Northwest Center for Small Fruits Research

2007 Annual Conference

Welcome to the 16th 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. There is a new format this year and we would appreciate your feedback on it at the end of the conference.

Research Priorities: During the conference, time is set aside to revisit all research priorities by commodity. 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.

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

Keynote Speaker: The keynote speakers for the Annual Conference will be Karen Lewis, Washington State University and Clark Seavert, Oregon State University. Their talk is entitled "Technology - Competitive Orchard Systems in Tree Fruit and Implications for Small Fruit"

Table of Contents

BERRY / GRAPE PROCESSING

Improving Fresh Market Quality of Highbush Blueberries Through Application of Edible Coatings

Yanyun Zhao, Associate Professor, OSU & Brian Yorgey, Senior Research Assistant, OSU; Bernadine Strik, Professor, Dept. of Horticulture, OSU

Objective of this study was to investigate appropriate edible coatings for enhancing storability and preserving antioxidant capacity of blueberries during refrigeration storage.

Two blueberry varieties, Duke and Elliott, were evaluated. Semperfresh, chitosan and calcium caseinate (CC) coatings were applied on Duke, and CC coating on Elliott. Fruits were washed in 200 ppm chlorinated water, coated, and stored at ~20°C for up to 12 d after an initial 1 wk of storage at 2°C. Non-washed and non-coated samples were used as controls. Firmness, decay rate and weight loss of fruits were analyzed, and total phenolic contents (TPC) and antioxidant capacity (AC) were determined by Folin-Ciocalteu and 2, 2-diphenyl-1-picryhydrazyl assays, respectively. Experiments were replicated and data were analyzed by SAS using LSD test at $P<0.05$.

Firmness of all samples decreased, while decay rate and weight loss increased during storage. Chitosan-coated Duke and CC-coated Elliott had the highest firmness value of 1.96 N and 2.32 N at 12d, respectively. Chitosan-coated Duke and non-coated Elliott received the lowest decay rate, 9.98% and 8.35% at 12d, respectively. Semperfresh-coated Duke and controlled Elliott had the lowest weight loss of 9.31% and 8.67% at 12d, respectively. Coatings significantly affected AC, but not TPC for both varieties, while storage time significantly affected both parameters. AC of Semperfresh-coated Duke was 2.50 mg AAE/100g FW, significantly lower than other Duke samples (2.75-3.10 mg AAE/100g FW), but non-coated Elliott has significantly higher AC (6.55 mg AAE/100g FW) than other Elliott samples (6.10-6.15 mg AAE/100g FW).

This study suggests that edible coatings may be beneficial for retaining quality of fresh blueberries. However, more studies are necessary to identify optimal coating materials and other packaging and storage conditions.

GENETICS

Evaluation of Hardy Kiwifruit Germplasm

Bernadine Strik[1], Kim Hummer[2], and Chad Finn[3]

[1]Dept. Horticulture, Berry Research Leader, NWREC, OSU

[2]Curator, Research Leader, National Clonal Germplasm Repository – ARS, Corvallis

[3]Research Geneticist, HCRL, ARS, Corvallis

The purpose of this study is to determine the chilling requirement of hardy kiwifruit germplasm to ascertain potential production range in the Pacific Northwest and whether there is a correlation between rate of acclimation, deacclimation, and total chilling requirement on time of bud break, bloom, and harvest in the field.

The following 13 genotypes of kiwifruit were evaluated in winter 2005-06 and 2006-07: 'Issai' and 'Hayward' (NWREC); 'Ananasnaya', 74-49, and 'Ken's Red' (2 locations: NCGR, Corvallis and NWREC, Aurora); 'Red Princess', *A. arguta var. purpurea*, 127-40, 'Kuchta', 'Geneva-1', 'Jumbo', 'Chang Bai Giant', and 'Chang Bai Mountain-3' (NCGR). Five to seven node cuttings of one-year-old wood were collected every two weeks from 14 Oct 2005 to 17 Feb. 2006 and 6 Oct. 2006 to Feb-Mar. 2007. Cuttings were stuck in moist media in the greenhouse and evaluated for percent bud break and days to bud break for up to 30 days.

There were 1551 and 1613 cumulative chilling hours at the NWREC and the NCGR, respectively, in 2005-06. Chang-Bai Mt. 3 had the lowest estimated chilling requirement at less than 310 hours. Genotypes with a medium chilling requirement (~ 610 hours) included Chang Bai Giant, Dumbarton Oaks, Meader, and *A. var purpurea*. Ananasnaya, Ken's Red, Issai, and Geneva-1 ranged from 610 to 750 chill units. Genotypes with the highest chilling requirement, 750 to 1000 CU, were Jumbo, Cornell, and Hayward. The study was repeated in 2006-07, but data have not been analyzed yet.

Edible-Fruited Honeysuckle (Lonicera caerulea L.): Cultivar Development and Advanced Trial Plots with Cooperators

Maxine M. Thompson, Department of Horticulture, OSU; Danny L. Barney, University of Idaho, Sandpoint REC

This year's efforts were directed towards evaluations of hybrid seedlings planted in previous years and of selections already established in preliminary trial plots. Among seedlings evaluated this year, 55 promising selections in Corvallis, and 11 in Sandpoint were chosen to be propagated for further testing. In Corvallis, two each of 42 promising selections propagated in 2007 were planted in the local trial plot this fall. Overall, one to 6 plants each of 221 selections propagated over the past 5 years are currently in this test plot. In Sandpoint, 17 selections from previous years have been propagated for further testing. In October, 2006, only 400 new hybrid seedlings were planted and none were created in 2007. After culling this year, there remain 2,123 seedlings in Corvallis; berries on some of these warrant a second evaluation and some will bear their first crops in 2008.

In fall, 2006, two replicated trial plots, including 8 plants each of 12 selections were established in Aurora, OR and Bandon, OR. A third set of these same selections was sent to Sandpoint where they will be planted when new land becomes available. and fourth set will be sent to Caldwell, Idaho this year. In September, 2007, 461 plants, including 57 Corvallis selections and 7 from Sandpoint were distributed to 36 grower-cooperators for testing in different regions. Two to 70 plants each were sent to recipients in Oregon, Washington, California, Nebraska, Wisconsin, and North Dakota. All have agreed to provide feedback on plant performance, including cold hardiness. This information will assist in identifying superior, widely adapted clones.

Domestication of Western Huckleberries

Danny L. Barney, Professor; University of Idaho, Department of Plant, Soil, & Entomological Sciences

Shade physiology trials continued for Cascade huckleberry (*Vaccinium deliciosum*) and mountain huckleberry (V, membranaceum). Both species survived under full sun through 70% shade. Preliminary data suggest a relatively flat photosynthetic rate vs. light intensity across a broad range of light intensities. Best plant growth and health occurred under 30% to 40% shade cloth at this 2,000 foot elevation site. Some mountain huckleberry plants 40 to 60 cm tall produced more than 740 flowers each under 40% and 50% shade cloth and one plant produced 658 flowers under 70% shade cloth. Preliminary rooting trials of bilberry (*V. myrtillus*) semi-hardwood shoots produced high rooting percentages but poor shoot growth., possibly as a result of the cuttings being collected too late in the growing season. Survival and growth of six western huckleberry and bilberry species in raised beds filled with amended soil and /or aged conifer bark beds were acceptable. Both the raised beds and bark beds were under thinned hybrid poplar stands. We began distributing plants to cooperators for testing in May 2007, but an outbreak of phytophthora and a complex of foliar pathogens at Sandpoint necessitated recalling and destroying the plants. Nearly all original stock plants survived. New plants are being propagated from in vitro back up cultures. We have tentatively identified the pathogens and are testing fungicides and modifications to cultural practices to control the diseases.

Developing Genetic Fingerprints for Cranberry

Nahla Bassil, Geneticist, USDA-ARS NCGR; Kim E. Hummer, Research Leader/Curator, USDA-ARS NCGR

Many cranberry cultivars were selected from native bog populations in the 1800's and early 1900's. Bog heterogeneity first appeared in 1931 when H. F. Bain had to sort out the "true McFarlin" from native cranberries in a Wisconsin bog. The varietal purity of cranberries continues to be questionable due to the vegetative spread of genetic variants originating from sexual propagation of volunteer seedlings or off types and native clones in a bog. The scarcity of qualitative morphological descriptors in cranberry also contributes to cultivar misclassification. In order to clearly identify these cultivars, we developed robust DNA markers called microsatellite or simple sequence repeat (SSR) markers using such markers from the related blueberry. We evaluated 46 blueberry markers and identified 16 that determine differences between 16 important cranberry genotypes. Fourteen of these blueberry SSR markers were used to fingerprint 41 cranberry accessions making up the core collection at the National Clonal Germplasm Repository (NCGR), and to evaluate genetic variation of important cultivars growing in Oregon and Vancouver (British Columbia). These markers differentiated between all cranberry varieties except for two sets of accessions: 'Howes' and 'Pride' and 'AJ', 'Ben Lear' and 'Potter's Favorite'. Multiple genotypes or variants were found in five cranberry cultivars ('Stevens', 'Crowley', 'McFarlin', 'Olson's Honkers' and 'Pilgrim') collected from 11 Oregon bogs and in two cultivars ('Bergman' and 'Stevens') collected from Vancouver. Four of these SSR markers were chosen as a fingerprinting set. This small set can be used in two multiplexes and differentiated between the same genotypes that were identified using all 14 SSRs except for 'Franklin' and 'Centennial' which were different at VCC-J5. We recommend using this set of four SSR primer pairs for variety identification. A database of these fingerprints generated with this fingerprinting set was developed and will be available to the industry.

Response of Black Currants to White Pine Blister Rust Inoculation

Danny Dalton, Department of Horticulture, OSU; K. E. Hummer, USDA ARS National Clonal Germplasm Repository

World production of currants and gooseberries was 874 MT in 2005. Currant and gooseberry production acreage is unreported for North America to the Food and Agriculture Organization, although small fruit growers have expanded acreage hoping to develop potential markets. White pine blister rust, an exotic plant disease originally from Asia, can infect black currants and white pine trees. This disease was introduced into North America about 1900 and has now naturalized. About 12 states restrict currant production because of the possibility of increasing rust infection in pines. Four black currant cultivars have been developed with immunity to rust. Our objective was to determine how genetic resistance of the immune gene (*Cr*) was conferred to black currant seedlings. We examined offspring from a cross of an immune and a susceptible type. The F1 seedlings were grown in a greenhouse until mature. They were transplanted to the field in the spring 2006. Stem cuttings were removed from plants and were inoculated in individual plastic chambers in summer and fall 2007. Our preliminary results show that 15% of the seedlings were susceptible. Further inoculations will be performed next year. The experimental procedure was complicated by infection of powdery mildew, another foliar disease of black currants. In 2008, we will modify the experiment to reduce mildew. We will also compare the response of the black currant seedlings to two different rust spore types, one obtained from rust-infected pines and one obtained from rust-infected currants.

