

Washington Blueberry Commission Research Proposal

Title: Evaluating New Blueberry Cultivars and Advanced Selections in the Pacific Northwest

Year Initiated 2022 **Current Year** 2023 **Terminating Year** Continuing

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Justification and Background:

As the Washington State and greater Pacific Northwest (PNW) blueberry industry expands, it is imperative that growers are utilizing both adapted and productive cultivars that meet the specific needs of the industry. Public and private breeders in the PNW are actively working on generating improved cultivars that meet industry needs through the generation of advanced selections, but those selections need to be tested in key production areas representative of the soil and environmental conditions of the commercial industry. Many of these breeders are already testing their selections on grower cooperator farms. While this is an important step in the process of generating new cultivars, on-farm testing on growers' private property has limitations for this type of research. For example, testing on growers' property brings challenges with hosting public events that allow other growers to visit and provide collective feedback regarding the suitability of advanced selections for the industry. Systematic testing of characteristics, like yield, fruit quality (firmness, fruit diameter, °Brix, pH, weight, etc.), pollination requirements, and pathogen susceptibility can also be limited. Additionally, private on-farm selection trials may not be designed in an experimental manner that

allows for statistical comparisons to be made across selections from other breeding programs and standard cultivars that can serve as “controls”.

This project has established cultivar and advanced selection trial locations in Prosser and Mount Vernon, Washington and these locations are part of a larger, integrated PNW trialing network with Oregon State University (OSU). The OSU advanced selection trial is funded by the Oregon Blueberry Commission and is located at the North Willamette Research and Extension Center (NWREC) in Aurora, OR, with management under the leadership of collaborator Scott Lukas. These regional trials provide information on the performance of cultivars and advanced selections generated by both public and private breeding programs. As plants at the trial locations in Washington mature, they can be leveraged for additional purposes including but not limited to research trials that evaluate machine harvest technologies for fresh market and pruning workshops. An additional and important component of this project proposal is the mummy berry (*Monilinia vaccinii-corymbosi*) screening led by co-PI Chakradhar Mattupalli, which will continue to provide information on the spectrum of disease susceptibility across different cultivars and selections that can be leveraged for resistance breeding.

A project of this nature is a tremendous investment on behalf of the commission and researchers. However, information about advanced selections and promising cultivars within Washington State and the greater PNW can help accelerate the process of developing improved blueberry cultivars and understanding any unique aspects of their management. Furthermore, the development of a PNW trialing network strengthens communication and coordinated efforts related to development and release of improved cultivars across the diverse conditions in the PNW. The project was funded by the commission in 2022 and 2023 and we seek continued funding for planting management and data collection.

Relationship to WBC Research Priority(s):

This proposal primarily addresses the priority “plant breeding and variety trials in Washington”. The pathology component of this work will also address the priority, “disease pests including alternaria, anthracnose, botrytis, mummy berry and root diseases such as armalaria”. Once the planting is allowed to flower and bear fruit, the trials will be used for pollination studies and pruning workshops. Thus, additional priorities addressed by this proposal includes “methods to improve pollination and fruit set” and “pruning workshops”.

Objectives:

- 1) Establish regional cultivar/advanced selection trials to inform breeding efforts that lead to the release and successful adoption of adapted cultivars.
- 2) Develop and implement a mummy berry screening protocol that can be used by breeders to select for resistance or low-susceptibility to the disease.

- 3) Create a PNW blueberry breeding network as a mechanism to gather industry feedback and coordinate information sharing and regional efforts.

Procedures:

Objective 1 – Cultivar/Selection Trials. Site preparation including soil acidification and pre-plant fertilizer application was completed in 2022 at two trial locations: the WSU NWREC in Mount Vernon and the WSU Roza Farm in Prosser. The trials were designed as a randomized complete block design in both locations with five plants per plot replicated four times (i.e., 20 plants per cultivar or advanced selection). Planting occurred in 2023, specifically May 25 in Prosser and June 12 in Mount Vernon, after raised bed formation using assistance from grower cooperators. Plant material was selected and provided by breeders and cooperating nurseries and include: ‘Duke’ (control), ‘Calypso’, DSA1, DSA2, DSA3, BC 18-18-154, BC 14-40-158, ORUS 264-1, ORUS 292-2, ‘ArabellaBlue’ (FC14-062), ‘LoretoBlue™’ (FC11-118), and advanced selection FC11-164. This panel of cultivars and advanced selections cover plant material from the British Columbia and USDA-ARS breeding programs, as well as Fall Creek and Driscoll’s. Space is available for four additional cultivars with Oregon Blueberry indicating a high likelihood in providing selections from their program in 2024. Plants will be maintained conventionally in Mount Vernon and organically in Prosser per industry standard. To encourage establishment, the plants will be prevented from fruiting until 2025. During non-fruiting years, the investigators will focus on the mummy berry greenhouse trial (see Objective 2). During fruiting years, we will collect plant growth data, as well as: 1) percent fruit bud set; 2) pollination requirements; 3) harvest timing; 4) yield potential; 5) fruit quality (average berry size, firmness, fruit diameter, Brix, pH, and TA; taste panels will also be conducted), and 6) cold hardiness.

