Northwest Center for Small Fruits Research

2008 Annual Conference

Welcome to the 17th annual conference of the Northwest Center for Small Fruits Research in Corvallis, Oregon. 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.

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.

Guest Speaker: The guest speaker for the Annual Conference will be Rufus La Lone, The Weather Cafe™. His talk is entitled "Partly to Mostly Cloudy - Forecasting Weather in the Pacific Northwest"

Table of Contents

BERRY / GRAPE PROCESSING

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

Yanyun Zhao, OSU

Brian Yorgey, OSU

Bernadine Strik,Dept. of Horticulture, OSU

Objective of this study was to investigate appropriate edible coatings for enhancing storability of pre-washed, ready-to-eat blueberries under commercial storage conditions.

In 2006, we evaluated two blueberry varieties, Duke and Elliott, by applying coating technologies to extend fresh fruit storability. Semperfresh, chitosan and calcium caseinate (CC) coatings were evaluated as coating materials. During Summer-Fall, 2008, 2 new coating materials, water soluble chitosan (WCH) and WCH blended with sodium alginate (WCH/SA), were applied on Duke and Elliott fruit, plus the use of un-vent containers (deli containers). The goal was to develop ready-to-eat fresh blueberry product with extended fresh market shelf-life. Fruit was washed in 200 ppm chlorine water, coated, and then packed in clamshell or un-vented plastic containers for preventing post-processing contamination and dehydration of fruit. Two controls were applied: unwashed and washed without coating. Coated fruit were stored at ~2 °C and 90% RH for 1 wk and then removed to room condition at ~22°C for up to 15 d. Firmness, pH, TA, total soluble solids, decay rate and weight loss of fruits were measured.

GENETICS

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

Maxine Thompson. Dept. of Horticulture, OSU

Danny Barney, University of Idaho, Sandpoint REC

The objective of this project is to develop superior cultivars that will lead to a successful new berry crop for the Northwest.

In Corvallis, evaluations continued for hybrid seedlings from previous year's breeding work. Unfortunately, berry evaluations were thwarted this year because the entire crop was taken by cedar waxwings. Twelve of the most promising selections were propagated for replicated trial plots. These were placed on an organic farm, a blueberry farm for testing mechanical harvesting, and in my plot. An additional 51 selections of interest were propagated and 2 to 4 each planted in a preliminary trial plot, with others distributed (in groups of 6 plants) to interested growers. Due to USDA budget cuts, the 2-acre haskap breeding plot must be abandoned. Before plants are pulled, 155 seedlings of potential interest will be propagated. Currently, my home plot is being expanded to accommodate 125 existing selections plus the new plantings. 300 hybrid seedlings whose fruit has not yet been seen will be moved, interplanted temporarily between selections and culled as berries are observed. Bird netting above the entire plot will, for the first time allow us to obtain accurate yield records and evaluate berries on all plants. Among these selections, several should emerge within a few years as superior and be worthy of cultivar status.

In Sandpoint, ID research plots also had to be moved to a new location. Most of the seedlings that had been evaluated over the past 2 to 4 years were discarded and 48 selections (40 for fruit production and 8 for ornamental use) were saved for further evaluation. Twenty five of these have been propagated and planted in a randomized, replicated plot with 9 plants of each. The other 15 selections have been rooted and will be planted in 2009. A few more years of intensive evaluations of these promising types should reveal which ones will prove acceptable for release.

Developing Genetic Fingerprints for Cranberry

Nahla Bassil, USDA-ARS NCGR

Kim Hummer, 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. Thirteen 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 13 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. While developing a database of fingerprints for the entire cranberry collection, 'Pilgrim' was found to display four different genetic profiles while two were present in 'Stanley'. We cannot in good faith upload this database to GRIN. We are concerned that each cranberry type may have subclones or consist of a mixture of genotypes. Therefore, more research needs to be done to define the number of genotypes representing each named cultivar.

Response of Black Currants to White Pine Blister Rust Inoculation

Kim Hummer, Research Leader, USDA-ARS NCGR

Joseph Postman, Plant Pathologist, USDA-ARS NCGR

Pest resistance is one of many factors to consider for production horticulture. Over the course of two growing seasons, F1 (first generation) seedlings from a cross between the black currant cultivars 'Ben Lomond' x 'Consort' were subjected to artificial greenhouse inoculation with spores of white pine blister rust (WPBR). This disease damages the leaves of black currants and gooseberries (*Ribes*) but can kill white pine trees. Of the 95 black currant types in the study, 48 (50.5%) showed signs of disease two weeks after inoculation or exposure. Two spore types were tested, one of which is produced on infected pine trees, and the other from infected *Ribes* leaves. Most plants responded similarly to each type of spore. The majority of plant types were also exposed to WPBR under field conditions. In the field, 41.6% of the types became infected. These data support our prediction that resistant and susceptible F1 individuals should occur in a 1:1 ratio in seedlings with the parentage 'Ben Lomond' x 'Consort,' regardless of spore type. This ratio indicates that *Cr* gene resistance segregates as a Mendelian simple dominant trait.

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, fruit size, fruit rot at harvest and rose bloom data are presented in Table 1. Based on production and other variables, none of the new selections out-yielded Pilgrim. CNJ 44-83, CNJ95-37 and CNJ93-9-42 appear to be the most promising new selections in the trial. BE and CNJ95-37 distinguish for fresh fruit potential based on yield and low fruit rot. Of the two new releases, Crimson Queen and Mullica Queen, only Crimson Queen has distinguished itself as a superior cultivar for the fresh fruit production in the PNW. Based on these data, either CNJ 44-83, CNJ95-37 or CNJ93-9-42 will be named and released in 2009 or 2010.

