforms cranberry yield components and sunlight into cranberries. Cranberry yield components are: 1) total number of uprights, 2) flowering upright number, 3) flower number, 4) berry number, and 5) individual berry weight.

From 1988 through 1990, we completed research that determined the relationship between N fertilization and yield. A cranberry bed planted with Stevens in south coastal Oregon that was seriously deficient in nitrogen was given 0, 20, 40 or 60 lb N/a for three years. The same treatments were supplied to an N sufficient bed planted with Crowley. Cranberry yield components were measured after three years of fertilizer application.

The relationship of N and yield was reported at the 1991 NACREW meeting. Recently, we began examining the relationships among yield components, yield component ratios, and yield.

Nitrogen applied to a deficient cranberry bed increases total upright number, flowering upright number, flower number, and yield or total berry weight. Based on prior research, the two important ratios calculated from these components are floral induction (proportion of flowering uprights per total uprights) and fruit set (Fruit number per flower number).

Addition of N to a deficient cranberry bed did not change the proportion of flowering uprights. About one-third the total uprights flower, regardless of the N rate. If each flowering upright will produce two berries and the proportion of flowering uprights to total uprights is constant, then the total upright number is critical. High yielding Stevens beds typically have 400 to 500 uprights per square foot.

Fruit set increased from 28 to 48 % or from about one-quarter to one-half when sufficient N is supplied. Such a large increase in the number of fruit produced from the flowers present (fruit set) indicates a change in the cranberry plant. The likely change is additional leaves to transform carbon from the atmosphere into plant energy (carbohydrates) for growth and storage.

Additional yield component data will be evaluated and presented.

AFTERNOON SPRINKLER IRRIGATION REDUCES AIR AND CANOPY TEMPERATURE OF CRANBERRY BEDS Matthew Lippert and Teryl Roper, Wood County Extension, P.O. Box 8095, Wisconsin Rapids, WI 54495, and UW-Madison, Dept. of Horticulture, 1575 Linden Drive, Madison, WI 53706

During the height of summer months air temperatures in cranberry growing areas of Wisconsin often exceed 32°C during the afternoon hours. Cranberries do not have fine stomatal control, therefore the balance between evaporation for cooling and tissue water retention may be compromised. Good data on the optimum temperature for photosynthesis of cranberry have not yet been published, but older data suggest that the optimum is around 24°C. When canopy or leaf temperature exceeds that value the rate of photosynthesis declines.

Cranberry growers have the ability to sprinkle irrigate their beds on hot afternoons in the summer to achieve evaporative cooling of the vines. We measured the effect of sprinkler irrigation on the canopy temperature and the air temperature above the vines on three hot summer afternoons in Wisconsin. Thermocouples (copper-constantan) were placed in adjoining beds at 1 meter and 0.2 meters above the soil surface, at the canopy height, and at 3 cm soil depth. The thermocouples were attached to a CR-1000 datalogger. We collected baseline data for 20-30 minutes then one of the two beds was irrigated for about 30 minutes. After the sprinklers were turned off we continued to monitor temperatures for 30-45 minutes.

Canopy and air temperatures in the irrigated beds dropped about 8°C within 10 minutes of beginning irrigation. Air temperature dropped faster than canopy temperature. Soil temperatures were not affected. The temperature differential between irrigated and non-irrigated beds continued steady through the duration of irrigation. Once the irrigation stopped air temperatures at 0.2 and 1.0 m climbed to near ambient within about 30 minutes. The canopy temperature of irrigated beds continued to be cooler than ambient beyond 30 minutes.

Overhead sprinkle irrigation will reduce canopy temperature for at least 30 minutes beyond the end of irrigation compared to non-irrigated areas. Growers can use this technique to reduce plant stress associated with hot afternoons.

RENOVATING CRANBERRY BEDS IN OREGON Linda White[1], John Hart[2], and Bernadine Strik[3]. 1. Oregon State University Extension Service, Coos and Curry County, 631 Alder St., Myrtle Point, OR 97458. 2. Oregon State University, Crop and Soil Science, 3045 ALS, Corvallis, OR 97331. 3. Oregon State University, Horticulture, 4017 ALS, Corvallis, OR 97331

Cranberry acreage increased rapidly on the southern coast of Oregon from 1997 to 2000. Vines for planting were difficult to obtain, and selection methods of pruned vines proved to be inadequate. Subsequent increases in cranberry prices are causing growers to examine the return from investment, management, and production costs from these beds. Many beds about 10 years in age have never reached the desired yield potential and are being removed.

Many beds currently being renovated have a sufficient sand base, adequate internal and surface drainage, and irrigation system. Only new genetic material is needed. As many growers are attempting to minimize the cost of renovation through their bed preparation methods, we are developing factors for consideration to help growers in their decision making processes.

For site preparation, growers involved in renovations need to at least consider: 1) methods of removing existing vines (mowing, scalping, burning); 2) whether to till the bed and any remaining duff layer or simply to add a layer of new sand; 3) whether to remove irrigation lines during bed preparation; 4) weed management prior to planting; 5) source and identification of desirable genetic material; and 6) planting date. Longer term considerations include weed management, soil pH and stratification, and fertilization practices.

PHENOLIC COMPOUNDS WITH POTENTIAL PEST-DETERRENT PROPERTIES FROM LEAVES OF EARLY BLACK CRANBERRY CULTIVAR (*VACCINIUM MACROCARPON*) Christine Dao[1], Michelle Botelho[2], Justine Vanden Heuvel[3] and Catherine Neto[1] [1]Department of Chemistry and Biochemistry, University of Massachusetts-Dartmouth, North Dartmouth, MA, [2]UMass Cranberry Experiment Station, Wareham, MA, [3]Department of Horticultural Sciences, Cornell University, Geneva, NY

Gypsy moth larvae (*Lymantria dispar* L.) and red-headed flea beetle adults (*Systena frontalis* F.) have demonstrated a strong preference to Howes variety cranberry leaves over Early Black, suggesting that Early Black cranberry foliage may contain compounds with pest-deterrent properties. A comparison of the phenolic compositions of Early Black and Howes foliage was conducted to investigate possible feeding deterrents. Leaves were harvested at time points coinciding with pest infestation from State Bog in Wareham, MA. Extraction and HPLC analysis showed several phenolic compounds present in higher quantities in Early Black. Quercetin glycosides were identified by comparison to known compounds in the fruit. The identities of several phenolic acids and tannins remain to be determined. Early Black leaves were later harvested in large quantity and a crude leaf extract prepared, which was subjected to the Kupchan partitioning method to target compounds of interest. A tannin-rich fraction was also prepared by extraction with aqueous acetone. HPLC analysis showed that the compounds of interest for identification appear primarily in ethyl-acetate soluble fractions. Column chromatography is being used to isolate these compounds for structure elucidation.