Selections/cultivars will be evaluated for disease susceptibility to the fungal pathogen *Monilinia vaccinii-corymbosi* by conducting in-field surveys. Surveys will evaluate disease symptoms such as blossom and shoot blight. Observed infections will be rated for each part of the plant forementioned, based on a disease percent scale (0-5; 0-100%) with the numerical value of 0 conveying disease free, and the numerical value of 5 conveying >75% infection. Evaluations will include all experimental cultivars and known susceptible and resistant cultivars. Disease incidence will be calculated by dividing the number of plant parts exhibiting disease symptoms by the total number of parts assessed. Statistical analysis will be conducted to test differences among selections/cultivars for disease incidence and severity values. Disease surveys will be conducted twice during a season (pre-bloom, March; post-bloom, June) on mature cultivars planted in-field for both research plots and co-operative grower fields at later stages of the project (Years 3+). This work will be ongoing and we propose this be considered as an annual expense by the commission to support cultivar development. In the future, the project team could expand their efforts by planting and evaluating promising selections from the replicated trial in large-plot, non-replicated trials on grower farms, allowing an additional screening of promising germplasm.

Objective 2 - Mummy Berry Screening. Resistance screening was performed for the fruit infection phase of mummy berry disease in 2022 and 2023 (Ehlenfeldt et al. 2010). Screening was done using container-grown 'Aurora', 'Bluejay', 'Calypso', 'Duke', 'Liberty', and 'Northland' plants from Fall Creek Farm and Nursery, Inc., DSA4 from Driscoll's, and USDA-ARS advanced breeding lines, ORUS264-1, ORUS292-2, ORUS587-1, and ORUS620-2. These plants were arranged in a randomized complete block design with five plants per genotype and maintained in either 1-gallon (all genotypes except 'Liberty') or 5-gallon pots in a greenhouse at the WSU NWREC in Mount Vernon. For assessing these genotypes for fruit rot susceptibility, fresh inoculum was prepared by dislodging conidia of the mummy berry pathogen (*Monilinia vaccinii-corymbosi*) from blighted leaf tissues (collected from an infested field in May 2022 and 2023). A conidial suspension (5.75×10^5 conidia/mL) was then applied manually to the stigma of open blueberry flowers using a paintbrush. Following inoculation, freshly collected pollen was applied to the stigma of the flower using a paintbrush to ensure cross-pollination and fruit development. Following inoculation, unopened flowers in the flower cluster were removed and a ribbon was tied to the shoot to differentiate the inoculated flower cluster as well as ensuring the flowers were inoculated only once. Green fruits developing from inoculated flower clusters were harvested and cut transversely to examine the presence of characteristic masses of white fungal growth. This work will be repeated in 2024 with additional genotypes provided by Driscoll's, Fall Creek Farm and Nursery, Inc., and Oregon Blueberry. Resultant information will be provided to breeders and serve as a foundation for resistance breeding.

Objective 3 – Breeder Network and Information Dissemination. We will formalize a regional blueberry breeding network composed of public and private breeders, horticulturists, plant pathologists, crop consultants, and growers. This committee would meet 1-2 times per year to share project information, provide feedback, and coordinate regional trialing efforts within Washington, Oregon, and British Columbia. To promote information sharing, field days will be held every year starting in 2025 during peak fruit production when fruit is available at the field trial site. Information on promising selections will be shared from trials across the regional network. Growers will be asked to engage in blind taste tests to evaluate fruit quality and also rate selections in the trial by walking the field and pointing out selections that they are impressed or dissatisfied with.

Describe how this research will benefit Washington blueberry growers:

Benefits derived from this project will be realized in the future, as cultivar development is a long process. This project represents a significant investment by the industry, with no absolute guarantee of a product. However, this project does benefit growers through the establishment of a partnership between the investigators of this proposal and plant breeders, which will create a formalized framework for the rigorous evaluation of advanced blueberry selections and cultivars within the PNW that encompasses both horticultural and disease assessments. The blueberry breeding network will also ensure that our activities are in alignment with the industry needs and promote coordination.

