Northwest Center for Small Fruits Research

2001 Annual Conference

Welcome to the tenth annual conference of the Northwest Center for Small Fruits Research in Boise, Idaho. We hope you will find this year's program interesting and useful.

Schedule: A detailed schedule has been provided in order to best choose the sessions you would like to participate in throughout the day. Each Technical Working Group will include a section for research reports and a featured presentation.

Research Priorities: During the conference, time is set aside to revisit all research priorities by commodity. After the Technical Working Group meetings, commodity groups will meet separately to review and revise priorities. Please refer to the enclosed schedule for the time and room assignments. Copies of all priorities can be found at the back of this booklet.

Organizational Handbook: The Organizational Handbook has been included in your registration packet. This booklet provides an overview of the NCSFR operations, detailed funding information and a member directory.

Idaho Wine Tasting: Prior to this evening's dinner, we will have the opportunity to enjoy sampling a variety of Idaho wines.

Two Keynote Speakers: This year we will have two keynote speakers during the evening dinner. Robert Corbell, executive director of the The Idaho Grape Growers and Wine Producers Commission, will speak to us on "Developing and Managing the Idaho Wine Industry." Krista Shellie, USDA-ARS located at University of Idaho Parma Research and Extension Center, will present an "Overview of Winegrape Production in Southern Idaho."

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BERRY/GRAPE PROCESSING

Packaging for Shelf-Life Extension of Fresh Raspberries

John K. Fellman, D.S. Mattinson, C. Edwards, Todd Edgington(NCSFR-funded GRA) WSU-Pullman, P. Moore WSU-Puyallup

Marketing of fresh raspberries is hindered by their brief shelf-life, manifested by high respiration and transpiration rates, morphological features that predispose them to crushing, and susceptibility to grey mold rot. A short extension of shelf life could allow shipment of fresh raspberries by surface means instead of air freight. In addition, fresh raspberries provide substantially larger returns to the producer compared to those grown for the processing market. Our overall objective is to extend the marketable shelf-life of fresh raspberries by using modified atmosphere packaging in conjunction with antifungal treatments. Progress since our initial experiments revealed a mixture of biological control organisms to be very effective in controlling postharvest *Botrytis* infections. Raspberries were harvested and placed under the following atmospheres: No modification (room air); Slight modification (15-19 % O_2 1% CO_2); Severe modification (8 - 12 % O_2 3-5% CO_2). Antifungal treatments were: No treatment; Lactic acid bacteria/ *Cryptococcus* sp. (a patented low-temperature biocontrol organism); Lactic acid bacteria or *Cryptococcus* alone. At 0, 4 or 8 days, fresh raspberries were removed from 1°C storage & analyzed for population of yeasts and molds, color, titratable acidity, moisture, pH, and anthocyanin content. The mixture of biocontrol organisms were effective at all holding temperatures. Modified atmospheres caused berries to retain brighter color, higher moisture content, and more acidity compared to control treatments. Use of an experimental ethylene action inhibitor, MCP, in conjunction with different MA treatments had a significant effect on berry firmness retention. Use of a proprietary clay product to control free moisture seemed to "scalp' aroma compounds from stored berries.

Advanced Drying Technologies for Berry Products

Juming Tang and Caleb Nindo, Biological Systems Engineering, Washington State University

John Fellman, Horticulture and Landscape Architecture and Charlie Edwards, Food Science and Human Nutrition, WSU

In year 2000/2001, we focused on evaluating energy efficiency of Refractance Window™ technology for producing high quality dried products, it's effect on reduction of food pathogens, and drying kinetics. The tests were conducted with pilot-scale and commercial scale systems.

Drying is the most energy intensive unit operation in food processing. A study was completed to evaluate energy efficiency of Refractance Window™ systems in drying pureed products. We recorded energy efficiencies in the range of 52% to 77% in commercial scale systems. These figures are equal to or higher than most other conventional methods. The energy used for moisture evaporation was about 20 to 24% lower than typical consumptions in freeze-drying, and 50% lower than tray drying. We conducted a comprehensive study in which samples were inoculated with a controlled population (10^7 CFU/g) of bacteria and dried in a pilot-scale Refractance Window™ system. We recorded 5 log reduction in total aerobic plate count (APC), and more than 6 log reduction in *Listeria innocua*, coliforms, and *Escherichia coli* counts in fresh and dried purees. Experiments were conducted to study drying kinetics. Moist product typically dried in 3~5 minutes. The circulating water temperature had the most important affect on the drying rate. The circulating water velocity and the product film thickness between 0.5 mm and 1 mm had little effect. Analyses of heat transfer and energy balance suggested that radiative heating significantly contributed to the transfer of thermal energy during the RW drying. Under similar operating conditions, the drying rate of RW dryer was comparable to that of a drum dryer

Flavor Volatiles of Marion (*Rubus spp. hyb*) and Evergreen (*Rubus laciniatus* L.) Blackberries

Keith Klesk, Co-P.I.-OSU, Michael C. Qian, Co-P.I-OSU, Chad Finn, Cooperator- USDA-ARS, Corvallis, OR

Research funding received May 31, 2000. The flavor volatiles of two blackberry cultivars (*Rubus spp. hyb,*

'Marion' and *Rubus laciniatus* L., 'Evergreen') will be isolated, identified, and quantified using capillary gas chromatography-mass spectrometry (CGC-MS), and two gas chromatography-olfactometry methods, aroma extract dilution analysis (AEDA), and OSME. Three extraction methods (headspace, liquid, and solid-phase micro-extraction (SPME)) will be compared in the analysis of blackberry volatiles. Preliminary separation of Marion volatiles is underway. Research goals are to provide understanding of Marion flavor, develop objective measurements to "quantify" Marion flavor, and apply the objective measurements to compare Evergreen to Marion. Results will also establish a baseline for genetic links of Marion blackberry flavor characteristics.

Impact of Processing on Blueberry Anthocyanins and Polyphenolics

Ronald E. Wrolstad, Jungmin Lee, Bob Durst, Richard Moyer, Food Science & Technology, OSU;

Chad Finn, USDA-HCRL, Corvallis; Kim Hummer, USDA/ARS, National Germplasm Repository

The primary objective of this project is to develop anthocyanin pigment and polyphenolic enriched extracts from blueberries and juice processing byproducts for use as colorants and nutraceuticals. Major efforts are directed to determining anthocyanin and polyphenolic composition of fruit and extracts and measurement of their antioxidant activities. Total anthocyanins, total phenolics, berry size, and antioxidant activities (ORAC and FRAP) were determined for 30 *Vaccinium* genotypes. Anthocyanins ranged from 34-515 mg/100g and ORAC values from 19-131 mmoles Trolox equivalents/g. Total anthocyanins and total phenolics were highly correlated with antioxidant activites. Highbush bluebery genotypes (n = 15) had a high correlation between berry size and total anthocyanins, however, this realtionship did not hold for other *Vaccinium* species and hybrids. The highest ORAC values belonged to wild plants and seedlings, not the cultivars.