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

Cultivar/selection	bbl/ac 9/27/05	bbl/ac 9/26/06	bbl/ac 10/1/07	bbl/ac 10/2/08	bbl/ac 2005 to 2008	fruit size g/fruit mean 06+07	Fruit rot % rot at harvest mean 2007 & 2008	Rose bloom infested upright/ft^2 1=0, 5>20 June 2008
Crimson Queen	77 cd	179 bc	347 abc	242 abc	846 bcd	1.72 ab	19.4 abc	4.7 ab
NJS95-37	85 c	277 a	322 bcd	246 abc	931 bc	1.33 e	5.7 d	3.0 cd
Mullica Queen	23 cde	20 d	252 cd	178 bc	473 fg	1.80 a	18.0 a-d	4.0 abc
CNJ96-44-83	54 cde	204 b	288 bcd	270 ab	816 b-e	1.58 c	20.5 ab	4.0 abc
CNJ95-20-20	32 cde	181 bc	253 cd	173 bc	639 ef	1.34 de	20.9 a-d	3.0 cd
CNJ93-9-42	61 cde	187 bc	451 a	266 ab	964 ab	1.43 d	18.0 a-d	3.7 a-d
CNJ93-13-100	46 cde	136 c	295 bcd	213 bc	690 de	1.31 e	40.9 bcd	2.7 cd
BE	150 b	217 b	383 ab	229 abc	980 ab	1.17 f	6.5 cd	5.0 a
AR	16 cde	223 b	290 bcd	239 abc	768 cde	1.56 c	14.8 a-d	2.3 d
Bain Favorite	46 cde	178 bc	212 d	200 bc	636 ef	1.81 a	28.6 a	2.7 cd
Pilgrim	257 a	202 b	327 a-d	345 a	1132 a	1.68 b	13.4 a-d	2.7 cd
Stevens	3 e	48 d	209 d	138 c	398 g	1.35 de	7.9 bcd	2.3 d
NJS98-65	11 de	201 b	335 a-d	196 bc	743 de	1.79 a	11.5 bcd	3.3 bcd
NJS93-13-100	27 cde	172 bc	352 abc	153 bc	704 de	1.55 c	12.4 bcd	4.0 abc
LSD (P=.05)	61	46	112	104	161	0.093	9.9	1.29
Treatment Prob(F)	0.0001	0.0001	0.0088	0.0371	0.0001	0.0001	0.04	0.0020

PEST MANAGEMENT

Biology and Management Control of Blackberry Rust

Kenneth Johnson[1] and Walter Mahafee[1,2]. [1]Dept. of Botany and Plant Pathology, OSU; [2]USDA-ARS Hort. Crops Research Laboratory

The blackberry rust pathogen, *Phragmidium violaceum*, was first observed in Oregon in spring 2005 where it was found on both weedy *Rubus armeniacus* and on commercially cultivated *Rubus laciniatus*, of which several plantings were impacted severely. Surveys in 2005-2006 indicated that *P. violaceum* could be found on *Rubus* spp. below 640 m in elevation and west of the Sierra Nevada and Cascade mountains from Santa Cruz, CA to the Canadian Broader. All five spore stages were observed over the course of the growing season with no asexual perrenation of the pathogen evident in the disease cycle. The only commercial blackberries infected in the field were Evergreen Thornless and Everthornless. In subsequent studies, we observed that teliospore germination and infection by basidiospores occurred mostly during April, and over three years of observation, the relative intensity/success of this phase appeared to greatly influence epidemic severity during the summer. Three years of field experiments with rotational trap plants indicated that basidiospore infection required wetness periods of >16 hour with mean temperatures >8°C, which in April, which was a relatively infrequent event. Growth chamber experiments programmed to a diurnal temperature regime indicated that infection by urediniospores was constrained to a mean temperature range of > 9°C and < 20°C with > 6 h continuous leaf wetness, which under western Oregon conditions coincides with periods of rain, dew or irrigation during mid- to late spring, and late summer to early autumn. Lime sulfur applied as a delayed dormant significantly suppressed basidiospore infection; myclobutanil, a demethylation-inhibitor fungicide, effectively inhibited infection by aeciospores and urediniospores. This information combined with climate data from the last 30 years indicate that severe blackberry rust epidemics will be sporadic and of minor importance in most years.

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

Vaughn Walton, OSU

Short Shoot Syndrome (SSS) is recognized to cause economic losses in vineyards in the Pacific Northwest of the United States. New grower reports of similar symptoms were found in Roseburg (Oregon), Monterey and Sonoma (California) vineyards during 2008. The aim of this research was to investigate the causes of SSS found in vineyards in this region. It was hypothesized that SSS are caused by eriophyid mite feeding on young developing tissues and is supported by research during the past three seasons. In order to minimize symptoms caused by eriophyid mites, winter shoot samples were analyzed on an industry-wide basis during 2007 and this survey was expanded during 2008 and control recommendations were made to growers based on mite incidence. Data from several treated vineyards during 2007 and 2008 show a decrease in mite numbers and damage. It is believed that *C. vitis* outbreaks occur on an industry-wide level in Oregon due to currently used fungicide spray regimes. For this reason, a focused research effort to develop integrated control practices for eriophyid mites, powdery mildew, and conservation biological control of spider mites is essential for sustainable grape production in the Northwest. In order to investigate the impact of often-used pesticides, trials were started in two mite-infested vineyards during 2007 and 2008. Data from 2007 and 2008 shows increased abundance of key biological control agents in blocks which received reduced and no sulfur. Field and laboratory trials are currently in process in order to optimize biological control of this damaging pest.

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

Robert Martin, USDA-ARS, HCRL

Vector transmissions with Black raspberry necrosis virus 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 late season transmission, which correlated with aphid numbers. It appears that black raspberry decline is caused by a virus complex, where Black raspberry necrosis virus is always present but together with at least one of several other viruses.