Inheritance of Vegetative and Reproductive Traits in Black Raspberry (*R. occidentalis*)

Michael Dossett and Chad Finn; OSU and USDA-ARS

Black raspberry (*Rubus occidentalis* L.) is a major crop for the processing industry in Oregon. The industry relies on 'Munger', which was developed in Ohio in 1890 and seldom produces for more than two to three years before succumbing to an array of fungal and viral pathogens. In the late 1990s, all available cultivars of black raspberry were evaluated at the Oregon State University (OSU) North Willamette Research and Extension Center. Based on these trials, parents were chosen for an incomplete partial diallel, consisting of 10 parents and 26 sibling families, for the study of variation and inheritance of vegetative and reproductive traits in black raspberry. Flowering and ripening seasons were recorded for each plant as well as average fruit weight from samples of 25 randomly collected non-primary fruit and vigor was rated on a numerical scale from 1-9 as part of an ongoing study on variation and inheritance. In the spring of 2006 and 2007, cane death over the winter was also scored. In addition, frozen fruit samples were collected in 2005 and 2006 for analysis of their anthocyanin profiles, total anthocyanins, total phenolics, °Brix, pH, and titratable acidity. Differences were observed in all traits measured and strong trends in plant parentage were noted for many of the traits. Further analyses showed that heritability of most of these traits was generally moderate indicating the level of genetic control over the observed traits and potential for breeding progress from within this group of parents in the available germplasm. Most of the heritable variation, however, was limited to a small number of parents emphasizing the need for a larger germplasm pool with which to work for making progress breeding for these traits.

A number of selections have been identified and are being propagated for further observation and testing at grower sites as well as for use in further crosses.

Evaluation of New Cranberry Germplasm for Fresh Fruit Production in the Pacific Northwest

Kim Patten, WSU Long Beach Research and Extension Unit

A replicated field planting of advanced selection of cranberries from the breeding program at Rutgers University was established in 2003. Comparisons were made to standard cultivars. Yield, fruit size, color, rot and keeping quality, disease resistance, and suitability for dry harvest parameters have been collected. Yield and fruit size are presented in Table 1. Based on production and other variable not shown, CNJ93-9-42 appears to be the most promising selection in the trial. Two new releases Crimson Queen and Mullica Queen, have yet to distinguish themselves as a superior cultivars for the PNW. One more year of data collection will be needed before recommendations can be made.

Table 1. Yield and fruit size of cranberry variety trials – Long Beach, Washington

variety	bbl/ac 9/27/05	bbl/ac 9/26/06	bbl/ac 10/1/07	bbl/ac 06+07	bbl/ac 05+06+07	fruit size g/fruit 9/26/06	fruit size g/fruit 10/1/07	fruit size g/fruit 06+07 mean
Crimson Queen	77 cd	179 bc	347 abc	527 a-d	603 bcd	1.87 b	1.56 bc	1.72 ab
NJS95-37	85 c	277 a	322 bcd	600 ab	685 abc	1.48 fg	1.18 hi	1.33 e
Mullica Queen	23 cde	20 d	252 cd	271 ef	294 f	2.09 a	1.52 cd	1.80 a
CNJ96-44-83	54 cde	204 b	288 bcd	491 bcd	546 cde	1.78 bc	1.39 ef	1.58 c
CNJ95-20-20	32 cde	181 bc	253 cd	433 cd	466 de	1.44 g	1.23 gh	1.34 de
CNJ93-9-42	61 cde	187 bc	451 a	638 a	699 abc	1.53 efg	1.34 fg	1.43 d
CNJ93-13-100	46 cde	136 c	295 bcd	431 cd	477 de	1.52 efg	1.10 i	1.31 e
BE	150 b	217 b	383 ab	601 ab	751 ab	1.23 h	1.11 hi	1.17 f
AR	16 cde	223 b	290 bcd	512 a-d	529 de	1.69 cd	1.42 def	1.56 c
Bain Favorite	46 cde	178 bc	212 d	390 de	436 e	1.89 b	1.73 a	1.81 a
Pilgrim	257 a	202 b	327 a-d	530 abc	787 a	1.89 b	1.48 cde	1.68 b
Stevens	3 e	48 d	209 d	257 f	260 f	1.62 def	1.09 i	1.35 de
NJS98-65	11 de	201 b	335 a-d	536 abc	548 cde	1.93 b	1.65 ab	1.79 a
NJS93-13-100	27 cde	172 bc	352 abc	524 a-d	551 cde	1.65 cde	1.46 c-f	1.55 c
LSD (P=.05)	61.0	46.0	112.0	120.7	138.3	0.141	0.112	0.093
Treatment Prob(F)	0.0001	0.0001	0.0088	0.0001	0.0001	0.0001	0.0001	0.0001

PEST MANAGEMENT

Integrated Management Strategies & Biology of Bud Mites in Oregon & Washington State Vineyards

Vaughn Walton, Horticultural Entomologist, Department of Horticulture

Patricia Skinkis, Extension Viticulturist, Department of Horticulture

Amy Dreves, Extension Entomologist, Department of Crop and Soil Science, Cordley Hall

Short Shoot Syndrome (SSS) causes severe crop losses in Oregon vineyards due to bunch necrosis during the early part of the season. Other symptoms include malformed leaves, unusually short and angled shoots, scar tissue and bronzed leaves close to harvest time. This work shows that SSS found in Oregon vineyards is closely associated with grape leaf rust mite, *Calepitrimerus vitis* (Nalepa) infestations.

Very few bud mites, *Colomeris vitis* (Pagenstecher), were found in the vineyards during the current year and no relationship could be found between SSS symptoms and this species. During winter, rust mites are dormant and no evidence of direct bud damage from rust mites was found inside undeveloped buds. Tissue damage from mites was first observed between bud break and the two-leaf stage in mite infested vineyards.

Rust mite colonies were found under outer bud scales and bark of canes close to the buds. Crop losses as high as 23.7% were directly linked to rust mite infestations and SSS from several vineyards sampled in Oregon. Temperature-related studies were done in order to determine the optimal, minimum and maximum temperature for development. This information will be used for timing of control and determining potential biocontrol strategies.

Biology and Control of Blueberry Gall Midge-Chemical Trials

Wei Yang[1], Lynell Tanigoshi,[2] and Leduardo Chavez[1]

[1] OSU, NWREC; [2] WSU, Northwestern WA Research & Extension, Mount Vernon, WA

Since completing the initial blueberry gall midge (*Dasineura oxycoccana* Johnson) life cycle and finding no relationship between number of midges and shoot tip damages from 2004-2005, we concentrated our effort in determining the timing and insecticide application for its control. In 2006, the insecticides used were Mustang Max (0.025 lb(AI)acre), Admire (0.125 lb(AI)acre), and Platinum (0.5 lb(AI)/acre). In 2007, the same experiment was repeated, substituting experimental Brigade (0.1 lb(AI)/acre) for newly registered Mustang Max. The treatments with an untreated control were applied as a soil drench after fruit set and arranged in a randomized complete block design with each experiment unit consisting of a 40' row of mature blueberries. Several soil traps were placed along the drip line of treated plots and yellow cards were hung on the trellis wire in each plot. Each week after insecticide application, traps and yellow card samples were collected to count number of adult gall midge fliers. Preliminary data analysis indicated all soil drench treatments resulted in good suppression of the emergence of midge adults in both years. In 2007, our modified soil trap seems to work better than the ones used in 2006. The new trap design will be displayed during the poster session.

Characterization and Control of Aphid-borne Viruses in Red and Black Raspberry Associated with Decline and Crumbly Fruit

Robert Martin, Virologist, USDA-ARS, HCRL

Vector transmissions with one the virus(es) from black raspberry were completed and it was shown that the large raspberry aphid (*Amphorophora agathonica*) and the green peach aphid (*Myzus persicae*) can transmit the virus efficiently with feeding times of 1 hour but poorly with short feeding times. The large raspberry aphid was a much better vector (from a researcher's point of view – more transmission) than the green peach aphid. Also, in field transmission studies the virus was transmitted primarily early in the season (May and June) with very little transmission late. The timing of transmission in the field was highly correlated with aphid incidence. The transmission of one of the new viruses in red raspberry has also been demonstrated with the large raspberry aphid. The transmission studies with the second virus in red raspberry have not been completed.

One of the new viruses from red raspberry (Raspberry mottle virus) in Washington has been sequenced and two of the 10 RNAs of the second virus have been sequenced. RT-PCR tests for detection of both of these viruses have been developed. The viruses have also been detected in black raspberry from Oregon, but not consistently associated with the decline of black raspberries. One of these viruses is a closterovirus and occurs in Europe as well as North America. It occurs in Raspberry leaf mottle and Raspberry leaf spot infected plants from Europe, two uncharacterized diseases of raspberry. We have found this virus in single infections in North America and when grafted onto the virus indicator, black raspberry, it does not cause the typical symptoms caused by either Raspberry leaf spot or Raspberry leaf mottle. The closterovirus causes a leaf mottling of the leaves and has been tentatively named Raspberry mottle virus. The second virus appears to have between 8-10 RNAs which is unusual for plant viruses. Two of the RNAs for the second virus have been sequenced and diagnostic tests developed. Tests for both of the new viruses have been incorporated into the virus clean-up programs virus testing protocols for Rubus species.

New Strategies to Replace Nemacur in Red Raspberries for Plant Parasitic Nematode Control

Jack Pinkerton, USDA-ARS Horticultural Crops Research Lab; Tom Walters, WSU-Mount Vernon NWREC and Ekaterina Riga, WSU-Prosser IAREC

Root lesion and dagger nematodes can reduce significantly the productivity and longevity of raspberry plantings in the Pacific Northwest. Nemacur was the only nematicide labeled for suppressing plant-parasitic nematodes affecting raspberry, but it is no longer available. Research was conducted in red raspberry fields near Lynden, WA to evaluate synthetic chemical and biological nematicides as replacements for Nemacur. Replicated trials were established in a 'Nootka' raspberry field in 2005 and a 'Willamette' field in 2006. Both trials will continue through harvest in 2008. Two nematicides, Vydate (oxamyl) and fosthiazate significantly reduced population densities of the root lesion nematode when applied in early spring. Fall applications of Vydate did not reduce nematode populations during the subsequent cropping season. Fruit yields did not differ between treatments, except in 'Nootka' plots treated with Vydate in the spring, which was phytotoxic. However, applications of Vydate in the spring were not phytotoxic to 'Willamette' or to other raspberry cultivars test at the WSU NWREC. Applications of Ditera, Cordon, and mustard meal were ineffective in reducing nematode population densities. Our research provides data needed to register Vydate as a replacement for Nemaucr on caneberries in the USA. These data have been included in a request for a Section 18 emergency use permit submitted by Alan Schreiber on behalf the PNW raspberry industry.

