

Project/Activity Number: NCCC 212 (North Central Coordinating Committee)

Project/Activity Title: Small Fruits and Viticulture Research

Period Covered: 10/28/14 through 10/21/15

Date of This Report: 12/15/2015

Annual Meeting Date(s): 10/19/2015 to 10/21/2015

Participants: (4,000 characters max)

Last Name, First Name (Email Address) Organization'

Ashrafi, Hamid, (hamidashrafi@ncsu.edu), NCSU; Baird, William (Vance) (bairdw@msu.edu) - Michigan State Univ.; Bassil, Nahla (nahla.bassil@ars.usda.gov) - USDA-ARS-NCGR; Coneva, Elina (edc0001@auburn.edu) - Auburn Univ.; Dossett, Michael (Michael.Dossett@agr.gc.ca) - Agriculture and Agri-Food Canada; East, William, (eastwill@aces.edu), ACES; Ernst, Taunya, (Ernst@uark.edu): Univ. of Arkansas; Fernandez, Gina (gina_fernandez@ncsu.edu) - NCSU; Finn, Chad (finnc@onid.oregonstate.edu) - USDA-ARS, HCRU; Gray, Gary, (graygar@auburn.edu), ACES; Hanson, Eric (hansone@msu.edu) - Michigan State Univ.; Hatterman-Valenti, Harlene (h.hatterman.valenti@ndsu.edu) - North Dakota State Univ.; Moore, Patrick (moorepp@wsu.edu) - Washington State Univ.; Rogers, Mary, (roge0168@umn.edu) Univ. of Minnesota; Samtani, Jayesh (jsamtani@vt.edu) - Virginia Polytechnic Institute and State Univ.; Stringer, Stephen, (stephen.stringer@ars.usda.gov), USDA-ARS, Poplarville, MS; Strik, Bernadine (bernadine.strik@oregonstate.edu) - Oregon State Univ.; Vinson, Edgar, (vinsoed@auburn.edu); Weber, Courtney (caw34@cornell.edu) - Cornell Univ.

Brief summary of minutes of annual meeting: (12,000 characters max)

Minutes of the NCCC212 Business meeting chaired by Elina Coneva, Tuesday, October 20, 2015

Old business

Minutes of the previous meeting were provided (October 27, 2014, Corvallis, OR)

Discussion: Two minor changes suggested

Move to approve: Chad Finn

Seconded: Nahla Bassil

Vote = unanimous

Future meetings:

2016 meeting will be held in Virginia Beach.

Chad Finn suggested that holding the meeting in last week of October would be great.

Chad suggested leaving a day and half for reports at least.

Small Fruit Germplasm CGC needs about 2 to 3 hours. It can fit in somewhere after the meeting too. Topic could be anything for e.g. genomics from campus; new tools available.

2017 meeting: Chad and Bernadine suggested emailing Andrew Jamieson to see if he would be interested and willing to host 2017 meeting and potentially co-chairing with David Percival, Charlie Fornie, Jayesh will be contacting them.

Kathy Demchak agreed that she would be willing to host meeting in 2017, if need be. Message conveyed through Eric Hanson.

Another back-up location would be Mary Rogers hosting in Minnesota.

Post 2015-2016:

Past Chair: Elina Coneva

Current Chair: Jayesh Samtani

Vice Chair (next year's host);

Secretary (host- 2 years out).

Discussion

(This section is summarized and written by Dr. William Baird)

Trends in Small Fruit/Berry professional positions: there is a concern that in 5 to 10 years, the landscape of land grant university faculty (and industry) positions responsible for small fruit physiology and breeding will be significantly different than today. This is despite the current size/value of these crops nationally, as well as on an individual state basis (for grower profitability), and their know and potential importance in human health. Breeding seems to be a bit better represented than physiologists and production/management positions. Even then, when a breeding position is replaced, they are tending to go toward genomicists and molecular geneticists — as well as private industry (principally CA and FL?) being a more attractive career path than academics (e.g., salary and focused efforts). In addition, it was pointed out the need for continuity in a breeding program, which will be continued, when it comes time for a changing of the guard — such that overlap or “bridging” between current/outgoing breeder and her/his replacement for a year or more (e.g., Univ. of Arkansas and Michigan State).

Other positions (e.g., whole plant physiologist, cultivation/management/production, etc.) are tending to be replaced by consolidation of the small-fruit responsibilities with another fruit/commodity — for example tree fruits, grapes, vegetables and ornamentals. This typically results in a dilution of the efforts in small fruits to near abandonment. And of course, there are

positions that are simply closed/redirected entirely to other needs. Finally, the above trends are having, and will continue to have, a negative impact on the development (mentoring/education) of the next generation of small fruit experts (and as mentioned above, a significant number of those that are being graduated may end up in industry — US and internationally). It was suggested that a potential method to stabilize small fruit positions at Land Grant universities, is to partner with the industry to partially to fully support salary/operation funds (e.g., endowments). If this is going to be an option, one needs to be forward thinking/proactive as it will likely take time to cultivate and coordinate.

B) Publications to include in state reports: it is suggested to include only articles/abstracts that are “archived” — meaning that when someone reads the NCCC-212 annual/termination report(s) they can find that information in published research/professional/trade journals, conference proceedings or websites that can be retrieved in hard-copy or digital/electronic format.

C) Membership Renewal: given that this is the final year of the existing NCCC-212 project (5-year increments), and that it is being “renewed” (courtesy of Dr. Covenia and the Executive Committee’s efforts), it will be necessary for all current members to request continuing their assignment to this Coordinating Committee (via your NIMSS administrator). Also, look at the three objectives:

1. Develop small fruit germplasm through cooperative breeding and evaluation programs
2. Develop practices for small fruit production tailored for climatic and market needs of growers
3. Explore the association between fruit constituents and human health impacts

and be prepared to communicate to your local NIMSS administrator as to which of these your efforts will be directed (e.g., one, two or all three). You should (if you have not already) receive an email from NIMSS central requesting that you communicate your intent to continue an official/formal association with the renewing project.

Adjourn meeting: Elina Coneva.

Move to adjourn the business meeting: Bernadine Strik

Seconded: Elina Coneva

Vote = unanimous

Accomplishments: (28,808 characters w/o spaces, 33,505 w/spaces; 30k max)

Objective 1 - Develop improved small fruit germplasm through cooperative breeding and evaluation programs.