Two novel viruses have been identified in red raspberry that may contribute to the severity of crumbly fruit symptoms associated with RBDV infection. The transmission of one of the new viruses in red raspberry (an Oryzavirus - still to be named) has been demonstrated with the large raspberry aphid but transmission studies with the second new virus (a Closterovirus, Raspberry mottle virus RMoV) have not been completed. RMoV from a Washington raspberry field has been sequenced and partial sequence from 8 of the 10 RNAs of the Oryzavirus have been obtained. 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. RMoV occurs in Europe as well as North America and may be the causal agent of one of the virus diseases named based on symptoms in Europe. 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. We are collaborating with colleagues at SCRI in Scotland to determine the importance of these viruses in disease development. The second virus appears to have between 8-10 RNAs which is unusual for plant viruses. Tests for both of the new viruses have been incorporated into the virus clean program managed in our laboratory and in 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; 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. Replicated trials were conducted in a 'Nootka' red raspberry field near Lynden, WA to evaluate synthetic chemical and biological nematicides as replacements for Nemacur. In the first trial, only Vydate (oxamyl) and fosthiazate significantly reduced population densities of the root lesion nematode when applied in early spring. Population densities root lesion nematode remained lower ($P < 0.05$) than the non-treated control and all other treatments in 2008, one year after applications were made. Fall applications of Vydate did not reduce nematode populations during the subsequent cropping season. In the second trial, Vydate was applied in the spring as a band application in the plant row and incorporated with irrigation or through a drip irrigation system. The band application was more effective in reducing nematode population densities of the lesion nematodes in the root than the drip applications. Band applications of Vydate in May were the most effective in reducing lesion and dagger nematode population densities in the soil. In both trials, plots treated with Vydate in the spring had lower yields than the non-treated control plots. We conclude that Vydate is phytotoxic to "Nootka" red raspberries. However, applications of Vydate in the spring were not phytotoxic to 'Willamette' or to other raspberry cultivars tested at WSU NWREC. Our research provides efficacy data needed to register Vydate as a replacement for Nemaucr on caneberries in the USA.

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

R. Paul Schreiner, USDA-ARS-HCRL

John Pinkerton, USDA-ARS-HCRL

David Bryla, USDA-ARS-HCRL

The objective of this study is to better understand the impact of the ring nematode, *Mesocriconema xenoplax,* on the productivity and physiology of grapevines grafted onto different rootstocks that showed varying resistance to ring nematodes under greenhouse conditions. Pinot noir grapevines (grafted onto 5 rootstocks or self-rooted) are in their third year of growth in microplots (25 gallon pot-in-pot). Six vines in each rootstock treatment have been infested or not with ring nematodes. Vines were thinned to 8 shoots (4 per fruiting cane) with 2 renewal spurs in late May, and fruit clusters were thinned to 1 per shoot in early August of 2008. All plots were irrigated as needed to maintain soil moisture above 15% volumetric water content. Nematode populations appear to have reached threshold levels in each of the different rootstock treatments (no increase since July 2007), and all have been consistently affected by rootstocks. The highest ring nematode populations were found in the self-rooted vines, while intermediate levels of nematodes occurred in 1103P and 3309C and the lowest levels occurred in 420A, 101-14 and 110R vines. The first signs of nematode impact on the vines were noticed below-ground (as one might expect) in the summer of 2007, with nematodes reducing fine root growth and percent colonization by arbuscular mycorrhizal fungi and increasing soil respiration in self-rooted vines only. However, there were no effects of the nematodes on above-ground plant growth, gas exchange, or water relations in 2007. Nematodes also did not affect vine nutrient status in 2007, although rootstocks did. So far in 2008, shoot length of vines measured in early July mirrored the effect we observed on roots last year, such that nematodes reduced shoot growth in self-rooted vines only. Our first measurement of gas exchange and soil respiration in 2008 have not shown a similar trend with respect to self-rooted vines, but both measures have been higher in nematode infested plots as compared to non-infested plots (main effect across all rootstocks). It will be interesting to see if ring nematodes begin to influence below-ground measures of vine performance of the vines grafted onto 1103P and 3309C roots this year, since these rootstocks are supporting intermediate levels of nematodes.

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

David 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.

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, about 600 leaf samples collected randomly from individual grapevines showing GLD symptoms in fourteen different wine grape cultivars in Washington State vineyards were tested for the presence of grapevine viruses. Together with data from previous years, the test results indicated the presence of six viruses associated with leafroll disease (Grapevine leafroll-associated viruse-1, -2, -3, -4, -5, and -9) and three viruses associated with Rugose wood disease complex (*Grapevine rupestris stem pitting-associated virus* [GRSPaV], *Grapevine Virus A* [GVA] and *Grapevine Virus B* [GVB]). Our results also confirmed for the first time the occurrence of a variant of GLRaV-2, denoted Red Globe variant of GLRaV-2 (GLRaV-2-RG) causing rootstock stem lesions and decline of grafted vines in California, in wine grape cultivars. We have also documented for the first time the occurrence of *Grapevine fanleaf virus* (GFLV), causal agent of grapevine degeneration disease, in two wine grape cultivars in Washington State vineyards. Although the number of samples tested positive for GLRaV-2-RG and GFLV was low, this finding underscores the need for continued monitoring of different vineyards in the PNW region to estimate the extent of the prevalence of these viruses in different wine grape cultivars. All these viruses have been found to occur as either single or mixed infections in individual vines. GLRaV-3 was found to be the most predominant virus and widely distributed in the PNW region.

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

Naidu Rayapati and Ken Eastwell, WSU, Irrigated Agriculture Research 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 were 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 are available as a source of virus for graft inoculations during Spring 2009. The impact of GLRaV-2 and -3 on the fruit composition (with emphasis on phenolics) of *Vitis vinifera* L. cv. Pinot noir was studied using grapes collected from paired plants in growers vineyards in Oregon.