ELICITATION OF INDUCED DEFENSES AS AN ALTERNATIVE TO CONVENTIONAL INSECTICIDES IN CRANBERRIES Cesar Rodriguez-Saona and Joseph Argentine, PE Marucci Center for Blueberry and Cranberry Research and Extension, 125 a Lake Oswego Rd., Chatsworth, NJ 08019

The plant hormone jasmonic acid (Ja) and its volatile derivative methyl jasmonate (MJa), so-called "jasmonates", are elicitors of direct and indirect plant defense responses. Direct defenses are phytochemicals that increase resistance to herbivores, while indirect defenses involve plant volatiles that may attract the herbivore's natural enemies. Experiments were conducted to determine the effects of jasmonates on survival of three lepidopteran pests in cranberries. Cranberries were treated in the field with 1.0 mM Ja or received no Ja. Mortality of neonate spotted fireworm, *Sparganothis* fruitworm, and gypsy moth fed on foliage from Ja-treated plants was 0, 60, and 84% greater, respectively, than those fed on controls. Similarly, *Spargonothis* fruitworm neonates had 45% higher mortality on 1.0 mM MJa-treated cranberries compared to control plants. Second, we investigated the volatile response of cranberries to exogenous MJa treatment. Treatments consisted of 0 (control), 0.5, 1.0, and 2.0 mM MJa. Cranberries treated with MJa emitted higher amounts of volatiles compared to controls. Induction of individual chemicals in MJa-treated plants was up to 55-fold higher than control plants, and the overall production of volatile chemicals was 5-fold higher. The principal MJa-inducible volatiles included cis-3-hexenyl acetate, myrcenone, nonanal, indole, caryophyllene, α-humulene and γ-cadinene. Induction of cranberry volatiles was dose dependent, with 2 mM MJa inducing the highest amounts of volatiles. Thus, jasmonates induce both direct and indirect response in cranberries; while the effect of cranberry volatiles on natural enemies remains unknown, direct effects varied depending on pest species.

THREE RUTGERS CRANBERRY VARIETIES: CRIMSON QUEEN, MULLICA QUEEN AND DEMORANVILLE Nicholi Vorsa, Jennifer Johnson-Cicalese, and Karen DeStefano, Marucci Center for Blueberry and Cranberry Research and Extension, SEBS College, Rutgers University, 125A Lake Oswego Rd., Chatsworth, NJ 08019

The New Jersey Agricultural Experiment Station announces the release of 'Crimson Queen™', 'Mullica Queen™', and 'Demoranville™', three new high yielding, high-color cranberry varieties. These advanced-generation varieties were evaluated in replicated variety trials over multiple years and locations and exhibited significantly improved performance over 'Stevens' and 'Ben Lear'. The Rutgers cranberry breeding program was initiated in 1985 to improve the yield, fruit quality, and genetic diversity of cranberries. Traits being evaluated include yield, total anthocyanin content, fruit chemistry (acidity, sugars, polyphenolic content and profile), and fruit rot susceptibility, all under the severe conditions of heat stress and disease pressure found in New Jersey.

'Crimson Queen™' (tested as NJS98-23) was derived from a cross made in 1988 between 'Stevens' and 'Ben Lear'. 'Crimson Queen's™' average yield was 16% and 44% higher than 'Stevens' in a New Jersey and Wisconsin trial, respectively. TAcy values were consistently twice that of 'Stevens' in Wisconsin, and 50% greater in New Jersey. In Ocean Spray Cranberry, Inc. regional trials in British Columbia and Massachusetts, 'Crimson Queen™' averaged over 400 bbl/A. 'Demoranville™' ('NJ98-35') was named in honor of Irving Demoranville, and was derived from a cross made in 1988 between 'Franklin' and 'Ben Lear'. 'Demoranville' has exhibited significantly higher yields, higher anthocyanin content (red pigment), and larger fruit size as compared to 'Stevens' in several trials. 'Mullica Queen™' (CNJ97-105-4) was derived from a cross made in 1997 between 'Lemunyon' and '#35', and is unique because of its genetic background being unrelated to 'Stevens' or 'Ben Lear'. Over a 5-year period, 'Mullica Queen™' exhibited very high yield potential, ranging from 339 to 591 bbls/acre, whereas Stevens ranged from 202 to 338 bbls/A. These new varieties are being patented by Rutgers and, and having been significantly supported by Ocean Spray Cranberries, Inc., will be available exclusively to grower members of the Ocean Spray Cooperative.

GENETIC VARIATION IN SELECT SPECIES OF THE NORTH AMERICAN CRANBERRY FRUIT ROT COMPLEX James Polashock, USDA-ARS, 125 a Lake Oswego Rd., Chatsworth, NJ 08019. Frank L. Caruso, UMass Cranberry Experiment Station, 1 State Bog Road, P.O. Box 569, East Wareham, MA 02538-0569. Peter V. Oudemans, Rutgers University, 125 a Lake Oswego Rd., Chatsworth, NJ 08019. Patricia McManus, Dept. of Plant Pathology, Univ. of Wisconsin, 1630 Linden Drive, Madison, WI 53706