Blackberry and Raspberry:

Characterization and manipulation of fruit susceptibility to *Drosophila suzukii*. Jana C. Lee, Daniel T. Dalton, Katharine A. Swoboda-Bhattarai, Denny J. Bruck, Hannah J. Burrack, Bernadine C. Strik, J. Megan Woltz, Vaughn M. Walton

Invasion biology of Spotted Wing *Drosophila* (*Drosophila suzukii*): a global perspective and future priorities. Asplen M. K., G. Anfora, A. Biondi, D. Choi, D. Chu, K. M. Daane, P. Gibert, A. P. Gutierrez, K. A. Hoelmer, W. D. Hutchison, R. Isaacs, Z-L. Jiang, Z. Kárpáti, M. T. Kimura, M. Pascual, C. R. Philips, C. Plantamp, L. Ponti, G. Véték, H. Vogt, V. M. Walton, Y. Yu, L. Zappalà, N. Desneux

Host stage preference, efficacy and fecundity of parasitoids attacking *Drosophila suzukii* in newly invaded areas. Biological control. M. Valerio Rossi Stacconi, M. Buffington, K. M. Daane, D. T. Dalton, A. Grassi, G. Kaçar, B. Miller, J. C. Miller, N. Baser, C. Ioriatti, V. M. Walton, N. Wiman, X. Wang, G. Anfora

Using comparative genomics to develop a molecular diagnostic for the identification of an emerging pest *Drosophila suzukii*. Murphy K.A., T. R. Unruh, L. M. Zhou, F. G. Zalom, P. W. Shearer, E. H. Beers, V. M. Walton, B. Miller, J. C. Chiu

Distribution and activity of *Drosophila suzukii* in cultivated raspberry and surrounding vegetation. Klick J., W. Yang, V. M. Walton, D. T. Dalton, J. R. Hagler, A. J. Dreves, J. C. Lee, and D. J. Bruck

Resident field-sampled parasitoids associated with *Drosophila suzukii* and their seasonal occurrence in two small fruit production regions. Betsey Miller, Gianfranco Anfora, Matt Buffington, Kent M. Daane, Daniel T. Dalton, Kim M. Hoelmer, M. Valerio Rossi Stacconi, Alberto Grassi, Claudio Ioriatti, Augusto Loni, Jeffrey C. Miller, M' bark quantar, Xingeng Wang, Nik G. Wiman, Vaughn M. Walton

Do targeted calcium applications to fruit increase fruit firmness and shelf-life in fresh market berries? Bernadine Strik, Amanda Vance, and Patrick Jones

Columbia Giant' released and patent application filed. Finn, Strik

Collaborative testing of blackberries identified outstanding florican performers. Finn, Strik, Clark, Fernandez

Collaborative testing of primocane fruiting blackberries. Finn, Strik, Clark.
Grower collaborates on cold hardiness evolution in blackberry. Finn

ORUS 4090-1 is primocane fruiting red raspberry that is being named and patent filed. Finn, Strik

'Lewis' red raspberry is in grower trial. Finn, Strik

Evaluation of Root Rot resistance at WSU. Finn, Moore

Ongoing collaborative trials for testing red raspberry genotypes from Wash. St. Univ., Cornell University and AgCanada. Finn, Strik, Moore, Dossett Weber

Developing the Genomic Infrastructure for Breeding Improved Black Raspberries (Bushakra et al.), SCRI Grant

Ongoing collaborative trials for testing black raspberry genotypes from Cornell University. (Finn, Strik, Weber

Evaluation of performance of raspberry selections in the Pacific Northwest. Patrick Moore, Washington State University, Chad Finn, USDA-ARS, Corvallis, OR, Michael Dossett, PacificAgri-Food Research Centre, Agriculture and Agri-Food Canada, Agassiz, BC

Evaluation of adaptation of raspberry selections to machine harvesting. Patrick Moore, Washington State University, Chad Finn, USDA-ARS, Corvallis, OR, Michael Dossett, PacificAgri-Food Research Centre, Agriculture and Agri-Food Canada, Agassiz, BC

Evaluation of raspberry selections to root rot. Patrick Moore, Washington State University, Chad Finn, USDA-ARS, Corvallis, OR, Michael Dossett, PacificAgri-Food Research Centre, Agriculture and Agri-Food Canada, Agassiz, BC

Enhanced Tools for Improving Root Rot Resistance in Red Raspberry. Patrick Moore and Wendy Hoashi-Erhardt, Puyallup and Michael Dossett.

Raspberry Bushy Dwarf Virus. Kara Lanning, Robert Martin and Patrick Moore

Developing effective methods for soilborne pathogen and pest management through removal of root inoculum in continuous red raspberry systems. L.W. DeVetter (PI), I. Zasada, M. Mazolla, S. Galinato, and T. Walters

Rubus crosses focus on heat tolerant primocane and to a lesser extent floricanes fruiting raspberries. Few crosses with blackberry ORUS and NC material. A replicated trial of advanced selections under tunnels in its 3rd and supposedly peak year suffered significant heat damage. Latham healthier than all other genotypes. Gina Fernandez, Rocco Schiavone and Christine Bradish

Black raspberry mapping population died this year, ORUS 4304-156, ORUS 4304-82 looked best at the end. Gina Fernandez, Rocco Schiavone and Christine Bradish

Prime-Ark® Traveler: Overview: Prime-Ark® Traveler was released in late 2014 and entered the market in 2015. This is the first thornless, primocane-fruiting cultivar with shipping-quality fruit recommended for the commercial market. Clark

J. Luby coop with John Clark, Courtney Weber – We continue to evaluate ~50 primocane fruiting selections from Minnesota and 5 from Cornell for adaptation to northern conditions. The most promising in 2015 based primarily on moderately early fruiting season, fruit size and fruit quality were two thornless selections, NY 1101 and NY 1103. Starting in 2014 we observed SWD in unsprayed evaluation blocks.

Dr. Dai continues to field test red raspberry cultivars for winter hardiness and fruit quality. His intention is to improve germplasm.

Initiated a germplasm enhancement project in 2009 with the goal of developing one red and white wine grape that will be winter hardy to -40 F without protection and ripen with only 1800 GDD base 50 F. Utilizing *V. riparia* for winter hardiness. Have planted approximately 5,000 seedlings in 2015 at two nursery locations (Minot and Fargo). Dai

Evaluation of Blackberry (*Rubus* spp.) Cultivars in Virginia. Jayesh B. Samtani and Mikel Conway

Blueberry & Huckleberry:

‘Perpetua’ will reach market as ornamental this spring as part of the Brazelberry® line of edible ornamentals. Finn

‘Baby Blues was named and a patent applied for. Finn, Hancock

Genotypes that are very slow to get *Blueberry shock virus* (BIShV) resistance have been identified. Finn, Martin

Released the ‘Heintooga’ pentaploid interspecific hybrid blueberry cultivar which produces medium size light blue high quality fruit that averages slightly less than one fully developed seed per berry and ripens with late midseason to late season highbush cultivars. It requires cross-pollination by rabbiteye or rabbiteye hybrid (preferably) or highbush cultivars. A USPP application is being filed for ‘Heintooga’. Maggie Schaber, Bill Cline, Hamid Ashrafi, Terry Bland, Benny Bloodworth and Jim Ballington