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

Ekaterini Riga, WSU, IAREC, Prosser

Jack Pinkerton and Inga Zasada, USDA-ARS

Markus Keller, WSU-IAREC

The purpose of this project is to evaluate the effect of one root knot and two dagger plant parasitic nematode (*Meloidogyne hapla, Xiphinema pachticum* and *X. americanum*) densities on vine establishment on two grape varieties, Chardonnay and Cabernet Sauvignon; and to develop nematode damage thresholds for the above varieties during the vine establishment period in Washington State and provide growers with knowledge that will lead to appropriate management practices. A field site for this experiment was identified and the site was double fumigated with Telone II in the middle of October 2006. Thirty gallon pots were buried and filled with Telone fumigated soil and each pot was additionally fumigated with Metam Sodium. In spring 2007, one-half of the pots were used for the root knot nematode trial, *Meloidogyne hapla*. Pots were infested with one of three *M. hapla* nematode densities or left as non-infested controls. Rooted cuttings of Chardonnay or Cabernet Sauvignon vines were planted immediately after infesting the soil. *Xiphinema pachticum* (75%) and *X. americanum* (25%) were used to inoculate rooted cuttings of Chardonnay or Cabernet Sauvignon vines in May 2008. All treatments have seven replicates in both root-knot and dagger nematode trials. Soil samples from all pots inoculated with *M. hapla* contained nematodes in both years. The data shows significant difference between the lowest and the other two densities i.e. the moderate and the high of *M. hapla* in the Chardonnay grapes in both years. So far, there was no significant difference between the moderate and the high densities of *M. hapla* in the Chardonnay grapes vines. There was no significant difference between the three densities of *M. hapla* in the Cabernet-Sauvignon vines. However, our nematode data represents only nematodes found in the rhizosphere soil of the grape vines. Root samples were not collected from both grape varieties as the vines are still very young – *M. hapla* is an endoparasite (it lives inside the roots and only eggs and juveniles are deposited outside the root). Soil from the control pots did not have any plant parasitic nematodes. The data from *Xiphinema* spp. is inconclusive as the vines were inoculated with dagger nematodes in May 2008 and the dagger requires at least 7 to 10 months to complete its life cycle. Data from vines inoculated with dagger will be collected over the next three years.

PRODUCTION / PHYSIOLOGY

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

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

[1]Department o Horticulture, Cornell University

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Many 'Concord' vineyards in central Washington are plagued by a leaf chlorosis problem that occurs around bloom. It significantly reduces vine size, vine uniformity and productivity, and even causes vine death. The yellowing of the leaves resembles classic iron (Fe) deficiency-induced chlorosis. However, total tissue iron level remains the same or even higher compared with normal leaves. The objectives of this project were to determine the physiological mechanism of leaf chlorosis, to devise physiologically relevant analysis to diagnose the problem, and to develop practical measures growers can use to overcome the problem in WA vineyards. During the last three years, 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) carried out controlled pH experiments to determine the effect of pH on leaf photosynthesis, carbon metabolism, and chlorosis of Concord vines, and also used soil pH in combination with ferric oxide addition to explore the mechanism of chlorosis paradox; 3) conducted an experiment on potted vines at a high soil pH first, then set up a field trial in central WA to determine the effectiveness of FeEDDHA application in alleviating Fe-deficiency-induced leaf chlorosis; 4) compared the tolerance of different rootstocks to lime-induced leaf chlorosis; and 5) tried different ways of extracting and measuring leaf active Fe for diagnosis of Fe-deficiency. Our results clearly show that 1) chlorotic leaves from WA vineyards have significantly lower active Fe compared with green leaves whereas total leaf Fe was the same or even higher; 2) high soil pH induces leaf chlorosis in Concord vines; 3) roots of Concord vines are able to upregulate ferric chelate reductase activity to compensate for the decreased Fe availability at high soil pH whereas leaf ferric chelate reductase activity is decreased by high soil pH. Although the increased root ferric chelate reductase activity helps maintain Fe assimilation at high soil pH, it appears that the form of Fe transported from roots to leaves cannot be utilized by leaves; 4) FeEDDHA is very effective in alleviating leaf chlorosis induced by high soil pH in potted Concord vines; 6) Field trial in central WA indicate that FeEDDHA application has significantly decreased the degree of leaf chlorosis, but clearly further testing is needed on the optimal rate and timing of FeEDDHA application; and 7) vines grafted onto 3009, 5C and 110R had better growth, higher photosynthesis and less chlorosis than the own-rooted vines at high soil pH (7.6). In addition, 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.

Nutrient Accumulation and Partitioning in Mature Blueberry Plants

Bernadine Strik, Horticulture, OSU

M. Pilar Bañados, Catholic Univ., Chile

Tim Righetti, Professor of Horticulture, OSU

The objectives of this study were to: determine the concentration of nutrients (N, P, K, Mg, Ca, S, B, Mn, Zn, Cu, Fe) in blueberry plant parts (roots, crown, 1-, 2-, and 3-year old wood and leaves) throughout the growing season and winter over two years; assess seasonal and yearly changes in plant part dry weight and nutrient concentrations to

determine total nutrient uptake and partitioning; calculate daily nutrient uptake of blueberry to determine peak demand amount and time; and determine the impact of nitrogen fertilization on the uptake and partitioning of other plant nutrients.

A two-year project monitoring blueberry plant growth, influence of nitrogen rate on growth, and uptake and flow of nitrogen was done in mature 'Bluecrop' in Oregon by Bañados (2006; Ph.D thesis). We thus have data on the changes in dry weight of roots, crown, 1-, 2-, and 3-year and older wood, shoots, leaves, flowers, and fruit over two seasons. In this study we are analyzing the tissue samples collected from this project to determine the concentration of other nutrients (Phosphorus, Potassium, Magnesium, Sulfur, Calcium, Boron, Copper, Manganese, Iron, and Zinc). Using the dry weight data already collected, we will calculate nutrient uptake over two seasons. We will also calculate changes in whole plant nutrient levels and in plant parts to show partitioning of each nutrient through the two seasons. We submitted ~ 1200 samples in late winter, have received the data, but have not yet completed the analyses.

Weed and Fertility Management of a Newly Established Organic Blueberry Field

Bernadine Strik and Handell Larco, Dept. Horticulture, OSU

Gil Buller, NWREC/OSU; Dan Sullivan, Crop and Soil Science, OSU; Dave Bryla, USDA-ARS; Wei Yang, NWREC, OSU; and Oregon and Washington organic growers

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

Plants were established in October, 2006 in a transitional plot at the NWREC. The plot is one acre in size. The planting was certified organic (Oregon Tilth) in May, 2008.

The treatments are as follows, arranged in a split-split plot design:

A) Planting method: Raised and flat

B) Cultivar: 'Duke'and 'Liberty'

C) Weed management: 1) sawdust mulch + hand weeding; 2) compost (1-2" deep) + 1" sawdust mulch + vinegar (20%); and 3) weed mat 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).

