Oregon Raspberry & Blackberry Commission

Research Reports
2023 - 2024

Prepared by: Agricultural Research Foundation – February 2024

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Reports

Research Report to the Oregon Raspberry and Blackberry Commission and the Agricultural Research Foundation: 2023-2024

Title: Impact of primocane management and plant spacing on planting performance and net returns of 'Columbia Star' blackberry

Principal Investigators: Amanda Davis, Senior Faculty Research Assistant II, (971) 801-0394; amanda.davis@oregonstate.edu

Scott Lukas, OSU Berry Crops Research Leader, NWREC, Oregon State University, 4017 ALS, Corvallis, OR 97331; scott.lukas@oregonstate.edu

Collaborators: Bernadine Strik, Emeritus Professor, OSU
David Bryla, USDA-ARS, HCRU

Objectives:

The goal of this project is to determine the impact of plant spacing, primocane management and pruning/training treatments on growth, yield, fruit quality, and labor requirements of 'Columbia Star' when machine-harvested for a processed market. This work started in 2020 with a project funded by the Northwest Center for Small Fruits Research and is in collaboration with Dr. David Bryla, who is measuring plant water requirements to determine irrigation needs (with separate funding).

Progress:

A 0.4-acre planting of 'Columbia Star' was established at the OSU North Willamette Research and Extension Center (OSU-NWREC) in 2020.

Treatments:

- In-row spacing: 5 ft. spacing or high density 2.5 ft.
- Pruning/training method: August training or a "new-over-old" system ("NOO", begun in 2021)
  In the traditional August trained system, spent floricanes are removed in late August and new primocanes trained onto the trellis wires. In "new-over-old" (no-prune system), spent floricanes are not removed; new primocanes grow through or are thrown up and over the older canopy.
- Primocane suppression: with or without use of chemical suppressants (begun in 2021)
  Evaluating the impact of using label-recommended rates of cane burning chemicals on labor requirement, plant growth, yield, and machine-harvest efficiency.

Study design: The planting design was established as a split-split plot with spacing as the main plot effect (whole rows), pruning/training treatment as sub-plot (half rows) and primocane suppression as sub-sub plots. There are four replicates of each treatment (32 plots). Each experimental plot is 20 ft. long with plots separated by 10 ft. of un-planted row space, to allow for clearing of fruit from the machine harvester before moving to the next plot. Row spacing is 10 ft. Aisles are maintained weed free using tillage (planting year only), herbicides, and hoeing as needed. The planting is flanked by guard rows. Plants are drip irrigated and fertigated. Primocane suppression occurs once each year between late April and early May, when canes average 12" (timing has not been affected by plant spacing or other treatments to date).

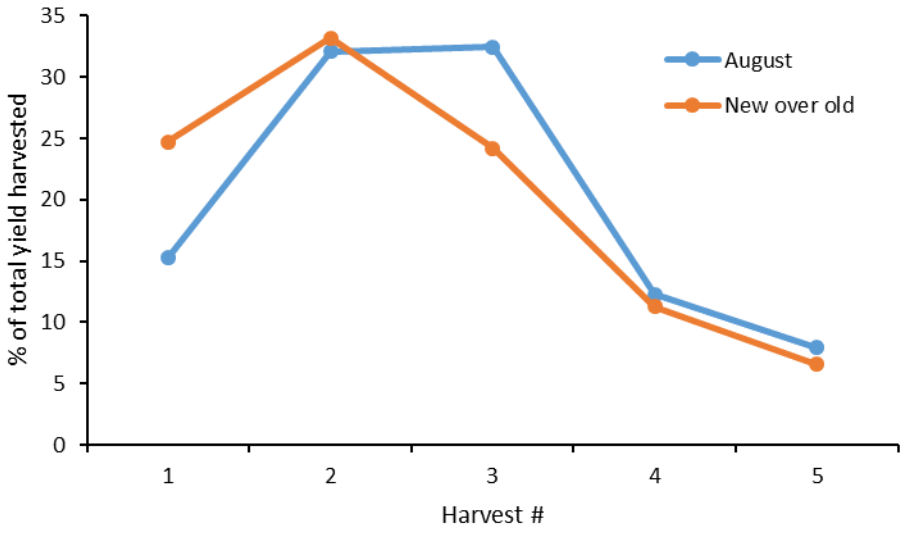
2023 Results:

Yield and fruit quality: 2023 was the third harvest year, with five harvests between June 29 and July 13. Yield was down for all treatments compared to 2022 (averaged 4.3 tons/acre in 2023 vs. 7.5 tons/acre in 2022). Yield per plant was higher for 5 ft. spacing (9.4 lb.) compared to 2.5 ft. (5.1 lb.), and for new-over-old (8.9 lb.) compared to august training (5.6 lb.). In 2021 and 2022, high density planting resulted in higher yield per acre, but for the first time in 2023, yield per acre was not statistically different between plant spacing, averaging 4.3 tons. NOO also yielded higher (5.2 tons/acre) than August trained plants (3.3 tons/acre). The percentage of fruit dropped on the ground during harvest was higher with August training at 5 ft. spacing (12%) than NOO (7%), but not different by training method at 2.5 ft. spacing. In contrast, there was a higher percentage of culled fruit (non-marketable, sorted out on the machine harvester conveyer belt) with NOO (5.5%) than August training (4.3%) at 2.5 ft. but no difference at 5 ft. spacing. These differences in cull are relatively small, but follow similar patterns as past years. Primocane suppression had no impact on dropped or culled fruit in 2023 and any minor effects on yield (per plant or per acre) were greatly outweighed by the effect of training or plant spacing.

In past years, training method had no effect on berry weight but in 2023, NOO resulted in heavier berries (7.0 g) than August trained (6.6 g). Plant spacing and primocane suppression did not impact berry weight this season. 2023 was the first year we measured total soluble solids (°Brix). August trained plants at 2.5 ft. spacing had higher °Brix than NOO (14.0 vs. 12.8), whereas there was no difference at 5 ft. spacing because NOO had higher °Brix at 5 ft. spacing (averaged 13.7). When primocanes were not suppressed, there was no difference in °Brix by plant spacing (averaged 13.5), but when they were suppressed, °Brix was higher at 5 ft. spacing (13.9 vs. 13.3). All these average values are above the reported °Brix in the 'Columbia Star' cultivar release paper, suggesting that they would be considered marketable and fully ripe when harvested.

New-over-old plants ripened slightly faster than August trained (Figure 1), with a significantly higher percentage of fruit picked from NOO plants on harvest 1 than August trained plants, and a lower percentage on harvest 3. Plant spacing did not affect the rate of ripening, and primocane suppression had a relatively minor interaction with training method on the fourth harvest (data not shown).

Figure 1: Percentage of fruit harvested at each of five harvests in 2023.



Cane growth and fruiting components: Plants were caned out (August training only) and trained in mid-August and primocanes were counted and measured. In all years, plants grown at 5 ft. spacing have had more primocanes per plant than at 2.5 ft. (2023 shown in Table 1). Primocane suppression increased cane number per plant in 2021 and 2023 but not in 2022 (data not shown), and reduced cane length in 2023. August training started showing an effect on cane number in 2022, but resulted in significantly more primocanes per plant in 2023 than NOO. Canes were much shorter in 2022 which could have been due in part to the cool, wet spring that delayed phenology, but a higher fruit yield that year may also have directed resources away from the primocanes.

In addition to primocanes, we measured floricane fruiting lateral length and number of berries per lateral. Lateral length averaged 15 inches and was not affected by any treatment (Table 1). Berry number increased from an average of 4 per lateral in 2021 to 4.8 in 2022 but decreased again in 2023 which contributed (along with lower berry weights and shorter primocanes in 2022) to the reduced yield this year. New-over-old has generally had more berries per lateral than August trained, and we saw a similar trend this year.

Table 1: Primocane and floricane growth and productivity in 2023

Treatment	# Primocanes/ plant	Primocane length (ft)	Floricane lateral length (in)	# Berries/ lateral
Plant spacing (ft)				
2.5	13	16	15	4.4
5	15	18	14	4.3
Primocane suppression (PS)				
No PS	12	19	14	4.2
With PS	16	16	15	4.5
Training				
August	16	19	14	4.1
New-over-old	12	16	15	4.7
Significance				
Spacing	0.0177	NS	NS	NS
PS	<.0001	0.0485	NS	NS
Spacing x PS	NS	NS	NS	NS
Training	0.0003	NS	NS	0.0558
Spacing x Training	NS	NS	NS	NS
PS x Training	0.0419	NS	NS	NS
Spacing x PS x Training	NS	NS	NS	NS

Training time: While we are not able to statistically compare recorded times for various training activities, the results presented are accurate representations of relative labor requirements. Caning out and training primocanes for August trained plants grown at 2.5 ft. required about 40% more time per linear ft. of row than those at 5 ft. (4.4 min./ft. compared to 2.7 min./ft.), but less time per plant (10.9 min./plant compared to 13.4 min. at 5 ft.). New-over-old training required more time per linear ft for 2.5 ft. spacing (28 seconds) than for 5 ft. spacing (23 seconds) but less time per plant (1.2 min./plant compared to 1.9 min./plant for 5 ft.). As expected, NOO required significantly less time than August training, with an 87% reduction in labor hours at 2.5 ft. spacing and an 81% reduction at 5 ft. spacing. While NOO training was faster in 2022 than in 2021 because there was a larger existing canopy for primocanes to grow into, thus

requiring less labor later in the season, training time increased in 2023 due to plants having more and longer primocanes. Primocane suppression reduced training time by approximately 24 seconds/plant with August training but did not affect training time for NOO in 2023. At 2.5 ft. spacing, primocane suppression also reduced training time by 24 seconds/plant but had little effect at 5 ft. spacing. While the times presented here are based on student labor and are likely slower than a trained professional crew, the relative differences remain applicable in a commercial setting.

Economics: Based on the above results for yield and labor cost, we are establishing a basic economic analysis by treatment. Average price paid to growers was calculated at $0.84/lb. based on assessment reports from 2018-2020 collected by the Oregon Raspberry and Blackberry Commission. Prices from 2021 and 2022 were omitted from the calculation because of the devastating impact of the 2021 heat dome which inflated prices beyond typical levels. Pricing from 2023 will be incorporated when available. Labor costs are estimated at $22/hour for general labor and $30/hour for tractor operators, which includes worker's compensation, unemployment, insurance, and overhead expenses. Primocane suppression comes at a relatively low cost compared to training, estimated at $58/acre including labor and herbicide product. In contrast, NOO training costed approximately $950/acre and August training costed between approximately $4900/acre (5 ft. spacing) and $7500/acre (2.5 ft. spacing) in 2023. Due to the lower yield this year, the cost of training at 2.5 ft. was more than the income potential from fruit sales, and these estimates do not include the many other farm- and production-related expenditures. The greatest net return came from plants grown at 2.5 ft. spacing and trained using the NOO method ($8,151/acre), about $600 more than NOO at 5 ft. spacing. The lowest return came from 2.5 ft. spacing with August training ($-1,752), $2,200 less than August training at 5 ft. spacing. Returns were slightly higher with primocane suppression because of the reduced labor cost for training, even though yields were similar with or without suppression.