Identified 36 new tetraploid hybrid blueberry selections on a grower-cooperator site in Bladen County, NC. These represent very diverse parentage including parents with *Vaccinium simulatum* in their background which results in segregation for late bloom as well as second backcrosses from rabbiteye to highbush for segregation for improved fruit firmness and plant adaptation, and intercrosses of parents that are 1/8 *V. arboreum*, which should segregate for adaptation to mineral soils and drought tolerance. Maggie Schaber, Bill Cline, Hamid Ashrafi, Terry Bland, Benny Bloodworth and Jim Ballington

Maggie Schaber had a replicated trial for 16 advanced accessions. The statistical analysis indicated that one accession has the potential of being release as a cultivar for mechanical harvest. We are going to repeat the experiment in 2016 to have the data of two years. Maggie Schaber, Bill Cline, Hamid Ashrafi, Terry Bland, Benny Bloodworth and Jim Ballington

We have been funded via a seed grant to generate preliminary genomic data for blueberry that can be used as seed for larger grants. We are developing a large array of transcriptome sequences that can be used for genome annotation or Single Nucleotide Polymorphism discovery. In the same project we are analyzing blueberry fruit during different developmental stages for metabolites. We are also going to conduct an epigenetic study during different fruit developmental stages. Maggie Schaber, Bill Cline, Hamid Ashrafi, Terry Bland, Benny Bloodworth and Jim Ballington

Norman, a southern highbush blueberry, has been released. Norman was named in honor of longtime fruit breeder James Norman Moore who began the Arkansas program in 1964 and directed it until his retirement in 1996. Chad Finn, Mark Ehlenfeldt both with USDA-ARS

Two wine grape selections, A-2245 (white) and A-2467 (red) are moving in the direction of release possibly in 2016. Clark, Bernadine Strik, Elina Coneva, John Strange and Jeff Wheeler, Patrick Conner.

Assessment of Performance of Newly Developed and Well-Established Rabbiteye Blueberry Cultivars. E. Coneva, E. Vinson, and A. Caylor.

Assessment of Performance of the UoG Blueberry Breeding Program New Releases, focusing on Rabbiteye Blueberry Cultivars. E. Coneva, E. Vinson, and A. Caylor, and Scott NeSmith.

Elderberry: none

Grapes:

Evaluation of Performance of Newly Bred Seedless Table Grape Selections from the University of Arkansas Breeding Lines. E. Coneva, E. Vinson, and A. Caylor, Auburn University, Auburn, AL; and John Clark, University of Arkansas.

Evaluation of Performance of PD Tolerant American and French-American Hybrid Bunch Grapes in AL. E. Coneva, Auburn University, Auburn, AL.

Investigations of Performance of UC Davis Developed Pierce's Disease (PD) Resistant 87.5% *V. vinifera* Grapes in AL. E. Coneva, A. Svyantek, and J. Pitts, Auburn University, Auburn, AL, and Andy Walker, UC Davis.

Assessment of Selected Muscadine Grape Cultivars in AL. E. Coneva, J. Pitts, Auburn University, Auburn, AL.

Ribes: none

Strawberry:

RosBREED2 takes off. Finn, et al.

Five crosses made in 2015 after a year off. Maggie Schaber, Bill Cline, Hamid Ashrafi, Terry Bland, Benny Bloodworth and Jim Ballington

Two elite lines, NCS 10-156 and NCS 10-038 at on-farm trials, NC, VA and SC. NCS 10-156 likely to be released in 2016. Maggie Schaber, Bill Cline, Hamid Ashrafi, Terry Bland, Benny Bloodworth and Jim Ballington

Sweet Sunrise (USPP 25,223) has been patented and continues to be impressive in trial. Finn, Moore, Dossett, Strik

Charm (USPP 25,300) has been released and patented. Finn, Moore, Dossett, Strik

ORUS 2427-4 will be released. Finn, Moore, Dossett, Strik

Ongoing collaborative trials for testing strawberry selections from Wash. St. Univ. and AgCanada. Finn, Moore, Dossett, Strik

Evaluation of performance of strawberry selections in the Pacific Northwest. Patrick Moore, Washington State University, Chad Finn, Michael Dossett.

Day-neutral strawberry cultivar development. Wendy Hoashi-Erhardt

Repeat Flowering and Powdery Mildew Evaluations on Day-Neutral Genotypes. Wendy Hoashi-Erhardt

Other small fruit crops:

Actinidia arguta (hardy kiwi, baby kiwi, wee-kee) selections look promising. Finn, Hummer

Evaluation of performance of cranberry selections in the Pacific Northwest. Kim Patten

Fresh fruit selections NC 1004, NC 1005, and NC 1006 continued to look promising at Castle Hayne, and NC 1006 also continued to look promising at Jackson Springs and Salisbury, NC. All three of these selections are open pollinated seedlings of 'Supreme'. Fernandez et al.

Seventeen crosses producing 1500 seed were made in 2015 for fresh fruit and wine grapes. Fernandez et al.

1500 seedlings were planted at Castle Hayne in 2014 and another 1500 were planted at Castle Hayne in 2015, selections will be made during the next 2-3 years. Fernandez et al.

Eleven selections from Castle Hayne and Reidsville were planted in a replicated trial in 2015 and will be evaluated for wine and fresh fruit potential during the next 3-4 years. Fernandez et al.

Collected native Juneberry biotypes for nursery evaluation in comparison to the most common cultivars available in Canada and the US. Thirty-one biotypes have been selected for further testing in a replicated study with 14 named cultivars at two locations (Williston and Absaraka) for phenotypic and fruit yield evaluations. Dr. Dai continues to test chokecherry lines for resistance to X-disease.

Objective 2 - Develop practices for small fruit production tailored for climatic and market needs of growers.

Blackberry and Raspberry:

Weed Management, Training, and Irrigation Practices for Organic Production of Trailing Blackberry. I. Mature Plant Growth and Fruit Production. E. Dixon, B.C. Strik, and D. Bryla

Weed Management, Training, and Irrigation Practices for Organic Production of Trailing Blackberry. II. Soil and Plant Nutrient Concentrations. E. Dixon, B.C. Strik, L.R. Valenzuela-Estrada and D. Bryla

Weed Management, Training, and Irrigation Practices for Organic Production of Trailing Blackberry. III. Accumulation and Loss of Biomass, Carbon, and Nutrients. E. Dixon, B.C. Strik, and D. Bryla

Weed Control Increases Growth, Cumulative Yield, and Economic Returns of Machine-Harvested Organic Trailing Blackberry. E. Dixon and B.C. Strik

Seasonal Variation in Mineral Nutrient Content of Primocane-fruiting Blackberry Leaves. Bernadine C. Strik

Leaf Nutrient Concentration in Blackberry – Recommended Standards and Sampling Time Should Differ Among Blackberry Types. B.C. Strik and A. Vance

Seasonal variation in mineral nutrient content of primocane and florican leaves in blackberry cultivars. I. Organic compared to conventional production systems. B.C. Strik and A. Vance

Seasonal variation in mineral nutrient content of primocane and florican leaves in blackberry cultivars. II. Comparison of trailing, erect, and semi-erect types in conventional production. B.C. Strik and A. Vance

Profitable practices for organic production of processing blackberries. (Bryla et al.)