Cranberry fruit rot is caused by a complex of pathogenic fungi. Variation in the populations within this complex from region to region could delay identification of the causal agents(s) and complicate management strategies. Our objective was to assess genetic variation within four widespread fruit rot pathogens (*Phyllosticta vaccinii*, *Coleophoma empetri*, *Colletotrichum acutatum*, and *Physalospora vaccinii*). Representative isolates of each species were collected from NJ, MA, WI, and British Columbia (BC). Species availability varied by region. For example, *Phyllosticta vaccinii* was rare in WI and BC, but common in NJ and MA. We hypothesized that genetic variation would be low in the pathogens with a limited host range, while those with a broad host range would be more variable. ITS sequence data showed that variation (98-100% nucleotide similarity) was less than expected in the broad host range *C. acutatum*, but as anticipated in the narrow host range *Phyllosticta vaccinii*. Most species could be divided into weakly supported clades. However, clade position was not correlated with site of origin, and the representatives in each clade were morphologically indistinguishable. One exception was *Physalospora vaccinii* where typical colony color is gray-brown. White isolates of this pathogen were collected from BC. Sequence analysis suggests that the white isolates represent a different species. ITS sequencing and probe development for rapid detection of all species is in progress.

CRANBERRY PROANTHOCYANIDINS SENSITIZE OVARIAN CANCER CELLS TO PLATINUM DRUG Ajay P. Singh[1,3], Rakesh K. Singh[2], Satyan S. Kalkunte[2], Roger Nussbaum[1], Kyukwang Kim[2], Hong Jin[1], Monica S. Torres[1], Laurent Brard[2], and Nicholi Vorsa[1,3] [1]Rutgers, The State University of New Jersey. Department of Plant Biology and Pathology. 59 Dudley Rd. New Brunswick, NJ 08901, [2]Program in Women's Oncology, Department of Obstetrics and Gynecolgy, Kilguss Research Centre, Women and Infants Hospital, Brown University, Providence,RI, U.S.A. [3] Marucci Blueberry-Cranberry Research Center, Rutgers University, 125a Lake Oswego Road, Chatsworth, NJ 08019

Bioactivity guided isolation of American cranberry yielded fractions having cytotoxicity towards platinum-resistant human ovarian cancer cell lines, neuroblastoma and prostate cancer cell lines. MALDI-TOF characterization of the most active fractions indicated the presence of proanthocyanidins (PACs) of M.W. (M+Na) between DP-2 to DP-12 with 1-4 A type bond and between 2-8 epicatechin units with a max. of one epigallocatechin unit. The IC50 of PACs was between 79-479μg/mL on various cancer cell lines. PACs were relatively non-cytotoxic to lung fibroblast (IC50>1000μg/mL) cells. Resistance of platinum resistant human ovarian cancer (SKOV-3) cells subjected to sub IC50 levels of paraplatin was significantly reduced with concomitant exposure to PACs in cell viability (MTS) assays. BrdU incorporation assay indicated depressed cell proliferation at lower doses of PACs in the presence of paraplatin. Collectively, these findings suggest a significant synergistic effect between PACs and paraplatin. The potential of negating platinum drug resistance has important clinical implications, especially in ovarian cancer.

LABORATORY
TOURS

A CHEMICAL ECOLOGY LAB FOR BLUEBERRY & CRANBERRY ENTOMOLOGY
Cesar Rodriguez-Saona, Extension Specialist, Rutgers Entomology

Plant volatiles serve as a source of airborne chemicals in insect communication. Insects may use plant volatiles to locate food and mates. Females may also use these chemicals to locate oviposition sites. Because these chemicals play an integral role in the insect's life, they can be used for insect control. A laboratory for the study of plant volatiles and insect response to these chemicals has been established at the P.E. Marucci Center, Rutgers University in Chatsworth, NJ. The laboratory accommodates equipment for the collection and analyses of plant volatiles, electro-antennographic detection, and insect's behavioral response to plant volatiles (repellency and attraction). We are currently studying the response of cranberry fruitworm and cranberry weevil to host-plant volatiles to develop better tools for monitoring these insect pests.

WHAT'S NEW IN CRANBERRY HEALTH BENEFITS RESEARCH Amy Howell, Associate Research Scientist, Rutgers University

Cranberry juice consumption has been shown clinically to prevent urinary tract infections, however until recently, the effect was thought to be due to acidification of the urine. Research suggests that specific compounds in cranberry called proanthocyanidins act to inhibit bacterial adherence to the uroepithelium, preventing subsequent colonization and urinary tract infection. Elucidation of the chemical structures of the cranberry proanthocyanidins reveals the presence of less common A-type, double interflavanoid linkages. Most proanthocyanidin-containing fruits, such as grape and chocolate, have B-type, single interflavanoid linkages. Research suggests the A-type linkage may be important in eliciting anti-adhesion bioactivity. The role of cranberry proanthocyanidins in preventing bacterial adhesion will be reviewed, as well as current research on identifying the urinary metabolites following cranberry ingestion and determination of a unique metabolite that can be utilized as a compliance marker in clinical trials. Other health benefits associated with cranberry consumption will be discussed, including promotion of heart and dental health, as well as cancer prevention.

A MULTIFACTED APPROACH TO CRANBERRY IMPROVEMENT James Polashock, Research Plant Pathologist, USDA-ARS

We have screened a large cranberry germplasm collection for resistance to fruit rot. Several families segregating for fruit rot resistance have been identified and DNA fingerprinting and bulked segregant analysis is being used to identify potential markers for resistance. Cranberry fruit rot is caused by a complex of pathogenic fungi and general resistance suggests a biochemical mechanism for resistance. A separate project is aimed at isolating and characterizing the bioactive (i.e. antifungal) compound(s) from fruit. With regard to the pathogens, it is not known how genetically variable they are or if the current taxonomic structure is accurate. We have assessed genetic diversity in several species using sequence data from ITS1-5.8S-ITS2. We found the pathogens to be quite similar across growing regions, but also identified a small number of rare non-chromogenic *C. acutatum* isolates from British Columbia and white isolates of *Physalospora vaccinii* that appear to represent a new species. To better understand the function(s) of key cranberry genes, we also have an ongoing tissue culture and transformation project. Details will be discussed.