The pH of the compost would be considered high for blueberry (7.3) compared to pH 4.2 for sawdust. There was not a lot of weed pressure in any treatment in 2007. Weed mat plots had the fewest weeds whereas compost mulched plots had the most. Vinegar, applied every 3 weeks during the warmer months worked well. There was a lower percentage of soil moisture in raised bed and weed mat plots; these thus required more irrigation. Soil temperature was 1 to 5C warmer in weed mat plots than in sawdust plots, especially in raised beds.

In late June, 2007, plants fertilized with feather meal looked very stressed (leaf N was 1.1 to 1.5% compared to 2.3 to 2.8% in plants fertilized with fish emulsion). An additional two applications of 3.5 lb N/a each of fish to the feather meal plots improved plant performance.

There was no effect of raised vs. flat bed production on total plant weight in Oct. 2007. Plants fertilized with 25 lb N/a of fish were larger than all other fertilizer treatments and had the largest crown and roots. Plants fertilized with 25 or 50 lb N/a feather meal (+ 7 lb N/a fish) were the same weight and were smaller than those fertilized with 25 and 50 lb N/a fish. Plants grown on weed mat were larger than those on sawdust mulch. 'Liberty' had a greater total plant weight than 'Duke', due mainly to a larger top growth, as roots were the same.

Plants were pruned to produce fruit in 2008, based on plant size. We had relatively poor fruit set, limiting yield. Data collected in 2008 on shoot growth, yield, berry size, tissue and soil nutrient content, LAI, plant dry weight, and economic factors are still being analyzed.

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

Bernadine Strik and Gil Buller, Dept. of Horticulture and NWREC, OSU

The objectives of this study were to determine the impact of primocane re-cutting date ("suppression" date) on yield, quality, and hardiness of 'Marion' blackberry planted at different in-row spacings. This study was 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 follow-up study, our treatments were: 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. Based on lowest recorded canopy temperature and subsequent bud break data, we observed cold injury in 2 of the 4 years of this study. Although the AY plots had a significantly higher yield per unit area in this study, particularly in years preceded by winter cold injury, growers with AY will have half their acreage fruiting in any given year. Thus, for a fair, economic comparison, we must compare treatments for cumulative yield (over the 4 years of this study) and use half the area per year for the AY plots. When we calculated cumulative yield (kg/20' plot for EY plots per year compared to kg/10' plot for AY treatments per year), the 5' EY, February-trained treatment still had the highest cumulative yield of 15.6 tons/acre. The AY treatments had a cumulative yield of 9 to 12 tons/acre. Average yield (for the 4 years) was 3.9 tons/acre in the 5' EY and 5.2 tons/acre (in the "on year") for the 5'AY. The percentage of yield achieved by AY production, compared to the 5' EY system, ranged from 58% (3' AY) to 74% (2' AY topped). The 5' AY system yielded 66% of the 5' EY in this study. The AY production systems may reduce fruit size (whether this is significant will depend on the processors).

Primocane-Fruiting Blackberry Production Systems for Season Extension

Bernadine Strik[1], Ellen Thompson[2], Chad Finn[3], Yanyun Zhao[4], and John Clark[5]

[1,2]Dept. Horticulture, OSU; [3]USDA-ARS, HCRL; [4]Dept. Food Science & Tech., OSU; [5]Dept. Horticulture, University of Arkansas

Primocane-fruiting blackberries may offer opportunities for season extension and off-season fruit production, particularly in mild climates like the Pacific Northwest using protected cultivation. In May 2005, 'Prime-Jan' was established at the North Willamette Research and Extension Center. Half of the planting was established under a high tunnel and the remainder planted in an adjacent open field. In 2006-07, primocanes were subjected to four pruning treatments to promote branching and/or delay harvest: 1) re-cut primocanes to just about the crown once reaching 0.25 m (~ 10 inches), then soft-tip the subsequent canes at 0.5 m (19.5 inches); 2) re-cut primocanes at 0.5 m, then soft-tip at 0.5 m; 3) double-tip canes (soft-tip main cane at 0.5 m, then soft-tip branches at 0.5 m); and 4) soft-tip main cane at 0.5 m (control). Plastic was placed on the top of the tunnel only on 5 Sept. 2006 and 31 Aug. 2007, about 1 to 2 wk before harvest, to protect fruit from inclement weather. Fruit harvest began on 12 Sept. in the open field and tunnel, but lasted about 3 weeks longer in the tunnel, ending on 16 Nov. Primocanes that were double-tipped had nearly twice the flowers and fruit than canes that were soft-tipped only once. In the tunnel, cumulative yield of double-tipped primocanes averaged 10.7 t/ha (4.8 tons/acre) in 2006 and 19.3 t/ha (8.6 tons/acre) in 2007. On average, cumulative yield for double-tipped primocanes was 47% less in the open field than in the tunnel. Harvest was not delayed in canes that were re-cut at 0.25 m in 2006, compared with the control and the double-tipped treatment; however, harvest was delayed by 2 weeks in 2007 in this treatment. In contrast, harvest was delayed by about 4 weeks when primocanes were re-cut at 0.5 m. Primocanes that were double-tipped produced heavier fruit (7.5 g) than other pruning treatments – 33% heavier than the control, on average. Double-tipped primocanes did not have more ovules per flower, but had significantly more

drupelets set compared to the control. In addition, plants growing under the tunnel tended to produce heavier fruit (32%, on average) than those grown in the open field. Harvest date affected fruit pH, total anthocyanins (TACY), and total soluble solids (TSS) in 2006, but not in 2007. Fruit pH and TACY were highest in the early season and TSS was lowest in late-season fruit. Although fruit under the tunnel was protected from rain, TSS, pH, TACY, and total phenolics began to decline in late October in both years, likely due to cool night temperatures and low light conditions. The pruning systems used here increased yield and offered options for season extension.