Impact of Blackberry Polyphenolics on Juice Quality

Ronald E. Wrolstad, Thanyaporn Siriwoharn, Bob Durst, Food Science & Technology, OSU;

The objectives of this project are to determine the polyphenolic composition of blackberries and their roles in antioxidant activity and formation of sediment and haze in blackberry juice. The qualitative composition of Marion and Evergreen blackberries is similar, the following compounds being detected and measured: Flavanols (quercetin-3-glucoside, quercetin-3-galactoside, quercetin-3-rutinoside, quercetin-glucuronide (tentative), kaempferol-glucuronide (tentative), & 5 additional quercetin glycosides); 8 different ellagic acid derivatives; catechin; epicatechin; procyanidins; gallic acid; 11 ellagitannin derivatives. Marion berries are higher than Evergreen in total anthocyanins, total phenolics, and antioxidant activity while Evergreen berries are higher than Marion in total flavonols, ellagic acid forms, and epicatechin. Seeds accounted for 4.97% of the weight of Marion fruit and 5.63% of Evergreen berries. Seeds are very rich in procyanidins and ellagic acid derivatives, but contain no flavonols.

Impact of Processing on Blueberry Anthocyanins and Polyphenolics

Ronald E. Wrolstad, Department of Food Science & Technology, OSU

Jung-Min Lee (GRA), FST OSU, Robert W. Durst, FST OSU

The objectives of this investigation are to develop methods for processing bluceberry juice which maximize anthocyanin pigment retention and anti-oxidant capacity. Frozen blueberries were processed into juice and concentrate where the effectiveness of heat and SO_2 treatments for inactivation of native polyphenoloxidase were compared to a control. Heat and SO_2 treated samples were higher in anthocyanins and polypohenolics. Pronounced losses of anthocyanins and polyphenolics occurred during thawing, crushing and depectinization. Juice yields ranged from 74-83% with only 15-29% of the anthocyanins and 25-28% of the polyphenolics being recovered in the pasteurized juice.The press-cake residue contained c.a. 40% of the fresh fruit anthocyanins and 21% of the polyphenolics. Thus the press-cake is a very rich source of anthocyanins (334-471 mg/100g) for utilization as natural colorants and nutraceuticals. HPLC analysis of the anthocyanin profile showed that delphinidin- and cyanidin- glycosides were very susceptible to degradation while malvidin-glycosides had greater stability. Within the polyphenolic fraction, cinnamic acid derivatives (chlorogenic acid) degraded at a faster rate than flavanol glycosides (quercetin-3-glucoside).

GENETICS

Evaluation of New Cranberry Cultivars and Selections for the Pacific Northwest

K. D. Patten, Associate Horticulturist, WSU-Long Beach Research and Extension Unit

P. R. Bristow, Associate Plant Pathologist, WSU-Puyallup Research and Extension Center

The objective is to evaluate 16 genotypes (12 cultivars and 4 selections) in a replicated planting during the 2001 to 2003 crop years for: a) horticultural traits (yield, berry size, color, return bloom, etc.), and reaction to b) insects (black-headed fireworm and cranberry fruitworm, and c) diseases (fruit rots, cottonball and rose bloom). 2000 was the fifth harvest year for this 1994 planting. Pilgrim and Wilcox were again among the top yielding genotypes; both out-yielded Stevens and McFarlin. Yields in 2000 were correlated with yield in 1999 and total yield from 1996-2000. All genotypes were susceptible to rose bloom disease with Howes having the highest disease incidence. To date, cottonball disease has been detected in all genotypes except Ben Lear, Howes, McFarlin and Wilcox. The incidence of fruit rot after 8 weeks of refrigerated storage was correlated with incidence at harvest (field rot). Insect damage to berries at harvest ranged from 1.0 to 6.1%; #35, A.J. and Wilcox had the lowest incidence. Because yields for Stevens plus one or two other genotypes declined in 2000, sand (ca 2 cm) was applied to one half of each plot during winter 2000-01. Plots were evaluated again in 2001 and measurements such as yield, return bloom, berry size, etc. were taken from both sanded and non-sanded halves of each plot. Pilgrim, Wilcox, #35, and Grygleski-1, combine productivity with low levels of fruit rot and damage from insects. Highest cumulative yields (1996-2001) occurred with Pilgrim, #35, Wilcox and Grygleski-1.

Development of Winter Hardy Blackberry Through Genetic Engineering

Tony Chen, Professor, Dept. of Horticulture, Oregon State University

Chad Finn, Res. Geneticist, USDA-ARS

This research aims to develop and implement a protocol for inserting genes that increase cold hardiness into 'Marion' and thornless blackberry advanced selections. Using an in vitro regeneration system optimized for 'Marion' blackberry (Meng et al., 2000), we have attempted to develop an *Agrobacterium*-mediated transformation protocol for this important blackberry cultivar. The following research has been conducted in order to optimize the system:

- Evaluation of antibiotic selection agents: It appears that kanamycin 40 mg/l or hygromycin 10 mg/l can completely inhibit shoot regeneration and thus can be used for allowing only the transformed cells to develop into transgenic shoots.

- *A. tumefaciens* strain and plasmid vector: We compared three *A. tumefaciens* strains, EHA105 (pGiPTVHP$^+$), EHA105 (pTOK47/pGiPTVHP$^+$), and LBA4404 (pTOK233) and concluded that on Marion Regeneration Medium (MRM) that the LBA4404 with pTOK233 is better than the other two EHA105 constructs.

- The length of time that explants and *Agrobacterium* cells were incubated in MRM medium: Explants were incubated in LBA4404 (pTOK233) suspension in MRM medium with 100 mM AS for either 15, 30, or 60 min. We found that 30 min incubation has the highest transient expression efficiency.

- The effect of acetosyringone (AS) concentration in the incubation medium: AS is reported to activate transcription of the virulence gene of *A. tumefaciens*. We found that increasing AS concentration to 400 mM in the incubation medium significantly improves the transformation efficiency.

- The effect of the AS concentration in the cocultivation medium: Based on the same rationale as above four levels of AS concentration during the cocultivation step were examined The highest % GUS positive explant was found in medium containing 400 mM AS.

- The effect of the duration of cocultivation on transformation efficiency: We compared the % GUS positive explants with five cocultivation time (3, 6, 9, 12, 15 days) and concluded that the optimum cocultivation duration is around 9-10 days.

- The effect of vacuum infiltration: We compared the GUS positive explants with 5 vacuum treatment and concluded that vacuum infiltration has significant effect on transformation when treatment time increases to > 2.5 min.

-The effect of sonication on transformation: Sonication gives a certain extent of wounding of explants and is reported to increase the efficiency of *Agrobacterium*-mediated transformation. We found that 4 min sonication

treatment has significant higher percent GUS positive explants than other treatments.

Conclusion:

Summarizing the individual experiments, the highest percentage of GUS-positive (15%) was obtained with the incubation of *Agrobacterium* cells for 30 minutes in the MRM medium containing 400 mM AS with vacuum for 2.5 minutes and sonication for 4 minutes, followed by 9 days of cocultivation on medium with 400 mM AS, and finally, selected on the medium with 10 mg/L hygromycin.

Domestication of Western Huckleberries

Dan Barney, U of I, SREC

To date, research efforts have focused on Vaccinium germplasm collections throughout the northwestern United States, development of seed and in vitro propagation methodologies, germplasm establishment and evaluation, characterization of volatile flavor chemicals, and interspecific hybridization. Germplasm representing V. caespitosum, V. deliciosum, V. membranaceum, V. myrtillus, V. ovalifolium, V. ovatum, V. parvifolium, V. scoparium, and V. ulignosum has been collected. Seed germination characteristics of V. membranaceum have been described and a mathematical model of germination proposed. In vitro cultures of V. deliciosum, V. membranaceum, V. myrtillus, and V. ovalifolium have been established and the methodologies for rooting in vitro cultured microshoots of V. membranaceum have been reported. Preliminary field trials of V. deliciosum, V. membranaceum, V. ovalifolium, V. ulignosum, and putative hybrids of V. membranaceum and V. ovalifolium have been conducted. V. deliciosum and V. ulignosum exhibited higher survival rates on silt loam soils than the other species or hybrids and plans are underway to test the effects of soil type and shade on huckleberry survival, growth, and development. Flavor chemical profiles have been documented for V. deliciosum, V. membranaceum, and V. ovalifolium. Fruit and seeds from V. membranaceum x V. ovalifolium reciprocal crosses have been obtained. Limited attempts to develop V. membranaceum x V. corymbosum and V. membranaceum x V. angustifolium have not yet been successful. Work is now underway to characterize the functional food profiles of the 10 Vaccinium species native to the northwestern United States.