A comparison between fertigation and granular fertilizer applications on yield and leaf nitrogen in red raspberry. (Bryla et al.)

Effects of geotextile landscape fabric on soil nutrient availability in an organic planting of 'Marion' trailing blackberry. (Bryla et al.)

Developing effective methods for soilborne pathogen and pest management through removal of root inoculum in continuous red raspberry systems. L.W. DeVetter, I. Zasada, M. Mazolla, S. Galinato, and T. Walters

Reducing *Phytophthora rubi* and *Pratylenchus penetrans* inoculum to improve efficacy of IPM

practices in red raspberry. I. Zasada, L.W. DeVetter, J. Weiland, T. Walters, and C. Benedict

Impacts of alleyway cover crops on soil quality and plant competition in established red raspberry. L.W. DeVetter, R. Rudolph (graduate student), M. Mazzola, and C. Benedict

Optimizing pre-plant management techniques for nematodes and soilborne diseases in red raspberry. L.W. DeVetter, I. Zasada, J. Weiland, and T. Walters

Integration of factors to improve soil health in red raspberry production. C. Benedict, E. Gerbrandt, and L.W. DeVetter

Comparison of alternate- and every-year production in summer-bearing red raspberry. L.W. DeVetter and S. Galinato

Assessing primocane management strategies across different cultivars of raspberry. T. Miller and L.W. DeVetter

Reducing *Phytophthora rubi* and *Pratylenchus penetrans* inoculum to improve efficacy of IPM practices in red raspberry. I. Zasada (PI), L.W. DeVetter, J. Weiland, T. Walters, and C. Benedict

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Integration of factors to improve soil health in red raspberry production. C. Benedict (PI), E. Gerbrandt, and L.W. DeVetter

Comparison of alternate- and every-year production in summer-bearing red raspberry. L.W. DeVetter (PI) and S. Galinato

Assessing primocane management strategies across different cultivars of raspberry. T. Miller (PI) and L.W. DeVetter

Flower to fruit phenology. On farm demonstration, with agents as tool for growers to predict harvest dates and peak yields. Documented on blog. Fernandez et al.

Bud removal to mimic winter injury. On farm demonstration with agents. Fernandez et al.

Growing Strawberries: A Public-Private Partnership. Garcia et al.

Performance of Three Table Grape Cultivars Under High Tunnel and Three Training Systems. Garcia and Johnson

Pest management on the various USAD and SARE projects in fruit and pecans. Curt Rom and Elena Garcia.

The organic fall-bearing blackberries had some insect pests in high tunnel screened on 11 June: primocanes emerged late-March when strawberry rootworm and *Pachybrachus* sp. leaf beetle adults both caused extensive shot holes in leaves – controlled by AzaDirect; from April until July aphids damaging fruiting terminals were reduced by Pyganic and AzaDirect, were heavily parasitized, were attacked by *Scymnus* sp. predatory beetle larvae, but tended by odorous house ant, *Tapinoma sessile*, that removed lady beetle aphid predators *C. maculata* (predator beetle releases by Eric Riddick, USDA in Stoneville, MS); grasshoppers were defoliating terminals in August; and stink bugs puncturing fruit in August and September.

Spotted wing drosophila monitoring and management projects funded by the AR Ag. Dept. and UA of Arkansas Extension IPM. Johnson

USDA/OREI - Proposal 2015-07403 - Development and implementation of systems-based organic management strategies for spotted wing drosophila (will evaluate insect screening; starts 1 October 2015). Johnson

USDA/Small Fruit Consortium/IR4 2015-6: Broad mite biology and management on blackberry. Johnson

UoA identified several new viruses in diseased elderberry, blackberry and currant. Characterization and epidemiology is underway. We are working on the population structure of the viruses across the United States and Europe. Ioannis Tzanetakis

Exclusion of SWD in raspberries. Eric Burkness and Bill Hutchison

SWD trapping and insecticide trial. Eric Burkness and Bill Hutchison

Two blackberry trials have just been initiated to identify methods for consistent fruit production. The first trial evaluates primocane blackberries in three environments, with a high tunnel as one environment. The second trial evaluates winter row coverings for 12 florican cultivars. Hatterman-Valenti

Blueberry & Huckleberry:

Humidity affects populations of *Drosophila suzukii* (Diptera: Drosophilidae) in blueberry. Tochen, Samantha, J. Megan Woltz, Daniel T. Dalton, Jana Lee, Nik G. Wiman, and Vaughn M. Walton

Characterizing damage of brown marmorated stink bug, *Halyomorpha halys* (Hemiptera: Pentatomidae), on commercial blueberries. Wiman N., J. Parker, C. Rodriguez-Saona, and V. M. Walton

Enhancing pollination efficiency of honey bees in blueberry using brood pheromone. R Sagili and J. Borden

Blueberry rootstock selection and evaluation in mineral soils. Wei Q. Yang and Heather Andrews

Field evaluation of grafted northern highbush blueberries. Wei Q. Yang and Heather Andrews

Evaluation of Fresh Fruit Quality of Four Highbush Blueberry Cultivars Harvested With a Hand-held Harvest Aid. Wei Q. Yang , Bo Hu , Heather Andrews , Fumi Takeda, and Changying Li

Seasonal Variation in Leaf Nutrient Concentration of Northern Highbush Blueberry Cultivars Grown in Conventional and Organic Production Systems. B.C. Strik and A. Vance

Mulch and Fertilizer Management Practices for Organic Production of Highbush Blueberry from Planting through Maturity. B.C. Strik, D.R. Bryla, D.M. Sullivan, and A. Vance

Relationship between soil and tissue nutrient concentration and yield over seven years in certified organic blueberry production systems. B.C. Strik and A. Vance

Nutrient, carbon and biomass allocation in mature 'Duke' and 'Liberty' when grown in certified organic production systems. J. Fernandez-Salvador and B.C. Strik

Root production, distribution, and turnover in conventional and organic northern highbush blueberry systems. (Bryla et al.)

Ion-specific limitations of sodium and calcium chloride on growth and nutrient uptake in northern and southern highbush blueberry. (Bryla et al.)

Lateral transfer of water and nitrogen in a drip-irrigated planting of northern highbush blueberry.

(Bryla et al.)

Strategies for maintaining fruit quality in blueberry under water limited conditions. (Bryla et al.)

Age-related changes in responses of highbush blueberry plants to drip irrigation. (Bryla et al.)

Nutrient requirements, leaf tissue standards, and new options for fertigation of northern highbush blueberry. (Bryla et al.)