Using Grafted Blueberries to Improve Mechanical Harvesting for Fresh Market Quality Berries

Wei Yang and Nonnie Bautista, OSU, North Willamette Research and Extension Center

A ¼ acre blueberry rootstock plot was established at the North Willamette Research and Extension Center (NWREC) in late 2005 to evaluate three rootstock selections. These three rootstocks (NC2845, NC8232, and NC8248) were from *Vaccinium elliottii* selections from Dr. James Ballington's breeding program. In 2006 and 2007, the growth of three rootstock selections indicated no differences in stem diameter. 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. Grafting of three blueberry cultivars (Duke, Bluecrop, and Elliott) onto these rootstocks in 2008 indicate Elliott appeared to be less compatible than Duke and Bluecrop. Propagation experiment found that all three rootstock selections are relatively easy to propagate for commercial production with over 90% rooting rate.

Correcting Iron Deficiency in Blueberries

Wei Yang, Nonnie Bautista, and Eduardo Chavez, OSU, North Willamette Research and Extension Center

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 in 2007. 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. In our pot study started in late spring 2008, we are adjusting growing media pH to the experimental range for the application of FeEDDHA.

Irrigation Management Practices for Improving Growth and Production of Blueberry

David Bryla, USDA-ARS Horticultural Crops Research Unit

Bernadine Strik, Department of Horticulture, OSU

Most commercial highbush blueberry fields in the U.S. are irrigated by overhead sprinklers or drip. In this study, we compared the water requirements for growing blueberry with overhead sprinklers and drip and determined which method produced the most growth after planting and the highest yields and best fruit quality once the plants matured. We also examined the possibility of using microspray (a.k.a. micro-jet or micro-sprinkler) irrigation. Although microsprays are not commonly used for blueberry, a study in Chile found that fruit production was higher with microsprays than with drip. We found that drip irrigation produced more plant growth and higher yield with much less water than either sprinklers or microsprays, but the highest yield overall was obtained when high amounts of water was applied by microsprays. Sprinkler irrigation, on the other hand, often resulted in lower yield and smaller fruit regardless of the amount of water applied, but this method along with under irrigation by the other two methods tended to delay harvest and produce firmer fruit better suited to storage and shipping.

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

Krista Shellie, USDA-ARS

Michael Glenn, USDA-ARS

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 and canopy density and to enhance berry composition for wine production. Reduced shoot growth increases the amount of light transmitted into the canopy, which can be beneficial for sustained productivity and high fruit quality, but increases the risk of fruit exposure to potentially damaging solar radiation and temperature. The objective of this research was to evaluate whether a foliar application of a commercially available particle film could reduce the risk of fruit injury when vines are under water stress. Field trial plots were established in 2006 at two sites in southwestern Idaho with well-watered or deficit-irrigated vines that were either sprayed or not sprayed with particle film. Midday leaf water potential, diurnal leaf gas exchange, yield components and harvest berry maturity were evaluated. Results to date show that particle film increased daily net leaf gas exchange but the increase varied according to vine water status. Particle film delayed the onset of the diurnal decline in stomatal conductance when vines were under mild water stress (leaf water potential ~ -1.2 MPa), but had no influence on leaf gas exchange under higher levels of water stress. Midday leaf water potential throughout the growing season was not influenced by particle film. Fruit surface browning was observed on deficit irrigated, particle film treated vines on exposed clusters on the west side of the canopy, indicating that the film did not eliminate development of stress symptoms on fruit under the most extreme environmental conditions evaluated in this study. Vines with particle film had a greater correlation between berry soluble solids and titratable acidity (Viognier) and between berry fresh weight and yield (Merlot) than vines without particle film, suggesting that the film attenuated the influence of environmental factors on these traits.

Changes in Grape Berry Size Due to Late-Season Irrigation

Markus Keller, WSU

Bhaskar Bondada, WSU

Many winemakers believe that rainfall or irrigation close to harvest may increase grape berry size and 'dilute' fruit quality or even crack berries. Wineries often encourage growers to withhold irrigation water at this 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 determined the influence of soil moisture on changes in berry volume by drying down and rewatering potted Merlot and Concord. In addition, we simulated massive overirrigation by pressurizing the root system of pot-grown vines. We also used a chemical dye to trace water movement in the vines' xylem (water conduits), immersed berries in water to test if water could be absorbed through the skin, and selectively eliminated either phloem or xylem flow through the peduncle. We found that pre-veraison berries shrank under water stress but began to recover as soon as the berries changed color. Applying irrigation water at this time led to a rapid increase in photosynthesis, which was associated with accelerated recovery of berry volume. Post-veraison berries responded much less to soil moisture changes; irrigating after veraison merely prevented berry shrinkage. Post-veraison Concord, but not Merlot, berries cracked when root pressure was applied. We found 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 showed that water could be absorbed through the berry skin. Eliminating phloem flow stopped ripening, but eliminating xylem flow had no effect. 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. 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; James Osborne, OSU; Jeff Rowe, OSU

Winemakers modify the amounts and quality of tannins in red wines by controlling extraction, 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. Our working hypothesis is that aging red wine on the yeast lees results in an improvement in texture by reducing astringency due to formation of complexes between grape tannins and yeast-derived mannoproteins extracted into wine during aging.

A sensitive assay for quantifying yeast mannoproteins in both red and white wines was developed able to detect as little as 10 ng of protein-associated mannan. Yeast protein extraction over 9 months of aging model wines on the yeast lees was monitored. Total protein and mannoprotein concentrations were quantified and individual proteins were identified following completion of fermentations by 7 commercial wine yeast strains. For most strains, protein and mannoprotein concentrations increased during, but decreased by the end of fermentation. Both protein and mannoprotein concentrations were found to increase again post-fermentation. The number of identified proteins in all samples increased to about 75 after one month on the yeast lees, but decreased to about 20 after 6 months on the lees. Over 50% of the identified proteins were shared among all 7 yeast strains. Mannoproteins were the predominant yeast proteins identified after 6 months on the lees. In contrast, most other yeast proteins detected during and soon after fermentation were not detected after 6 months, indicating poor stability in wine. In order to assess potential interaction of mannoproteins with tannin, a typical yeast mannoprotein, invertase, was assayed for binding to tannin relative to a non-mannoprotein, BSA. BSA had about a 10-fold greater binding affinity for tannin than invertase, suggesting that tannin-mannoprotein complexes may be stabilized by relatively weak forces.