BIOLOGY AND CONTROL OF CRANBERRY PLANT PATHOGENS Peter Oudemans, Chris Constantelos, Jen Vaiciunas, and Donna Larsen Marucci Center for Blueberry and Cranberry Research and Extension, Cook College, Rutgers University, 125A Lake Oswego Rd., Chatsworth, NJ 08019

Work is progressing on the elucidation of life histories of cranberry fruit rot pathogens. Currently, our target organism is *Physalospora vaccinii,* which is one of the most common species found in North America. We believe the fungus survives on green leaves as a latent infection. These infections become active as the leaf begins to die and perithecia are formed on the leaf surface. Ascospores are forcibly ejected from the perithecia and infect new leaves or fruit. It is likely that infections may be up to two years old before perithecia are formed and therefore the fungus is easily transported with vines to new plantings. It has been very difficult to determine what triggers ascospore release. In 2007 we initiated a spore trapping survey (against my better judgement). This survey has yielded (not surprisingly) unexpected results. Spore numbers increased throughout the summer with the greatest numbers trapped in August and September. Since fungicide applications are most effective during late June and early July we expected to find higher numbers during that time period.

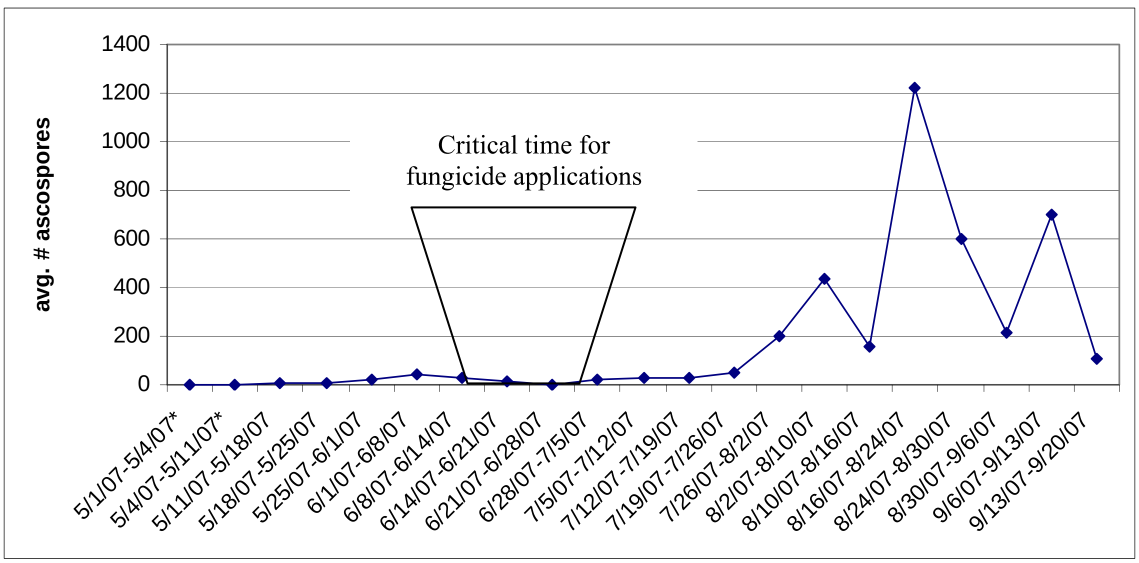
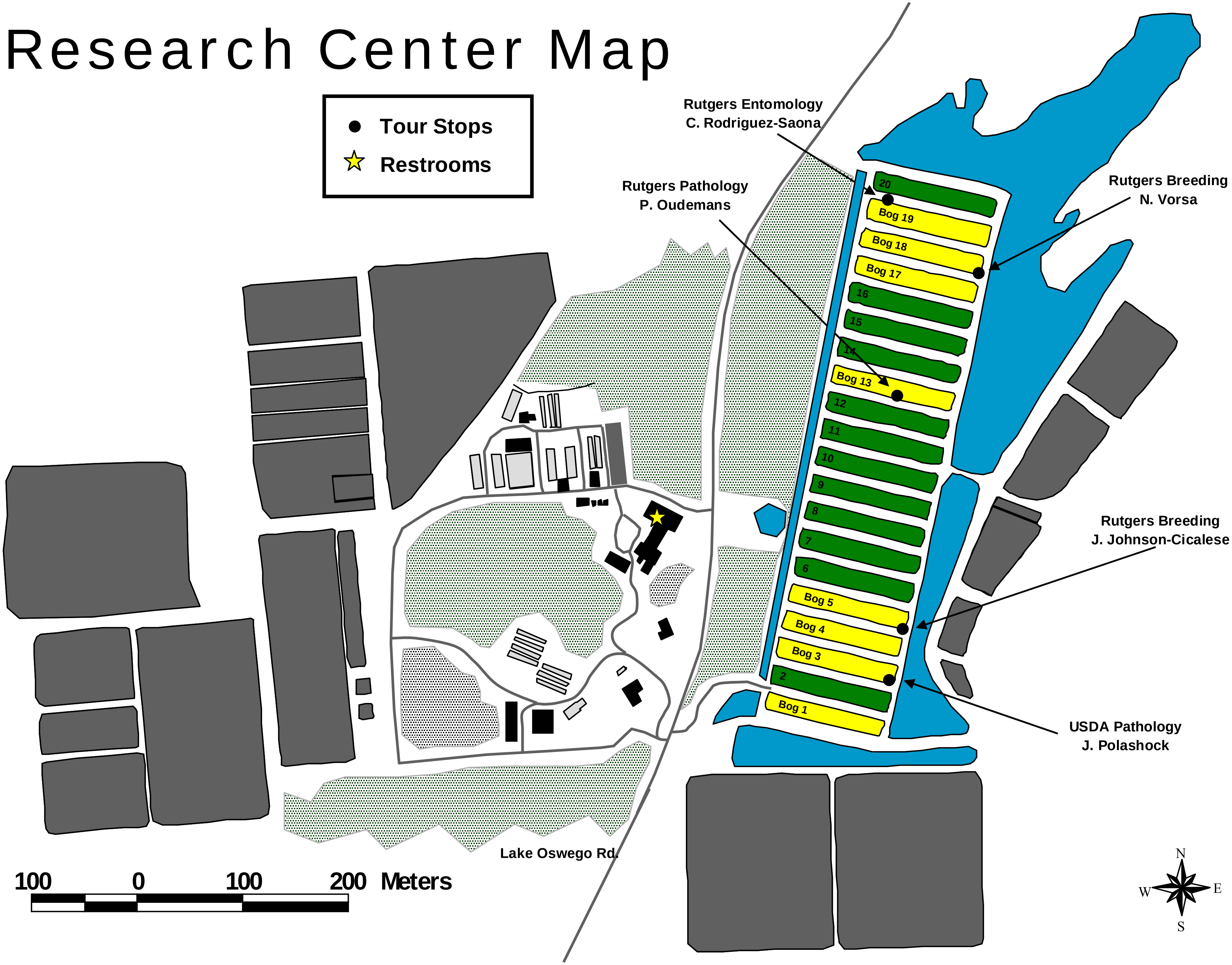