Showed *Blueberry fruit drop associated virus*, BFDaV, is correlated with fruit drop symptoms. (Martin, USDA et al)

In collaboration with Dr. Tzanetakis at University of Arkansas, and collaborators in Michigan, New Jersey, North Carolina, Georgia, Pennsylvania, California and Washington we are carrying out a survey of blueberry viruses in the U.S. (Martin, and Tzanetakis)

Relating honey bee activity to fruit set and yield in Washington Highbush blueberry. L.W. DeVetter, E. Elle, K. Sakalauskas, and R. Sagili

Evaluating the Role of Boron in Enhancing Fruit Set of Highbush Blueberry. L.W. DeVetter

Blueberry tissue nutrient standards for eastern Washington production. J. Davenport and L.W. DeVetter

Determining blueberry cold hardiness in Washington. G.A. Hoheisel, M. Salazar, G. Hoogenboom, and L.W. DeVetter

Scale-neutral harvest-aid system and sensor technologies to improve harvest efficiency and handling of fresh market blueberries. C. Li, F. Takeda, S. Sargent, R. Beaudry, A. Freivalds, K. Gallardo, W. Cline, D. Zilberman, W. Yang, E. Stafne, H. Scherm, J. Chen, J. Williamson, and L.W. DeVetter

Determining the effect of biodegradable and living mulches on annual weeds and growth of newly-planted blueberry. T. Miller and L.W. DeVetter

Relating honey bee activity to fruit set and yield in Washington Highbush blueberry. L.W. DeVetter (PI), E. Elle, K. Sakalauskas, and R. Sagili

Evaluating the Role of Boron in Enhancing Fruit Set of Highbush Blueberry. L.W. DeVetter

Blueberry tissue nutrient standards for eastern Washington production. J. Davenport (PI) and L.W. DeVetter

Determining blueberry cold hardiness in Washington. G.A. Hoheisel (PI), M. Salazar, G. Hoogenboom, and L.W. DeVetter

Determining the effect of biodegradable and living mulches on annual weeds and growth of newly-planted blueberry. T. Miller (PI) and L.W. DeVetter

Elderberry: none

Grapes:

Evaluation of table grape cultivars and selection for adaptation to small farm production in the Willamette Valley, Oregon. Amanda Vance and Bernadine Strik

Drosophila suzukii (Diptera: Drosophilidae) and its potential impact to wine grapes during harvest in two cool climate wine grape production regions. Ioriatti C., V. Walton, D. Dalton, G. Anfora, A. Grassi, S. Maistri, V. Mazzoni

Impacts of vine vigor, nitrogen, and carbohydrate status on fruitfulness of Pinot noir. Patricia A. Skinkis

Validating Canopy Quantification Methods for Hedged Vine Canopies. Patricia A. Skinkis

Statewide Crop Load Project: Defining Yield Management Practices for Quality Pinot Noir in Oregon. Patricia A. Skinkis

Yield management impacts on vine physiology of Pinot noir. Patricia A. Skinkis

Understanding the genetic basis of ripening in grapevine through the prism of uneven ripening in a grape cluster. Laurent Deluc, Yanming Di, Claudia Maier, and Molly Megraw

Timing of ripening initiation in grape berries and its relationship to seed content and pericarp auxin levels. Laurent Deluc, Dr. Sarah Zenoni, Pr. Mario Pezzotti

RNA-Seq analysis of stages of seed during the ripening transition revealed a gene expression specific signature that coincides with the ripening transition of the pericarp. Laurent Deluc, Anne Fennell, Aaron Fait

Developmental duration and seed content as sources to explain variable ripening initiation of grape berries within a cluster. Laurent Deluc

A genomic approach to understand the impact of grape Leaf-Roll Virus on berry ripening. Laurent Deluc

Determine the impact of fruit compositional variability on wine attributes and complexity. Laurent Deluc

Determine the impact of viticulture practices on the dynamics of Plant Growth Regulators in grape berry. Laurent Deluc

Developing a biotechnology platform for genetic improvement of grapevine at OSU. Laurent Deluc

Development of a new visualization tools to conceptualize large-scale data in grapevine. Sushma Naithani, Pankaj Jaiswal

Efforts over the past two years have focused on Grapevine red blotch virus (GRBV), which was first characterized in 2012 at Cornell and Davis. (Martin, USDA et al)

A trial has been completed examining the effects of four trellis systems and three leaf-removal practices on the yield and quality of 'Frontenac' grapes. Another trial will evaluate two single curtain and two double curtain trellis systems for 'Marquette' and 'Petite Pearl' grapes. Data collection has been completed for several trials: 1) Evaluating the stability of photoperiod based acclimation; 2) Evaluating nitrogen timing and rate effect on 'Prairie Star'; and 3) Evaluating alternative weed control methods during grape establishment. Hatterman-Valenti

Ribes: none

Strawberry:

Development of day-neutral strawberries adapted to the Canadian climate and to new sustainable

production systems. Desjardins, Dale, Hughes, Zandstra, Gosselin, Mintenko

Producing strawberries throughout the growing season with a small environmental footprint. Popple, Hoover, Petran, Tillman

Development of a comprehensive, engaging e-learning tool for strawberry farmers. Hoover, Tepe, Martin, Wold-Burkness, Petran, Poppe, Asche, Erickson, Gelderman, Kildegaard Univ. of Minnesota - Morris, Center for Small Towns

Monitoring and management of strawberry aphids in Ontario. Fisher, Pate, Hallett

Monitoring and management of SWD in Ontario. Fisher, Fraser, Appleby, Beaton, Huffman

High tunnel small production of strawberry. Garcia

Hydroponic strawberry production in greenhouse. Evans, Garcia, Johnson -

Strawberry powdery mildew, global distribution of mating types and fruiting body formation. J Broome, Gadoury,

Use of anaerobic soil disinfestation (ASD) for management of soil-borne pathogens in strawberry and vegetable farming systems. Broome, Shennan

Methyl bromide alternatives for strawberry nurseries. Broome, Kong, Epstein et al.

Fumigation alternatives for Florida strawberry production. Sambhav, Noling

Development of a mobile steam applicator for pre-plant use in strawberries for weed and soil-borne pathogen management. Broome, Fennimore, Dorn, and others.

New diagnostic methods, epidemiology and integrated management of angular leaf spot (*Xanthomonas fragariae*) in strawberry nursery. Broome, Kong, McRoberts, Turechek

Metagenomic approaches for rhizosphere soil analysis in organic and conventional strawberry production. Chellemi, Ward, Driscoll's, Epstein.

Evaluation of strawberry cultivars for Virginia. Samtani, Flanagan III, Johnson, Romelczyk, Lawrence, Pattison

To evaluate performance of pre-plant soil solarization and mustard seed meal treatments to a fumigant in annual plasticulture production system. Samtani, Johnson

Evaluation of sequential row cover applications for plasticulture strawberry winter protection in Kentucky. Wright

Sustaining soil management practices for sustainable strawberries. Walmart Foundation.

Schroeder-Moreno, Fernandez, Cardoza, Burrack, McWhirt

Strawberry grower education and adoption of research innovations: technology transfer of production recommendations. Perkins-Veazie, Fernandez, Baros, Pattison, Chester-Davis.