Raspberry Bushy Dwarf Virus (RBDV) in 'Marion' Blackberry

Robert Martin, Virologist, USDA-ARS, HCRL, Bernadine C. Strik, Professor, Horticulture, Oregon State University,. Paul Kohnen, University of Puget Sound,

Isolate identification and collection

Leaf material was collected from a blackberry demonstration block at the North Willamette Research and Extension Center and tested for the presence of RBDV. Three commercial fields where RBDV had been found previously were sampled to identify individual plants that tested positive for RBDV. A blackberry sample from Arkansas that was positive for RBDV was obtained and included in the study as well. Virus from nine different isolates to date have been transmitted to *Chenopodium quinoa* (a host used for laboratory studies of many plant viruses that is easier to grow and work with in the greenhouse than blackberry.

Several methods were tried to clone and sequence the RBDV directly from the *Rubus* materials but the results were sporadic. Therefore, isolates were transferred to *C. quinoa* prior to cloning and sequencing. Total RNA was extracted from infected plants and used as template for reverse transcription-polymerase chain reaction (RT-PCR) to prepare DNA for cloning. The DNA was cloned into a suitable plasmid and sequencing has begun. At this time the coat protein of seven isolates have been sequenced. More isolates will be collected from local sources as well as from more distant sources to look for consistent differences in the isolates from raspberry or blackberry. The project is on schedule for completion in the original time frame of two years.

Production of Virus-Free Small Fruit Selections

Robert R. Martin, USDA-ARS, HCRL

Paul Kohnen left the program to take up a teaching position at University of Puget Sound in the summer of 2000. In March we hired Nola Mosier, half time, to run the program. During the six month interim, we maintained the tissue culture plants but did not put new material through the process. Nola is now up to speed on the process and together with undergraduate student labor has the process up and running again. Also, during the year we have adapted some new lab tests to improve the testing in the program. A student in the lab has developed a test for

strawberry pallidosis and the group at Davis, CA, has developed a test for strawberry veinbanding virus. We plan to have lab tests for strawberry mottle and crinkle during the upcoming year. This would give us rapid tests for all the important strawberry viruses and decrease the time required to get material through the process of clean up and testing. With the finding of RBDV in blackberry, there is the expectation that blackberry material will now be going through the clean-up process in addition to strawberry and raspberry.

Propagation of WSU Strawberry and Raspberry Selections for Testing

Patrick P. Moore, Scientist, Washington State University, Puyallup Research and Extension Center

Robert R. Martin, Virologist, USDA-ARS, Corvallis, OR

Project Initiated: Fall 2001

In 2000-01, strawberry selections were micropropagated at WSU Puyallup, transferred to Bob Martin's (USDA-ARS, Corvallis, OR) laboratory where they were heat treated and meristemmed for virus elimination, then returned to WSU Puyallup where they were multiplied in tissue culture and planted at WSU Puyallup.

Fifteen strawberry selections were propagated, treated for virus elimination, and planted in the field in 2001. Additional selections have been propagated, heat treated and multiplied, but were not ready for field planting in 2001. These selections will be planted in the field in 2002 along with selections made in 2001. Additional selections are being propagated and will be transferred to Bob Martin's laboratory for virus elimination. Twenty-four new selections were made in 2001 and these will be propagated in 2001-02.

Sixty-two raspberry selections were tissue culture propagated and planted in the field in 2001. Additional selections were propagated, but were not ready for field planting in 2001. These selections will be planted in the field in 2002 along with selections made in 2001. Forty-eight new raspberry selections were made in 2001 and these will be propagated in 2001-02.

Identifying Winter Tolerant Blackberry Selections and Cultivars

Derek Peacock, Research and Development Manager, Enfield Farms, Lynden

Chad Finn, Res. Geneticist, USDA-ARS;

Mary Peterson, Res. Assistant, USDA-ARS

'Marion' blackberry's lack of winter tolerance and it's thorniness are consistently cited as two of the major problems facing the Northwest's trailing blackberry industry. The USDA-ARS breeding program needs to have a method to identify selections and breeding material that are more winter tolerant if they are going to make progress towards developing winter hardy cultivars. Waiting for a test winter and artificial freezing runs are two approaches to identification of tolerant plants, but we feel at this point in time that these are unsatisfactory approaches. Placing the genotypes in an environment such as northern Washington where they are more likely going to receive a test winter in a commercial setting should help address several challenges. The objectives of this work are to identify winter tolerant, primarily thornless trailing blackberry genotypes in the USDA-ARS breeding program and to determine whether these thornless selections are machine harvestable. The USDA-ARS propagated 34 selections or cultivars which were planted in Spring 2001 at Enfield Farms (Lynden, Wash.). The plants established well and were scored in September 2001 for vigor and ease of training. The plants were trained up in the fall to maximize the chances that they are exposed to winter damage. An additional 40-50 selections are being propagated to plant in Spring 2002. Beginning in 2002 fruiting characteristics and winter injury will be evaluated.

Evaluation of Raspberry and Strawberry Cultivars for Local Specialty Sales in Southern Idaho

Dr. Jo Ann Robbins, University of Idaho, Extension Educator

Dr. Michael Colt, University of Idaho, Horticulture Specialist

Cooperator: The Sawtooth Botanical Garden, Sun Valley, ID

Selected cultivars of raspberries ('Algonquin', 'K-81-6', 'Lauren', 'Nova', 'Qualicum', and 'Reveille') and strawber-

ries ('Allstar', 'Cavendish', 'Honeoye', 'Jewell', 'Kent', 'Mesabi', 'Mira', 'Northeastern', and 'Winona') are being grown under short season, cold winter conditions in Idaho. Plants were planted on May 26, 1999.

The raspberries were harvested for the first time in 2001. On June 13 and 14, when a freeze occurred, few flowers were open and little damage occurred to the raspberries. Weekly harvest began on July 26 and continued through September 13. Highest yielding cultivar was 'Nova', followed by 'Reveille'. Fruit weight for all cultivars was around 2 grams. Fruit weight was consistent during the early harvests and decreased during the last one or two. Early fruiting cultivars were 'Lauren', 'Reveille', and 'Nova'. Latest were 'Qualicum' and 'K-81-6'. Fruit quality was good for all cultivars, but all fruit evaluators preferred the flavor and appearance of 'K-81-6'.

In June, the strawberry plants were in full bloom when the freeze occurred on the 13th and 14th. It was estimated up to ½ of the yield was lost on some cultivars due to the open flowers freezing. Strawberry plants were harvested weekly from July 5 through August 9. This was the second year of harvest. 'Mesabi' out yielded all other cultivars. 'Winona' and 'Cavendish produced better than the rest of the cultivars. Berry weight began large and decreased at varying rates in all cultivars as the season progressed. Over the whole season, 'Winona' and 'Cavendish' had the heaviest fruit. Early fruiting cultivars were 'Cavendish', 'Kent', and 'Mesabi'. Latest were 'Allstar' and 'Winona'. Fruit quality was high, with good external color on all cultivars. Flavor was rated highest in 'Mesabi' and 'Cavendish' and lowest in 'Mira'.