The mummy berry screening trial will be beneficial by giving breeders a tool and foundation to breed for resistance. The plots can also be leveraged for additional research trials and pruning workshops. In the long term, our goal is that this research will contribute to the release of adapted blueberry cultivars that benefit Washington and other PNW growers.

References:

Ehlenfeldt, M. K., Polashock, J. J., Stretch, A. W., and Kramer, M. 2010. Ranking cultivated blueberry for mummy berry blight and fruit infection incidence using resampling and principal components analysis. HortScience 45:1205–1210.

Budget:

Category	2024	2025
Salaries ^{1/}	\$12,093	\$16,856
Time-Slip ^{2/}	\$0	\$5,400
Operations (goods & services) ^{3/}	\$25,420	\$10,525
Travel ^{4/}	\$4,693	\$4,693
Meetings	\$0	\$0
Other	\$0	\$0
Equipment ^{5/}	\$13,000	\$13,000
Benefits ^{6/}	\$6,000	\$8,816
Total	\$61,206	\$59,290

^{1/}Technical support in Mount Vernon (DeVetter’s program: Rogers at 100% FTE for 0.75 mo at \$3,537/mo and Maupin at 100% FTE at 1 mo at \$4,619/mo) for plant maintenance, harvest support, fruit quality analyses, and data management; Mattupalli’s program: Elcan at 40% FTE at 2 mo at \$3,454/mo) and Prosser (Hoheisel’s program: Blom at 100% FTE for 0.5 mo and 1.5 mo in 2024 and 2025, respectively, at \$4,115/mo).

^{2/}Nonstudent timeslip for harvest support at \$15/hour x 30 hours/week x 10 weeks starting in 2025.

^{3/}Land-use fees (Mount Vernon: \$454/year; Prosser: \$580/year); greenhouse rental for mummy berry trials (\$1,300/year); grower reimbursement for weed management in Prosser (\$350/year); grower reimbursement and fees for raised bed installation, planting support, and installation support for irrigation/ET and fertigation in Prosser (\$11,995 in 2024); Prosser farm equipment rental for mowing, trellis installation, leveling, and tractor work (\$4,000 in 2024 and \$1,000 in 2025); Mount Vernon farm equipment rental for mowing, cover crop establishment, trellis and weedmat installation (\$3,500 in 2024 and \$3,000 in 2025); sample bags for leaf and soil samples, pest monitoring, reagents for fruit quality analyses starting in 2024, and insulated coolers and shipping expenses in both locations (\$150 in 2024 and \$750 in 2025); miscellaneous field supplies including stakes, labels, wires (\$1,500/year); Prosser and Mount Vernon farm equipment maintenance fees and fuel (\$1,500/year).

^{4/}Mileage for DeVetter’s program for roundtrip (RT) travel for pruning and field data collection from Mount Vernon to Prosser (0.655/mi x 370 RT=\$242/trip x 9=\$2,181); per diem for lodging at GSA rates in Prosser for DeVetter (\$118/day x 9 nights=\$1,629); per diem meals and incidentals at GSA rates for DeVetter’s roundtrip travel to Prosser (\$69/day x 9 days=\$621); per diem travel for Hoheisel to the field trial location (20 trips to farm * 20 miles RT * 0.655/mi).

^{5/}Firmness tester in Prosser (2024) and to replace DeVetter’s tester in Mount Veron (2024). DeVetter’s current tester is dated technology, runs on WindowsXP (the manufacturer will not do software updates), and is not expected to last another season.

^{6/}Benefits calculated at: Rogers = 58%; Maupin = 43.4%; Elcan = 53.5%; Blom = 47.5%; nonstudent timeslip = 10.1%.

NOTE: The proposal was initially awarded \$26,665, which was \$13,324 more than the original requested amount, for the project to be expanded into eastern WA. This amount was insufficient and remaining 2023 expenses for the trial in Prosser are added onto this budget. These expenses were largely covered by our grower cooperators who assisted in plot establishment. If this amount is too high for the commission, the PD and co-PIs would welcome a discussion on how to make the costs viable. Also, note we lack a firmness tester in Prosser and the firmness tester in DeVetter’s lab will soon be needing replacement. This adds \$13,000 per year in the equipment category.

*Approved by Susan Kendall on Dec. 11, 2023