Increasing strawberry productivity in NY with Day Neutral/Everbearing strawberries by evaluation varieties, planting dates and plant types. Weber

Coordinated studies on etiology, improved detection, spread, and management of strawberry decline disease outbreak which is threatening strawberry production in Atlantic Canada. Abbasi, Sanfaçon (Co- PLs) w/ participants across Canada. Jamieson (PL), Forney, Abbasi, and Fillmore, Charles

Biodegradable agricultural mulches: Assessing potential for chemical migration in horticultural crops and their role in organic agriculture. DeVetter (PI), Miles, Sablani

RosBREED: combining disease resistance with horticultural quality. Recently funded USDA-SCRI project being done in collaboration with A. Iezzoni and 29 co-PDs

Defining salinity thresholds for plant function and visual symptoms in strawberry. Bryla

Biodegradable agricultural mulches: Assessing potential for chemical migration in horticultural crops and their role in organic agriculture. L.W. DeVetter, C. Miles, and S. Sablani

Finalized evaluation of sustainable soil management practices effects on yield, fruit quality, insect populations and soil quality in both fumigated and non-fumigated systems. Fernandez et al.

Found interactions of soil management practice and fumigation on yield. Fernandez et al.

Few significant differences between fumigated and non-fumigated system for measures of yield. Fernandez et al.

Higher measures of fruit flavor in non-fumigated, lower fruit decay in fumigated. Fernandez et al.

Fumigation reduced pollinators and increased spider mite populations. Fernandez et al.

AMF could not be re-established via the plug into the fumigated system. Fernandez et al.

Created enterprise budgets for conventional, compost & cover crop (non-fumigated) and organic production systems. Fernandez et al.

Publication evaluating economics viability and environmental impacts of the 3 enterprise budget systems. Fernandez et al.

Producing Strawberries throughout the Growing Season with a Small Environmental Footprint. Steve Poppe, Emily Hoover, Andrew Petran, Jack Tillman, Jared Rubenstein

Evaluate performance of pre-plant soil solarization and mustard seed meal treatments to a fumigant in annual plasticulture production system. Jayesh B. Samtani, Charles S. Johnson

Evaluate performance of pre-plant reduced soil solarization periods and pelleted products in annual plasticulture production system. *Sanghamitra Das and Jayesh B. Samtani*

Monitoring for presence of strawberry clipper weevil in Virginia. Hannah J. Burrack, North Carolina State University and Jayesh B. Samtani

Other small fruit crops:

The National Clean Plant Network (NCPN) is up and growing. (Martin, USDA et al)

To improve control methods of the new invasive spotted wing drosophila, we studied the pupation habits, as they were unknown. (Jana Lee et al.)

To better understand the new invasive brown marmorated stink bug, we continue to study their voltinism, ovarial status, nutrient physiology and parasitoids that attack their eggs. (Jana Lee et al.)

Research will lead to the development of RNA interference (RNAi)-based insecticide which is a new direction of insect pest management as an environmentally-friendly control tool. (Jana Lee et al.)

Development of receptor-based insecticide discovery may help develop insecticides.

Cranberry cultivars, advanced selections and breeding lines from Rutgers and private breeders were evaluated for yield, fruit quality and fruit rot resistance. L.W. DeVetter

Optimizing Protected Culture Environments for Berry Crops. Demchak, E. Hanson, E. Hoover, K.

Lewers, M. Pritts and M. Rogers

Second year of a black current cultivar trial. Hatterman-Valenti

General:

Development and implementation of systems-based organic management strategies for spotted wing drosophila. H. Burrack and M. Rogers

Objective 3 - Explore the association between fruit constituents and human health impacts.

Blackberry and Raspberry:

What's really in your bokbunja drink? (Jungmin Lee)

Prebiotics carbohydrate analysis. In 2015, total of 35 strawberry and 30 raspberry samples were collected from SC and NC. In addition, 11 raspberry samples were collected in 2014 fall. Our first year preliminary data indicated that SC and NC gown strawberries are a rich source of prebiotic carbohydrates. For example, 100 g of fresh strawberries provide 4-8 g and raspberries provide 4-5 g of prebiotic carbohydrates. Strawberry cultivars, Chandler and Merced and raspberry cultivars, NC 612, NC 682, and Dorman Red showed high concentrations of prebiotic carbohydrates compared to the other cultivars. With Dilruski Thavarajah Clemson Univ. Fernandez et al.

Blueberry & Huckleberry:

Optimization of Solvent and Ultrasound-assisted Extraction for Different Anthocyanin Rich Fruit and Their Effects on Anthocyanin Compositions. Yanyun Zhao

Stabilization of Blueberry Anthocyanin Extracts using Chitosan-based Microencapsulation with Different Negative Ionic Cross-linking Agents. Yanyun Zhao

Elderberry: none

Grapes:

Fourteen fruit samples were analyzed for anthocyanins at the Plants for Health Institute in 2014 and 19 samples will be analyzed for anthocyanins in 2015. Fernandez et al.

Muscadine grapes evaluated for fresh market and storage life. Most promising cultivars and selections have large size, thin or non slip skin, crisp flesh, high sugars. Grapes could be held up to 56 days at 4 C. Marker cultivars for good shelf life include Supreme (purple) and Summit (bronze). NC 1005 ripens in the early-mid season slightly after Supreme and has good storage life and the NC1006 is a later season purple variety with good storage life and crisp flesh. Fernandez et al.

Exploring collaboration with Dr. Shetty to selectively modify and stimulate the phenolic profiles using system-based metabolic innovation and up-regulation of key defense related pathways to enhance both fruit quality and longevity during post-harvest stages. Hatterman-Valenti

Strawberry:

Prebiotic carbohydrates in strawberry. Fernandez, Dilruski Thavarajah.

Impacts: (500 characters max per “text box”)

Impact 1. (Walton et al.) *Invasion biology of Spotted Wing Drosophila (Drosophila suzukii): a global perspective and future priorities.* We through this work on SWD have a clearer understanding of its biology and current pest status in endemic and recently invaded regions. We identified future research needs for the development of predictive models for its geographic expansion. We highlighted prospects for both natural and classical (=importation) biological control of SWD in invaded habitats, with emphasis on the role of hymenopteran parasitoids.

Impact 2. (Walton et al.) *Humidity affects populations of Drosophila suzukii (Diptera: Drosophilidae) in blueberry.* Our humidity-dependent population model predicted lower densities of *D. suzukii* relative to populations at higher humidity. This study supports the hypothesis that cultural practices that minimize lower humidity levels in crops can contribute to the management of *D. suzukii*. Such methods may include open pruning, drip irrigation and field floor management.