Evaluation of Nematode Resistant Grape Rootstock for Managing *Mesocriconema xenoplax*

R. Paul Schreiner, Research Plant Physiologist, USDA-ARS-HCRL

John Pinkerton, Research Plant Pathologist, USDA-ARS-HCRL

David Bryla, Research Horticulturalist, USDA-ARS-HCRL.

Objectives

To evaluate the impact of the ring nematode, *Mesocriconema xenoplax* on the physiology and productivity of phylloxera-resistant grape rootstocks as a basis for recommending rootstocks in the Pacific Northwest.

Experimental Procedures

The experiment was established in microplots (pot-n-pot system) at the OSU Woodhall Research Vineyard in 2006 by planting 'Pinot noir' vines grafted to 6 rootstocks in fumigated Jory soil. Beneficial, arbuscular mycorrhizal fungi (AMF) were added to all plots and half of the plots were infested with *M. xenoplax* (ring nematodes). Vines were planted in early May, 2006 in a randomized block design and drip-irrigated to maintain volumetric soil water content above 15% in 2006. Vines were 2-budded before the 2007 growing season. A single shoot was retained for most of the summer, but this shoot was pruned back to establish the trunk and head, and to encourage lateral growth in mid-August. Two laterals from this main shoot will serve as next year's (2008) fruiting canes. Soil moisture was monitored weekly for most of the growing season by time domain reflectometry (TDR) using buriable waveguides installed in half of the plots. Growth of vines was assessed by periodic measurements of shoot length and leaf area. Gas exchange was monitored at the beginning (porometry) and end (portable IRGA system) of August. Leaf samples were collected from each plant at veraison in 2006 and 2007 for mineral nutrient analysis, but this analysis is not yet complete. Nematode populations were assessed in the autumn of 2006, summer 2007, and again in autumn 2007. Root growth and colonization by AMF was determined in the autumn of 2006 and at veraison in 2007.

Results and Discussion

All vines (except a single replicate on 1103P roots) grew well in 2007, easily producing main shoots over 2 m in length and two lateral shoots below the newly established head greater than a meter in length. Shoot growth was not affected by rootstock or ring nematode treatments in 2007. This was true for main shoots early in the season and for lateral shoots later in the summer. Similarly, leaf area of vines was not significantly affected by our treatments in 2007 (data not shown). The small effect of rootstock treatment on plant growth that was observed in 2006 (Schreiner et al. 2006) did not extend to the 2007 season. Leaf gas exchange measured in early August on a stressful day (at the end of an irrigation cycle) was also unaffected by rootstock or nematode treatments. Late August measurements on a less stressful day (in the middle of an irrigation cycle) produced similar results (data not shown).

Despite the general lack of impact on above-ground plant parameters, differences were occurring below-ground. After a single growing season (autumn 2006), ring nematode populations in soil were already affected by different rootstocks, even though populations were still very low (<1 nematode g^{-1} soil). The susceptible rootstocks in our trial (self, 3309C, 1103P) supported greater nematode populations than the resistant rootstocks (420A, 110R, 101-14), confirming previous findings under controlled conditions (Pinkerton et al. 2005). By the summer of 2007, nematode populations in soil were very high in self-rooted vines, intermediate in 3309C and 1103P rootstocks, and still quite low in 110R, 101-14 and 420A rootstocks. Nematodes in the noninfested controls for all rootstocks were still zero. We began to see an impact of nematodes on roots in 2007; a significant interaction between nematode and rootstock treatments occurred for fine root growth assessed in late summer (Sep. 12). Fine root mass of the self-rooted vines was reduced in nematode infested plots as compared to the noninfested controls, while other rootstocks were not. Soil respiration also was significantly affected by an interaction between nematodes and rootstocks. Self-rooted vines with nematodes had greater soil respiration rates than those without nematodes (Table 1). Other rootstocks were not different, although similar trends occurred in the other two susceptible rootstocks (3309C and 1103P). This result was somewhat surprising, since the self-rooted vines in the infested plots had less fine root mass. These results suggest that the nematodes themselves are a significant component of total soil respiration, or that the nematodes are causing a greater turnover (death) or activity of fine roots that boosts total soil respiration (possibly as a result of

increased microbial activity). An effect of nematodes on AMF colonization of roots was not significant at the end of the first growing season (2006), but our analysis from 2007 is not complete. Our analysis of the physiological responses of 'Pinot noir' grafted onto different rootstocks in the presence of ring nematodes will continue over the next few years.

Herbivore-Induced Plant Volatiles as an Aid to Conservation Biological Control in Grapes

David G. James, Irrigated Agriculture Research and Extension Center, WSU

Conservation biological control (CBC) is an important component of integrated pest management strategies being developed for vineyards in Washington. CBC is based on recruitment and maintenance of specific and general-feeding natural enemies in vineyards. When attacked by pests, grapevines emit volatile chemicals which serve as 'alarm signals'. Natural enemies of pests 'hear' these cries for help and are attracted to the distressed plants. One of these alarm signals is methyl salicylate (MeSA), which is being field-tested in this project for its efficacy as a natural enemy attractant and aid to improving CBC in grapes.

The deployment of MeSA dispensers in commercial vineyards resulted in significant increases in population densities of natural enemies of grape pests, including mite-eating ladybeetles (*Stethorus* spp), ladybeetles (Coccinelidae), Green lacewings (Chrysopidae) and Hover Flies (Syrphidae). Additionally, pest numbers were lower in MeSA-baited vineyards. It is expected that larger populations of natural enemies in vineyards will lead to improved CBC.

Attraction and Retention of Beneficial Insects Through Enhanced Plant Biodiversity in Irrigated Vineyards (*Vitis vinifera* L.)

David James, Research Entomologist; Mercy A. Olmstead, Extension Viticulturist; and Essa Grasswitz, Research Associate; WSU, Irrigated Agriculture Research and Extension Center

The aim of this project is to evaluate various cover crops for their ability to attract and retain beneficial insects and hence improve the level of naturally-occurring biological control of vineyard pests. The treatments tested in 2007 were (i) cereal rye (*Secale cereale*), (ii) a mixture of flowering annuals that included California poppy (*Escholschzia californica*), California bluebell (*Phacelia campanularia*), dwarf cornflower (*Centurea cyanus*), and buckwheat (*Fagopyrum esculentum*), and (iii) resident vineyard weeds. A commercial mixture of medic species (*Medicago* spp.) developed for arid conditions was tested in 2006 but subsequently dropped from the study as a result of poor establishment. In both years, treatments were sown in autumn in two study sites in south-central Washington: one conventionally managed vineyard and one organic vineyard.

In 2006, sweep samples taken from the ground flora showed significant differences between treatments for populations of some of the more important predatory insects (e.g. big-eyed bugs (*Geocoris* spp.), Damsel bugs (*Nabis* spp.) and minute pirate bugs (*Orius* spp.), with populations generally being higher in the flowering mix than in the other three treatments for at least part of the season. However, no effect on the two key pests (Western grape leafhopper (*Erythroneura elegantula*) and Virginia creeper leafhopper (*Erythroneura ziczac*)) could be demonstrated. Preliminary analysis indicates similar results for 2007, with populations of *Orius* and *Geocoris* spp. again being significantly enhanced in plots sown with flowering annuals, but with no demonstrable effects on pest numbers. There were minimal effects on vine and berry growth due to cover crop treatments in both vineyards in 2006 and 2007.

Applications of New Pest Strategies in Cranberries

Kim Patten, WSU Long Beach Research and Extension Unit

Weed control: Herbicide trials for efficacy on numerous perennial weed species and crop phytotoxicity were conducted. Mesotrione, chlorimuron and quinclorac were all promising and are now progressing through the registration process. The effects of various surfactants on enhancing weed control or crop damage of mesotrione were evaluated. Effects varied by weed species and differences were minor.

Weevil control: Numerous insecticides (imidacloprid, clothianidin, dinotefuran, chlorantraniliprole, flubendiamide and metaflumizone) and nematodes *(Steinernema kraussei)* were evaluated in growers' fields for larvicidal efficacy on Blackvine weevil *(*BVW*).* Imidacloprid, clothianidin, metaflumizone and *Steinernema kraussei* were all reasonably effective. Based on limited data, *Steinernema kraussei* is one of the most effective treatments overall. Numerous insecticides (thiamethoxam, dinotefuran, clothianidin, chlorantraniliprole and metaflumizone) and sodium silicofluoride-based baits mixed in apple or sugar beet press cake were evaluated for adulticide efficacy on BVW. All products had adulticide activity. Based on one-year of efficacy, metaflumizone was slightly better than other broadcast-applied insecticides. Both apple and beet press cake silicofluoride baits showed efficacy equal to or much better than the commercial Cryolite bait.

Fruit rot control: The fungicides azoxystrobin and fenbuconazole were evaluated for their effectiveness as supplemental early fungicides. Comparisons were made to traditional fungicide applications and timings. An aggressive early fungicide program did not reduce yield. Only minor differences of rot or keeping quality due to treatments were noted in the first two years of field trials. In year three, major increases were observed with increased nitrogen and early fungicide timings reduced fruit rot on some sites.

Profiling Viruses Associated with Grapevine Leafroll Disease in the Vineyards of the Pacific Northwest

Naidu Rayapati, Ken Eastwell, David James and Tess Grasswitz, WSU

Robert Martin, USDA-ARS-HCRL

Grapevine leafroll disease (GLD) is the most important viral disease affecting wine grapes in the Pacific Northwest (PNW) region. This project was developed to document the occurrence of grapevine leafroll-associated viruses (GLRaVs) and their variants in the PNW vineyards for developing strategies to mitigate crop losses due to GLD. Using molecular techniques, a total of nearly 300 samples from five red-fruited cultivars in twelve different vineyards from Washington State vineyards were tested for GLRaV-1, -2, -3, -4, -5, and -9. Nearly 65% of the samples showing GLD symptoms tested positive for one or more of these six GLRaVs. GLRaV-3 was found to be the most common, followed by GLRaV-2 and GLRaV-4. All these viruses have been found to occur as either single or mixed infections in individual vines. Together with the results from previous years, we have so far documented the presence of six of the nine known GLRaVs in Washington State vineyards. Grapevines tested positive for GLRaV-3, -4, and -9 were used as a source for virus transmission by grape mealybugs. Inoculated plants are being tested for the presence of these viruses.