PEST MANAGEMENT

Soil Solarization as a Component of an Integrated Program to Control Phytophthora Root Rot of Red Raspberry

Peter R. Bristow, WSU-Puyallup Research and Extension Center, Puyallup, WA

John N. Pinkerton, NCSFR, USDA-ARS, HCRL, Corvallis, OR

The objective of the project is to evaluate soil solarization alone and in combination with raised beds and gypsum soil amendment in an integrated plan for controlling Phytophthora root rot of red raspberry. The following six treatment were established in July 2000: 1) flat bed, no solarization (untreated check), 2) raised bed, no solarization, 3) flat bed, solarization, 4) raised bed, solarization, 5) raised bed, gypsum incorporated (into the soil at the rate of 6 tons/A), and 6) raised bed, gypsum incorporated, solarization. Plots to be solarized were covered with a clear polyethylene tarp in late July 2000 and the tarp remained in place until May 2001. Soil in solarized plots had noticeably better tilth. Immediately prior to planting, soil in flat beds was rototilled to a depth of ~10 cm. Tissue culture propagated plants of two root rot susceptible cultivars (Malahat and Willamette) were planted in mid-May. Six weeks after planting weed cover was assessed. Weed cover in non-solarized plots was significantly more than in solarized plots. In non-solarized flat beds, there was nearly a pure stand of smartweed (*Polygonum* spp.) Four months after planting, plants in solarized soil were markedly larger than those in non-solarized soil.

Comparison of Control of Powdery Mildew in Gooseberries

Kim E. Hummer, USDA ARS NCGR, Corvallis, OR., and Deric Picton, Graduate Research Assistant, Oregon State University

Objectives for 2001:

- To determine the effect of JMS Stylet oil sprays on powdery mildew incidence on gooseberries in Corvallis or
- To compare the effect of JMS Stylet oil to commercial fungicide and bio-control agents on powdery mildew.

Procedures:

An experimental gooseberry plot was established in a greenhouse in the spring of 2001 using 2-year old rooted *Ribes uva-crispa* 'Industry'. This cultivar is susceptible to powdery mildew. Powdery mildew occurs on gooseberry stems and leaves during the spring and early summer. The study was performed on greenhouse plants (completely randomized block design, three plant replicates per treatment) in the late spring and early summer with spraying occurring from mid-March to the end of June. The treatments are as follows: No spray; stylet oil (8 mls/L) sprayed every two weeks; Plant Shield ®, a fungal agent (4.5 g/L) sprayed every two weeks and Cleary 3336, a fungicide (1.5 g/L), sprayed every two weeks.

Final observations were taken in July. Disease severity was assessed on percentage coverage of leaf or stem. Percent leaf coverage was subjected to ANOVA and LSD analyses.

Expected Results:

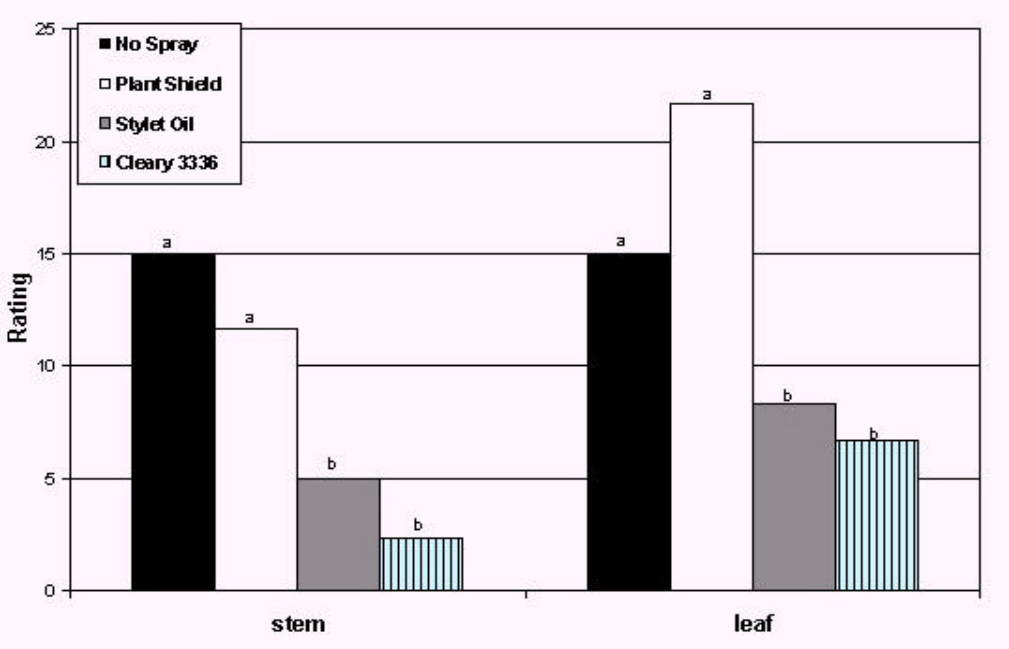
We expected to determine the effects of oil spray application for the control of powdery mildew as compared to other means of control under greenhouse conditions at Corvallis, OR.

Accomplishments:

ANOVA was calculated for treatment effects ($F = 10.6$, $P < 0.004$ for stem infection; $F = 11.3$, $P < 0.003$ for leaf infection). A mean separation test (LSD) was applied to determine differences in the treatments. This test indicated that the Plant Shield® response was not significantly different than the untreated control although the stylet oil and Cleary were significantly different than the untreated control. Stylet oil and Cleary responses did not significantly differ.

Conclusions: Both Cleary 3336 and Stylet Oil reduced powdery mildew on the leaves and stems of gooseberries. Plant Shield ® was ineffective in mildew control on stems or leaves of gooseberries under these greenhouse conditions.

Figure 1. Powdery mildew severity for the four treatments. Oil (8 ml/L), Plant Shield ® 4.5 g/L and Cleary 3336 1.5 g/L was applied at 2-week intervals form April to June 2001. Disease severity ratings were taken on 25 July 2001. Each bar represents the mean of 3 samples. LSD (0.05)=6.66.



Significance to Industry:

Powdery mildew is a significant fungal pathogen which can cause sever damage to the fruit and leaves of *Ribes*. The control of this disease is a priority as listed in the Pest Management Technical Working Group. The damage renders the fruit unusable and the plant vulnerable to attack from insect pests and other diseases. This fungus is endemic to the Northwest and cannot be avoided. An economical and practical approach for the control of mildew on *Ribes* is necessary for the establishment of a prosperous *Ribes* industry. Last year we determined that stylet oil could control mildew in susceptible black currants. Oil spray coats leaves and could reduce photosynthesis or plant health over time. This year we looked the fungicide, Cleary, and a biological control Plant Shield in addition to the oil spray. We also looked at gooseberries.

We determined that stylet oil and the fungicide Cleary 3336 both significantly reduced mildew in gooseberry leafs and stems. The response from Plant Shield ® (biological) was not significantly different than that of the untreated control group.