Impact 3. (Walton et al.) *Host stage preference, efficacy and fecundity of parasitoids attacking Drosophila suzukii in newly invaded areas. Biological control.* This study showed current lack of biocontrol agents. It highlights the importance of foreign exploration for new parasitoids as biocontrol agents against *D. suzukii*

Impact 4. (Walton et al.) *Resident field-sampled parasitoids associated with Drosophila suzukii and their seasonal occurrence in two small fruit production regions.* These findings highlight the need for improved biological control of *D. suzukii* through introduction or augmentation of specialist parasitoids from native range of *D. suzukii*. This report provides baseline data on the current status of biological control of *D. suzukii* in Italy and Oregon.

Impact 5. (Walton/Wiman) Growers can use the molecular diagnostic tool to quickly and accurately determine possible *D. suzukii* (SWD) infestation in shipments. This quick diagnostic will result in improved market access and savings in shipping costs.

Impact 6. (Walton/Wiman) We know the current status of parasitoid biocontrol, the first step towards long-term management for SWD.

Impact 7. (Walton/Wiman) Growers can use our descriptions of BMSB symptoms to determine when during the growing season BMSB attacked their crop. We have also for the first time described direct impact of BMSB on blueberry.

Impact 8. (Walton/Wiman) Growers can use our results on the stylet ‘probing’ behaviors of BMSB to determine when during the day and growing season they will most likely be having damage by BMSB feeding. This work also shows typical climates where most severe damage is expected.

Impact 9. (Strik) Application of liquid calcium sources, using several commercially-available products within the recommended label rate of Ca as a foliar, targeted application to developing fruit did not increase the %Ca of blueberry, blackberry, raspberry, or strawberry fruit or leaves. Research is planned to see if higher rates will have a positive or negative impact. Our findings illustrate that foliar application of these products at the label rates/timings is not economically feasible for growers.

Impact 10. (Strik) Primocane-fruiting blackberry should have leaf samples collected for nutrient analysis at the early green fruit stage (on primocanes) rather than on a specific calendar date as was recommended prior to this study. Our findings will help growers better manage fertilizer programs optimizing use efficiency and plant performance.

Impact 11. (Strik) In florican-fruiting blackberry we are developing cultivar specific sampling recommendations and standards to help growers better manage fertilizer programs optimizing use efficiency and plant performance.

Impact 12. (Dixon/Strik) Weed management strategies, training time, and the cultivar being grown were found to affect many growth factors, yield, and nutrient and carbon content of trailing blackberry when grown in a certified organic production system, machine-harvested for

processing. Weed control, using weed mat or hand-weeding, increased yield 19% and 61% over non-weeded plots, on average, in ‘Marion’ and ‘Black Diamond’, respectively. It is clear that weed control is critical in this type of blackberry. Only training in February is recommended if ‘Marion’ is grown, to minimize risk of winter cold injury. There was no training time effect in ‘Black Diamond’. Yields of the best performing organic treatments were comparable to those seen in conventional production showing promise for industry growth. However, the life of organically-grown ‘Black Diamond’ may be limited if it becomes infested with raspberry crown borer (*Pennisetia marginata* Harris), a pest that is difficult to control in this organic production system; only this cultivar was sensitive to the pest.

Impact 13. (Dixon/Strik) In trailing blackberry grow in certified organic production systems, there was no impact of withholding irrigation after fruit harvest (August and September) saving an estimated 500,000 L·ha⁻¹ per year.

Impact 14. (Strik) Leaf nutrient concentrations in blueberry varied by sampling time and often by cultivar grown. However, we have shown that cultivars that differ in fruiting season should NOT be sampled at different times (as industry was tending to do). Current tissue sufficiency levels, which were developed mainly using ‘Bluecrop’, were applicable to all cultivars tested, but the cultivars did vary greatly. Cultivar specific leaf tissue sampling and perhaps nutrient management is recommended.

Impact 15. (Strik) From 2006, the start of our study, through 2014, total blueberry harvested area in Oregon increased from 4,400 to an estimated 10,000 acres. Organic area in Oregon increased from an estimated 60 acres in 2006 to an estimated 1500 to 2000 acres in 2014. The phenomenal increase in organic area planted in Oregon can be attributed, at least in a large share, to our positive research findings. The farm gate value of organic production in Oregon in 2006 was estimated at \$2.7 million (1% of fresh production x \$1.56/lb); this value increased to \$8.4 million (9.5% of fresh production x \$2.45/lb). Organic fruit has increased grower price by an average of 20% to 50% compared to conventional.

Impact 16. (Strik) Over 95% of the planted organic area in Oregon is estimated to be established on raised beds using weed mat mulch. In addition, the use of weed mat mulch in new conventional plantings in Oregon has increased from an estimated 10% of the acreage in 2006 to more than 80% of the new acreage from 2010-2014. We believe that our positive findings have had a significant impact on the establishment of weed mat mulch as a “standard” production system in Oregon at present. Growers with weed mat use an average of 2 fewer strip herbicide applications per year than those with sawdust mulch, saving \$100 per acre. During the 6 years of this study, the impact of this would be \$280,000 (2,800 acres planted with weed mat x \$100).

Impact 17. (Strik) Given the impact of the various organic production systems tested over 8 years, research is underway to assess the long-term impact of these practices on soil and plant nutrient status and yield. The goal is to develop nutrient management guidelines for organic blueberry production.

Impact 18. (Walton et al.) *Characterization and manipulation of fruit susceptibility to Drosophila suzukii*. We have improved knowledge of factors affecting fruit susceptibility. Blueberry fruit sprayed with calcium silicate in the field had greater penetration force and firmness and reduced number of eggs laid by *D. suzukii* compared to untreated fruit. This cultural method of control can result in more sustainable management of SWD. There are additional horticultural advantages such as increased shipping quality and market access.

Impact 19. (Yeo/Sullivan). By selecting cultivars with superior resistance to *Phytophthora cinnamomi*, growers may avoid yield losses associated with the disease, enhancing production profitability. An integrated control program is required for cultural suppression of blueberry root rot disease. Organic production using highly susceptible cultivars in the presence of *P. cinnamomi* is difficult, and may not produce equivalent yields to conventional production. Improved plant performance in the presence of *P. cinnamomi* was observed in trials using cultivar resistance, gypsum, and widely-spaced drip irrigation lines. Other cultural practices, such as careful irrigation scheduling, and appropriate rate and timing of N fertilizer application are also important for disease suppression.

Impact 20. (Skinkis). Early findings that basal buds are fruitful suggests that spur pruning may be a viable option for Pinot noir vineyards, and this could save on labor costs. Information that we obtain about causes of low fruitfulness will allow us to provide growers with management practices to potentially adjust vine vigor and increase yield for more balanced growth and more sustainable yields.

Impact 21. (Skinkis). Our work provides an evaluation of rapid methods for mapping canopy leaf distributions, determining canopy density and estimating exterior leaf area in VSP canopies where heavy management, dense canopies with intertwining shoots and tendrils complicate traditional measures for evaluating grapevine canopies. Methods outlined may help researchers increase accuracy in quantifying canopy metrics under such conditions.