Summary:

During the third fruiting season, plants grown at high density spacing (2.5 ft.) produced similar yield per acre and berry size compared to those grown at a typical plant spacing of 5 ft. Yield was highest with NOO training and labor costs were reduced significantly compared to traditional August training. We will continue this study for one more year to better understand multi-year and cumulative treatment effects on yield and cost of production as the plants continue to mature.

Progress Report to the Agricultural Research Foundation, 2023-2024

Title: Evaluating the Performance of Blackberry Cultivars Grown under Heat Stress.

Principal Investigator:
Michael Hardigan, Research Geneticist,
USDA-ARS, HCPGIRU
3420 NW Orchard Ave, Corvallis, OR 97330
Phone: (541) 738-4037
Email: michael.hardigan@usda.gov

Cooperators: David Bryla, Research Horticulturist, USDA-ARS, HCPGIRU
Lisa Wasko-Devetter, Associate Professor, WSU NWREC

Objectives:

- Establish a multi-year, replicated trial to assess the impacts of heat damage in commercial cultivars and advanced selections of blackberry and to identify genotypes with higher resilience to heat stress.
- Collect three years of phenotypic data on each genotype, including plant growth, leaf damage, canopy temperature, yield, and fruit quality (berry weight, firmness, sunburn, color, and soluble solids) for developing new cultivars with higher resilience to heat damage.

Progress

We are on track to plant a genetically diverse population of 25 blackberry cultivars and USDA advanced selections (Table 1) at the Washington State University Irrigated Agriculture Research and Extension Center (IAREC) site located in Prosser, WA in 2024 to support the proposed blackberry heat tolerance trial. We have secured a half-acre of land at the WSU Roza farm site where other small fruit experiments are being conducted. We intend to contract with the Olsen Brothers for field maintenance to ensure trial plots are properly cared for (field preparation, weed management, irrigation installation, fertility management). Planting will occur in May of 2024 upon delivery of plants from North American Plants, Inc. Blackberries will be planted in a randomized complete block (RCB) design with 5 replicates of 5-plant plots and trained using a two-wire trellis system. Data collection will begin in 2025 after establishment in 2024.

Table 1. Proposed diversity panel of 25 blackberry varieties to include in heat stress trial at WSU-IAREC.

Name	Type	Flowering	Origin
Caddo	erect	floricane	Arkansas
Natchez	erect	floricane	Arkansas
Navaho	erect	floricane	Arkansas
Osage PPAF	erect	floricane	Arkansas
Ouachita	erect	floricane	Arkansas
Ponca	erect	floricane	Arkansas
Prime-Ark 45	erect	primocane	Arkansas
ORUS 4999-2 (Thunderhead)	erect	primocane	Oregon
Tupi	erect	floricane	Brazil
Black Satin	semi-erect	floricane	Unknown
Chester	semi-erect	floricane	Illinois
Eclipse	semi-erect	floricane	Oregon
Loch Ness	semi-erect	floricane	Scotland
ORUS 4670-1 (Celestial)	semi-erect	floricane	Oregon
Triple Crown	semi-erect	floricane	Illinois
Twilight	semi-erect	floricane	Oregon
Black Diamond	trailing	floricane	Oregon
Columbia Star	trailing	floricane	Oregon
Kotata	trailing	floricane	Oregon
Marion	trailing	floricane	Oregon
Newberry	trailing	floricane	Oregon
Obsidian	trailing	floricane	Oregon
ORUS 4222-1 (Zodiac)	trailing	floricane	Oregon
ORUS 4344-3	trailing	floricane	Oregon
ORUS 4892-1	trailing	floricane	Oregon

Progress Report to the Agricultural Research Foundation, 2023-2024

Title: Virus testing of cooperative raspberry and blackberry breeding programs.

Principal Investigator:
Michael Hardigan, Research Geneticist,
USDA-ARS, HCPGIRU
3420 NW Orchard Ave, Corvallis, OR 97330
Phone: (541) 738-4037
Email: michael.hardigan@usda.gov

Cooperators: Dimitre Mollov, Research Plant Pathologist, USDA Corvallis
Wendy Hoashi-Erhardt, Program Lead, WSU Puyallup REC
Mary Peterson, Technician, USDA-ARS, HCPGIRU
Scott Lukas, Berry Crops Research Leader, NWREC
Patrick Jones, Senior Faculty Research Assistant I, NWREC
Amanda Davis, Senior Faculty Research Assistant I, NWREC
Michael Dossett, Berry Cultivar Development Inc.

Objectives:

- Testing field plots at breeding program core research and propagation locations for viruses common in PNW in order to verify clean or infected status.
- Maintaining breeding populations of clean, virus-free plant material to support efficient generation of new breeding families and advanced selections.
- Updated report of virus infection-status and susceptibility following each season.

Progress

We performed virus testing by ELISA test for three important viruses that effect raspberry and blackberry in the PNW: raspberry bushy dwarf virus (RBDV), strawberry necrotic shock virus (SNSV), and tomato ringspot virus (ToRSV). Testing was conducted for all trial plots at the OSU North Willamette Research and Extension Center (OSU-NWREC) in Aurora, OR, and we are in the process of running ELISA assays for the foundation/parental block plots located at OSU Lewis Brown Farm in Corvallis, OR. This totaled roughly 1,050 plots to-date. The results have identified infected plant material, indicating the susceptibility of a range of selections and cultivars contained in the USDA raspberry and blackberry breeding material, and identifying plots that are safe or unsafe to use for generating future breeding families. Both RBDV and SNSV appear to infect red and black raspberry much more quickly and readily than blackberry, with a large number of both being infected and relatively few blackberry plots. Black raspberries were particularly susceptible to SNSV, with a majority of fields being infected. ToRSV appears to pose the lowest risk of infection at the moment, with only one selection (ORUS 4715-2) identified as containing the virus. Raspberry selections that have remained virus-free for 6 or more years will be used as parents to develop new selections that are slow to develop infection.

Blackberry –

- **RBDV –** Results indicate that blackberries, while potentially susceptible, are slow to become infected with RBDV compared with red and black raspberries. We identified RBDV-infected

plots of Black Diamond, Metolius, and Nightfall. Each were in plantings that were at least five years old.

- **SNSV –** Similar to RBDV, blackberries appear less susceptible to SNSV infection than raspberry, with observation of infected plants of ORUS 5138-2, Prime Ark 45, and Silvan.
- **ToRSV –** We did not identify any cases of ToRSV in blackberry.

Red Raspberry –

- **RBDV –**
  - Approximately 25% of red raspberries indicated susceptibility to RBDV infection at the OSU-NWREC.
  - Notable selections that have been planted in 2018 or 2019 (5+ year old plots) and remain free of RBDV infection include: Cascade Harvest, Finnberry, Heritage, Kokanee, Meeker, ORUS 4487-1, ORUS 4858-2, ORUS 4978-3, ORUS 5114-1, Vintage, and Wakefield.
- **SNSV –**
  - Approximately 35% of red raspberries indicated susceptibility to SNSV infection at the OSU-NWREC.
  - Notable selections that have been planted in 2018 or 2019 (5+ year old plots) and remain free of RBDV infection include: ORUS 4858-2, ORUS 4961-1, ORUS 4965-3, ORUS 4974-1, ORUS 4978-3, ORUS 5106-1, ORUS 5114-1, ORUS 5250-1, Polka, Wakefield, and Wakehaven.
- **ToRSV –** We identified a single red raspberry plot containing ORUS 4715-2 that was infected with ToRSV.

Black raspberry –

- **RBDV –**
  - Approximately 20% of black raspberries indicated susceptibility to RBDV infection at the OSU-NWREC.
  - Notable selections that have been planted in 2018 (6 year old plots) and remain free of RBDV infection include: ORUS 3038-1, ORUS 3217-1, ORUS 3381-3, ORUS 4110-2, ORUS 4395-1, ORUS 4412-2, ORUS 4820-1, ORUS 4945-2, ORUS 4958-1, ORUS 5076-1, and ORUS 5083-1.
- **SNSV –**
  - ***NEARLY ALL black raspberries located at the OSU-NWREC were found to be infected with SNSV*, including new plots, reflecting the extreme susceptibility of this crop to infection compared with other *Rubus* species.**
  - Notable selections that remained free of SNSV infection included Jewel, ORUS 4833-1, ORUS 5083-1, and ORUS 5088-2. ORUS 5083-1 is a hybrid derived from the Korean black raspberry, highlighting the importance of incorporating new genetic diversity into PNW germplasm.
- **ToRSV –** We did not identify any cases of ToRSV in black raspberry.

Table 1. Susceptibility (S) vs. clean (-) status for relevant cultivars and nursery list selections tested at OSU-NWREC in 2023 for RBDV, SNSV, and ToRSV. Clean status does not guarantee resistance, only that the tested plants did not contain virus.

Blackberry	**RBDV**	**SNSV**	**ToRSV**
Black Diamond	S	-	-
Celestial	-	-	-
Columbia Giant	-	-	-
Columbia Star	-	-	-
Columbia Sunrise	-	-	-
Eclipse	-	-	-
Galaxy	-	-	-
ORUS 4344-3	-	-	-
ORUS 4663-1	-	-	-
ORUS 4892-1	-	-	-
ORUS 5037-1	-	-	-
ORUS 5041-1	-	-	-
Thunderhead	-	-	-
Twilight	-	-	-
Zodiac	-	-	-
Red Raspberry	**RBDV**	**SNSV**	**ToRSV**
Cascade Harvest	-	-	-
Finnberry	-	S	-
Kokanee	-	-	-
Meeker	-	S	-
ORUS 4487-1	-	S	-
ORUS 4715-2	S	S	S
ORUS 4858-2	-	-	-
ORUS 4974-1	S	-	-
ORUS 5106-1	S	S	-
ORUS 5209-1	-	S	-
Vintage	-	S	-
Wakefield	-	-	-
Wakehaven	-	-	-
Black Raspberry	**RBDV**	**SNSV**	**ToRSV**
Jewel	-	-	-
Munger	S	S	-
ORUS 3217-1	-	S	-

ORUS 3381-3	-	S	-
ORUS 4310-1	S	S	-
ORUS 4820-1	-	S	-
ORUS 4833-1	-	-	-
ORUS 5083-1	-	-	-
ORUS 5308-1	-	S	-

Research Report to the Oregon Raspberry and Blackberry Commission
and the Agricultural Research Foundation
2023-2024

TITLE: Caneberry Pesticide Registration, Tracking, and New Chemistries

PRINCIPAL INVESTIGATOR: Dani Lightle
Assistant Professor (Practice)
North Willamette Research and Extension Center
15210 NE Miley Rd, Aurora, Oregon
danielle.lightle@oregonstate.edu

OBJECTIVES:

1. Keep the caneberry industry informed of new developments in pest management trends and pesticide registration issues.

2. Update & maintain the Pesticide Registration chart and MRL chart for Oregon caneberry producers.

3. Provide data or information to pesticide regulatory agencies that are necessary to ensure the pest management needs of Oregon's caneberry growers are being met.