Temperature Effects on the Life Stages of Populations of Grape Phylloxera (*Daktulosphaira vitifoliae*) that are from Different Grape Growing Regions of the Pacific Northwest

James R. Fisher, PI. USDA, ARS, HCRL, Corvallis, Oregon

Grape phylloxera is a recent pest threatening to destroy over 25,000 acres of self-rooted winegrapes in the Pacific Northwest region of the USA. Some vineyards have coexisted with this pest for over 15 years while others have been devastated in less than 5 years. We conducted this study to determine if life processes of populations of phylloxera from four different areas in the Pacific Northwest, USA, would show differences in survival, development and reproduction when reared at myriad of constant temperatures (3 - 36ºC at 3º intervals). Individual differences were observed among the four populations for development, survival and reproduction, but no trends were observed for any one population. However, the numbers for each parameter followed a general trend among temperatures. The optimum temperature range for maximum response for all parameters was between 24ºC and 27ºC. Upper and lower temperature thresholds were, respectively, <6ºC and >33ºC. The results from this study and others support the hypothesis that localized differences in 'virulence' of infestations from vineyard to vineyard over an appellation may be a function, in part, of localized temperature differences caused by such factors as soil type, aspect, slope, pruning, ground cover, and plant spacing

Development of Mating Disruption as a Management Strategy for the Currant Borer, *(Synanthedon Tipuliformis)*

David G. James, Irrigated Agriculture Research and Extension Center, Washington State University

Full scale commercial trials of mating disruption for currant cane borer (*synanthedon tipuliformis*) were conducted during 2001 on 78 acres of red currants in the Prosser area of south central Washington. Conventional twist tie dispensers containing the formulation of pheromone used by Washington *S. tipuliformis,* identified in 2000, were obtained from Shin-Etsu in Japan and placed in five fields at rates from 189-275/acre during 15-17 May (higher rates were used in fields known to have larger populations of borers). Novel, high release-low point (HRLP) source lures were obtained from Chem Tica Internacional in Costa Rica and used in a sixth field at a rate of 12/acre. An abandoned red currant field served as a reference site. Pheromone-baited sticky traps placed within blocks and timed counts of moth activity monitored the success of mating confusion.

Few moths were caught in monitoring traps during the trials indicating mating disruption was effective. For example in a field that had a trapping rate of 88 moths/trap/week prior to mating disruption (insecticide control) in 2000, only 1 moth/trap/week was caught in 2001. Trap rates in the other mating disruption (twist-tie) fields were 0.01, 0.01, 0.2, and 0.13 moths/trap/week. Less success was achieved in the HRLP field with 4.9 moths trapped/week/trap. An average of 10 moths/30 minutes was observed during the flight period in a field that averaged 54 moths/30 minutes in 2000. Cooperating growers were extremely pleased with the results. Mating disruption for control of currant borer in Washington red currants appears to be a practical and cost-effective solution, substantially reducing chemical inputs to this crop.

Biological Control of Spider Mites in Washington Viticulture

David G. James, Irrigated Agriculture Research and Extension Center, Washington State University

Sampling sites for spider mites and natural enemies were established in June 2001 at a number of conventional, low-input and abandoned vineyards in south central Washington. These sites were visited monthly until September for leaf and vacuum sampling of the canopy. Samples were examined in the laboratory and all mites and other arthropods are being identified.

Early results indicate two phytoseiid species (*Galendromus occidentalis, Metaseiulus citri*) dominate the predatory mite fauna in Washington vineyards. However, many other species also occur. The non-phytoseiid complex of mite natural enemies is also significant.

G. occidentalis and *M. citri* have been established in culture at WSU-Prosser and will serve as resources for studies on biology and pesticide susceptibility. Initial toxicity studies indicate that many pesticides used in Washington viticulture are harmful to *G. occidentalis.*

Management and Control of Tomato Ringspot Virus

Principal Investigators: Robert R. Martin and Dr. Jack Pinkerton, USDA-ARS Horticulture Crops Research Lab

In fall 1998, plots were established in 0.5 acres area of raspberry field in Vancouver, WA with plants symptomatic of TomRSV. The distribution of TomRSV and *Xiphinema ameicanum* in the plot had been determined. Four treatments; perennial grass maintained weed-free, rape (canola), clean fallow, and raspberry with mixed grass-weed ground cover, in the alleys, have been established in randomized block design with five replicates. The perennial grass and rape, although hosts for *X. americanum,* are not hosts for TomRSV. Thus, TomRSV should be eliminated from the plots planted with these crops. Soil has been collected monthly and assayed to quantify nematode populations and to determine the persistence of TomRSV in the nematodes with a cucumber assay protocol described below. The plots were planted with red raspberry in spring 2000. Field plots planted with different cover crops have been monitored for *Xiphinema* populations monthly for the past 2 years. Nematodes have been collected and fed on trap plants in the greenhouse to monitor virus content. 'Meeker' red raspberry plants were put into a plot that was maintained weed free for two years. This plot will be used to study movement of TomRSV within rows and between rows with different types of cover crops. 'Meeker' red raspberry has been transformed with the coat protein and nontranslatable RNA from TomRSV. The plants are in tissue culture and in the process of being rooted. They will be planted into a site that is heavily infected with TomRSV and has high numbers of the vector *Xiphinema americanum* in replicated blocks.

Experiments to detect TomRSV directly in *X. americanum* are being conducted. ELISA tests have not been successful and efforts have concentrated on PCR. Using reverse transcription-polymerase chain reaction (RT-PCR) we have been able to detect the virus in nematodes but not consistently.

Cranberry Pest Management

Kim Patten, WSU- Long Beach and Peter Bristow, WSU- Puyallup

Post-emergent herbicide efficacy trials were conducted on *Potentilla pacifica*, *Ranunculus repens, Lysimachia thyrsiflora,* A*ster subspicatus, Juncus* spp. and *Hypericum* spp. Triasulfuron and chlorimuron provided good control of several of these perennial species with little crop damage. *Ranunculus* control was timing independent and 100% efficacious. *Potentilla* control required multiple applications for complete control. *Aster, Lysimachia, Juncus and Hypericum* control ranged from minor to good, depending on timing, species and age of stand. Triasulfuron was, in general, more efficacious than chlorimuron. Insecticidal efficacy trials using "reduced risk" products were conducted on blackhead fireworm (BHFW), blackvine weevil (BVW), cranberry fruitworm (CFW), cranberry tipworm (CTW) , and cranberry gridler (GC). Data is pending for control of BVW and CG. Populations crashes in BHFW and CFW nullified experiments. Indoxacarb and methoxyfenozide suppressed early CTW damage. Fungicide trials using "reduced-risk" fungicides azoxystrobin, fenbuconazole, and fludioxinil + cyprodinil for twig blight and fruit rot control were conducted. Data are pending (spring 2002 for twig blight control and late fall 2001 for fruit rot and keeping quality).

The Effects of Cover Crops in Raspberry Production Systems-3rd year

Tom Peerbolt, Peerbolt Crop Management and Dr. Jack Pinkerton, USDA ARS

This project has been put on hold for one year to allow us the rework the research design. The plot sizes proved to be too large causing logistical problems coordinating with the grower and weed control problems. It is being redesigned with smaller plot sizes and will be completed next year.

Raspberry fields in Southwest Washington that produce high yields have traditionally been grown with the inter-row area kept clean by frequent rotovation. Introduction of a cover crop has numerous potential benefits. This trial evaluates five treatments. The treatments are Amity Oats, Companion Grass, Rapeseed, natural weed and fallow. The trial site has a known population of *Xiphinena americanum* (dagger nematodes) so that we can evaluate cover crop effects on its population dynamics and spatial distribution. Other objectives are to determine cover crop effects on nutrient status and arthropod populations.