Fig. 1. Ascospore trap data for *Physalospora vaccinii* for 2007.

FIELD
TOURS

Research Center Map



DOMESTICATED & NATIVE CRANBERRY GERMPLASM COLLECTION Nicholi Vorsa, Professor Plant Biology & Pathology, Jennifer Johnson-Cicalese, Research Associate, Karen DeStefano, Field & Greenhouse Technician, Rutgers University

An essential component of any breeding project is a collection of germplasm (gene pool) to work with. From 1988 through 1994, a collection of cranberry accessions was made from: 1) the domesticated gene pool of varieties from cultivated beds throughout North America and the previous USDA breeding program, and 2) from native marshes, bogs, rivers and streams. Plants were collected from New Jersey, New York, Massachusetts, Maine, Delaware, West Virginia, Pennsylvania, Michigan, and Wisconsin. A PCR-based DNA fingerprinting technique was developed and the germplasm collection was systematically fingerprinted to delineate cranberry varieties and access the genetic diversity. In May 1995, this collection was planted in Bogs 1 and 4, in 604 25-ft^2 plots.

Over the years, the collection has been evaluated for yield, fruit size, fruit chemistry, and fruit rot. Individuals with exceptionally high and low sugars, acids, and total phenolics have been identified. Fungicides were withheld for two years in order to screen the collection for fruit rot resistance. Most plants were highly susceptible but a few selections exhibited some resistance. These unique plants have been used extensively in crosses in the cranberry breeding program and will continue to be maintained for this purpose.

ALTERNATIVE METHODS FOR CRANBERRY BED ESTABLISHMENT Jennifer Johnson-Cicalese, Research Associate, Nicholi Vorsa, Professor Plant Biology & Pathology, Rutgers University

A trial was planted to test the practical potential of several alternative establishment methods, particularly when plant material is limiting. The following aspects were considered: 1) quantity of plant material used; 2) cost of planting, including plant material and labor; and 3) maximizing rate of establishment.

With the release of new cranberry varieties, more and more growers are considering replanting older beds. However, because of the limited availability of the new cranberry varieties, and the desire to maintain genetic purity, the traditional planting method using 1-2 tons of plant material per acre, is less viable. The methods tried in this study used from 27 to 440 lbs of plant material per acre. Both rooted and unrooted cuttings were used, with varied planting methods, dates and densities described in Table 1. The 'Sticks' treatments involved pressing 3" deep holes into the bed with a board covered with protruding nails, and then placing 6" cuttings into the holes; the holes were not pressed closed. With the "Layed-out" treatment, the 8" vine pieces were laid on the bed surface in such a way that a modified disk would run over the middle of each vine piece and press it into the soil; the rows were 7" apart and approximately 6 cuttings were placed per square foot.

Table 1. Establishment Study with Mullica Queen, Bog 5

Treatments	Planting method	Planting date	Cuttings per ft^2	Size of cutting	lb of vine per acre	New growth rating 8/7/07 1-5 scale, 5=most
Unrooted cuttings:						
Sticks-2	Cuttings stuck upright into holes on bed surface	25-Apr-07	2	6"	110	1.7
Sticks-4	Cuttings stuck upright into holes on bed surface	25-Apr-07	4	6"	220	2.2
Layed-out	Layed on surface in a row and pressed in with modified disk	25-Apr-07	6	8"	440	4.1
Sprinkled	Sprinkled over plot and pressed in with modified disk	25-Apr-07	6	8"	440	3
Rooted cuttings:						
Rooted-1	Hand planted	31-May	1	3"	27	4
Rooted-1.5	Hand planted	31-May	1.5	3"	41	4.5
Rooted-June	Hand planted	26-Jun	1	3"	27	4.2

With the unrooted cuttings treatments, 'Layed-out' and 'Sprinkled' had much better establishment than 'Sticks'. The 'Sprinkled' treatment was similar to the conventional planting method except the vine was cut up into 8" pieces, allowing for better contact of the vine with the soil. A high density of new plants has developed, even though less than a quarter ton of plant material was used. By laying out the pieces of vine in rows 7" apart (the distance between the disks), the 'Layed-out' treatment maximized the number of vine pieces that were pressed in. However, because it was so time-consuming, this method would only be practical if it was automated in some way. The 'Sticks' treatment is a planting method that has been traditionally used by cranberry growers. In our study, however, even though the plots were irrigated right after planting, there was poor soil/cuttings contact, and the cuttings either dried up and died, or were severely stressed. Perhaps 'rolling' of these plots at planting would have resulted in better growth.

With the rooted cuttings treatments, establishment was more uniform than with unrooted cuttings, and generally better, even though they were planted 1-2 months later. The 'Rooted-June' treatment had an equal amount of growth as the May plantings, indicating that the later planting date had little effect on establishment. An advantage of using rooted cuttings is being able to apply preemergent herbicides at planting and much better weed control can be achieved. Some studies suggest, however, that low rates of Devrinol have little to no effect on rooting so it may be possible to have better weed control when planting unrooted cuttings.