PROGRESS:

- Four trials were conducted under Good Laboratory Practices (GLPs) to support registration of new active ingredients in caneberry. Three studies were on cyflumetofen (trade name: Nealta), and the fourth was on novaluron+acetamiprid (trade name: Cormoran).
    - Cyflumetofen (Nealta) is a miticide. One trial was conducted at NWREC, and two trials were conducted with grower cooperators.
    - Novaluron+acetamiprid (Cormoran) is an insecticide that is requested for control of spotted wing drosophila. The trial was conducted at NWREC.
- The pesticide MRL charts were updated June 2023. The registration chart was updated in March and June 2023. The most recent charts, which have been distributed to industry stakeholders, are available at the end of this report. The most recently updated charts are available online at this website: https://agsci.oregonstate.edu/nwrec/research/ir-4specialty-crops-registration
- Table 1 shows pesticide registration activities that have occurred within EPA in 2023. A new material, Miravis Prime, is now available for use in caneberry.

Objective 3: All EPA pesticide re-registration activity was tracked through 2022. A comment was submitted to EPA on the proposed interim decision (PID) for zinc phosphide. I also submitted comments on two proposals related to EPA compliance with the Endangered Species Act (Vulnerable Species Pilot Plan, and the Draft Herbicide Strategy). Both of these plans have significant impacts on how pesticides will be regulated in the future, and are not workable for Oregon's specialty crop industries, as proposed. I am continuing ongoing conversations with EPA and other stakeholders to look for solutions that will

meet the Endangered Species Act requirements without placing undue responsibility on agricultural producers.

Other Pesticide Registration Research Center activities which impact the Oregon Caneberry Industry:

- I serve as the Network Coordinator for the Pacific Northwest, a signature program through the Western Region IPM Center. The Network Coordinator follows the EPA Pesticide Re-registration Review process, solicits feedback from OSU/WSU specialists and industry contacts about the impacts of proposed label changes, and submits informed comments to EPA to aid their decision making process.

Table 1. Pesticide registration activity in 2023 that is relevant to the caneberry industry.

Active ingredient	**Trade name**	**Type of material / use**	**Status**
Difenoconazole	Component of several premixes	Fungicide	EPA PRIA date was June 2023; tolerance not yet set
Flonicamid	Beleaf	Insecticide	Tolerance established September 2023
*Pydiflumetofen	Miravis Prime (pre-mix pydiflumetofen + fludioxonil)	Fungicide	Tolerance established February 2023; supplemental label for use is available
Pyraziflumid	Parade	Fungicide	EPA PRIA date July 2025
Saflufenacil	Treevix	Herbicide	Tolerance set; label not available
Trifloxystrobin	Flint	Fungicide	Tolerance set; label not available

An A.I. preceded by an asterisk (*) indicates that a label is currently available for growers to use.

Insecticide & Miticide Registrations in Oregon Caneberries – June 2023

Dani Lightle, Pesticide Registration Research Leader, Oregon State University
danielle.lightle@oregonstate.edu

This document is a guide and not intended as a recommendation or endorsement of the pesticides listed within. Trade names are given as examples only, and other products containing the same active ingredient may also be available. Target pests named are as listed on the product label(s) consulted for this document. Pesticide registrations and labels are subject to change at any time. Read pesticide labels carefully and consult with your supplier, field representative, pest consultant or OSU Extension Service Agent prior to pesticide use.

Always remember – *the label is the law*.

Active Ingredient	Example trade Name	IRAC[1]	REI[2] (hours)	PHI[3] (days)	Aphids	Leafrollers	Root Weevils	Mites	Fruitworm	Thrips	SWD	Crown Borer	Others
Abamectin/Avermectin	AgriMek	6	12	7				✓					
Acequinocyl	Kanemite	20B	12	1				✓					
Acetamiprid	Assail	4A	12	1	✓				✓	✓			leafhoppers
Beauveria bassiana	Mycotrol	UNF	4	0	✓								many insects (see label)
Bifenazate	Acramite, Vigilant	20D	12	1				✓					
Bifenthrin	Brigade	3A	12	3		✓	✓	✓			✓	✓	
Bt	DiPel, Javelin, etc.	11A	4	0		✓							other leps (see label)
***Burkholderia* spp.**	Venerate XC	?	4	0	✓	✓			✓	✓	✓		
Carbaryl	Sevin	1A	12	7	✓	✓			✓				other insects (see label)
Chlorantraniliprole	Altacor	28	4	3		✓						✓	
***Chromobacterium* spp.**	Grandevo WDG	?	4	0	✓	✓			✓	✓	✓		
Cyantraniliprole	Exirel	28	12	1			✓				✓		
Cyclaniliprole	Verdepryn	28	4	1		✓			✓		✓	✓	Other insects (see label)
Diazinon	Diazinon	1B	5 days	7					✓			✓	
Esfenvalerate	Asana XL	3A	12	7	✓	✓	✓						
Etoxazole	Zeal	10B	12	0				✓					
Fenazaquin	Magister SC	21	12	7				✓					
Fenbutatin-Oxide	Vendex *(Raspberry only)*	12B	48	3				✓					
Fenpropathrin	Danitol	3A	24	3		✓		✓	✓		✓		armyworm, leafhoppers, lygus bug, stinkbug
Fenpyroximate	FujiMite SC	21A	12	1									mites, leafhoppers
Flupyradifurone	Sivanto	4D	4	0	✓								

Active Ingredient	Example trade Name	IRAC[1]	REI[2]	PHI[3]	Aphids	Leafrollers	Root Weevils	Mites	Fruitworm	Thrips	SWD	Crown Borer	Others
GS-omega/kappa	Spear-Lep	32	4	0		✓			✓				Other leps (see label)
Hexythiozox	Savey	10A	12	3				✓					
Imidacloprid	Admire Pro (foliar)	4A	12	3	✓					✓			leafhoppers
Imidacloprid	Admire Pro (soil)	4A	12	7	✓								leafhoppers
Malathion	Malathion	1B	12	1	✓			✓		✓			leafhoppers
Methoxyfenozide	Intrepid	18	4	3		✓			✓				armyworm
Neem	AzaDirect, etc.	UNE	4	0	✓	✓							other insects/mites
Oil	BioCover, 6E, etc.	UNE	4	0				✓					other insects (see label)
Propargite	Omite	12C	10	365				✓					
Pyrethrin	Pyganic	3A	12	0	✓	✓							other insects (see label)
Pyriproxyfen	Esteem/Knack	7C	12	7					✓				scale
Soaps	Safer, M-Pede	?	12	0	✓								
Spinetoram	DelegateWG	5	4	1		✓			✓	✓	✓		armyworm, looper
Spinosad	Success, Entrust	5	4	1		✓			✓				armyworm, looper
Sulfoxaflor	Transform WG	4C	24	1	✓								leafhoppers
Tebufenozide	Confirm	18	4	14		✓							other leps (see label)
Thiamethoxam	Actara	4A	12	3	✓		✓						leafhoppers, stinkbugs
Tolfenpyrad	Bexar	21A	12	1	✓	✓					✓		leafhoppers
Zeta-cypermethrin	Mustang	3A	12	1		✓	✓						

[1]IRAC: Insecticide (and Miticide) Resistance Action Committee Code Number. Insecticides/ Miticides with the same number should not be used consecutively, as they are similar in chemistry and/or mode of action and doing so may increase the risk of insecticide resistance.

[2]PHI: The preharvest interval (PHI) is the amount of time that must elapse between the last application of a pesticide and harvest of the crop. PHI (usually days) is found on the label in the use directions for each crop that is listed on the label.

[3]REI: All pesticide products have a prescribed-time restricted entry interval (REI) for worker protection. REI is clearly stated in the Agricultural Use Requirements section on the label. Generally, entry into treated areas during the prescribed time (usually hours) REI is not allowed unless Personal Protective Equipment (PPE) is worn or used.

Active Ingredients in **bold type** indicates some formulations are approved for organic production.

Fungicide Registrations in Oregon Caneberries – November 2023

Dani Lightle, Pesticide Registration Research Leader, Oregon State University
danielle.lightle@oregonstate.edu

This document is a guide and not intended as a recommendation or endorsement of the pesticides listed within. Trade names are given as examples only, and other products containing the same active ingredient may also be available. Target pests named are as listed on the product label(s) consulted for this document. Pesticide registrations and labels are subject to change at any time. Read pesticide labels carefully and consult with your supplier, field representative, pest consultant or OSU Extension Service Agent prior to pesticide use.

Always remember – *the label is the law*.

Active Ingredient	Example Trade Name	FRAC[1]	REI[2]	PHI[3]	Anthracnose	Powdery Mildew	Botrytis	Septoria Leaf Spot	Spur Blight	Root Rot	Rust	Other
Aureobasidium pullulans	Botector	?	4	0	✓		✓					
Azoxystrobin	Abound	11	4	0	✓	✓		✓	✓		✓	
Azoxystrobin + propiconazole	QuiltXcel	11 + 3	12	30	✓	✓		✓			✓	
Bacillus subtilis	Serenade	?	4	0	✓		✓					
Boscalid + pyraclostrobin	Pristine	7 + 11	12	0	✓	✓	✓	✓	✓		✓	
Calcium polysulfide	Lime Sulfur (Rex)	?	See label	Delayed dormant	✓	✓		✓	✓		✓	Cane blight
Captan	Captan	M4	48	3	✓		✓		✓			
Captan + fenhexamid	Captevate (Raspberry only)	M4+ 17	48	3	✓		✓		✓			
Copper	Kocide, Champ, etc.	M1	48	0	✓			✓			✓	Purple blotch
Cymoxanil + famoxadone	Tanos	27 + 11	12	0	✓			✓	✓			
Cyprodinil + fludioxonil	Switch	9+12	12	0	✓		✓					
Fenhexamid	Elevate	17	12	0			✓					
Fluopyram + pyrimethanil	Luna Tranquility	7+9	12	0		✓	✓	✓				
Fosetyl-al	Aliette	33	12	60						✓		
Iprodione	Rovral, Meteor	2	24	0			✓					
Isofetamid	Kenja	7	12	7			✓					
Mefenoxam	Ridomil Gold SL	4	48	45						✓		