Development of an IPM (Integrated Pest Management) Program for Leafrollers in Caneberries

Tom Peerbolt, Peerbolt Crop Management and Dr. Lynell Tanigoshi, Washington State University

Leafrollers are one of the primary insect pests on caneberries, contaminating thousands of pounds of fruit annually. This project surveyed weekly caneberry fields throughout Clark County, WA, and Washington, Clackamas and Marion counties in Oregon from April through September. Larvae were collected and pheromone trap numbers recorded at all sites. Larvae collected were then reared out with species of leafroller and any parasitoids present recorded. Traps counts and larvae species are now being analyzed to determine the accuracy of pheromone traps to predict actual field populations of larvae. The data will also be used to determine the timing of various control strategies including biocontrol agents, insect growth regulators and attract and kill formulations.

PRODUCTION/PHYSIOLOGY

Investigation of Potential Climatic and Nutritional Causes of Grape Chlorosis

Joan R. Davenport and Robert G. Stevens, Washington State University Irrigated Agriculture Research and Extension Center

Every year Concord grape in the Yakima Valley show a leaf yellowing symptom known as grape chlorosis. The severity of this disorder varies from year to year and from vineyard to vineyard. However, leaves of grape plants that develop this symptom eventually die and fall off resulting in a reduction of productivity and, in time, can result to vine death. Historically grape chlorosis was thought to be due to a deficiency in the plant nutrient iron. However, research looking at iron supplements has had little to no positive effect on the disorder. Foliar iron sprays have been shown to green existing affected leaves with no effect on leaves produced after the spray. The fact that the disorder appears around bloom and varies from year to year indicate that there may be a relationship with annual weather (climatic) patterns. There is also a possibility of a nutritional relationship. The objective of this project is to evaluate plant nutrition and climatic conditions for their roles as environmental stress factors in causing chlorosis in Concord Grape. We hypothesize that the possible causes of grape chlorosis are a single element nutrient deficiency, a multiple element nutrient insufficiency, high concentration of one nutrient element causing the exclusion of uptake of other nutrient elements, plant water stress affecting roots ability to access nutrients, or a combination of these factors. In 2001 we established study sites in 6 commercial vineyards that vary from never to always in the annual occurrance of chlorosis monitored nutrients (soil and tissue Ca, Mg, K, Na, Fe, and Al), soil moisture, soil temperature, and macro level climatic factors (e.g. air temperature). The data has been collected and compiled and is currently being analyzed.

Improving Efficiency of Nitrogen Fertilization and Soil Nitrogen Uptake in Red Raspberry

Hannah Rempel, Bernadine C. Strik, and Tim Righetti, M.S. graduate student, and Professors, Department of Horticulture, Oregon State University

The objectives of this study are to determine the effects of nitrogen (N) fertilization rate and timing on fertilizer N uptake and partitioning and the amount and use of stored nitrogen (N) and where stored fertilizer is partitioned in the red raspberry. This study is located in a mature 'Meeker' red raspberry field at the North Willamette Research and Extension Center. The following treatments were applied in spring 2001 to monitor the uptake and movement of N: A. No added nitrogen; B. N applied at a full rate of 80 lb per acre just after bud break (^{15}N depleted fertilizer); C. N applied at a rate of 40 lb per acre just after bud break (^{15}N depleted); D. N applied at a rate of 80 lb per acre split with half at bud break (not depleted) and half in late May at early fruit set (^{15}N depleted). Plants were destructively sampled throughout 2001 on each of 6 dates: one month after application of spring ^{15}N (April), early-June (late bloom); early-July (late fruit maturity); early-August (floricane senescence); just before leaf senescence (late September); and dormancy (December). Plants were partitioned into roots (portion) crown, primocanes, primocane leaves, floricanes, and laterals, dried to a constant dry weight and analyzed for amount of total N and ^{15}N present. Data were collected on total yield, berry size and N content of fruit (including fertilizer N content from the labeled

applications in spring 2001). In 2002, only non-labeled N fertilizer will be applied so that used of labeled stored N (from fertilizer application the previous year) can be monitored. Results to-date will be presented.

Management of 'Marion' Blackberry to Reduce Thorn Contamination of Harvested Fruit

Bernadine Strik and Gil Buller-Professor and Research Assistant, Department of Horticulture

The objectives of this study are to continue to evaluate mechanical methods to minimize thorn contamination of machine-harvested 'Marion' fruit and to begin to study the efficacy of chemical defoliants at removing the thorny leaf petiole in the fall. The effectiveness of using a rotary machine harvester equipped with standard heads or modified brushing heads in February to remove debris was evaluated at a grower cooperator site. A quad-head Littau machine harvester equipped with 4 brushing heads was evaluated by using the machine once during the dormant season (February, 2001). There was no negative effect of brushing in the winter on yield the subsequent season, confirming our earlier work. In 2001, we found no significant effect of mechanical brushing on thorn content (petioles, large or small thorns) in harvested or cull fruit. However, in 2000 we did observe that running a machine harvester equipped with rotary picking heads or brushes in the dormant season decreased subsequent thorn content by 19 to 68% compared to an untreated control. The differences between years could be environmental (same grower site) or related to the type machine used. In fall 2001, we will be evaluating the following treatments for their effectiveness as a chemical defoliant: 4% and 8% zinc sulfate; 8% zinc sulfate in fall followed by a machine harvester in late winter; a machine harvester alone in late winter; 5% copper sulfate; 5% copper chelate; and an untreated control. This study will be done in a mature planting of 'Marion' at the North Willamette Research and Extension Center. Plots will be replicated four times and harvested by machine during the fruiting season in 2002 with thorn contamination evaluated.

Pre-plant Options for Improving Economics of Strawberry Production and Minimizing Weeds and Root Weevil Larvae

Bernadine Strik and Gil Buller-Professor and Research Assistant, Department of Horticulture, OSU

The objectives of this study are to determine whether growing and incorporating meadowfoam (*Limnanthes alba*) prior to planting strawberries, will reduce weed and root weevil larval populations. Also, we are determining whether strawberry growers can harvest a cash crop, peas or meadowfoam for seed production, prior to establishing strawberries in the planting year. The study is being conducted at the North Willamette Research and Extension Center. The following treatments are being compared prior to planting strawberries: 1) meadowfoam seeded October 12, 2000 and incorporated into the soil at bloom (May 24, 2001); 2) meadowfoam seeded in fall, 2000 (October 12) and incorporated into the soil after seed set (June 12, 2001); 3) fallow ground in winter 2000/01, with peas seeded (February 28, 2001) and harvested June 11, for a commercial crop and residue incorporated (June 12, 2001); and 4) an unseeded, fallow, control with hoeing of any weeds present or use of conventional tillage prior to planting strawberries. After residue incorporation, raised beds were formed in each 10' by 30' plot and 'Totem' planted in 15" single matted rows on June 18, 2001. Weed presence by counting the number of grass and broadleaf weeds in a one-meter section of row in each plot was done on July 18, August 20, and September 21, 2001. Strawberry plant size was also evaluated on each of those dates. A pre-emergent herbicide was applied to the research planting on July 20 (Devrinol®) and August 20 (Select®); however, the area that is being assessed for weed growth was covered with plastic which was subsequently removed after the herbicide application. Data for the planting year will be presented, although we won't have results illustrating any effects of pre-plant treatments on strawberry yield until 2002.