Impact of Rootstock-Scion-Virus Interactions on Grape Yield and Quality Attributes

Naidu Rayapati and Ken Eastwell, WSU, Irrigated Agriculture Res. and Extension Center

Robert Martin, USDA-ARS-HCRL

The goal of this project is to conduct research to address which rootstocks are most sensitive to graft incompatibility issues when the scions are infected with grapevine leafroll-associated viruses (GLRaVs) and grapevine rupestris stem pitting-associated virus (GRSPaV), and to examine the affects of virus infections x scion x rootstocks on grapevine establishment and longevity and on grape yield components and fruit quality. A research vineyard has been established at the Botany and Plant Pathology research farm at Oregon State University, Corvallis, OR. The Pommard clone of Pinot Noir was grafted on to four rootstocks, namely Couderc 3309, MGT 101-14, 420A and Riparia Gloire as well as self-rooted vines. Cuttings collected from virus-infected grapevines have been established in the greenhouse. The plants derived from individual cuttings are being tested by molecular diagnostic assays to verify the presence of GLRaVs and GRSPaV. Grapevines infected singly with GLRaV-1, GLRaV-2, GLRaV-3, and GRSPaV will be used as a source of virus for graft inoculations during the coming season. Plant growth data will be collected over the next two years.

Effects of Plant Parasitic Nematode Densities on Grapevine Establishment – Development of Damage Thresholds

Ekaterini Riga, Washingotn State Univeristy, IAREC; Jack Pinkerton, USDA-ARS Horticultural Crops Research Lab

Success in planting or replanting a vineyard requires the removal or reduction of physical or biological constraints found in the field. Plant parasitic nematodes are major pests of grapes worldwide and are one of the biological constraints in vine establishment. It is estimated that in California root-knot nematodes cause 20% of economic loss (1,2,3,4). Even low populations of *Meloidogyne* spp. (root-knot nematode), *Tylenchulus semipenetrans* (citrus nematode), *Pratylenchus vulnus* (lesion nematode), and *Xiphinema index* (dagger nematode) in the soil can result in extensive damage if grapes are being either planted or replanted into a field within three years after perennials were grown (1). However, most of the above nematode species are not found in Washington State whose wine grape industry in young and problems such as plant-parasitic nematodes, have not been widely recognized, yet. In 2003, a survey of 77 sites of Washington State vineyards conducted by USDA-ARS and WSU scientists found a cosmopolitan distribution of plant parasitic nematodes, with many vineyards surveyed having nematode densities considered damaging in California (Santo, unpublished). The root knot nematode, *Meloidogyne hapla,* and the dagger nematodes, *Xiphinema pachticum* and *X. americanum* were the main nematodes found during the survey (Pinkerton and Riga, unpublished). Recent soil sample analysis revealed that the dagger populations in WA are mixed populations consisted of approximately 75% *P. pachticum* and 25% *X. americanum* (Riga, unpublished). Dagger nematodes are ectoparasitic nematode, i.e. they do not enter the root but feed on the growing root tips. Some species are virus vectors and can cause stunted plants and can impact both yield and berry quality. Due to their capability to transmit virus, the threshold for dagger nematodes is very low and there are no registered nematicides for use in established fields to control this nematode (9). The root knot nematodes are endoparasites, they live inside the roots by establishing permanent feeding sites, deprive the plant from nutrients and causing the roots to look deformed (9). Damage thresholds caused by the root knot and dagger nematodes that account for management characteristics in Washington state vineyards are not available.

The strategies used to manage plant-parasitic nematodes in grapevines will depend on the specific nematode species present and the vineyard characteristics. Pre-plant management options to control nematodes include soil fumigation, application of soil amendments, crop rotation, and selection of nematode resistant or tolerant rootstocks.

However, there are limited options for managing nematodes in established vineyards. Therefore, it is imperative that the grower is aware of how different nematode densities effect the establishment of vines during the first 3 years to take appropriate measures, i.e. decide on pre-pant pr post-pant management practices and the associated costs.

We propose to evaluate the effect of densities of two main species of plant parasitic nematodes found in Washington State (*Meloidogyne hapla* and *Xiphinema pachticum / X. americanum*) during the vine establishment period using two grape varieties, Chardonnay and Cabernet Sauvignon. In addition, we propose to develop economic damage thresholds for the above varieties caused by plant parasitic nematode species in Washington State during the vine establishment period.

So far, *M. hapla* has established itself in all the vines and started to reproduce.

Biology and Management Control of Blackberry Rust

Ken Johnson, Dept. of Botany and Plant Pathology, OSU; Walt Mahaffee, USDA-ARS Hort. Crops Res. Lab

The project focuses on understanding the biology and management of *Phragmidium violaceum* on blackberry.

1) Determine when infection cycle of *Phragmidium violaceum* is initiated in spring. For a second year, teliospore germination was measured weekly and compared to a predicted phenology based on weather and spore germination data from Montpelier, France. Teliospore germination in Oregon closely matched the predicted window (late March to late April). About half of teliospores germinated before Evergreen blackberry became susceptible to infection.

2) Identify the kind of weather and host developmental stages that allow for initial host infection. For a second year, a rotational trap plant study involving 600 potted blackberry plants was completed at two locations in western Oregon. Specific infection events were identified in this study. The trap plant experiments show that the inoculum that initiates the new disease cycle is local, and not originating at distant sources.

3) Develop an efficient chemical control program. Fields experiments were conducted at two locations in western Oregon to evaluate appropriate timing and application intervals of fungicides. Lime sulfur applied as a delayed dormant (early April) provided significant suppression of infections initiated by basidiospores. An early May application of fungicide (Rally 40W) provided better overall suppression of infections initiated by summer spores than did fungicide applications delayed until mid-May.

4) Evaluate the significance of a fall infection and the potential for asexual perrenation. An autumn fungicide trial in Evergreen blackberry demonstrated that the fall infection is significant, and likely impacts plant vigor the following spring. This experiment identified fungicides with activity against *P. violaceum*. These data were used to obtain a 24C special local need registration for myclobutanil (Rally 40W). Asexual perrenation in leaves or leaf bud was scouted for and not observed, which is consistent with previous descriptions of the disease cycle.

5) Examine the effects leaf wetness and temperature interactions on the infection frequency of *P. violaceum*. Growth chamber experiments with constant temperature indicated the disease was optimal between 10 to 20 C (50 to 68 F) and required at least 6 h of leaf wetness required for infection. Similarly, experiments simulating diurnal temperature fluctuations observed in the field indicated that average daily temperatures 10-15 C (50-59 f) with >9h leaf wetness are optimal for infection. Interruption of leaf wetness prior to accumulation of 6 continuous hours resulted in no infection. The data from Objectives 1, 2, and 5 will be used to develop infection risk models forecast to help time fungicide applications.

6) Determine the susceptibility cultivated blackberries and germplasm. A collection of 87 *Rubus* spp. and varieties has been screen for susceptibility under optimal conditions for disease development. The blackberry species (*R. armeniacus, R. erythrops, R. grabowskii, R. geoides, R. insularis, R. lanciniatus, R. lindebergii, R. ulmifolius* [f. *bellidiflorus*]) and varieties (Black Satin, Burbank thornless, Chester, Ebony King, Evergreen thornless, Everthornless, Hull thornless, Dirksen Thornless, Watlab) were confirmed as susceptible to *P. violaceum* infection to some degree. One raspberry sp. (R. hawaiensis) was demonstrated to be susceptible. Genetic distinct isolates from Objective 7 will be screened against this collection individually.

7) Determine the genetic diversity of *P. violaceum* present in the Pacific Northwest. *P. violaceum* was identified on blackberries below 2100 ft west of the Cascade Mountains from Santa Cruz, CA to the Canadian Border in 191 or 536 sites examined. A collection of 33 of single uredinium isolates from OR, WA and CA has been success-

fully established on detached leaves. AFLP analysis was expanded to multiple primer sets that captured the genetic diversity present in isolate collection. Preliminary data indicates three genetically distinct lineages of *P. violaceum* are present in Oregon and that they are distinct from 23 isolates from Europe and Australia. Further collections will be gathered in 2008. The observed genetic diversity in pathogen and in weedy Himalayans indicates that there maybe selection pressure for new races.

PRODUCTION / PHYSIOLOGY

Leaf Chlorosis of 'Concord' Grapevines: Physiological Mechanisms and Practical Solutions

Lailiang Cheng[1], Markus Keller[2] and Joan Davenport[2]

[1]Department oF Horticulture, Cornell University, [2]WSU, IAREC

The overall objective of this project was to understand the underlying physiological mechanism of leaf chlorosis in Concord vines and develop practical measures for growers to overcome the problem in WA vineyards. During the first two years of the project, we have 1) collected leaf samples from three vineyards in central WA that have consistently had chlorosis problems to determine the Fe status in chlorotic leaves; 2) set up a controlled pH experiment to determine the effect of pH on Fe assimilation by roots and leaves, leaf photosynthesis and organic acid metabolism of Concord vines; 3) conducted an experiment on potted vines at a high soil pH (7.6) and carried out an field trial in central WA to determine the effectiveness of FeEDDHA (a chelated form of Fe) application in alleviating Fe-deficiency-induced leaf chlorosis; and 4) tried different ways of extracting and measuring leaf active Fe for diagnosis of Fe-deficiency. The key findings of this project to date are: 1) Chlorotic leaves from WA vineyards have significantly lower active Fe compared with green leaves; 2) High soil pH induces leaf chlorosis and decreases leaf photosynthesis of Concord vines; 3) Roots of Concord vines are able to increase the activity of ferric chelate reductase, the key enzyme in Fe assimilation, to compensate for the decreased Fe availability at high soil pH. However, the Fe assimilated by root ferric chelate reductase cannot be effectively utilized by leaves because leaf ferric chelate reductase activity is decreased by high soil pH. 4) Leaf citrate level increases in response to Fe deficiency at high soil pH, but it's still much lower when compared with other species, which may be linked to Fe-inefficiency of 'Concord'; and 5) FeEDDHA is very effective in alleviating leaf chlorosis of potted vines grown at a high soil pH. The field trial in central WA indicates that FeEDDHA application has significantly decreased the degree of canopy chlorosis and increased leaf active Fe content, but it appears that its effect is not as strong as that observed on potted vines. Clearly more work is needed on the optimal rate before any recommendation is made to growers; and 6) We have developed an analytical test for measuring physiologically active Fe in 'Concord' grape leaves using dried leaf tissues, which will provide effective diagnosis of Fe-deficiency of Concord vines.