Active Ingredient	Example Trade Name	FRAC[1]	REI[2]	PHI[3]	Anthracnose	Powdery Mildew	Botrytis	Septoria Leaf Spot	Spur Blight	Root Rot	Rust	Other
Mefenoxam + Copper Hydroxide	Ridomil Gold Copper	4 + M1	48	0								Downy mildew
Metalaxyl	MetaStar	4	48	See label						✓		
Myclobutanil	Rally	3	24	0		✓					✓	
Oil	BioCover; Sun; JMS	?	4	Delayed dormant or postharvest		✓						
Oxathiapiprolin	Orondis Gold 200	U15	4	1						✓		
Phosphorous acid	Fosphite, Phostrol	33	4	None listed		✓				✓		Downy Mildew
Polyoxin-D	Ph-D, Oso	19	4	0	✓	✓	✓					
Potassium bicarbonate	Kaligreen	?	4	1		✓						
Penthiopyrad	Fontelis	7	12	0			✓		✓		✓	
Propiconazole	Tilt, others	3	12	30		✓		✓			✓	
Pydiflumetofen + fludioxinil	Miravis Prime	7 + 12	12	0		✓	✓		✓			Alternaria
Pyraclostrobin	Cabrio	11	12	0	✓	✓	✓	✓	✓		✓	
Pyriofenone	Prolivo	50	4	0		✓						
Reynoutria sachalinensis	Regalia	P5	4	0	✓	✓	✓				✓	
Streptomyces lydicus	Actinovate	?	4	0			✓					
Sulfur	Microthiol, others	M2	24	None listed		✓		✓				Downy mildew

[1]FRAC: Fungicide Resistance Action Committee Code Number. Fungicides with the same number should not be used consecutively, as they are similar in chemistry and/or mode of action and doing so may increase the risk of resistance.

[2]PHI: The preharvest interval (PHI) is the amount of time that must elapse between the last application of a pesticide and harvest of the crop. PHI (usually days) is found on the label in the use directions for each crop that is listed on the label.

[3]REI: All pesticide products have a prescribed-time restricted entry interval (REI) for worker protection. REI is clearly stated in the Agricultural Use Requirements section on the label. Generally, entry into treated areas during the prescribed time (usually hours) REI is not allowed unless Personal Protective Equipment (PPE) is worn or used.

Active Ingredients in **bold type** indicates some formulations are approved for organic production.

Herbicide and Misc. Registrations in Oregon Caneberries – June 2023

Dani Lightle, Pesticide Registration Research Leader, Oregon State University
danielle.lightle@oregonstate.edu

This document is a guide and not intended as a recommendation or endorsement of the pesticides listed within. Trade names are given as examples only, and other products containing the same active ingredient may also be available. Target pests named are as listed on the product label(s) consulted for this document. Pesticide registrations and labels are subject to change at any time. Read pesticide labels carefully and consult with your supplier, field representative, pest consultant or OSU Extension Service Agent prior to pesticide use.

Always remember – *the label is the law*.

Active Ingredient	Example Trade Name	HRG[1]	REI[2] (hours)	PHI[3] (days)	PRE	POST	Grass	Broadleaf	Others
Acetic acid	Vinagreen	?	48	2		✓	✓	✓	
Bentazon	Basagran	6	48	365 (non-bearing)		✓		✓	sedges
Caprylic & Capric acids	Suppress	?	24	0		✓	✓	✓	
Carfentrazone-ethyl	Aim	14	12	15		✓		✓	Primocane suppression
Clethodim	Select Max; Arrow	1	24	7		✓	✓		
Clopyralid	Stinger	4	12	30		✓			
Dichlobenil	Casoron	20	12	Avoid new shoots	✓			✓	some grasses
Diquat dibromide	Reglone	22	24	365 (non-bearing)		✓	✓	✓	
Diuron	Karmex	7	12	Late Spring or Fall	✓		✓	✓	
Fluazifop-P-Butyl	Fusilade	1	12	1		✓	✓		
Flumioxazin	Chateau	14	12	7	✓			✓	some grasses
Fluridone	Brake On!	12	48	30	✓		✓	✓	
Glyphosate	Roundup, Others	9	4	14		✓	✓	✓	
Halosulfuron	Sandea	2	12	14	✓	✓		✓	nutsedge
Indaziflam	Alion	29	12	Prior to bud swell	✓		✓	✓	
Isoxaben	Trellis	21	12	60	✓			✓	
Mesotrione	Callisto	27	12	Pre-bloom	✓	✓		✓	
Napropamide	Devrinol	15	24	Spring/Fall use	✓		✓	✓	
Norflurazon	Solicam	12	12	60	✓		✓	✓	
Oryzalin	Surflan	3	24	Spring or Fall use	✓		✓	✓	
Oxyfluorfen	Goal	14	24	*Raspberry* = 50 *Blackberry* = 15	✓	✓		✓	Primocane suppression

Active Ingredient	Example Trade Name	HRG[1]	REI[2] (hours)	PHI[3] (days)	PRE	POST	Grass	Broadleaf	Others
Paraquat	Gramoxone	22	24	Avoid new shoots		✓	✓	✓	
Pelargonic acid	Scythe	17	12	1		✓	✓	✓	
Pendimethalin	Aquapen 3.8 Herbicide	3	24	30	✓		✓	✓	
Pronamide	Kerb	3	24	Fall or Winter use	✓		✓	✓	
Quinclorac	Quinstar	4	12	30	✓	✓	✓	✓	
Rimsulfuron	Matrix	2	4	21	✓	✓	✓	✓	
Sethoxydim	Poast	1	12	45		✓	✓		
Simazine	Simazine; Princep	5	12	Spring or Fall use	✓		✓	✓	
S-metolachlor	Dual Magnum	15	24	28	✓		✓	✓	nutsedge
Sulfentrazone	Zeus XC	14	12	3	✓		✓	✓	nutsedge
Terbacil	Sinbar	5	12	70	✓		✓	✓	

Misc.

Active Ingredient	Example Trade Name	REI[3] (hours)	PHI[2] (days)	Purpose (as listed on label)
Ethephon	Ethrel (Blackberry only)	48	3	PGR, promotes fruit ripening
Iron Phosphate	Sluggo	0	0	Slugs and snails
Metaldehyde	Deadline, others	12	0	Slugs and snails
Zinc Phosphide	Prozap ZP Pellets	?	70 (Dormant use only)	Rodents (voles)

[1]HRG: Herbicide Rotation Guide (from the Weed Science Society of America). Based on mode of action. To avoid selecting for herbicide-resistant weeds, do not use herbicides from the same group more than once within three years. Rather, rotate to a different group every year of the production system.

[2]PHI: The preharvest interval (PHI) is the amount of time that must elapse between the last application of a pesticide and harvest of the crop. PHI (usually days) is found on the label in the use directions for each crop that is listed on the label.

[3]REI: All pesticide products have a prescribed-time restricted entry interval (REI) for worker protection. REI is clearly stated in the Agricultural Use Requirements section on the label. Generally, entry into treated areas during the prescribed time (usually hours) REI is not allowed unless Personal Protective Equipment (PPE) is worn or used.

Active Ingredients in **bold type** indicates some formulations are approved for organic production.

Raspberry Maximum Residue Limits (MRLs) for USA and Foreign Trade Markets - Insecticides

Dani Lightle, Pesticide Registration Research Leader, Oregon State University
danielle.lightle@oregonstate.edu

Current as of: June 20, 2023

Active Ingredient	Example Trade Name	USA	Australia	Canada	China	CODEX	EU	Great Britain	Hong Kong	Japan	Korea	Taiwan
Abamectin	AgriMek	0.2	0.2	0.2	0.2	0.2	{0.08}	{0.08}	---	{0.05}	0.2	{0.02}
Acequinocyl	Kanemite	4	{0.02}	4	{0.01}	---	{0.01}	{0.01}	---	{0.01}	{0.5}	---
Acetamiprid	Assail	1.6	2	4	2	2	2	2	---	2	{1}	{1}
Bifenazate	Acramite	5	7	5	---	7	7	7	---	7	{0.5}	---
Bifenthrin	Brigade	1	3	1	---	1	1	1	1	1	1	1
Carbaryl	Sevin	12	15	{10}	---	---	{0.01}	{0.01}	---	12	{0.01}	{0.5}
Chlorantraniliprole	Altacor	1.8	2.5	{0.9}	{1}	{1}	{1.5}	{1}	{1}	2	{1}	1.8
Cyantraniliprole	Exirel	4	{0.05}	4	4	---	{0.01}	{1.5}	---	{0.01}	{0.3}	---
Diazinon	Diazinon	0.75	{0.5}	{0.1}	---	{0.2}	{0.01}	{0.01}	{0.2}	{0.2}	{0.01}	{0.5}
Esfenvalerate	Asana	1	1	{0.1}	{0.2}	---	{0.02}	{0.02}	{0.2}	1	{0.01}	1
Etoxazole	Zeal	1.5	{0.5}	1.5	---	---	{0.01}	{0.01}	---	{0.01}	{0.2}	{0.01}
Fenbutatin-Oxide	Vendex	10	{1}	{0.1}	---	---	{0.01}	{0.01}	10	10	{0.01}	---
Fenpropathrin	Danitol	12	---	12	{5}	---	{0.01}	{0.01}	{5}	12	{0.01}	{3}
Fenpyroximate	FujiMite	3	3	{0.1}	---	---	{1.5}	{1.5}	---	3	{0.7}	{0.5}
Flupyradifurone	Sivanto	5	6	5	---	6	6	6	---	{0.01}	{1}	---
Hexythiazox	Savey	3	{1}	{1.5}	---	---	{0.01}	{0.5}	---	{0.01}	{0.01}	{1}
Imidacloprid	Admire	2.5	5	2.5	5	5	{0.01}	5	5	4	{1.5}	{1}
Malathion	Malathion	8	10	8	---	---	{0.02}	{0.02}	8	8	{6}	{0.01}
Methoxyfenozide	Intrepid	6	6	6	---	---	{0.01}	{0.01}	---	6	{1}	{0.01}
Pyrethrins	Pyganic	1	1	1	---	---	1	1	---	1	{0.01}	---
Pyriproxyfen	Esteem	1	1	{0.1}	---	---	{0.05}	{0.05}	---	{0.01}	{0.01}	{0.5}
Spinetoram	Delegate	0.8	{0.5}	{0.5}	0.8	0.8	1	1	---	0.8	{0.7}	{0.5}
Spinosad	Entrust	1	{0.7}	{0.5}	---	1	1.5	1.5	---	1	{0.5}	1
Sulfoxaflor	Transform	1.5	1.5	{0.1}	---	1.5	{0.01}	{0.3}	---	2	{0.5}	1.5
Tebufenozide	Confirm	3	{0.05}	{0.1}	---	{2}	{2}	{2}	{2}	{2}	{0.01}	{2}
Thiamethoxam	Actara	0.35	0.5	0.5	0.5	0.5	{0.01}	{0.01}	0.5	0.5	1	0.5
Tolfenpyrad	Bexar	7	---	{0.1}	---	---	{0.01}	{0.01}	---	{0.01}	{0.01}	{0.01}
Zeta-cypermethrin	Mustang	0.8	{0.5}	0.8	---	---	{0.5}	{0.5}	---	0.8	{0.5}	2