WINE

Control of Hydrogen Sulfide Formation During Fermentation

Alan Bakalinsky, Ph.D., Associate Professor; Olga Martin, Research Assistant, Department of Food Science and Technology, OSU

Cooperators: Donald Reed, Ph.D., OSU; Sara Spayd, Ph.D., WSU-IAREC

Overall objective

We wish to test the hypothesis that formation of undesirable hydrogen sulfide by yeast during vinification can be limited through natural removal of excess intracellular sulfite, its immediate biochemical precursor.

Hydrogen sulfide and related sulfur compounds produced by yeast during fermentation are considered highly undesirable if they exceed threshold concentrations in the finished wine. Factors which affect their production include, but are not limited to, the nutritional status of the grapes, yeast strain, and fermentation conditions. Yeast produces this class of compounds internally as a byproduct of the normal and necessary synthesis of the sulfur-containing amino acids, methionine and cysteine. Excessive synthesis leads to excretion into the wine. The threshold for hydrogen sulfide is on the order of parts per billion and that for some of the other reduced sulfur compounds derived from hydrogen sulfide ranges from parts per million to parts per billion. Thus, even a very small amount excreted into the wine by the fermenting yeast is problematic. Because hydrogen sulfide is produced within the yeast cell directly from sulfite, its immediate biochemical precursor, we are testing the hypothesis that high activity of the yeast sulfite efflux pump Ssu1 will minimize hydrogen sulfide levels in wine.

We are currently measuring activity of the sulfite efflux pump in three laboratory strains which cover the range from normal activity to no activity to hyperactivity. We are also measuring activity in a number of wine strains. Once activities in the laboratory and wine strains are confirmed, a model grape juice will be fermented by each and hydrogen sulfide will be measured at the end of fermentation to determine if a correlation exists between pump activity and residual hydrogen sulfide.

Manipulating Soil Moisture and Nitrogen Availability to Improve Fermentation Behavior and Wine Quality– I. Effect of Nitrogen, Irrigation, and Soil Management on Vegetative Growth, Gas-Exchange, Yield Components, and Fruit Composition

Jessica Howe and M. Carmo Vasconcelos ,Oregon State University, Department of Horticulture,

Barney Watson and Mina McDaniel, Department of Food Science and Technology, Oregon State University

With this study, we proposed to manipulate soil moisture and nitrogen availability using different approaches: supplemental irrigation, nitrogen addition to the soil or to the leaves and elimination of the competition for water and nutrients between the ground cover and the grapevine by timely management of the cover crop. In Oregon, low nitrogen content in the fruit is a widespread phenomenon and it is recognized by the industry as one of their major problems. Fruit ripening is affected by soil water availability. Under drought conditions, juice and wine composition may become unbalanced, originating off flavors such as premature aging (UTA). The nitrogen content of grape juice affects both fermentation rate and time to completion of fermentation. Deficiencies of nitrogen in the fruit result in stuck or sluggish fermentations.

The goal of the first part of the project is to observe *vine physiological response* to various vineyard practices aimed at increasing nitrogen availability to the vine. Treatments were applied in a factorial design to vary irrigation, cultivation, and nitrogen application to mature Pinot noir grapevines in a commercial vineyard. Irrigated vines received 2" supplemental irrigation after lag phase. Cultivation of alternate rows was performed in early spring to encourage nitrogen utilization and reduce nutrient and water competition. Nitrogen treatments consisted of soil-applied urea (35lbsN/acre), foliar applied urea (2.66lbsN/acre), and zero nitrogen. Soil nitrogen was applied in early spring. Foliar nitrogen was applied once at the beginning of véraison and again at 50% color change.

Photosynthesis, transpiration, water use efficiency, chlorophyll content, pruning weights, petiole nutrient content, ripening dynamics, juice composition, and yield components of mature Pinot noir vines were measured during the growing season. Irrigated vines assimilated CO_2 and transpired at a significantly higher rate than non-irrigated vines. Similarly, tilled treatments assimilated CO_2 at a significantly higher rate and maintained higher water use efficiency. Nitrogen treatments had little impact on leaf gas exchange and chlorophyll content. Cultivation had the only significant treatment effect on pruning weight and cane weight.

Soil Cultivation had the largest impact on petiole nutrient content, with significant differences in phosphorus, potassium, manganese, copper, boron, carbon and total nitrogen. Irrigation increased total petiole nitrogen in the second year of the study.

Significant yield component differences occurred between irrigated and non-irrigated vines Non-irrigated vines had more berries per cluster than irrigated vines. However, non-irrigated vines tended to have a smaller average cluster weight. Berry weight was higher in vines that had been irrigated but they also had higher sugar content. There were no significant differences juice pH or TA among any of the treatments.

Protecting the Stuck Wine Fermentations with Lysozyme

Mark Daeschel, Oregon State University

To provide a possible alternative for the antimicrobial action of sulfur dioxide in winemaking, and address the issue of stuck fermentations, we studied the efficacy of hen lysozyme (EC 3.2.1.17) as an antimicrobial in grape juice. Two forms of lysozyme were used: native lysozyme (NL), and partially unfolded lysozyme (PUL), *Lactobacillus kunkeei* and *Acetobacter pasteurianus*, two bacteria associated with stuck fermentations were used. Grape musts were inoculated with *L. kunkeei* and two days later with yeast and incubated for 10 days. The addition of 250ppm of either NL or PUL reduced populations of *L. kunkeei* to less than 10 CFU/mL in 24 hours while in inoculated grape must that did not contain any lysozyme, the bacteria grew to 10^9 CFU/mL in two days. Musts supporting growth of *L. kunkeei* developed up to 14 times more volatile acidity than the control or either of the lysozyme treatments. In peptone water, 200ppm of PUL caused more than 95% reduction in populations of *A. pasteurianus* within two hours. When inoculated into a mixture of broth and grape juice, no inhibition was observed and the bacteria grew to similar numbers in all treatments. Addition of 200ppm of NL did not cause inhibition of *A. pasteurianus* either in peptone water or broth medium.

Inducement of Malolactic Fermentation in Musts from the Pacific Northwest

C.G. Edwards, Associate Food Scientist, Washington State University, Pullman

The ability of six different strains of *Oenococcus oeni* to grow and complete malolactic fermentation in a Chardonnay wine from the Pacific Northwest was assessed. Juice was provided by The Hogue Cellars (22.1°Brix; pH 3.5) and fermented to dryness using yeast strain CY3079. Strains of malolactic bacteria (*O. oeni*) previously isolated from Washington wines were commercially prepared as “direct inocula” and added to the Chardonnay wines. Bacterial viability and ability to utilize malic acid were measured during the course of fermentation. Although the viability of all bacterial decreased soon after inoculation, strains differed in the time required to enter logarithmic growth and induce MLF. Three strains, WS-6A, WS-10C, and Enoferm Alpha recovered more quickly than strains WS-8, WS-7B and WS-20. Concurrently, fermentations inoculated with WS-6A, WS-10C and Enoferm Alpha also completed MLF faster. It is believed that the initial decrease in bacterial viability was at least partially due to the presence of substances produced by *Saccharomyces* during alcoholic fermentation. Research is continuing to investigate how yeast inhibit malolactic bacteria and methods to reduce this antagonism in order to encourage MLF when desired.