This study will continue to be evaluated for establishment rate and eventually yield. The cost of rooted cuttings is slightly higher than unrooted cuttings, but preliminary data suggests better establishment. Higher earlier yields may more than make up the initial expense. The small quantity of plant material (27 lbs/acre) needed with rooted cuttings allows for careful scrutiny of the material, optimizing genetic purity. The 'Sprinkled' treatment was the least labor intensive method, with the other treatments being about equal.

Achnowledgement: We thank Abbott Lee for generously supplying plant material and equipment, and for his suggestions and discussions on planting methods. And we thank our hard working crew for their help in the tedious task of planting this trial.

INHIBITION OF FRUITING TO IMPROVE CRNABERRY BED ESTABLISHMENT

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New cranberry beds are usually started with rooted cuttings or pressed in vines. Establishment and the time to first production harvest vary depending on such factors as planting density, fertilizer regime and cultivar, but 2-3 years is typical. During the first two years, inhibition or elimination of fruiting could be advantageous for several reasons. These include increased resource allocation to vegetative growth, maintenance of cultivar purity by reducing volunteer seedlings and reduction in fungal inoculum from rotted fruit. There are two basic approaches to fruit elimination. First, there are various compounds, such as ammonium thiosulfate (ATS), that will burn the flowers. Second, there are plant growth regulators that can prevent flowering and/or fruit set such as Ethephon. An established bed of 'Stevens' was selected for preliminary testing. Compounds tested included ATS, Ethephon, Sulforix, ProGibb, and Induce. Some treatments effectively removed open flowers (e.g. ATS and Ethephon). However, fruit set was still high suggesting timing is critical and that multiple applications are required for complete flower elimination. ProGibb dramatically increased runner growth this year and is predicted to reduce flowers next season.

MANAGEMENT OF CRANBERRY FRUIT ROT Peter Oudemans, Donna Larsen, Chris Constantelos, Jen Vaiciunas Marucci Center for Blueberry and Cranberry Research and Extension, Cook College, Rutgers University, 125A Lake Oswego Rd., Chatsworth, NJ 08019

Cranberry fruit rot is the most important cranberry disease in New Jersey. Without management disease levels can easily reach 100% causing a complete crop loss. The disease is caused by several species of plant pathogenic fungi. Therefore, control of this disease is dependent on older broad spectrum fungicides such as chlorothalonil (i.e. Bravo), EBDC's (i.e. Dithane) or Ferbam. Very few of the modern fungicides possess sufficient spectrum of action to control this disease complex. Some new chemistries such as azoxystrobin (Abound) or fenbuconazole (Indar) are effective but there are also noticeable gaps. The fungicides are able to inhibit several of the major fruit rotting fungi that cause this disease. In our research we are conducting field trials designed to optimize the efficacy of fungicide applications.

1. Timing. We have developed and utilize phenology-based fruit rot spray program. This program arose from trials that demonstrated anthesis is the most critical time for fungicide applications. The basis for these phenology-based sprays are trials conducted with the cultivar "Early Black" using plantings at the PE Marucci Center in Chatsworth NJ. We are now expanding these trials to include cultivars such as "Ben Lear" and "Stevens" as well as testing the results in a variety of locations.

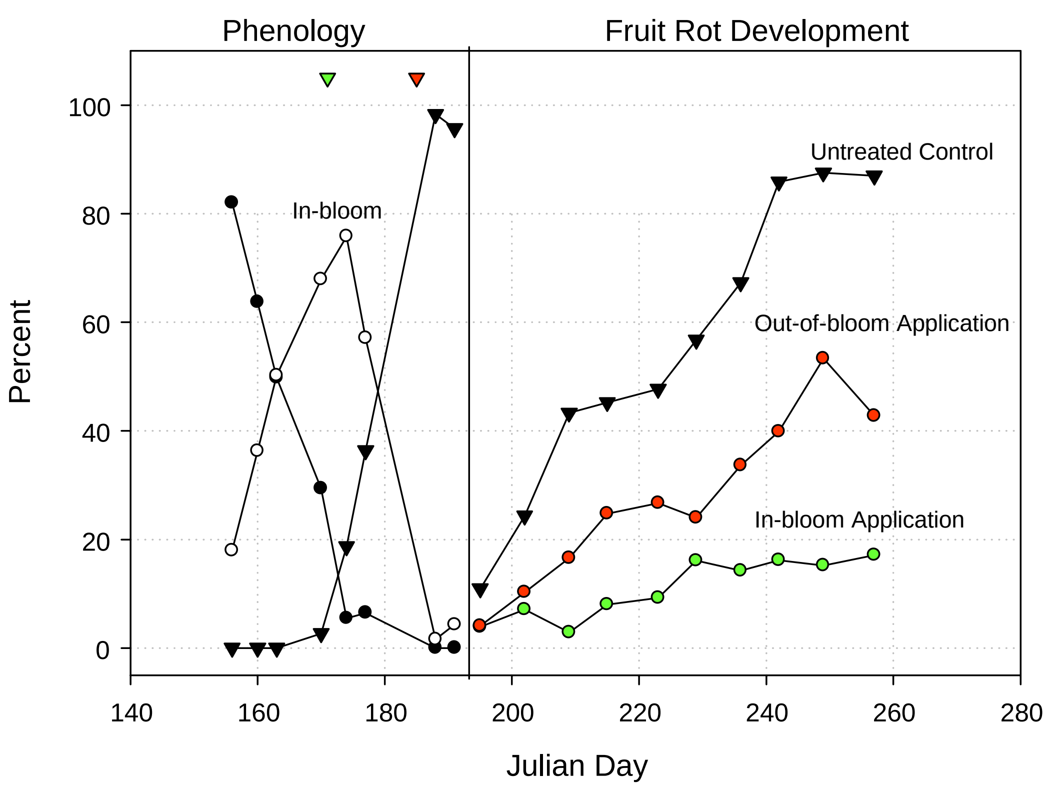

Fig. 1. The effects of fungicide timing on the development of field rot in Early Black.