Understanding Micro-Oxygenation Technique and the Oxidation of Grape/Wine Polyphenolics: Year 2

Jungmin Lee, USDA-ARS-HCRU

Julie Tarara, USDA-ARS-HCRU

James Kennedy, OSU

Wine phenolics (tannins, anthocyanins, etc) are crucial factors of red wine quality that can be altered by grape growing and winemaking practices. Tannins (proanthocyanidins) play important roles in red wine by stabilizing color and enhancing mouthfeel, which impart qualities to a premium wine. By studying the changes that purified compounds undergo in a controlled system (i.e. model wine system, gas doses, etc), it is easier to identify and monitor their changes that occur in wine. We are continuing in the second year to better understand tannin evolution in wine by developing and modifying analytical techniques, and applying these techniques to wines produced by our industry cooperators. Progress has been sluggish due to changes in personnel, but the study will be completed in the next few years.

Impact of Specific Amino Acids and Pantothenic Acid on Yeast Metabolism and H_2S Formation

C.G. Edwards, Dept. of Food Science and Human Nutrition, WSU

J.C. Bohlscheid, C. Ross, and J.Q. Sturgeon

Sluggish/stuck alcoholic fermentations and the undesirable formation of H_2S continues to cause problems for winemakers. Rather than relying on addition of diammonium phosphate to increase the amount of nitrogen available to yeast, an alternative approach relying on use of specific amino acids will be explored. The research will focus on the impact of aspartic acid and glutamine towards improving fermentation rate and decreasing H_2S evolution. In addition, metabolic interactions of these amino acids with a vitamin known to affect H_2S (pantothenic acid) as well as timing of nutrient additions will be studied. Procedures to prepare purified yeast inoculums (*Saccharomyces cerevisiae* EC1118 and UCD522) have been developed while the graduate student became experienced with H_2S analysis (Wang et al. 2003). In short, H_2S evolved during fermentation was measured by fermentation gasses passing through $Cd(OH)_2$ trapping solutions. Through literature review and discussions with cooperators, the concentration of aspartic acid, glutamine and diammonium phosphate required to prepare the synthetic media at various YAN levels have been established.

Rootstock and Scion Influences on Grape and Wine Composition and Quality

James Harbertson, WSU, Irrigated Agriculture Research & Extension Center

Markus Keller, WSU, Prosser

Although phylloxera is not an immediate threat to vineyards in Eastern Washington it still remains the most significant threat to vines in the world. No chemical or biological means of controlling the pest exist. Resistant rootstocks have been grafted to achieve not only resistance to phylloxera, but also nematodes. Unfortunately it is not clear if grafted vines under Eastern Washington soil and climatic conditions will have similar fruit composition as own rooted vines. Information on grafted vine performance will be important should the situation arise that grafting is necessary. The objective of this project was to determine the effects of rootstock and scion combinations on fruit ripening and composition at harvest. A field experiment was conducted with three wine grape varieties (Merlot, Syrah, Chardonnay) that were either grown on their own roots or grafted to five different rootstocks (1103-P, 5C, 3309, MGT 101-14, or Ru-140). The crop yield data showed that own-rooted Chardonnay tended to have greater yields than grafted vines, while no clear differences were observed for Merlot. Own-rooted Syrah had the lowest yields and 3309-Syrah grafts were the highest. For Chardonnay and Merlot the rootstocks did not influence sugar and color accumulation, nor the rate of acid decline. As a contrast own-rooted Syrah ripened fastest, and Syrah-140-2 had significantly lower color. Own-rooted Chardonnay and Merlot consistently had the highest pH during ripening. For the finished wines own-rooted Chardonnay had the highest pH and lowest titratable acidity. For the most part Merlot wines showed no differences except that 1103P and 140R which had the greatest titratable acidity. Own-rooted Syrah had the highest pH and second highest titratable acidity while Syrah grafted to 3309 had the lowest pH and highest titratable acidity. In contrast to last year all of the rootstock scion combinations were high in proline and low in arginine. Only Syrah had significant amounts of arginine and had relatively lower amounts of proline than the other two varieties. The wines were made under modest conditions (25 gallon garbage cans) and moderate success was gained throughout the process. Within a variety there were no observed differences in the alcohol concentration for any of the wines produced. All of the red wines were evaluated for their tannins, anthocyanins, and total iron reactive phenolics content at pressing. The results show that for Merlot there are no significant differences between any of the phenolic components. For Syrah there were no significant differences for the tannins and total phenolics, however some small detectable differences were seen with anthocyanins. The rootstocks 101-14, 1103 P, and 5C had significantly greater anthocyanins than the other rootstocks and own rooted vines.

SMALL FRUIT INITIATIVE

USDA-ARS/OSU Small Fruit Breeding Program for the Pacific Northwest at OSU - Plant Improvement

Bernadine Strik and Chad 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 genotype's performance and ultimately develop recommendations for commercial cultivation. Genotypes that perform well are moved into commercial trials. In 2008, 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; 15 plantings with over 1700 individual plots! The new blackberry cultivars, especially 'Black Diamond', 'Black Pearl', and 'Metolius', are being widely commercially planted. 'Wild Treasure' (ORUS 1843-3) blackberry will be written up shortly and ORUS 1523-4 will hopefully be the trial balloon for the USDA-ARS's venture into intellectual property rights. 'Valley Red' (ORUS 1790-1) is being written up for release. Within each crop, several selections are being propagated for grower trials.

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 2005-2008. In 'Obsidian' and 'Siskiyou, yield at the higher planting density, 30" in the row, has been about 10 to 20% higher – an economic analysis is needed to see if this would be economical. 'Siskiyou' has been less cold hardy than 'Obsidian', yielding significantly less in 2 of the 4 years, particularly in EY systems. Thus AY production has led to a more consistent yield in 'Siskiyou'. In both cultivars, berry size was reduced in AY plots compared to EY plots.