Primocane Management Systems for Increased Yield and Hardiness in 'Marion' Blackberry

Bernadine Strik and Gil Buller; Professor and Senior Research Assistant, Dept. of Horticulture and NWREC, OSU

The objectives of this study are to determine the impact of primocane suppression date on yield, quality, and hardiness of 'Marion' blackberry planted at different in-row spacings. This study is being conducted in a mature 'Marion' blackberry planting established at the North Willamette Research and Extension Center. In an earlier study we found that cumulative yield was 57% higher for 5'EY than 5' AY treatments from 2002 through 2004 (with half the AY plots fruiting in a given year). The 2' AY treatments had 17% higher cumulative yield than the 5' AY plots. Our results indicated that all treatments were sensitive to cold injury, depending on when canes were trained and when the cold event occurred. However, in our earlier work, we did not do any primocane suppression.

In this study, our treatments are: 2' AY, no suppression, but primocanes topped at 6'; 2' AY, primocanes suppressed (re-cut in off year) in June; 3' AY, primocanes suppressed in May; 5' AY, primocanes suppressed in April; and 5' EY with no suppression, trained in February.

The recorded temperature at the NWREC for the winter of 2004-05 never fell below 30°F. There was no significant treatment effect on yield in 2005, which averaged 5.6 tons/acre.

The lowest recorded temperature at the NWREC for the winter of 2005-06 was 19°F (sheltered) on Dec. 15-17, 2005 and 19.5 to 22.5°F on Feb. 16-20, 2006. There was an effect of primocane suppression date/spacing on yield in 2006. The 2' AY, 3' AY, 5' AY, and 5'EY yielded 5, 4.4, 4.5, and 2.5 tons/acre, respectively. The 5' EY had only 38% bud break compared to a high of 69% bud break in the 2' AY treatment. However, the 5' EY treatment produced much larger berries (6.1 g) than the AY treatments (4.4 to 5.1 g) – some of this effect was likely due to the low yield in the 5' EY.

In 2006, on Sept. 6, average primocane length was 13', 10.5', 10.5', 12.5' and 19' for the 2'AY topped, 2'AY, 3'AY, 5'AY, and 5' EY, respectively. Suppression increased the cane number per plant from 5.4 in the 5' EY to 7.4 to 10.8 in the 2', 3' or 5' AY such that there was no significant effect of treatment on total cane length per plant. The lowest recorded temperature at the NWREC for the winter of 2006-07 was 25°F (sheltered) on Nov. 28 and Dec. 17, 18, 2006 and 21 to 26°F on Jan. 12-16 and 25 to 26°F on Feb. 1-2, 2007. There was an effect of primocane suppression date/spacing on yield in 2007 ($P<0.01$). Machine-harvested yield averaged 7.9 tons/acre for the 2' AY topped and 7.1 tons/acre for the 5' AY, whereas yield for the 5' EY was 5.3 tons/acre. Percent bud break was significantly higher for the 2' AY topped and 5' AY (41 to 48%) than for the other treatments (24 to 26%). Berry weight was not significantly affected by treatment in 2007, averaging 4.1 to 4.6 grams.

Primocane-Fruiting Blackberry Production Systems for Season Extension

Bernadine Strik and Ellen Thompson; Professor and M.S. Graduate Student, Dept. Hort., OSU

John Clark, Professor and Breeder, University of Arkansas; Chad Finn, Research Geneticist, USDA-ARS

The objectives of this study are to: 1) determine the impact of tunnel production on 'Prime-Jan' blackberry; 2) evaluate the effect of various primocane manipulations on yield and season extension; and 3) evaluate the impact of tunnel production on berry chemistry and insect pollination.

In May 2005, seven-month old, container grown 'Prime-Jan'® was established at the North Willamette Research and Extension Center. Half of the planting was established under a Haygrove tunnel, and the remainder planted in an adjacent field with no tunnel protection. Throughout the growing season, primocanes were managed under four treatments to promote branching and/or delay harvest: 1) re-cut primocanes [to crown] at 0.25 m, then "soft-tip" [2 to 5 cm of tip removed] at 0.5 m, 2) re-cut primocanes at 0.5 m, then soft-tip at 0.5 m, 3) double-tip (soft-tip at 0.5 m, then soft-tip branches at 0.5 m), and 4) soft-tip at 0.5 m (control). Plastic was placed over the tunnel on 5 Sept. 2006 to protect fruit from inclement weather. Harvest began on 14 Sept. and lasted until 26 Oct. in the field, and 15

Nov. in the tunnel. Primocanes that were double-tipped had nearly twice the flowers and fruit than canes that were soft-tipped only once. Also, double-tipped primocanes developed larger fruit than any other treatment, on average. Harvest was not delayed in canes that were re-cut at 0.25 m, compared with the control and the double-tipped treatment. In contrast, harvest was delayed by about 4 weeks when primocanes were re-cut at 0.5 m. Although fruit under the tunnel was protected from rain, quality began to decline in late October, likely due to cool night temperatures. Data collection is being repeated in 2007.

Weed and Fertility Management of a Newly Established Organic Blueberry Field

Bernadine Strik and Handell Larco; Professor and M.S. Graduate Student, Dept. Hort., OSU

Gil Buller, Senior Research Assistant, NWREC/OSU; Wei Yang, Assistant Professor, NWREC, OSU

Dan Sullivan, Assoc. Professor, Crop and Soil Science, OSU; Dave Bryla, USDA-ARS; Tom Walters, WSU

Additional members on advisory committee: Nick Andrews (OSU), Charlie Prade (organic grower, OR), Eric Pond (organic grower, OR), Adam Wagner (Fall Creek Farm and Nursery, research, OR), Steve Erickson (Fall Creek Farm & Nursery, OR), Chrislyn Particka (Sakuma Bros. research, WA), Joe Bennett (Small Planet Foods, WA)

The objectives of this study are to: 1) establish a transitional and then organic, certified blueberry field for research at the NWREC; 2) determine the effect of raised beds on soil and plant water status, plant growth, and weed management options; 3) study organic weed management systems for effectiveness and economic feasibility; 4) ascertain the effectiveness of organic fertilizer treatments and various rates for yield, plant nutrient status, and growth; 5) determine whether an early and late-fruiting cultivar differ in ease of organic management; and 6) develop economic analysis and comparisons among treatments at end of study

The planting was established in October, 2006 on a Willamette Silt Loam at the NWREC, Aurora, Ore. Treatments being studied are: A) Planting method (Raised bed or flat ground); B) Cultivar: 'Duke' and 'Liberty'; C) weed management: 1) sawdust mulch + hand (or mechanical) weed management; 2) compost (yard debris 1-2" deep) + 1" sawdust mulch + Vinegar (20%) as needed; 3) landscape fabric with sawdust mulch in the 6" diameter plant hole; D) organic fertilization type and rate: 1) feather meal at either 25 lb N/a ("L") or 50 lb N/a ("H") – split 2x [3 Apr. and 16 May; liquid slurry on weed matt plots only]; 2) liquid fish fertilizer at 25 lb N/a ("L") or 50 lb N/a ("H") – split 7x [16 Apr. to 9 July; every 2 weeks].

A baseline soil analysis was completed for nutrients, pH, organic matter, and microbiological activity. The compost and sawdust were similarly analyzed. Blossom buds were pruned off plants at planting to prevent cropping in year 1 (2007). Weed pressure is being recorded as percent coverage. Weed control methods are being evaluated for their effectiveness and costs recorded. If hand weeding is required, then this will be done (to ensure blueberry plant well being), but this will be recorded as a result (cost and treatment effectiveness). Any plant injury from weed or fertilizer treatments will be recorded. The first week of August, 2007, samples were collected from each treatment in 3 reps for tissue nutrient analyses. Soil moisture status is being measured throughout the season using a TDR probe. Plant water status is being monitored with a pressure bomb. The planting is irrigated with drip irrigation, and the rate and timing is being adjusted through the season, as required, due to treatment effects. Soil temperature as affected by planting method and weed management is being recorded. One plant per plot was dug in October, 2007, separated into roots, crown, and above plant growth, dried, and weighed. Data are still being analyzed.

Fertility and Soil Management in Newly Established Blueberry Fields

Bernadine Strik and Linda White; Professor, Dept. of Horticulture, OSU; Assistant Professor, Coos County Extension

Note: From the M.S. thesis of L. White

The objectives of this study were to determine the effects of incorporated sawdust, sawdust mulch, and nitrogen fertilizer rate on soil properties, plant growth, and N uptake in a young 'Elliott' blueberry planting. The study was conducted at the North Willamette Research and Extension Center in a Willamette silt loam soil type. Planting occurred in October 2003 on raised beds that were either constructed with the incorporation of fir sawdust amendment, or left un-incorporated. Plots were then mulched with sawdust or left bare after planting. Depleted nitrogen fertilizer (^{15}N) was applied at three rates in the growing season of 2004; 22 kg N/ha, 68 kg N/ha, and 114kg N/ha. Non-labeled N fertilizer was applied at the same rates in the 2005 growing season.

Plots amended with sawdust had a decreased level of soil moisture and it was difficult to maintain adequate soil moisture within the plant root zone. Incorporated plots required 5-6 times more irrigation water during the growing season. Total plant dry weight was greatest in un-incorporated, mulched plots. Nitrogen fertilizer rate had no effect on total plant dry weight or partitioning. The proportion of N derived from fertilizer was highest in plants growing in incorporated, un-mulched plots. Unincorporated, mulched plants had the greatest fruit yield and plants in un-incorporated plots produced significantly firmer berries than those in incorporated plots. Nitrogen rate alone had no effect on fruit firmness or yield. Overall, plant growth, yield, and soil moisture were adversely affected by the addition of sawdust in a Willamette silt loam soil.

Correcting Iron Deficiency in Blueberries

Wei Q. Yang, Nonnie Bautista, and Eduardo Chavez, OSU, NWREC

Two commercial blueberry fields (one in Silverton, Location 1 and one in Salem, Location 2) were selected to use FeEDDHA application to correct Fe deficiency symptoms. Four FeEDDHA treatment concentrations, 0 (being the control), 0.5, 2.5, and 5.0 ppm FeEDDHA were applied on the soil surface at 20 ml per square feet around plant crown area. Such treatments were arranged in a randomized complete block design with 5 replications for the two experimental locations. Soil pH concentrations were also obtained for each of the treatment. Leaf samples were taken before and after a month of application of the FeEDDHA for foliar Fe analysis. Thus far, we have determined the growth parameters of treated plants in both locations and no significant effect of FeEDDHA on plant growth were observed. A similar greenhouse experiment will be conducted in spring of 2008.