All MRLs listed in ppm

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Blackberry Maximum Residue Limits (MRLs) for USA and Foreign Trade Markets - Insecticides

Dani Lightle, Pesticide Registration Research Leader, Oregon State University
danielle.lightle@oregonstate.edu

Current as of: June 20, 2023

Active Ingredient	Example Trade Name	USA	Australia	Canada	China	CODEX	EU	Great Britain	Hong Kong	Japan	Korea	Taiwan
Abamectin	AgriMek	0.2	0.2	0.2	0.2	0.2	{0.08}	{0.08}	---	{0.05}	0.2	{0.02}
Acequinocyl	Kanemite	4	{0.02}	4	{0.01}	---	{0.01}	{0.01}	---	{0.01}	{0.5}	---
Acetamiprid	Assail	1.6	{1}	4	2	2	2	2	---	2	{1}	{1}
Bifenazate	Acramite	5	7	5	7	7	7	7	---	7	{0.5}	---
Bifenthrin	Brigade	1	3	1	1	1	1	1	1	1	1	1
Carbaryl	Sevin	12	{0.02}	{10}	---	---	{0.01}	{0.01}	---	12	{0.01}	{0.5}
Chlorantraniliprole	Altacor	1.8	2.5	{0.9}	{1}	{1}	{1.5}	{1}	{1}	2	{1}	1.8
Cyantraniliprole	Exirel	4	{0.05}	4	4	---	{0.01}	{1.5}	---	{0.01}	{0.3}	---
Diazinon	Diazinon	0.75	{0.5}	{0.1}	{0.1}	{0.1}	{0.01}	{0.01}	{0.1}	{0.1}	{0.01}	{0.5}
Esfenvalerate	Asana	1	1	{0.1}	{0.2}	---	{0.02}	{0.02}	{0.2}	1	3	1
Etoxazole	Zeal	1.5	{0.5}	1.5	---	---	{0.01}	{0.01}	---	{0.01}	{0.2}	{0.01}
Fenpropathrin	Danitol	12	---	12	{5}	---	{0.01}	{0.01}	{5}	12	{0.01}	{3}
Fenpyroximate	FujiMite	3	{0.1}	{0.1}	---	---	{0.7}	{0.7}	---	3	{0.7}	{0.5}
Flupyradifurone	Sivanto	5	6	5	---	6	6	6	---	{0.01}	{1}	---
Hexythiazox	Savey	3	{1}	{1.5}	---	---	{0.01}	{0.5}	---	{0.01}	{0.01}	{1}
Imidacloprid	Admire	2.5	5	2.5	5	5	{0.01}	5	5	4	{1.5}	{1}
Malathion	Malathion	8	10	8	---	---	{0.02}	{0.02}	8	8	{6}	{0.01}
Methoxyfenozide	Intrepid	6	{0.03}	6	---	---	{0.01}	{0.01}	---	6	{1}	{0.01}
Pyrethrins	Pyganic	1	1	1	---	---	1	1	1	1	1	---
Pyriproxyfen	Esteem	1	1	{0.1}	---	---	{0.05}	{0.05}	---	{0.01}	{0.01}	{0.5}
Spinetoram	Delegate	0.8	{0.5}	{0.5}	---	---	1	1	---	{0.7}	{0.7}	---
Spinosad	Entrust	1	{0.7}	{0.5}	1	1	1.5	1.5	---	1	{0.5}	1
Sulfoxaflor	Transform	1.5	1.5	{0.1}	---	1.5	{0.01}	{0.3}	---	2	{0.5}	1.5
Tebufenozide	Confirm	3	{0.05}	{0.1}	---	---	{0.01}	{0.01}	3	3	{0.01}	{0.01}
Thiamethoxam	Actara	0.35	0.5	0.5	0.5	0.5	{0.01}	{0.01}	0.5	0.5	1	0.5
Tolfenpyrad	Bexar	7	---	{0.1}	---	---	{0.01}	{0.01}	---	{0.01}	{0.01}	{0.01}
Zeta-cypermethrin	Mustang	0.8	{0.5}	0.8	---	---	{0.5}	{0.5}	---	0.8	{0.5}	2

All MRLs listed in ppm

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Raspberry Maximum Residue Limits (MRLs) for USA and Foreign Trade Markets - Fungicides

Dani Lightle, Pesticide Registration Research Leader, Oregon State University
danielle.lightle@oregonstate.edu

Current as of: June 20, 2023

Active Ingredient	Example Trade Name	USA	Australia	Canada	China	CODEX	EU	Great Britain	Hong Kong	Japan	Korea	Taiwan
Azoxystrobin	Abound	5	5	5	5	5	5	5	5	5	{3}	5
Captan	Captan	25	30	{5}	---	{20}	{20}	{20}	{20}	{20}	{5}	{20}
Fenhexamid	Elevate	20	20	20	{5}	{15}	{15}	{15}	{15}	{15}	{5}	---
Fosetyl-al	Aliette	0.1	100	0.1	---	---	300	300	---	70	{0.01}	20
Iprodione	Rovral	15	{12}	25	---	30	{0.01}	{0.01}	30	{5}	{10}	{5}
Isofetamid	Kenja	4	5	4	---	{3}	7	{3}	---	4	{0.01}	4
Mefenoxam	Ridomil Gold	0.7	{0.5}	{0.2}	---	{0.2}	{0.02}	{0.02}	{0.2}	{0.2}	{0.01}	1
Myclobutanil	Rally	2	2	2	---	---	{0.01}	{1}	---	2	{0.01}	{0.5}
Oxathiapiprolin	Orondis Gold	0.5	0.5	0.5	---	0.5	0.5	0.5	---	0.5	0.5	---
Penthiopyrad	Fontelis	10	10	10	---	10	{0.01}	10	---	10	{0.5}	---
Propiconazole	Tilt	1	1	1	---	---	{0.01}	{0.01}	---	{0.05}	{0.01}	{0.5}
Pyraclostrobin	Cabrio	4	4	{3.5}	---	{3}	{3}	{3}	{2}	{3}	{3}	{3}
Pyriofenone	Prolivo	0.9	0.9	0.9	---	0.9	0.9	0.9	---	0.9	{0.01}	---
Fungicide pre-mixture formulations												
Azoxystrobin + propiconazole	QuiltXcel	5	5	5	5	5	5	5	5	5	{3}	5
		1	1	1	---	---	{0.01}	{0.01}	---	{0.05}	{0.01}	{0.5}
Boscalid + pyraclostrobin	Pristine	10	10	{6}	10	10	10	10	10	10	{9}	{6}
		4	4	{3.5}	---	{3}	{3}	{3}	{2}	{3}	{3}	{3}
Captan + fenhexamid	Captevate	25	30	{5}	---	{20}	{20}	{20}	{20}	{20}	{5}	{20}
		20	20	20	{5}	{15}	{15}	{15}	{15}	{15}	{5}	---
Cymoxanil + famoxadone	Tanos	4	---	4	---	---	{0.01}	{0.01}	---	4	{0.01}	{1}
		10	10	10	---	---	{0.01}	{0.01}	---	10	{0.01}	{0.01}
Cyprodinil + fludioxonil	Switch	10	10	10	10	10	{3}	{3}	10	10	10	{3}
		5	5	7	---	5	5	5	5	5	5	5
Fluopyram + pyrimethanil	Luna Tranquility	5	5	5	{3}	5	5	5	---	5	6	---
		15	15	15	15	15	15	15	---	{10}	15	{10}
Mefenoxam + Copper Hydroxide	Ridomil Gold Copper	0.7	{0.5}	{0.2}	---	{0.2}	{0.02}	{0.02}	{0.2}	{0.2}	{0.01}	1
		exempt	exempt	exempt	exempt	exempt	exempt	exempt	exempt	exempt	exempt	exempt

All MRLs listed in ppm

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Blackberry Maximum Residue Limits (MRLs) for USA and Foreign Trade Markets - Fungicides

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Current as of: June 20, 2023

Active Ingredient	Example Trade Name	USA	Australia	Canada	China	CODEX	EU	Great Britain	Hong Kong	Japan	Korea	Taiwan
Azoxystrobin	Abound	5	5	5	5	5	5	5	5	5	{3}	{2}
Captan	Captan	25	30	{0.1}	---	---	{20}	{20}	---	{0.01}	{5}	{20}
Fenhexamid	Elevate	20	20	20	{15}	{15}	{15}	{15}	{15}	{15}	{5}	---
Fosetyl-al	Aliette	0.1	70	0.1	---	70	300	300	---	70	{0.01}	20
Iprodione	Rovral	25	25	25	30	30	{0.01}	{0.01}	30	{12}	{10}	{5}
Isofetamid	Kenja	4	5	4	---	{3}	7	{3}	---	4	{0.01}	---
Mefenoxam	Ridomil Gold	0.7	{0.5}	{0.1}	---	---	{0.02}	{0.02}	---	0.7	{0.01}	1
Myclobutanil	Rally	2	2	2	---	---	{0.8}	{1}	---	2	{0.01}	{0.5}
Oxathiapiprolin	Orondis Gold	0.5	0.5	0.5	---	0.5	0.5	0.5	---	0.5	0.5	---
Penthiopyrad	Fontelis	10	10	10	---	10	{0.01}	10	---	10	{0.5}	---
Propiconazole	Tilt	1	1	1	---	---	{0.01}	{0.01}	---	{0.05}	{0.01}	1
Pyraclostrobin	Cabrio	4	4	{3.5}	{3}	{3}	{3}	{3}	---	{3}	{3}	{3}
Pyriofenone	Prolivo	0.9	0.9	0.9	---	0.9	0.9	0.9	---	0.9	{0.01}	---
Fungicide pre-mixture formulations												
Azoxystrobin + propiconazole	QuiltXcel	5	5	5	5	5	5	5	5	5	{3}	{2}
		1	1	1	---	---	{0.01}	{0.01}	---	{0.05}	{0.01}	1
Boscalid + pyraclostrobin	Pristine	10	10	{6}	10	10	10	10	10	10	{9}	{6}
		4	4	{3.5}	{3}	{3}	{3}	{3}	---	{3}	{3}	{3}
Cymoxanil + famoxadone	Tanos	4	---	4	---	---	{0.01}	{0.01}	---	4	{0.01}	{1}
		10	---	10	---	---	{0.01}	{0.01}	---	10	{0.01}	{0.01}
Cyprodinil + fludioxonil	Switch	10	10	10	10	10	{3}	{3}	---	10	10	{3}
		5	5	7	5	5	5	5	5	5	5	5
Fluopyram + pyrimethanil	Luna Tranquility	5	{3}	5	{3}	5	5	5	---	5	6	{2}
		15	15	15	15	15	15	15	---	{10}	15	{4}
Mefenoxam + Copper Hydroxide	Ridomil Gold Copper	0.7	{0.5}	{0.1}	---	---	{0.02}	{0.02}	---	0.7	{0.01}	1
		exempt	exempt	exempt	exempt	exempt	exempt	exempt	exempt	exempt	exempt	exempt