Impact 26. (Skinkis). Vineyard managers and winemakers have learned how to implement research on their site and how to utilize data collection protocols. Many of them report having a greater understanding of the whole vineyard system, are much more observant in the vineyard, and are beginning to look at yield management differently. Some collaborators have begun to change their yield management practices in other blocks outside of their research blocks and consider the impact this is making on wines during different vintages. Cluster thinning is conducted using manual labor, averaging 40 hours and \$540 per acre annually. If no thinning is required to achieve wine quality, a \$540/acre savings can be realized, a lower dependence on labor, and there could be a 10-40% increase in yields. If growers can increase yields by a modest 0.5 tons/acre, this would increase profits by nearly \$100,000 annually for a 50 acre vineyard.

Impact 27. (Skinkis). The information learned will serve as a physiological basis for growers to

better understand how their cluster thinning practices may be influencing vine health and productivity. Over time, this information will help them determine if they would need to add more irrigation or fertilization to support greater yields.

Impact 22. (Walton et al.). *Drosophila suzukii* (Diptera: Drosophilidae) and its potential impact to wine grapes during harvest in two cool climate wine grape production regions. We described wine grape susceptibility parameters to *D. suzukii*. We demonstrated that incised berries are more favorable for *D. suzukii* oviposition and as a nutrient substrate. Such an increase of feeding and oviposition may increase the likelihood of spoilage bacteria vectoring due to *D. suzukii*.

Impact 23. (Vance/Strik) New information being learned will provide table grape growers in the Willamette Valley, Oregon with cultivar recommendations for fresh fruit quality.

Impact 24. (DeLuc). Understanding the mechanisms responsible for source-sink relationship of individual fruits within a grape cluster will enable the development of practices aimed to improve with a minimum of input (water and nutrient).

Impact 25. (DeLuc). Understanding the impact of seeds on the rate of ripening in grape berry will promote new practices aimed to improve fruit quality.

Impact 26. (DeLuc). Unraveling the complex network of genes involved in the development of seeds will help improving our knowledge of grape berry development.

Impact 27. (DeLuc). Contribution of the seed content rather than developmental duration to determine when grape berries enter the ripening phase will promote new research projects aimed to identify genotypes with early or late ripening.

Impact 28. (DeLuc). Identification of the molecular mechanisms responsible for the grape leafroll virus infection and its impact on fruit ripening will help devise new technology tools to prevent grapevine production loss.

Impact 29. (DeLuc). Understanding the influence of fruit composition variability in wine complexity is a major step to improve uniformity of wine quality.

Impact 30. (DeLuc). Characterization of the dynamics of Plant Growth Regulators in the context of grape berry development will serve as baseline for the development of new practices aimed at modifying the profiles of specific hormones known to affect particular yield and ripening traits.

Impact 31. (DeLuc). The development of new tools aimed at linking the function of a gene to a phenotypic trait of interest will facilitate speeding up new breeding programs in wine grapes.

Impact 32. (DeLuc). The development of new bioinformatics tools aimed to facilitate visualization of large-scale data such as RNA-Seq will improve our understanding of physiological processes associated with the ripening program in grape berry.

Impact 33. (Zhao) Extraction conditions are critical for the correct identification and quantification of polyphenols and anthocyanins in berry fruit. Results generated from this study would provide some baseline information about the appropriate extraction conditions for different berry fruits.

Impact 34. (Zhao) The study on chitosan based microencapsulation of blueberry anthocyanin extracts provided new information about the technology for stabilizing blueberry anthocyanin extracts during ambient storage.

Impact 35. (Moore). Small fruit plant sales in the Pacific Northwest (PNW) for 2013-2014 were reported by plant propagators. The PNW public breeding programs developed small fruit cultivars that comprise 60% of the raspberry PNW plant sales, 62% of the strawberry plant sales and 72% of the blackberry plant sales. The value of production for 2014 in Washington and Oregon was \$24.2 million for strawberries, \$66.8 million for raspberries and \$43.2 million for blackberries. A new raspberry cultivar (Cascade Harvest) was released in late 2013. It is productive, machine harvestable, raspberry bushy dwarf virus resistant, root rot tolerant with good flavor.

Impact 36. (Fernandez). Black raspberry fruit composition GXE. E is more significant. Fruit from two mapping populations (ORUS 4304 and ORUS 4305) and grown at 4 locations around the US were compared for fruit composition over two years. Monomeric anthocyanin content was highest in fruit from Oregon-grown seedlings and lowest in those from North Carolina and Ohio but was not different among genotypes. Titratable acidity was highest in 'Jewel' (a grandparent in the population) and soluble solids content highest in ORUS 4304 and its parent.

Impact 37. (Fernandez). A quick test for muscadine color stability correlated with the presence of malvidin 3-glucoside developed. Muscadine juice of black/purple grapes changes from red to brown over time due to an absence of malvidin 3-glucoside (M3G) and/or acylated malvidin. Detection of these pigments must be done by chromatography (usually HPLC), a tedious and costly process. A method was developed to aid breeders in screening for M3G in muscadine grapes. Homogenized grape peel was heated for 1 min at 80 C then puree extracted and total anthocyanin determined by the pH differential method. Genotypes with 10% M3G had 0 to 10% loss in total anthocyanin compared to 50% loss in those without M3G.

Impact 38. (Clark). The major impact of the small fruit breeding effort is in plantings of released

blackberry cultivars, totaling over 1.8 million plants for marketing season 2014-2015. Of these, approximately 800,000 are PF. This indicates that PF acreage is increasing and this late summer to fall crop has become a component of the domestic blackberry marketing season. The production is for both the shipping and local markets. In grapes, the impact is much less although increased plantings of the new cultivars along with Jupiter and Neptune in a range of states in the east and Pacific Northwest are being made. These are mainly for the local market.

Impact 39. (Samtani). Growers in Virginia are now aware of the damage caused by clipper weevil. Prior to the study, most growers were unaware of clipper weevil.

Impact 40. (Samtani). Using several grant projects to promote the production of berry crops in Virginia, we have been able to assist Virginia growers to plant and market berry crops including raspberry, blueberry and blackberry. In 2015, the estimated gross sales of berry crops working directly with Virginia Cooperative Extension was estimated to be \$650,000.00. These projects generated 107 seasonal jobs in different communities.

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Oregon Wine Research Institute is a research cooperative at Oregon State University and includes the Viticulture and Enology Research and Extension programs. The Institute has an updated website where program information and Extension publications are available. (<http://owri.oregonstate.edu>)

Spotted Wing Drosophila Website (Spottedwing.com) – c.a. 98,546 page views/year for past two years, visitors from 50 countries

BMSB (<http://horticulture.oregonstate.edu/group/brown-marmorated-stink-bug-oregon>), 3,500 page views past year.

Honey Bee Lab Website: <http://honeybeelab.oregonstate.edu/>

Oregon Master Beekeeper Program Website: <http://extension.oregonstate.edu/mb/>

Berry Crops Web site, NWREC: <http://oregonstate.edu/dept/NWREC/programs/berry-crops>

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