Using Grafted Blueberries To Improve Mechanical Harvesting For Fresh Market Quality Berries

Wei Q. Yang and Nonnie Bautista, OSU, NCSFR

A ¼ acre blueberry rootstock plot was established at the North Willamette Research and Extension Center (NWREC) in 2005. The plot was fertilized with 20 lbs and 50 lbs of N in 2006 and 2007 using a triple 16 fertilizer. A 3" deep sawdust mulch was applied in the fall of 2006 to control weeds within the planting row. This plot is under drip irrigation. The three rootstocks (NC2845, NC8232, and NC8248) were from *Vaccinium elliottii* selections from Dr. James Ballington's breeding program. The growth of three rootstock selections in 2006 and 2007 indicated no differences in stem diameter among three selections. In 2006, NC2845 exhibited longer shoot length compared to NC8232, while NC8248 had the shortest shoot length. NC 2845 also was the tallest plant. NC8248 had the most sucker produced after one growing season. In 2007, NC 2845 continued performing well in terms of number of suckers and new growth. NC 2845 appears to be the best selection to be a potential rootstock. In addition, we have propagated a large number of hardwood and softwood cuttings of these three rootstocks for future use.

Canopy Design, Variety Evaluation, and Crop Adjustment to Improve Fruit Quality of Table Grapes

Esmaeil Fallahi, Professor of Fruit Physiology, University of Idaho

John Clark, University of Arkansas; Ray Ethell, Broadacres Nursery; Bill Burnet, Bellevue, WA

Table grape, even at a small scale would perfectly fit in the operation of any wine grape and small fruit grower and will have excellent local and export markets. Our earlier experiments showed that table grapes mature between early September and late October under Southwest Idaho conditions. This is the time that fresh table grapes are not available from California, and thus provides an excellent window of opportunity and niche market for our grape and other fruit growers in the PNW. Berry color development in table grapes is a problem in California, but we don't have any problem with color development in the PNW because of cool nights during ripening. The first step for any new industry, including table grape, is to find new cultivars adaptable to the region and then improve the cultural practices such as cluster and crop adjustment and canopy design. In the first phase of developing our new table grape industry, we evaluated several cultivars. The search for newer cultivars should continue. Now, it is time to search for a proper canopy design and crop adjustment strategy by cluster cutting and cluster removal. The preliminary tests shows that cluster management can improve berry size in the PNW. This is a new project and is considered as "Number 1" priority for Idaho and is in the top priority list of the Northwest Center for Small Fruit Center Research. Our objectives in this project are:1)To study the effects of various canopy designs on yield and berry and cluster quality of selected table grapes. 2) To study the effects of crop load management and viticultural practices, including cluster thinning, cluster removal, girdling, and gibberellic acid (GA), and CPPU applications on berry maturity and quality of table grape selections and cultivars that have shown promising results in our earlier phase of evaluation. 3) To evaluate vine performance, yield, and berry quality attributes of new selections and cultivars of table grapes and to study their suitability for the climate conditions of Southwest Idaho, Oregon, and Washington.

Procedures: Objective 1: In this objective, three different canopy designs in selected table grapes ('Alborz', 'Jupiter', 'Emerald', 'Ralli' ('Anahita'), 'Autumn Royal', and A-2494) will be evaluated. These grapes are chosen based on their superior performance in growth, yield, and fruit quality from our earlier evaluation. The canopy designs are 1) Quadrilateral canopy: In this system, the main trunk will be cut at about 52 inches height and two 18-inch arms will be trained at 90 degree on the trunk. On each of these 18-inch arms, a bilateral cordon system will be established. 2) One-sided/Tilted Bilateral Cordon canopy: In this system, the main trunk will be cut at about 55 inches height from the ground level and a bilateral cordon system will be formed on each vine. However, in this system, the entire canopy will be laid one side of the V shape wall. 3) Traditional Bilateral Cordon system: Cordon arms are

trained to a bilateral system at 55 inches height. The plan of action during the 3 years of this project for objective 1 is as follows: in 2007, the ground has been prepared. In spring of 2008, the dormant cuttings will be taken, rooted, and planted. The support posts and drip irrigation will be installed. In 2009, vines will be trained and initial data will be gathered. In 2009 and 2010, canopy and vine training will continue. Fruits will be sampled and vine survival, yield and fruit quality (berry size, soluble solid, color, berry size, cluster size, texture) will be evaluated in 2009 and 2010.

Objective 2: The following table grape cultivars were found to be superior in the first phase of our evaluation and thus, will be used in objective 2: 'Alborz', 'Fresno', 'Italia', 'Emerald', 'Crimson', 'Jupiter', 'Rally', 'Princess', and selections A-2640 and A-2494. The plan of action during the 3 years of this project for objective 2 is as follows: in 2008-2010, vines will receive one of the following treatments: cluster removal, cluster cutting, cluster removal and cluster cutting, girdling plus cluster cutting and thinning, or gibberrelic acid (GA) and/or CPPU. In all experiments of objective 2, yield and quality attributes, including berry size, soluble solid concentrations, berry color, berry size, cluster size, peel and berry texture and vine survival will be measured in 2008-2010. Storability of selected cultivars in objective 2 under conditions of a regular atmosphere storage will also be studied.

Objective 3: The plan of action in this objective is as follows: In 2006 and 2007, the ground was prepared. Several promising selections out of 120 selections from the University of Arkansas Table Grape Breeding Program are selected and planted at the University of Idaho vineyard, during spring of 2006. The selections from the University of Arkansas are: A-1105, A-1966, A-2034, A-2126, A-2304, A-2310, A-2335, A-2392, A-2412, A-2473, A-2480, A-2485, A-2486, A-2494, A-2497, A-2514, A-2560, A-2600, A-2610, A-2612, A-2640, and A-2653. In addition to these selections, several new cultivars, including 'Autumn Royal', 'Fantasy', 'Red Globe', 'Anahita', 'Strawberry', 'Kashishi', and 'Kathy' were also propagated and added to the experiment in 2006. In 2008, 'Autumn King', 'Sweet Scarlet', 'Scarlet Royal', and 'Sugra Thirteen' and additional cultivars will be planted in Idaho. Performance and fruit quality attributes in all new grapes in Objective 3 will be studied during 2008-2010. In 2008, we will plant 'Alborz', 'Emerald', 'Jupiter', 'Anahita', and a few more cultivars in Hubbard, Oregon, and Moses Lake, Washington. In 2009 and 2010, in cooperation with our collaborators, we will also monitor and measure vine performance, yield and fruity quality attributes of these cultivars and conduct experiments with cluster cutting, cluster thinning, GA application, and girdling in 'Alborz' and perhaps other cultivars in Oregon and Washington.

Irrigation Management Practices for Improving Growth and Production of Blueberry

David Bryla, USDA ARS Horticultural Crops Research Unit; Bernadine Strik, Department of Horticulture, OSU

A study was done to determine the effects of irrigation method on water use by young northern highbush blueberry (*Vaccinium corymbosum* L. 'Elliott'). Plants were irrigated by overhead sprinkler, microspray, or drip at 50, 100, and 150% of the estimated crop evapotranspiration (ET_c) requirement. Irrigation was applied twice a week by sprinklers and three times per week by microsprays and drip. During the first two years after planting, plants irrigated by drip required only half the water for maximum shoot production as those irrigated by sprinklers or microsprays, using 203 mm (Jul.-Sept.) the first year and 376 mm (Apr.-Sept.) the following year. Overall, shoot dry weight was highest when plants were irrigated at 100% ET_c by drip or at 150% ET_c by microsprays. The benefit of these two treatments was likely due to higher soil water content and/or higher irrigation frequency, which probably enhanced plant water status over the other treatments. Based on plant responses to water applications, additional water (>150% ET_c) may further improve growth with microsprays but does not appear liable to improve it with sprinklers and drip. In fact, irrigation at 150% ET_c saturated the soil and significantly reduced shoot dry weight with drip. Further study is underway to determine how these irrigation methods will affect production and water use in mature plants.

Particle Film and Deficit Irrigation: Partners to Enhance Wine Grape Quality and Sustainability

Krista Shellie, USDA-ARS Parma, ID and Michael Glenn, USDA-ARS Kearneysville, WV

Supplying wine grapes with less water than needed for optimum growth, a strategy called deficit irrigation, is a production tool particularly well suited for warm, arid growing regions, to control shoot growth, canopy density, and to enhance berry composition for wine production. The reduced shoot growth resulting from vine water stress increases the amount of light transmitted into the canopy, which is beneficial for sustained productivity and high fruit quality, but provides less shade to protect fruit from potentially damaging high temperature and solar radiation. The objective of this research was to evaluate whether a foliar application of a commercially available particle film can reduce the risk of solar injury and heat stress under deficit irrigation. Field trial plots were established in 2006 at two sites in southwestern Idaho and vines were either sprayed or not sprayed with particle film and evaluated under well-watered or deficit irrigated conditions. Preliminary results suggest that particle film influences leaf gas exchange and fruit composition, but response differs according to vine water status. Particle film application under deficit irrigation did not prevent development of sunscald in the white wine grape cultivar 'Viognier'.

Developing Tissue Nutrient Standards for Irrigated Wine Grape in the Pacific Northwest

Joan R. Davenport, Associate Professor/ Soil Scientist, WSU; Robert G. Stevens, Extension Soil Scientist, WSU

Soil and plant tissue testing are routine tools used by growers to assess the status of their crops to determine what, if any, supplemental fertilizers are needed to reach both quality and quantity production goals. In wine grape, as in many perennial fruit crops, leaf tissue testing is often used as the primary assessment tool. In this project, we undertook to use a survey approach to begin the process of establishing tissue nutrient guidelines. Leaf petiole and blade samples were collected from six different winegrape cultivars (2 white, 4 red) from eight different sites that geographically encompass the Columbia Valley AVA (inclusively), the Milton-Freewater area in Oregon, and the Parma area in Idaho. Samples were collected at three different growth stages and analyzed for nutrients by a commercial laboratory. Preliminary findings from this two-year sampling show that many of the nutrient concentrations in the samples tissues fall outside of the ranges currently considered normal/adequate in published standards. Compilation of these data with yield, quality and fertilizer records will be used to develop region specific standards.