All MRLs listed in ppm

{ } = indicate a MRL that is lower than US tolerances

--- = no MRL established in that market

Raspberry Maximum Residue Limits (MRLs) for USA and Foreign Trade Markets - Herbicides

Dani Lightle, Pesticide Registration Research Leader, Oregon State University
danielle.lightle@oregonstate.edu

Current as of: June 20, 2023

Active Ingredient	Example Trade Name	USA	Australia	Canada	China	CODEX	EU	Great Britain	Hong Kong	Japan	Korea	Taiwan
Carfentrazone	Aim	0.1	{0.05}	0.1	---	---	{0.02}	{0.01}	0.1	0.1	0.01	0.1
Clethodim	Select Max	0.3	{0.1}	{0.1}	---	---	{0.1}	{0.1}	---	{0.01}	{0.01}	---
Dichlobenil	Casoron	0.1	1	0.1	0.2	0.2	{0.01}	{0.01}	---	{0.01}	{0.01}	---
Diuron	Karmex	0.1	{0.05}	0.1	---	---	{0.01}	{0.01}	0.1	{0.05}	{0.01}	---
Fluazifop	Fusilade	0.08	0.2	0.08	{0.01}	0.08	0.08	{0.01}	---	{0.01}	{0.01}	{0.01}
Flumioxazin	Chateau	0.5	{0.02}	0.5	---	---	{0.02}	{0.02}	---	{0.01}	{0.01}	---
Fluridone	Brake On	0.1	---	0.1	---	---	{0.01}	{0.01}	---	{0.01}	{0.01}	---
Glyphosate	Roundup	0.2	0.2	{0.1}	{0.1}	---	{0.1}	{0.1}	0.2	0.2	{0.05}	0.2
Halosulfuron	Sandea	0.05	0.05	0.05	---	---	{0.01}	{0.01}	---	0.05	{0.01}	---
Indaziflam	Alion	0.01	---	0.01	---	---	0.01	0.01	---	0.01	0.01	---
Isoxaben	Trellis	0.01	---	0.1	---	---	0.05	0.05	---	0.01	0.01	---
Mesotrione	Callisto	0.01	0.01	0.1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	---
Napropamide	Devrinol	0.1	0.1	0.1	---	---	{0.01}	0.1	0.1	0.1	{0.01}	{0.01}
Norflurazon	Solicam	0.2	{0.05}	{0.1}	---	---	{0.01}	{0.01}	---	0.2	{0.01}	---
Oryzalin	Surflan	0.05	0.1	0.1	---	---	{0.01}	{0.01}	0.05	0.08	{0.01}	---
Oxyfluorfen	Goal	0.05	0.05	0.05	---	---	{0.01}	0.05	---	{0.01}	{0.01}	{0.01}
Paraquat	Gramoxone	0.05	0.05	0.05	{0.01}	{0.01}	{0.02}	{0.02}	{0.01}	0.05	{0.01}	{0.01}
Pronamide (propyzamide)	Kerb	0.05	{0.02}	0.1	---	---	{0.01}	{0.01}	---	{0.01}	{0.01}	---
Quinclorac	Quinstar 4L	0.08	---	0.1	---	---	{0.01}	{0.01}	---	{0.01}	{0.01}	---
Rimsulfuron	Matrix	0.01	---	0.01	---	---	0.01	0.01	---	0.01	0.01	---
Sethoxydim	Poast	5	{0.1}	5	---	---	{0.1}	{0.1}	---	{0.01}	{0.01}	{0.5}
Simazine	Simazine	0.2	{0.1}	{0.1}	---	---	{0.01}	{0.01}	---	0.2	{0.01}	0.2
S-metolachlor	Dual Magnum	0.1	---	0.1	---	---	{0.05}	{0.05}	---	{0.01}	{0.01}	{0.01}
Sulfentrazone	Zeus XC	0.15	---	0.15	---	---	{0.01}	{0.01}	---	{0.05}	{0.01}	---
Terbacil	Sinbar	0.2	---	{0.1}	---	---	{0.01}	{0.01}	---	{0.1}	{0.01}	---

All MRLs listed in ppm

{ } = indicate a MRL that is lower than US tolerances

--- = no MRL established in that market

Raspberry Maximum Residue Limits (MRLs) for USA and Foreign Trade Markets – Misc. Materials

Active Ingredient	Example Trade Name	USA	Australia	Canada	China	CODEX	EU	Great Britain	Hong Kong	Japan	Korea	Taiwan
Metaldehyde	Deadline	0.15	1	0.15	---	---	{0.05}	{0.05}	0.15	{0.01}	{0.01}	---

Blackberry Maximum Residue Limits (MRLs) for USA and Foreign Trade Markets - Herbicides

Dani Lightle, Pesticide Registration Research Leader, Oregon State University
danielle.lightle@oregonstate.edu

Current as of: June 20, 2023

Active Ingredient	Example Trade Name	USA	Australia	Canada	China	CODEX	EU	Great Britain	Hong Kong	Japan	Korea	Taiwan
Carfentrazone	Aim	0.1	{0.05}	0.1	---	---	{0.02}	{0.01}	0.1	0.1	{0.01}	---
Clethodim	Select Max	0.3	{0.1}	{0.1}	---	---	{0.1}	{0.1}	---	{0.01}	{0.01}	---
Dichlobenil	Casoron	0.1	{0.05}	0.1	0.2	0.2	{0.01}	{0.01}	---	{0.01}	{0.01}	---
Diuron	Karmex	0.1	{0.05}	0.1	---	---	{0.01}	{0.01}	0.1	{0.05}	{0.01}	---
Fluazifop	Fusilade	0.08	0.2	0.08	{0.01}	0.08	0.08	{0.01}	---	{0.01}	{0.01}	{0.01}
Flumioxazin	Chateau	0.5	{0.02}	0.5	---	---	{0.02}	{0.02}	---	{0.01}	{0.01}	---
Fluridone	Brake On	0.1	---	0.1	---	---	{0.01}	{0.01}	---	{0.01}	{0.01}	---
Glyphosate	Roundup	0.2	{0.05}	{0.1}	{0.1}	---	{0.1}	{0.1}	0.2	0.2	{0.05}	0.2
Halosulfuron	Sandea	0.05	---	0.05	---	---	{0.01}	{0.01}	---	0.05	{0.01}	---
Indaziflam	Alion	0.01	---	0.01	---	---	0.01	0.01	---	0.01	0.01	---
Isoxaben	Trellis	0.01	---	0.1	---	---	0.05	0.05	---	0.01	0.01	---
Mesotrione	Callisto	0.01	0.01	0.1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	---
Napropamide	Devrinol	0.1	0.1	0.1	---	---	{0.01}	0.1	0.1	0.1	{0.01}	{0.01}
Norflurazon	Solicam	0.1	{0.05}	0.1	---	---	{0.01}	{0.01}	0.1	0.1	{0.01}	---
Oryzalin	Surflan	0.05	0.1	0.1	---	---	{0.01}	{0.01}	0.05	0.08	{0.01}	---
Oxyfluorfen	Goal	0.05	0.05	0.1	---	---	{0.01}	0.05	0.05	{0.01}	{0.01}	{0.01}
Paraquat	Gramoxone	0.05	0.05	0.05	{0.01}	{0.01}	{0.02}	{0.02}	{0.01}	0.05	{0.01}	{0.01}
Pronamide (propyzamide)	Kerb	0.05	{0.02}	0.1	---	---	{0.01}	{0.01}	0.05	{0.01}	{0.01}	---
Quinclorac	Quinstar 4L	0.08	---	0.1	---	---	{0.01}	{0.01}	---	{0.01}	{0.01}	---
Rimsulfuron	Matrix	0.01	---	0.01	---	---	0.01	0.01	---	0.01	0.01	---
Sethoxydim	Poast	5	{0.1}	5	---	---	{0.1}	{0.1}	---	{0.01}	{0.01}	---
Simazine	Simazine	0.2	{0.1}	{0.1}	---	---	{0.01}	{0.01}	0.2	0.2	{0.01}	---
S-metolachlor	Dual Magnum	0.1	---	0.1	---	---	{0.05}	{0.05}	---	{0.01}	{0.01}	{0.01}
Sulfentrazone	Zeus XC	0.15	---	0.15	---	---	{0.01}	{0.01}	---	{0.05}	{0.01}	---
Terbacil	Sinbar	0.2	---	{0.1}	---	---	{0.01}	{0.01}	---	{0.1}	{0.01}	---

All MRLs listed in ppm

{ } = indicate a MRL that is lower than US tolerances

--- = no MRL established in that market

Blackberry Maximum Residue Limits (MRLs) for USA and Foreign Trade Markets – Misc. Materials

Active Ingredient	Example Trade Name	USA	Australia	Canada	China	CODEX	EU	Great Britain	Hong Kong	Japan	Korea	Taiwan
Ethephon	Ethrel	30	{0.1}	{20}	---	---	{0.05}	{0.05}	30	{2}	{0.01}	{2}
Metaldehyde	Deadline	0.15	1	0.15	---	---	{0.05}	{0.05}	0.15	{0.01}	{0.01}	---

Progress Report to the Agricultural Research Foundation, 2023-2024

Title: Cooperative breeding program - Caneberries

Principal Investigators: Scott Lukas, Berry Crops Research Leader, NWREC
Patrick Jones, Senior Faculty Research Assistant I, NWREC
Michael Hardigan, Research Geneticist, USDA-ARS, HCPGIRU

Collaborators: Mary Peterson, Technician, USDA-ARS, HCPGIRU
Amanda Davis, Senior Faculty Research Assistant II, NWREC

Cooperators: Oregon State University Department of Food Science & Technology
Washington State University Department of Horticulture
North American Plants, Inc.
Enfield Farms & Northwest Plants
Oregon fruit growers
Oxbo & Littau Harvesters Inc.