2. **New Materials:** Several new fungicide groups have been tested and two have received Section 3 labels within the past 3 years. Our goal is now to develop optimized recommendations for their use against fruit rot. We have taken two approaches to developing optimized use patterns. In the first we are investigating the efficacy of tank mixes of Indar plus Abound against these fungicides alone as well as against Bravo. The logic of this trial is to improve the spectrum of action that is lacking when either fungicide is used alone. This trial will be harvested on October 2, 2006 however, initial indications are promising. A second trial was named the "Last Minute" trial. This was initiated to investigate the impact of Indar applications made following the end of anthesis. Results from this trial are presented in Fig. 2 show that a single application of Indar can effectively reduce the rate of fruit rot development. Again this trial will be harvested on Oct. 2, 2007.

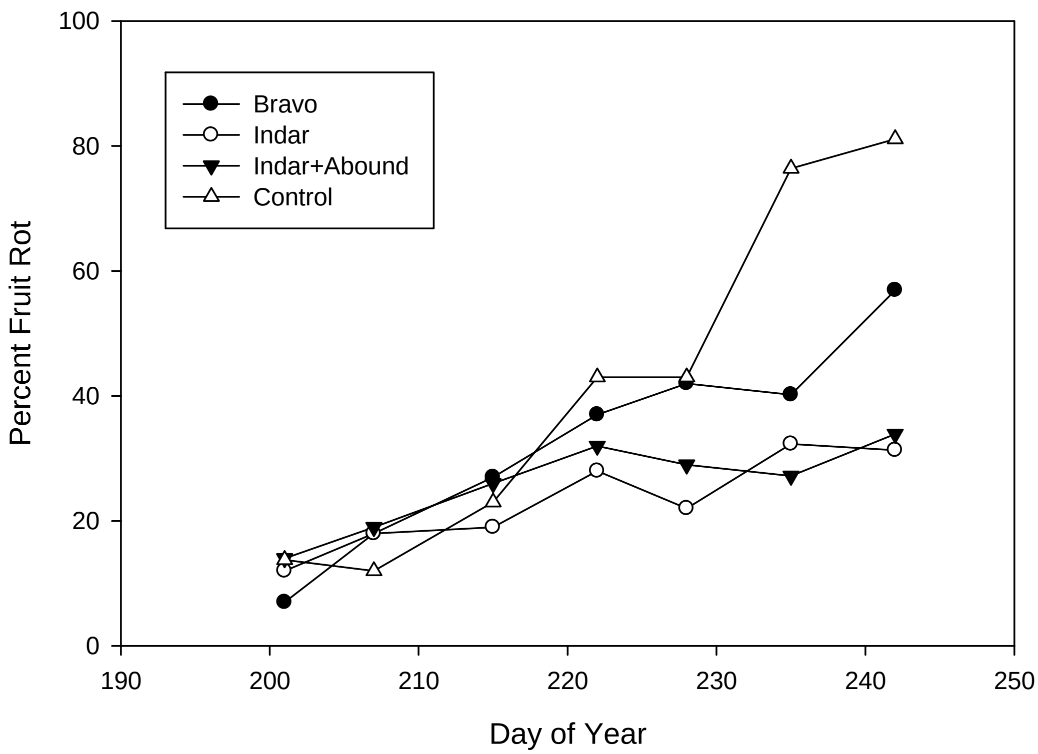

Fig. 2. Impact of a post-anthesis spray on the development of fruit rot in Early Black.

3. **Lime Sulfur**. There has been increasing interest in organic farming for increasing returns. Over the past several years we have tested a variety of organically approved fungicides and biofungicides all of which have failed to control this complex disease. This year we initiated testing of the fungicide Lime Sulfur. This material is typically used as delayed dormant application in deciduous fruit crops such apple, brambles, blueberries etc. The biggest problem with Lime Sulfur is the phytotoxicity of this material. Recent work on apples has demonstrated success with Lime Sulfur as an in-season application for diseases such as apple scab, bitter rot and fly speck. This work gave impetus to examine the effects of lime sulfur on fruit rot of cranberry with an eye on the relationship of rate, phytotoxicity and disease control. In this experiment we have

tested the following treatments to assess the feasibility of Lime Sulfur in cranberry culture.

Treatments for Lime Sulfur Test, 2007				
Trt	15-Jun	27-Jun	4-Jul	11-Jul
1	Lime Sulfur 0.5%	Lime Sulfur 0.5%	Lime Sulfur 0.5%	Lime Sulfur 0.5%
2	Lime Sulfur 1%	Lime Sulfur 1%	Lime Sulfur 1%	Lime Sulfur 1%
3	Lime Sulfur 2%	Lime Sulfur 2%	Lime Sulfur 2%	Lime Sulfur 2%
4	Lime Sulfur 4%	Lime Sulfur 4%	Lime Sulfur 4%	Lime Sulfur 4%
5	Bravo	Bravo	Bravo	Bravo
6	Control	Control	Control	Control

Results from this trial show that lime sulfur has potential as a cranberry fruit rot fungicide. Some phytotoxicity was observed at the highest concentration. The plots were harvested on Sept. 20. Results show a dosage response however under high fruit rot pressure losses will be significant. A treatment using Bravo was tested and final rot levels were 4.2%.