Changes in Grape Berry Size Due to Late-Season Irrigation

Markus Keller, Washington State University; Bhaskar R. Bondada, WSU; Julie M. Tarara, USDA-ARS

There is a widespread belief in the wine industry that rainfall or irrigation close to harvest may increase berry size and cause a 'dilution' of fruit quality or even cracking (splitting) of berries. Wineries often encourage growers to withhold irrigation water at this critical time to avoid any perceived adverse effects. This practice interferes with growers' desire to maintain berry size during the prolonged 'hang time' often demanded by wineries. We used large pressure chambers to pressurize the root system of pot-grown Merlot and Concord vines, enabling us to determine the influence of soil moisture on changes in berry volume. In addition, soil moisture was altered by drying down and rewatering potted vines. We also used a chemical dye to trace water movement in the vines' xylem (water conduits)

and immersed berries in water to test if water could be absorbed through the skin. We found that the volume of pre-veraison berries declined under water stress but increased again as soon as the berries began to change color. Post-veraison berries, on the other hand, responded little to soil moisture; application of irrigation water after veraison merely prevented berry shrinkage. Post-veraison Concord, but not Merlot, berries cracked when root pressure was applied. We discovered that the xylem connection between the berries and the shoot remains intact after veraison, but the berries stop using this pathway for water influx and instead use it to recycle excess phloem (sugar conduits) water out of the berry. We also demonstrated that water could be absorbed through the berry skin. Our results have direct practical implications, since they suggest that late-season drip or flood irrigation should have little effect on berry size and composition, whereas overhead sprinkler irrigation or rainfall might effectively dilute berry solutes. Growers may apply irrigation water to the soil late in the season to maintain berry size without interfering with fruit composition. This could enable them to leave the fruit on the vine longer for flavor development without compromising replenishment of storage reserves and cold hardiness.

WINE PROCESSING

Enhancing Red Wine Texture by Aging on the Yeast Lees

Alan Bakalinsky, OSU; Jim Harbertson, WSU; Jeff Rowe, OSU; Jim Kennedy, OSU

Wine tannins have profound effects on red wine quality as they contribute color, bitterness, and astringency. Winemakers modify the amounts and quality of tannins in red wines by controlling extraction (pre-fermentation maceration, timing of pressing), post-fermentation oxygenation, addition of fining agents and wood extracts, and aging practices. The broader term “texture” is often used to describe the quality of astringency and has been defined as the cumulative affect of all wine components on the perception of astringency. Understanding and controlling wine texture is a fundamental interest of winemakers because this characteristic is central to the sensory quality of wine. Unfortunately, because our scientific understanding of texture is poor, modification of this important parameter by winemakers is usually limited to empirical approaches. This proposal seeks to provide winemakers with a practical and objective tool to assess and to modify wine texture through detection of the interactions that occur between grape tannins and yeast mannoproteins. Our central hypothesis is that aging red wine on the yeast lees results in a desirable reduction in astringency due to formation of complexes between grape tannins and yeast-derived mannoproteins.

Because we are interested in the interactions that occur between grape tannins and a subclass of wine proteins—yeast-derived mannoproteins—we developed an immunoblot assay for quantifying mannoproteins in wine. The assay is suitable for both red and white wines and was found to have a sensitivity of less than 10 ng of mannoprotein. We also initiated a kinetic study in model grape juice to follow release of mannoproteins from yeast during the process of aging on the yeast lees. We developed procedures for identifying the released proteins by analysis of the MS-MS spectra of tryptic fragments. Model wine samples taken two weeks post-inoculation were found to contain up to 120 yeast proteins. Sampling over the next 9 months will reveal which of these proteins and which mannoproteins among them will remain in solution for potential interaction with grape tannins.

Understanding Micro-Oxygenation Technique and the Oxidation of Grape/Wine Polyphenolics: Year 1

Jungmin Lee, USDA-ARS-HCRU; and James Kennedy, OSU

Wine tannins and color are important red wine quality factors that can be manipulated by grape growing and winemaking practices. Tannin quality in wine is a high-interest research topic. Tannins stabilize wine color, enhance mouthfeel, and can impart characteristics that enhance the quality perception of red wines. We seek to better understand tannin evolution in wine by developing and modifying analytical techniques (utilizing high performance liquid chromatography coupled with a diode array detector and mass spectrometer detection), and applying these techniques to wines produced by industry cooperators.

Rootstock and Scion Influences on Grape and Wine Composition and Quality

Markus Keller, WSU (for Sara Spayd); James Harbertson, WSU

Although phylloxera does not pose an immediate threat to the wine industry in eastern Washington, it is the most significant insect pest of wine grapes throughout the world. Since it cannot be controlled by chemical or biological means, grafting susceptible wine grapes onto tolerant rootstocks is the only long-term insurance against this devastating root pest. Some rootstocks also provide resistance to nematodes that may reduce vineyard longevity and fruit quality, but it is not clear if the rootstocks themselves alter grape composition and, ultimately, wine quality. The performance of three winegrape varieties on five rootstocks or on their own roots was evaluated in the WSU-IAREC rootstock block. We collected fruit samples throughout ripening and determined yield components and fruit composition at harvest. The results from the 2006 season indicated a pronounced effect of both variety and rootstock. Own-rooted Chardonnay tended to have higher yields than grafted vines, while no clear differences were found for Merlot, and own-rooted Syrah had the lowest yields and Syrah grafted to 3309 the highest. The rootstocks had no influence on sugar and color accumulation and acid degradation in Chardonnay and Merlot. On the other hand, sugar accumulation was fastest on the (undercropped) own-rooted Syrah, and less color accumulated on Syrah grafted to 140-2. Throughout ripening, Chardonnay and Merlot, but not Syrah, consistently had the highest pH on their own roots (Merlot also on 101-14) and the lowest on 140-2. The color of Merlot juice decreased as berry size increased, but this was not true for Syrah. Although there was no significant rootstock effect on juice potassium (K^+) content, the difference in pH between and within varieties was in large part explained by variations in K^+ rather than titratable acidity: Merlot contained the most and Chardonnay the least K^+. Proline and arginine were by far the dominant amino acids present in grape juice, and their were marked differences among varieties: Merlot juice was high in proline but low in arginine, Syrah was low in proline but high in arginine, while Chardonnay was low in both amino acids. Juice from own-rooted Chardonnay and Syrah, but not Merlot, contained considerably more arginine than did juice from grafted vines. This is of practical significance, since musts deficient in arginine may result in sluggish or stuck fermentations. Grafting did not affect juice proline.

SMALL FRUIT INITIATIVE

USDA-ARS/Oregon State University Small Fruit Breeding Program for the Pacific Northwest at Oregon State University (Small Fruits Initiative - Plant Improvement)

Bernadine C. Strik and Chad E. Finn; Dept. Horticulture & NWREC, OSU and USDA-ARS, HCRL

The goals of this research are to develop cultivars that meet the needs of the Northwest commercial small fruit industry and to optimize management systems for new cultivars. Each of the crops, including blackberry, blueberry, strawberry, and black and red raspberry have a group of specific traits of interest that were developed with industry input. Towards these goals, the USDA-ARS makes crosses between parents and evaluates their offspring in Corvallis. Selections from these offspring are then planted at Oregon State University's North Willamette Research and Extension Center (NWREC) in observation and replicated trials and grown using commercial practices. While many selections are established at NWREC, only those that are promising are hand harvested to determine yield and fruit size. Fruit are shipped to the OSU Department of Food Science to assess processed fruit quality. Plants are scored for vigor, growth habit, and fruit quality. As appropriate, production methods are evaluated to optimize a genotypes performance and ultimately develop recommendations for commercial cultivation. Genotypes that perform well are moved into commercial trials. In 2007, 140 successful raspberry/blackberry, 69 strawberry and 60 blueberry crosses were made. Dozens of selections were made within each crop. Selections were planted or harvested and evaluated at NWREC; 17 plantings with over 1500 individual plots! The new blackberry cultivars, especially 'Black Diamond', 'Black Pearl', and 'Metolius', are being widely commercially planted. 'Wild Treasure' (ORUS 1843-3) blackberry had propagation problems but should be available in 2008. ORUS 1523-4 and ORUS 1793-1, fresh market blackberries, will be released as soon as the USDA-ARS decides whether they will protect their releases by patenting. In strawberry, ORUS 1790-1 and possibly ORUS 2180-1 will be released in 2008. In red raspberry, the floricane fruiting ORUS 1142-1 and the primocane-fruiting ORUS 2786-5 are being targeted for commercial trial. 'Esquimalt', 'Saanich' and 'Cascade Bounty' red raspberry were recently released based in part on performance at NWREC. ORUS 5-1 blueberry has been propagated for commercial trial.

From 2005-07, 'Obsidian' and 'Siskiyou' were compared in 30" and 5' every year (EY) and alternate year (AY) production systems. Yield of 'Obsidian' was higher than that of 'Siskiyou' in 2005 and 2006. In 'Obsidian', yield of the 5' EY and 30" EY was similar in both years. However, the higher density AY plots yielded about 25% more than the 5' AY. In 'Siskiyou', higher density plots do not seem to yield significantly more than the lower density plantings in AY or EY production systems. The lowest recorded temperature at the NWREC for 2005-06 was 19°F (sheltered) on Dec. 15-17, 2005 and 19.5 to 22.5°F on Feb. 16-20, 2006. There was an effect of production system on yield in 2006. 'Siskiyou' was more affected by cold temperature than was 'Obsidian'. Yield of 'Obsidian' averaged 36 kg/plot in EY and 56 kg/plot (30" AY) and 44 kg/plot (5' AY). 'Siskiyou' averaged 42 kg/plot in the AY (no effect of spacing) and 12 kg/plot in 30" EY and 16 kg/plot in 5' EY. This is the equivalent of about 14 and 9 tons/acre in the 30" AY and 30" EY 'Obsidian', respectively, and 10 and 3 tons/acre in the 30" AY and EY 'Siskiyou', respectively. Berry weight tended to be reduced in the 30" AY compared to 30" EY in 'Obsidian' but not in 'Siskiyou'. In both cultivars, berry size was reduced in AY plots compared to EY plots. Work is on-going.

We are also studying the following cultivars in machine-harvest production systems of 30" AY and EY and 5' AY and EY: ORUS 1431-1, planted May 2003; 'Nightfall', June 2005; 'Black Diamond', May 2003; and 'Black Pearl', May 2006.

Small Fruit Breeding for the Pacific Northwest at Washington State University Puyallup

Patrick P. Moore, OSU

1) To develop processing red raspberry cultivars that are adapted to the PNW and that are machine harvestable. Additional traits to incorporate into new cultivars are RBDV resistance and root rot tolerance.