Objectives:

- To develop new blackberry cultivars for the Pacific Northwest that are high yielding, thornless, heat and cold tolerant, machine-harvestable, and have excellent fruit quality. Emphasis is placed on blackberries with excellent processed fruit quality. Fresh market cultivars are also being developed.
- To develop new raspberry cultivars for the Pacific Northwest that are high yielding, thornless, heat and cold tolerant, machine-harvestable, and have that have superior processed fruit quality. High quality fresh market cultivars are also being developed.
- To develop black raspberry cultivars with improved durability, plant health, disease and aphid resistance, combining fruit quality and productivity on par with 'Munger' with improved longevity.
- To collect, evaluate and incorporate new *Rubus* germplasm into the breeding program.

Progress - Blackberry

Blackberry cultivar development remains the highest priority for the USDA-ARS caneberry breeding program. We conduct on-farm trials to screen new and promising selections at the North Willamette Research and Extension Center (OSU-NWREC; Aurora, OR) in cooperation with the Oregon State University Department of Horticulture's Berry Crop Leader, Dr. Scott Lukas. We are developing thornless, machine harvestable blackberry cultivars for Pacific Northwest (PNW) growers. Our objective is to identify new thornless selections with firmness, processing quality, and machine harvestable yields on par with 'Columbia Star', and flavor on par with 'Marion'. While the primary focus for cultivar development continues to be on trailing blackberry varieties, we have increasingly begun incorporating the genetics of eastern US semi-erect and erect blackberry species and varieties in an effort to increase yield, plant vigor, and pest tolerance. We are continuing efforts to adapt these genetic backgrounds to the PNW and incorporate their genetics into PNW trailing types, with promising results. We have identified selections capable of extending production of blackberries with high processing quality beyond the typical trailing blackberry season. Our aim is to combine the exceptional flavor and processing quality of current Oregon blackberry cultivars with

improved stress tolerance, disease resistance, and fresh market potential (fruit firmness and shelf life).

The USDA/OSU cooperative breeding program completed the patenting and licensing of three new blackberry cultivars in early 2023. The three blackberry varieties released were 'Zodiac' (formerly ORUS 4222-1), a thornless trailing type for machine harvest and processing, 'Celestial' (formerly ORUS 4670-1), a thornless semi-erect type that competes with 'Chester' for yields with significantly better fresh eating quality, and 'Thunderhead' (formerly ORUS 4999-2), an erect primocane-fruiting type with exceptional plant vigor and yields for the fresh market.

Cultivar Releases

Patents Approved

- **'Zodiac' (USPP app. 17/687,937; available)** – Formerly ORUS 4222-1. A thornless high-yielding trailing blackberry. In multiple trial years it has shown similar or greater yields than 'Columbia Star'. Compared with 'Columbia Star', 'Zodiac' produces larger numbers of 'Marion'-sized fruit, with a uniform conical shape, as well as good firmness and ease of release for machine harvest. The fruit are typically sweeter with higher soluble solids than 'Columbia Star' or 'Black Diamond'. Ripens one week later than 'Columbia Star'. *Processing*.
- **'Celestial' (USPP app. 17/697,900; available)** – Formerly ORUS 4670-1. A thornless semi-erect blackberry that has shown similar or better yields than 'Chester' while ripening 10 days ahead of 'Chester' and slightly later than 'Triple Crown'. Similar or slightly larger fruit size than 'Chester' but typically shows better firmness with lower UV damage, defects, and much better flavor. The fruit have better post-harvest quality than 'Chester'. *Fresh or processing*.
- **'Thunderhead' (USPP app. 17/697,907; available)** – Formerly ORUS 4999-2. An extremely vigorous and high-yielding primocane-fruiting blackberry. When managed properly 'Thunderhead' has shown higher yields than any blackberry yet evaluated by the breeding program. The canes are vigorous and establish quickly, with the potential to produce a year-one crop better than other primocane-fruiters. The fruit are medium sized for a primocane type, firm, tough-skinned, with good sweetness and low bitterness. Reduced thorns, not completely thornless. *Fresh market*.

Future Releases

- **ORUS 4535-1** – A dwarf, thornless trailing blackberry for homeowner market. While a floricane type, it has short internodes, and its 0.60-0.75 m (2-2.5 ft.) long canes will cascade out of containers. The fruit quality is good but lower than commercial trailing types.

Nursery/Propagation List

In addition to any above current/future variety releases, the following have been/are being propagated for grower trials:

- ****ORUS 4344-3*** (trailing) – Thornless and high yielding, outperformed 'Columbia Star' and 'Black Diamond' in all three years with yields 50% > C. Star in 2020, 41% > C. Star in 2021, and 52% > C. Star in 2022. (East x West) hybrid background is 1/2 trailing, 1/4 erect primocane, 1/8 semierect, and 1/8 wild *R. ursinus*, behaves like a mid-to-late season trailing type. Greater heat tolerance (fruit & canopy) than our traditional trailing selections, exceptional fruit quality last 3 yrs. While the fruit look more like a fresh market berry than a

'Columbia Star' or 'Marion' trailing type, their quality was quite good in the 2022 IQF cutting, indicating they may be suitable for fresh and processing if they can machine harvest.

- ***ORUS 4892-1*** (trailing) – Thornless and high yielding. 'Columbia Star' progeny with very large fruit possibly suited for fresh, and well suited for processed. Combines great size and flavor. Firmness, consistency, and drupelet uniformity are near 'Columbia Star', and very good for such a large berry. Early season for trailing type; was as early as C. Sunrise in 2022. Fruit show excellent lateral presentation and on plants and look terrific in flats.
- ***ORUS 5014-1*** (trailing) – Machine harvested w/ low winter injury in northern Washington. Best yielding numbered selection in 2019 trial for both 2021 and 2022 seasons, with 37% higher yield than 'Columbia Star' in 2022. Berries are gorgeous and have excellent quality, showed lower defects after days at 115F than others. Great Flavor. Late season for trailing type. In 2022 fruit seemed to come on late with quick harvest window for high yields.
- ***ORUS 5037-1*** (trailing) – Best yielding REP selection in 2021-22 for 2019 trial. Berries are very pretty with slight purple tint, somewhat similar looking to 'Marion' but larger and better quality. Firmness greater than 'Marion' but lower than 'Columbia Star'. Late season for trailing type.
- ***ORUS 4892-2*** (trailing) – A thornless trailing selection that has yielded higher than 'Columbia Star' for two seasons, with very good firmness, skin toughness, and overall fruit quality.
- ***ORUS 4663-1*** (trailing) – A thornless and high yielding selection with excellent fruit quality, average yield was higher than 'Columbia Star' and 'Black Diamond' from 2018-20, and significantly higher than both in 2020. Fruit is large for a trailing type, has good texture and terrific flavor, separates well, but lacks firmness of 'Columbia Star'. Might be suited for fresh.

**Available for trial at North American Plants, Inc.*

Grower Trials – Oregon (OSU-NWREC)

The 2023 season was characterized by weak performance among many of the trailing blackberry selections and varieties compared to previous years. The primary exception was 'Black Diamond' which, by contrast, performed exceptionally well in 2023. In the 2020 trial plots, 'Black Diamond' showed an 80% yield increase in 2023 from 2022. The average difference in yields from 2022 to 2023 for other genotypes was a reduction of 56%, including a reduction by 67% in 'Columbia Star', which showed similar fruit size to the previous year but a significant reduction in the number of fruits per lateral. In the 2019 trial plots, 'Columbia Star' showed a 66% yield reduction from 2022 to 2023 while 'Black Diamond' showed a 76% increase.

We are continuing to observe new selections that are thornless with yields on par with or better than current cultivar standards, and berries are evaluated for quality as fresh fruit and as thawed individual quick-frozen (IQF) samples during the winter. Since 2021, five new advanced selections (ORUS 4344-3, ORUS 4892-1, ORUS 4892-2, ORUS 5014-1, ORUS 5037-1) have become available for grower trials at regional nurseries. All are thornless trailing blackberries.

2019 Trailing Blackberry (Table Bk-TR 1)

- **'Black Diamond'** performed exceptionally well in 2023 while **'Columbia Star'** showed significantly decreased yields. **'Zodiac'** showed its weakest performance in 2023 but averaged higher yields than **'Columbia Star'** over the course of the trial. **'Kotata'** showed the weakest performance of all cultivars in the 2019 trial.

- **ORUS 5014-1 (OBS)** showed higher yield potential than cultivar standards in 2021-22 due to big late season picks. Large, beautiful fruit with very good flavor and good IQF rating. Yields suffered in 2023 like many other trailing types. Need to see if machine picks.
- **ORUS 5037-1 (REP)** showed excellent yields in 2021 that have subsequently decreased, causing some concern. Fruit show very good flavor, however, firmness and skin toughness are slightly lower than 'Columbia Star'.

2020 Trailing Blackberry (Table Bk-TR 2)

- **'Black Diamond'** performed exceptionally well in 2023 while **'Columbia Star'** showed significantly decreased yields.
- **ORUS 5148-2 (REP)** is very late season for a trailing blackberry, ripening alongside early semi-erect types. Produces large berries with good IQF quality and fresh potential. Despite large size the fruit show good firmness, skin toughness, texture, and flavor compared to 'Columbia Giant'. With late window could extend season for trailing blackberry fruit.
- **ORUS 5016-1 (OBS)** was the highest yielding trailing blackberry selection in 2022, but was much lower in 2023, being similarly impacted alongside other trailing types. Contains 'Newberry' and 'Tayberry' in its pedigree, combining the 'Boysen-type' and 'Tay-type' genetics to produce a unique flavor/aroma in fruit that are dark, glossy, and firm.
- **ORUS 5041-1 (OBS)** produces berries with a unique purple and slightly fuzzy appearance and blocky shape, somewhat like Boysen types, contains amazing flavor and citrus aroma. Possible new Boysen alternative with better yields. Thorny. Yields higher than 'Columbia Star' and 'Marion' in 2023.

2021 Trailing Blackberry (Table Bk-TR 3)

- **'Black Diamond'** and **'Columbia Star'** performed similarly, their plots were not exceptionally high yielding in 2022, whereas **'Marion'** was a yield standout.
- **ORUS 5253-3 (OBS)** was great overall with high yields for the season, very high firmness, skin toughness and gloss under heat, good flavor, small seeds, and healthy plants.
- **ORUS 4663-1 (OBS)** is an older selection that has been on the nursery list for several years. In 2023 demonstrated good visual plant health and high yield potential of large berries with good firmness and flavor. Will retain on nursery list.
- **ORUS 5271-1 (OBS)** shows promise as a very early ripening selection with good yields for such an early type. 75% of total yield was harvested at the first pick on June 27th, indicating concentrated ripening or fruit could have been picked even earlier in season. Thick canes and good plant health.