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.

Quality Evaluation of Berry Selections and Varieties

Brian Yorgey, Food Science & Technology, OSU

Yanyun Zhao, Food Science & Technology, OSU

In cooperation with Chad Finn and the USDA-ARS/OSU 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 2007/08 season the following numbers of samples were processed and analyzed:

- strawberries – 12 cultivars and 43 selections
- red raspberries – 10 cultivars and 26 selections
- black raspberries – 6 selection
- blackberries – 15 cultivars and 82 selections
- blueberries – 14 cultivars and 24 selections

Processed fruit was displayed for evaluation on nine occasions during the past year:

- Breeders and researchers evaluation at OSU
- 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

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
Industry blackberry blind evaluation Day at the OSU North Willamette Research and Extension Center

Small Fruit Breeding for the Pacific Northwest at WSU, Puyallup

Patrick Moore, WSU, Puyallup

Wendy Hoashi-Erhardt, WSU, Horticulture Fruit

Objectives**:**

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

2) To develop new strawberry cultivars adapted to the PNW that have higher picking efficiency than current industry standards. Additional traits to incorporate 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 2008, a planting was established with 100 plots including 81 WSU selections. This planting will be machine harvested in 2010 and 2011. In the past seven years, 551 different raspberries have been planted in machine harvesting evaluation plantings, including 370 WSU selections. One WSU selection that has been evaluated in this manner was distributed to commercial propagators in 2007 for increase for grower trials.

The machine harvesting plantings established in 2005 and 2006 were machine harvested in 2008. There were nine newly evaluated selections in the 2006 planting that appeared particularly promising. 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.

One hundred five selections were made among the 19,300 raspberry seedlings evaluated at WSU Puyallup in 2008. Several of the selections in the 2006 seedling field appeared very promising and will be evaluated on an accelerated schedule.

Strawberry crosses have used parents chosen for large fruit size, firm fruit and productivity. Forty-nine selections were made in 2008 among the seedlings planted in 2007. These selections will be propagated for planting in yield plots. The 2006 planting had several very productive selections with extremely large fruit. Plants of a promising selection in this planting will be multiplied by a commercial propagator for planting by growers in 2010. A limited number of tissue culture propagated plants of this selection will be available for trial spring 2009.

2007-2008
NCSFR Research Priorities

Grape (Table, Wine & Juice) Viticulture Research Priorities 2007-2008

1) A) Evaluation of scions, rootstocks for cold hardiness, vigor, water requirements, effect of edaphic factors, nutritional status, yield parameters, and grape quality attributes. Soil, biological and chemical below ground environment.

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) Organic production

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

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

C) Evaluation of new and lesser known winegrape varieties and clones

3) A) Phylloxera

B) Biodynamic production

NORTHWEST CENTER FOR SMALL FRUITS RESEARCH

Wine Processing Research Priorities 2007-2008

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.

I. Micro nut status

Managing fermentations to optimize wine quality

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

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 2007-2008

1) Birds and other vertebrate control

Plant breeding/varietal evaluation, including but not limited to
-extend/shift harvest windows
-suitability for mechanized harvesting
-cold hardiness
-fruit quality
-disease resistance

Pollination issues

Organic production systems (including both horticultural and pest management issues)

Improve or extend fresh market through controlled atmosphere storage and packaging, mechanized harvesting, physical covers or chemicals, post harvest handling and cultural inputs

2) Fertility management in organic and conventional systems

Improved irrigation management/irrigation guidelines

Management of viruses

Frost protection

Biology management of gall midge, root rot, winter moth and pseudomonas

3) Plant architecture and training systems

Root Weevils

Genotyping

Food Safety

Methods to reduce cost of labor

NORTHWEST CENTER FOR SMALL FRUITS RESEARCH

Cranberry Research Priorities 2007-2008

1) Fresh fruit keeping quality

Weeds

Soil borne pests (cranberry girdler and root weevil)

Organophosphate alternatives

Renovation and new planting systems (H2O use efficiency)

2) Irrigation for frost and heat protection and pesticide delivery

Effect of harvest date on fruit physiology and quality

Pollination/fruit set

Tipworm

New cultivar development

3) Nutrient and fertilizer management

Dieback

“Monkey face” – physiologic disorder?

Market expansion through nutraceuticals/health

Sanding alternatives including sand use in new plantings

NORTHWEST CENTER FOR SMALL FRUITS RESEARCH

Strawberry Research Priorities 2007-2008

1) Explore alternative production models (e.g. tunnels, day neutral varieties, plasticulture, irrigation management)

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

Biology and control of insects and anthropods, (e.g. root weevil, aphids, mites, lygus, symphylans)

Biology and control of diseases, (e.g. powdery mildew, fruit rots, root rots, viruses, etc.)

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

Weeds

Food safety/sanitation/security

Value added products

3) Robotics

Irrigation Management

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Blackberry Research Priorities 2007-2008

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

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

Development of genetic marker technology for varietal identification

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

Fruit composition and nutraceutical properties

Water and nutrient management

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

Primocane management/systems approach

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

Thorn management and reduction systems

Raspberry Bushy Dwarf Virus in blackberries

Redberry mite control

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Red/Black Raspberry Research Priorities 2007-2008

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

Management of viruses and crumbly fruit

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

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

2) Product and production certification systems – food safety and security, standards, traceability
Labor saving cultural practices, mechanical pruning and tying techniques

Weed control

Nutrient/irrigation management

Optimal soil fumigation techniques

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

Nutraceutical/nutritional benefits for product development

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New Specialty Crops Research Priorities 2007-2008

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

Note: Priorities ranked "1" (five of them) apply to all new 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 and/or improve a production system (how do we grow these crops?)

New product development/marketing

Nutraceuticals

2) Foliar disease Ribes

Fresh market storage

Investigation of mycorrhizal associations in Huckleberry

Pollination/fruit set

Frost Protection of Hardy Kiwifruit

3) Quality of new fruit crops

Currant fruit fly (also called gooseberry maggot)

Nutrition of new crops(fertilization)

Phytophthora in Hardy Kiwifruit