2) To develop strawberry cultivars that are adapted to the PNW and that have higher picking efficiency than current industry standards. Additional traits to incorporate into new cultivars are: fruit firmness and disease resistance.

After raspberry selections are made, the next evaluation is planting 10 plant plots with a cooperating grower. These plantings are managed commercially and evaluations of the machine harvestability of the selections are made by the breeding program. In 2007, a planting was established with 100 plots including 58 WSU selections. This planting will be machine harvested in 2009 and 2010. In the past six years, 465 different raspberries have been planted in machine harvesting evaluation plantings, including 299 WSU selections. Two WSU selections that have been identified as machine harvesting well were distributed to commercial propagators in 2007 for increase for grower trials.

The machine harvesting plantings established in 2004 and 2005 were machine harvested 2007. Selections that appear to machine harvest well will be propagated for evaluation in replicated plots at WSU Puyallup. Those that continue to appear promising will be increased for grower trials.

Ninety-five selections were made among the 13,000 raspberry seedlings evaluated at WSU Puyallup in 2007. These selections will be propagated for evaluation in machine harvesting trials.

Strawberry crosses have used parents chosen for large fruit size, firm fruit and productivity. Forty-one selections were made in 2007 among the seedlings planted in 2006. These selections will be propagated for planting in yield plots. The yield planting established in 2005 had several very productive large fruited selections. The 2006 planting had several very productive selections with extremely large fruit. The most promising selections will continue to be evaluated and if sufficiently promising, propagated for grower trial.

Quality Evaluation of Berry Selections and Varieties

Brian Yorgey, Senior Faculty Research Assistant, Food Science & Technology, OSU
Yanyun Zhao, Assistant Professor, Food Science & Technology, OSU

In cooperation with Chad Finn and the USDA-ARS/Oregon State University Small Fruit Breeding Program

Our part in this group effort to bring new berry varieties to the growers, processors and consumers of the Northwest is focused on fruit quality evaluation. Berries from the breeding plots at the North Willamette Research and Extension Center plots were picked weekly and brought to the OSU Food Science Department in Corvallis for evaluation from early June through September 2006. Basic chemical data were collected on strawberries, raspberries, blackberries, and blueberries for several harvest dates throughout this period. Samples were frozen and will be displayed to industry representatives and researchers during the fall, winter and early spring. This information will be used with field data to select the berries which will be included in further breeding trials.

During the 2006/07 season the following numbers of samples were processed and analyzed:

- strawberries – 11 cultivars and 75 selections
- red raspberries – 5 cultivars and 10 selections
- black raspberries – 10 cultivars and 1 selection
- blackberries – 10 cultivars and 51 selections
- blueberries – 16 cultivars and 21 selections

Processed fruit was displayed for evaluation on nine occasions during the past year:
Breeders and researchers evaluation at OSU
NCCC-22 Small Fruit and Viticulture

Northwest Center for Small Fruits Research annual research meeting in Kenniwick, WA
Northwest Food Processors Association annual meeting in Portland, OR
Oregon Horticultural Society, Caneberry Section, annual meeting in Portland, OR
Oregon Strawberry Commission annual meeting at the OSU North Willamette Research and Extension Center
International Berry Health Symposium at OSU
OSU Strawberry Field Day at the OSU North Willamette Research and Extension Center
OSU Caneberry Field Day at the OSU North Willamette Research and Extension Center

Grape (Table, Wine & Juice) Viticulture Research Priorities 2006-2007

1) A) Evaluation of rootstocks for cold hardiness, vigor, water requirements, effect of edaphic factors, nutritional status, yield parameters, and grape quality attributes.

B) Evaluation of table grape varieties for cold hardiness, vigor, water requirements, effect of edaphic factors, nutritional status, yield parameters, and grape quality attributes

C) Development of integrated/sustainable production systems

D) Effect of viticulture practices (e.g. nutrient management, canopy management, crop load, water management, vegetation management, cover crops) on the quality of table, juice and wine grapes

E) Biology and management of powdery mildew, viruses and vectors, mites, nematodes, cutworms, mealy bug, leaf hoppers and Asian lady beetle.

2) A) Yield Estimation/Modeling/Yield Prediction

B) Organic production

C) Biology and control of Botrytis bunch rot and sour rot, Thrips, crown gall, weeds, Glassy-winged Sharpshooter, Eutypa fungal disease, and nematodes

D) Evaluation of winegrape varieties and clones

3) A) Phylloxera

B) Biodynamic production

Wine Processing Research Priorities 2006-2007

1) Effects of vineyard cultural practices, rootstocks and clones on grape and wine quality including nutritional status, fermentation behavior, water management, cover crops, and fruit maturation composition.

Problem Fermentations

I. Yeast/bacterial interactions
II. Reductive character
III. Yeast and bacterial spoilage organisms
IV. Stuck/sluggish fermentations
V. Tannin management in the winery and vineyard

Managing fermentations to optimize wine quality

2) Winery waste management and utilization for value added products

3) Ethyl carbamate

Organic processing

Processing Technology (high pressure, filtration)

*The subheadings under each priority are not presented in any order and simply represent key areas to be investigated.

NORTHWEST CENTER FOR SMALL FRUITS RESEARCH

Blueberry Research Priorities 2006-2007

1) Establishment of a Northwest breeding program to develop and evaluate adapted cultivars for season extension, disease resistance, mechanical harvesting, and improved fruit characteristics

Improve or extend fresh market (quality or timing) through mechanical harvesting, plant architecture, harvester engineering, post-harvest handling, cultural inputs or changes, physical coverings or chemicals

Better utilization of inputs through improved management of nutrients, pollination, irrigation, weeds, soil amendments, integrated soil health and organic production systems

Biology and control of diseases: scorch, shock, other viruses, SOD, mummy berry, fruit rot complex.

Biology and control insect and arthropods e.g. root weevil gall midge, winter moth, and insect contamination

2) Alternative weed control methods including organic production systems

Biology and control of vertebrate, e.g. birds, deer, etc.

Develop added-value products e.g. nutraceutical, controlled atmosphere storage, packaging, and health benefits

Biology and greater understanding of Mycorrhizal Relationships in a production system

Genotyping

NORTHWEST CENTER FOR SMALL FRUITS RESEARCH

Cranberry Research Priorities 2006-2007

1) Fresh fruit keeping quality and predictive modeling of fruit rot
   Weeds
   Soil borne pests (cranberry girdler and root weevil)
   New cultivar development
   Organophosphate alternatives

2) Irrigation technology for frost and heat protection and pesticide delivery
   Effect of harvest date on fruit physiology and quality
   Genotyping – Identity certification benefit research
   Pollination/fruit set
   Tipworm

3) Nutrient Management
   Dieback
   "Monkey face" – physiologic disorder?
   Market expansion through nutraceuticals/health
   Fall Fruit worm

NORTHWEST CENTER FOR SMALL FRUITS RESEARCH

Strawberry Research Priorities 2006-2007

1) Root weevil

Aphid borne virus complex

Develop cultivars with processed and fresh market potential, including earlier and later ripening cultivar

Weeds

Alternate production systems for economic efficiency (e.g. harvest efficiency), increased yield and cultivar management

2) Nutritional/Nutraceutical benefits

Development of research programs to define and enhance strawberry quality related to marketability

Symphylans

Phytophthora

Fruit rots - botrytis

3) Food safety/sanitation/security

Mites – Twospotted, Cyclamen

Irrigation Management

Powdery Mildew

Value added products

NORTHWEST CENTER FOR SMALL FRUITS RESEARCH

Blackberry Research Priorities 2006-2007

1) Breeding cultivars that are summer bearing, thornless, high-yielding, winter hardy, machine harvestable, disease resistant, and that have superior fruit quality

Biology and control of diseases (e.g. botrytis, purple blotch, dry cell syndrome)

New chemistries to address harvest contaminants and other problems stemming from the loss of long-standing insecticides and nematacides, e.g., Raspberry Crown Borer control

Understanding soil ecology and soil borne pathogens and their effects on plant health and crop yields

Wee control of hard to control perennials (e.g. thistle, bindweed, quackgrass and equisetum)

2) Develop and improve cultural, chemical and biological practices to improve cold hardiness

Development of genetic marker technology for varietal identification

Fruit composition and nutraceutical properties

Blackberry rust control - *Phragmidium violaceum*

Water and nutrient management

3) Fresh market – season extension, protection of fruit shelf life

Primocane management/systems approach

Thorn management and reduction systems

Raspberry Bushy Dwarf Virus in blackberries

Redberry mite control

NORTHWEST CENTER FOR SMALL FRUITS RESEARCH

Red/Black Raspberry Research Priorities 2006-2007

1) Develop cultivars that are summer-bearing, high-yielding, winter hardy, machine-harvestable, disease resistant, virus resistant and have superior processed fruit quality

Understanding soil ecology and soil borne pathogens and their effects on plant health and crop yields

Virus complex control strategies

Technologies and methods to support product and production certification systems – food safety and security, standards, traceability

New chemistries to address harvest contaminants and other problems stemming from the loss of long standing insecticides and nematodes

2) Nutraceutical/nutritional benefits for product development

Labor saving cultural practices, mechanical pruning and tying techniques

Fruit rot including pre-harvest, post-harvest and/or shelf-life

Weed control

Nutrient/irrigation management

3) Season extension: improve viability for fresh marketing, protection of fruit shelf life

Yellow Rust control strategies

Development of technologies leading to value added raspberry products

Mite Control

Optimal soil fumigation techniques

NORTHWEST CENTER FOR SMALL FRUITS RESEARCH

Minor Crops Research Priorities 2006-2007

Lonicera, Bilberry, Schisandra chinensis Baill, Gooseberry, Currants, Hardy Kiwifruit, Lingon Berry, Huckleberry, Chokeberry (Aronia melanocarpa), Elderberry, Sea Buckthorn Berry (Hippophae), Buffalo Berry (Shepherdia)

Note: Priorities ranked "1" (five of them) apply to all minor berry crops; those ranked "2" & "3" are commodity specific.

1) Pesticide tracking, registration and re-registration issues for new up-and-coming crops

Cultivar Development: Germplasm collection, improvement, evaluation, and introduction

Develop a production system (how do we grow these crops?)

New product development/marketing

Nutraceuticals

2) Foliar disease Ribes

Fresh market storage of Hardy Kiwifruit

Investigation of mycorrhizal associations in Huckleberry

Pollination/fruit set Hardy Kiwifruit

3) Quality of Hardy Kiwifruit

Currant fruit fly (also called gooseberry maggot)

Nutrition of Hardy Kiwifruit plants (fertilization)

Irrigation of Hardy Kiwifruit

Phytophthora in Hardy Kiwifruit