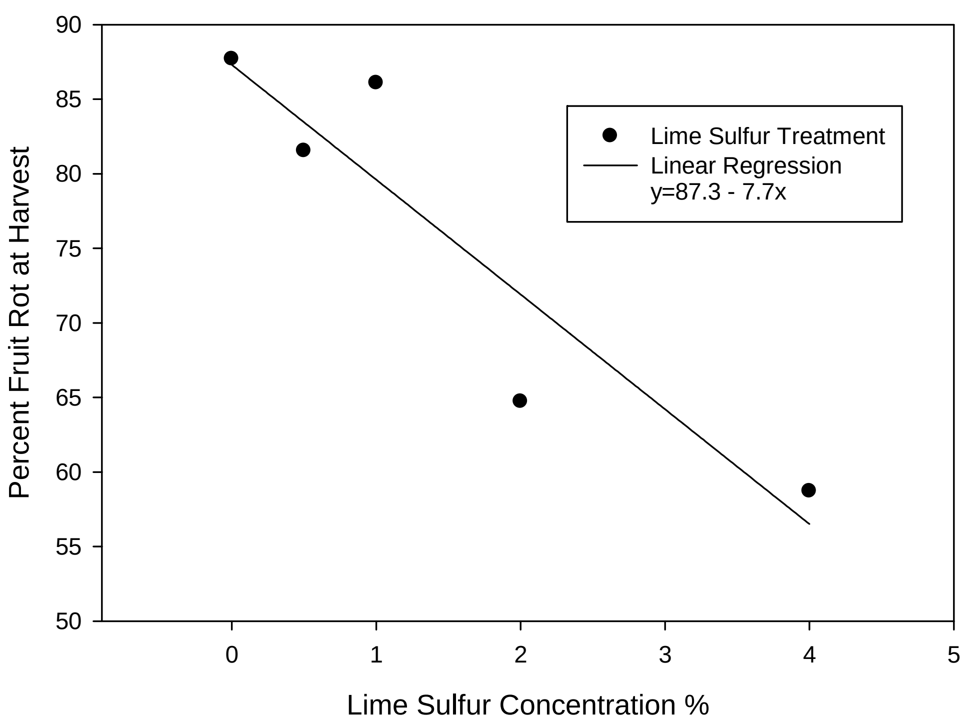

Fig. 3. Regression analysis showing the response of fruit rot levels to increasing lime sulfur concentrations

RUTGERS CRANBERRY VARIETY TRIAL: ADVANCED SELECTIONS AND VARIETIES Nicholi Vorsa, Professor Plant Biology & Pathology, Jennifer Johnson-Cicalese, Research Associate, Karen DeStefano, Field & Greenhouse Technician, Rutgers University

This trial represents the most promising selections from our breeding program during the period of 1985 to 2000. The trial was established to further evaluate the selections for yield, fruit rot, fruit size, season, and fruit quality traits, e.g. brix, TAcy, and titratable acidity. Three replications of each selection were planted in 10' by 10' plots, 1 rooted cutting per square foot, on June 16, 2003. The selections were chosen from over 9000 progeny representing several hundred crosses made among the following parents: Ben Lear, Beckwith, Bergman, Black Veil, Budd's Blues, Champion, Franklin, Gebhardt Beauty, Lemunyon, Pilgrim, Stevens, #35, Wilcox, AW2. Selections NJS98-23 (Crimson Queen), CNJ97-105-4 (Mullica Queen), and NJS98-35 (Demoranville) have been released by Rutgers University. Stevens, Ben Lear and #35 plots were included as standards. Objectives include: high reliable productivity, color (TAcy), fruit rot resistance, and vine vigor. Some selections were selected for higher brix (soluble solids) and phenolics levels, and low TAcy (for 'White' cranberry program).

Our first yield data was collected in 2006 from two square foot samples per plot. Yields ranged from 83 to 320 g/ft^2, with a trial mean yield of 188 g/ft^2. Yields of industry standards Stevens and Ben Lear were 156 g/ft^2 and 158 g/ft^2, respectively. Currently, the trial is being managed according to generally accepted cranberry production practices, including nutrition and pest management.

EVALUATION OF NEW INSECTICIDES AND ENTOMOPATHOGENIC NEMATODES Cesar Rodriguez-Saona, Extension Specialist, Elizabeth Bender, Senior Laboratory Technician, Robert Holdcraft, Plant & Soils Technician, Rutgers University

Experiments were conducted to test efficacy of several newer insecticides with various mode of action and entomopathogenic nematodes against above- and belowground insect pests:

Screening new insecticides against gypsy moth, Sparganothis *fruitworm, and spotted fireworm.* This test was conducted in an 'Early Black' field, located at the PE Marucci Center. Five registered and unregistered insecticides (Acetamiprid/Assail, Novaluron/Rimon, Spinetoram/Delegate, Flubendiamide, and Methoxyfenozide/Intrepid) were tested for efficacy against neonate gypsy moth, spotted fireworm, and *Sparganothis* fruitworm and compared to untreated controls. Plots were 2'x2' each, replicated 3-4 times in a randomized complete design. Each plot was separated by a 2' buffer zone. Five cranberry uprights from treated plots were placed in individual water picks with 3-5 1st instars of one of the three insect species. Colonies of all three species are maintained on artificial diets throughout the year at the PE Marucci Center, Entomology lab. Plants and insects were placed in the lab at approx. 25 °C. Mortality was assessed 6 days after transfer. Number of larvae alive, dead, or missing was recorded. All provided good control against gypsy moth. Although *Sparganothis* mortality was higher than 60% for all treatments, only Spinetoram and Methoxyfenozide provided control greater than 90%. Spinetoram, Flubendiamide, and Methoxyfenozide provided best control against spotted fireworm (>95%).

Evaluation of Actara against blunt-nosed leafhoppers. In 2006, Actara was tested against blunt-nosed leafhoppers under lab conditions. Actara proved to be very effective against blunt-nosed leafhopper in confined lab experiments. Our results led to a label change for 2007 to allow the use of Actara for blunt-nosed leafhopper control in cranberries. In 2007, Actara was tested against leafhoppers under field conditions. This study was conducted in a commercial cranberry bog with prior history of high leafhopper populations. Nymphal densities were assessed before and after insecticide applications by sweepnet sampling. Actara reduced leafhopper populations by > 95%.

Evaluation of entomopathogenic nematodes and new insecticides against Phyllophaga grubs. The efficacy of entomopathogenic nematodes was evaluated against white grubs in the greenhouse in potted cranberry plants. Three species of entomopathogenic nematodes: the newly identified *Steinerma scarabaei* and *Heterorhabditis bacteriophora* and *H. zelandica* were evaluated against 2nd and 3rd instars of *Phyllophaga georgiana* and compared to untreated controls. Eight white grubs, collected from commercial cranberry bogs, were placed in individual 7' pots containing approx. ten cranberry vines each. Mortality was assessed 3 weeks after treatment. *S. scarabaei* was the most effective species with 76–100% control at a rate of 2.5×10^9 IJ/ha. *H. zealandica* and especially *H. bacteriophora* were generally less effective and required rates of 5×10^9 IJ/ha for acceptable control.

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