Impact of Selected Vitamins on Alcoholic Fermentations Induced by *Saccharomyces*

C.G. Edwards, Associate Food Scientist, Washington State University, Pullman

Fermentations of the “synthetic grape juice” with variable concentrations of vitamins (biotin and pantothenic acid) and nitrogen were conducted to study the impact of these nutrients on fermentation characteristics. Treatments contained none (0 µg/L), low (1 µg/L) or high (10 µg/L) amounts of biotin or low (10 µg/L), medium (50 µg/L), or high (250 µg/L) amounts of pantothenic acid. Nitrogen contents of these musts were either low (60 mg/L YANC) or high (250 mg/L YANC). In general, the rate of fermentation and yeast growth seemed to be more dependent on the amount of assimilable nitrogen in the medium rather than on biotin. Without biotin, fermentations did not reach dryness and yeast growth was very poor. Pantothenic acid had a similar influence on yeast growth. However, it was determined that both biotin and pantothenic acid influenced production of H_2S and other volatiles important for quality. In the case of biotin, maximum amounts of H_2S were produced in fermentations containing 1 µg/L biotin and low nitrogen, an amount that was 2.5 times that formed in fermentations containing the same amount of nitrogen (low) but higher amounts of biotin (10 µg/L). An increase in the concentration of pantothenic acid (10 to 250 µg/L) resulted in a dramatic decrease in H_2S production under conditions of low or high nitrogen. If fermentations containing the same amount of pantothenic acid (10 or 50 µg/L) but different amounts of nitrogen, higher amounts of H_2S were produced under high levels of nitrogen. These data indicate that while pantothenic acid does impact H_2S production by wine yeast, the impact is highly dependent on the availabilty of nitrogen. These observations help explain why yeast may produce high amounts of H_2S even under conditions of high nitrogen as some have observed.

Evaluation of Wine Grape Cultivars Under Cool Desert Conditions

Esmaeil “Essie” Fallahi, Project Leader, Professor of Fruit Physiology, University of Idaho, Parma Research and Extension Center Bob Wample, Collaborator, Washington State University, Presser.

Objectives:

1. To evaluate cold tolerance of wine grape cultivars under cool desert conditions, similar to those of Southwest Idaho, Eastern Oregon, and Washington; 2. To determine adaptation, nutritional physiology and requirement, fruit maturity, and vine and berry physiological characteristics of each cultivar under cool desert conditions; 3. Canopy development and management, and irrigation requirements of different varieties of wine grapes.

Materials and Methods:

A wine grape vineyard has been established at the University of Idaho Parma Research and Extension Center. The vineyard ground was plowed and prepared in spring of 1997. The spacing is 7 x 9 ft. Cuttings from several varieties/clones were rooted and planted in each spring of 1997, 1998, 1999, 2000, and 2001 in four replications of eight vines per plot. A drip irrigation system was installed in 1997 and 1998.

Results and Discussion:

Planted cultivars in the first phase of this experiment are: Cabernet Franc, Cabernet Sauvignon, Carignane, Dijon Clone (any Dijon), Chardonnay 29, 30 or 31, Dolcetto, Grenache, Limberger, Malbec (cot), Merlot, Meunier, Nebbiolo, Petit Verdot, Petite Sirah (Durif), Sangiovese, Valdepenas, Viognier, Pinot Noir - 18, Gamay Beaujolais, and Pinot Gris. In the second phase, Barbera 02, Cabernet Franc 04, Cabernet Sauvignon 02, Cabernet Sauvignon 04, Merlot 01, Merlot 15, Muscat of Alexandria, Pinot Gris 04, Shiraz 07, and Chardonnay 37 were planted in 1998. In 1999, Chardonnay 38, Blauer Portugieser 01, Pinotage 01, Tempranillo 02, and Flora 01 were added to this experiment. In the Spring of year 2000, Chardonnay 49, Flora 01, Pinotage 01, Souzao 01, Shiraz 07, Touriga 02, Chardonnay 38, Tempanillo 02, Cabonett Franc 04, Primitivo, Blauer Portugieser 02, and Pinot Gris 04 were planted to complete and/or add to the previous cultivars/selections. Several additional new cultivars was added to this experimental vineyard in 2001. Cabernet Franc 01 and Malbec 06 were more seriously damaged by winter or spring freeze, thus had a higher number of vines with new growth from mid-trunk area than other cultivars in 1999. Chardonnay 29 and 49 were the first ones to ripen and harvested and Dolcetto was the latest one. Seventeen cultivars had sufficient fruit in 2000 and over 25 cultivars were harvested in 2001. Fruit from all varieties were harvested according to their sugar content every year. Wines were made by Saw tooth winery in 1999, by Parma Rige Winery in 2000, and by Ste Chapelle in 2001.

Carignane, and Grenache had high higher yield and large clusters but Chardonay 49 and Petite Verdot had smaller clusters and lower yield. Merlot 01 and Dolcteto had higher sugar but Carinane had lower sugar.

Impact of Irrigation and Crop Load Strategies on Flavor and Phenolic Profiles of Wines and Grapes

S. E. Spayd and R. Smithyman

J. Tarara, D. Gore, M. Nye, and J. Fellman

Cabernet Sauvignon vines were irrigated under three regimes: 1) standard irrigation (weekly irrigation based on water use and loss), 2) during period of berry cell division weekly irrigation to replace 50% of water consumed (early deficit), and 3) standard irrigation until veraison when only 50% of water replaced (veraison deficit). Two crop loads were established by cluster thinning within each irrigation level:1) ca. 3 tons/acre (low) and 2) ca. 6 tons/acre (high). The treatments were replicated four times. Wines were prepared at the Stimson Lane research winery. In 2001, wines from the 1999 vintage were analyzed for phenolic profiles and sensory characteristics. Phenolic profiles and sensory characteristics were similar between all treatments for wines of the 1999 vintage.

Manipulating Soil Moisture and Nitrogen Availability in the Vineyard to Improve Fermentation Behavior and Wine Quality

Barney Watson, Mina McDaniel, Anna Specht, Kate Wall, and H.P.Chen. Department of Food Science and Technology, Oregon State University

This research is being done in collaboration with Carmo Vasconcelos and Jessica Howe in the Department of Horticulture at Oregon State University. The objectives of this study are to evaluate the effects of manipulating soil

moisture and nitrogen availability using different approaches, including supplemental irrigation, nitrogen addition to the soil or to the leaves, and the elimination of competition for water and nutrients between the ground cover and the grapevines by tilling. The experimental design of this study is a factorial of irrigation, nitrogen soil (SN) and foliar (FN) applications, and soil cultivation in a randomized block design. The effects of these viticultural practices on juice and must composition, fermentable nitrogen content, fermentation behavior, wine composition including color intensity and phenolic profiles, aroma, flavor, and wine quality are being conducted over several vintages at a mature commercial Pinot noir vineyard in the southern Willamette Valley of Oregon. Average berry weights were greater at harvest for Irrigated compared to Dry treatments. Anthocyanin content and color intensity were greater in the Dry treatment wines compared to the Irrigated treatment wines in 1999 but not in 2000. The total phenolic content was greater in the SN treatment wines compared to the 0N treatment wines in both vintages. The color intensity of the SN treatment wines was also greater than either 0N or FN treatments in both vintages. During ripening the ammonia content of the berries decreased and the alpha amino acid content increased significantly in all treatments. In 1999 and 2000 the yeast assimilable nitrogen content (YANC) was greater at harvest in Dry compared to Irrigated treatments. In 2000 the YANC was greater in Till vs No Till treatments and the Till treatments tended to ferment more rapidly. The wines are currently undergoing sensory evaluation in our Sensory Science Laboratory.