2019-21 Erect/Semierect Blackberry Trials (Table Bk-SE 1)

- **'Chester Thornless'** remains a semierect yield standard due to its consistently high yields of fruit with moderate quality in the late season. **'Triple Crown'** showed excellent performance in 2022, with higher yields than **'Chester'** in the 2020 planted trial.
- **2019 – ORUS 5057-1 (OBS)** has shown yields similar to or approaching 'Chester Thornless' from 2021-23 with larger, more attractive berries. Fruit show slightly better firmness than 'Triple Crown' and may be too soft for fresh market. Thawed IQF quality was good.
- **2020 – 'Celestial' (OBS)** had similar yields to 'Chester Thornless' in 2022 and higher yields in 2023 with significantly higher fruit quality, better flavor, and an earlier picking season with more condensed harvest window. Combined with good post-harvest and IQF quality it may be a good candidate for late season machine harvest and processing in addition to fresh.

    - **'Celestial'** plot showed weak plant health in newly established 2021 trial, appeared to cause significant yield reduction in first year.
- **2021 – ORUS 5276-1 (OBS)** showed was productive while being extremely early for a semi-erect blackberry, with peak harvest on July 11th during trailing blackberry season.

2019 Primocane Blackberry Trials (Table Bk-PF 1)

- **'Thunderhead' (REP)** significantly outcompeted other selections and cultivar standards in regard to both yield and fruit quality. Extremely vigorous plants. Will likely remain the program yield standard for some time.
- **'Prime-Ark 45' (REP)** was productive but slow to begin ripening, leading to a very late season crop. Good fruit quality and consistency but not as good as 'Thunderhead'.

2020 Primocane Blackberry Trials (Table Bk-PF 2)

- **'Thunderhead' (OBS)** significantly outcompeted other selections and cultivar standards in regard to both yield and fruit quality. Extremely vigorous plants. Will likely remain the program yield standard for some time.
- **'Prime-Ark 45' (REP)** was too slow to begin ripening, leading to a very late season crop that could not be completely harvested before October.
- **ORUS 5173-1 (OBS)** is thornless and small in stature with smaller numbers of large size berries; possibly of interest for growers who want a less vigorous and more manageable, albeit lower yielding, primocane-fruiter than 'Thunderhead'.

2021 Primocane Blackberry Trials (Table Bk-PF 3)

- Observed lower primocane-fruiting blackberry productivity in the 2021 trial planting in 2023. **'Thunderhead' (OBS)** showed the highest productivity, followed by **'Prime-Ark 45' (REP)**. ORUS 4545-2 was less productive but offered a smaller-fruited alternative to both cultivars with good firmness and consistency.

By the Numbers: Crosses, Seedlings & Selections

- Attempted 48 blackberry crosses including 20 trailing, 10 erect/semi-erect, 8 primocane, 10 "east x west hybrid".
- Planted 3,609 blackberry seedlings from 2022 crosses including 2,104 trailing, 798 erect/semi-erect, 322 primocane, and 385 "east x west hybrid".
- ***No selections were made – due to absence of breeder for guiding crosses in 2020, no 2021 seedlings were planted for evaluation in 2023.***

Progress - Red Raspberry

The USDA-ARS caneberry breeding program in Oregon is working to develop cultivars that are commercially viable for the PNW region while simultaneously evaluating the performance and fruit quality of USDA and WSU experimental lines alongside cultivar standards. We continue to prioritize the development and testing of floricane-fruiting varieties with the aim of developing a genetic baseline of raspberry material that is machine-harvestable, high-yielding, winter hardy, and possessing superior processed fruit quality. We are also developing primocane-fruiting varieties with improved fresh market and post-harvest quality, and potential for season extension in the Northwest. In addition to testing both USDA and WSU selections in the northern Willamette Valley, we send USDA selections for testing in Washington to evaluate winter hardiness and performance in commercial machine harvest trials (Lynden, WA), and root rot tolerance (Puyallup, WA). The USDA

breeding program acts as a partner by providing an additional testing ground and source of genetics for WSU to develop improved processing varieties, while simultaneously making advances in the fall-fruiting and fresh market space.

We have continued to test USDA and WSU raspberry selections to assess their performance including yield and machine-harvested fruit quality in the northern Oregon trials at OSU-NWREC (Aurora, OR) (**Table Ry-FL 1**). In recent years we have generated results from replicated field trials showing that several WSU red raspberry selections that are of interest to growers, including WSU 2130, WSU 2088, and WSU 2188, were among the top performing red raspberry individuals in Oregon. In 2022 we observed three newer WSU selections that performed particularly well, with high machine harvestable yields and/or fruit quality: WSU 2087, WSU 2069, WSU 2516. WSU 2087 did not repeat as the top yielding WSU selection in 2023 but continued to exhibit exceptional firmness and durability off the machine harvester, with the main drawback being higher contamination with green/stem material than other WSU selections. WSU 2069 and WSU 2472 showed the best combination of yield and machine harvested appearance and quality in 2023, although WSU 2472 was less productive in 2022, possibly indicating a longer establishment period.

The USDA/OSU cooperative breeding program completed the patenting and licensing of one new red raspberry cultivar in early 2023. The one red raspberry variety released was 'Finnberry' (formerly ORUS 4716-1), a primocane-fruiting red raspberry with high yields of fruit with excellent flavor and fresh market quality. Several previously identified machine-harvestable selections from the USDA including ORUS 4715-2, ORUS 4974-1 and ORUS 5106-1 are currently available for propagation and trialing through North American Plants, Inc.

Cultivar Releases

Patents Approved

- **'Finnberry' (USPP app. 17/829,023; available)** – Formerly ORUS 4716-1. A primocane-fruiting selection with good firmness and flavor. The fruit can be picked early at a range of colors from light pink to blush and still have sweetness and a good flavor. The season starts at about the same time as 'Heritage', but it peaks and finishes about 7d later than 'Heritage'. *Fresh*.

Nursery/Propagation List

In addition to any above current/future variety releases, the following have been/are being propagated for grower trials:

Floricane-fruiting:

- ****ORUS 4715-2*** – Best machine harvested fruit quality of OR selections in 2019 trial with easy release, best ability of any OR selection to hang and recover after high temperature stress.
- **ORUS 4974-1** – Machine harvested well at higher beater speed, best yields of REP selections in 2019 trial, fruit have nice color, gloss and shape, firm with low leakage, sweet/tangy flavor, nice canopy with laterals that remain upright/open under fruit load.
- ****ORUS 5106-1*** – While not as productive as 'Wakefield', has shown machine harvestable quality and yield on par with 'Meeker' in both OR and northern WA trials, with good firmness and better flavor than 'Meeker'. Contains 1/8 *R. leucodermis* genetics.
- ****ORUS 4371-4*** – High machine harvested yield in both OR and northern WA. Good winter tolerance. High quality fruit.

Primocane-fruiting:

- ***ORUS 5209-1*** – Plant has sturdy/erect canes, high yields of large, attractive fruit with few defects, excellent firmness and coherence, appear to hang well in heat, great flavor/aroma.
- ***ORUS 4487-1*** – Very early and high yielding primocane-fruiting selection.

Other:

- ***ORUS 4089-2*** – An intermediate type with weak-PF habit. Fruit are an attractive orange-red color and looked good in OR and northern WA. Bright firm and attractive as PF type.

**Available for trial at North American Plants, Inc.*

Grower Trials – Washington; Honcoop Machine Harvest

The USDA program sends selections annually to Washington State University to be included in the Washington machine harvest trials at Honcoop Farms, located in the Lynden, WA area in order to evaluate winter hardiness and machine harvestability in a commercial setting.

- **ORUS 5315-3 and ORUS 5315-5** showed excellent machine harvest fruit quality with high yields of berries with good shape, color, firmness, coherence, and flavor, although yields were lower than 'Cascade Harvest'. Berries were similarly attractive with high machine harvested fruit quality in Oregon in 2023.

Grower Trials – Oregon (OSU-NWREC)

In contrast to floricane blackberry performance, floricane red raspberry performance in 2023 was much better. Fruit quality in the OSU-NWREC machine harvest trial was easily the best observed since 2020. In the second harvest year of the 2020 trial plots, fruit size was 62% larger in 2023 compared to 2022 and yields were 71% higher in 2023 compared to 2022. In addition to larger fruit size and higher yields, average berry quality was noticeably improved with visibly better drupelet cohesion and reduced shattering and leakage. Among the USDA material, several non-replicated selections showed promise in 2023 in the newest trial planting (**Table Ry-FL 2**). In particular, ORUS 5310-1 exhibited the highest yields of any plots at the OSU-NWREC, which was combined with an early ripening season and excellent fruit quality. ORUS 5329-1 exhibited a combination of large fruit size with exceptional firmness and coherence on the machine harvester and excellent shape, color, and gloss. We identified another floricane selection, ORUS 5323-2, with possible fresh market potential based on its high firmness and pink lemonade appearance. These selections will be rotated into replicated plots in 2024 for further testing and evaluation in 2026.

2020 Floricane Red Raspberry Trials (Table Ry-FL 1)

- **WSU 2087 (REP)** showed the highest average yields for replicated selections in 2022-23. Fruit are dark, round and firm, better than 'Wakefield'. Main drawback was significant stem matter came off with the fruit during machine harvest.
- **WSU 2069 (REP)** was similarly productive to WSU 2087 and produced very attractive fruit with good color and great flavor, though lower firmness. Quality was overall quite good. Observed that firmness and coherence tailed off on warmer days and in late season, and fruit took on dusty appearance if left to hang.

2021 Floricane Red Raspberry Trials (Table Ry-FL 2)

- **'Meeker' (RED)** was the highest yielding replicated selection in 2023.
- **Several selections in held in observation were significantly higher yielding than 'Meeker' and will be moved into REP and WSU trials in 2024**

- **ORUS 5310-1 (OBS)** showed very high yields combined with early season production. Produced relatively large berries with very beautiful shape, color, gloss. Firmness was good but not exceptional. Berries still released well and held up well on machine due to good drupelet coherence.
- **ORUS 5329-1 (OBS)** was high yielding and produced the most attractive berries observed on the machine harvester in 2023, with great combination of high gloss, firmness, and coherence. Very nice fruiting laterals. Flavor good but not outstanding.
- **ORUS 5323-2 (OBS)** is a floricane-fruiting selection with potential fresh market value. High yielding with strong fruiting laterals, produces berries with a lighter color that had tremendous firmness, coherence and good flavor.

2020 Primocane Red Raspberry Trials (Table Ry-PF 1)

- **'Finnberry' (REP)** set fruit and ripened very late to a degree that many did not finish ripening during the regular harvest season. Still healthier and more productive than most other selections. Fruit quality and flavor were very good as usual.
- **ORUS 4487-1 (OBS)** continued to look good as an early season and high yielding advanced selection. Fruit are firm and consistent with great flavor and color. On the smaller side (size similar to 'Heritage') but otherwise a good fresh market raspberry.
- **ORUS 5345-1 (OBS)** produced very high yields of fruit with excellent color and flavor but low firmness and coherence.

2021 Primocane Red Raspberry Trials (Table Ry-PF 2)

- **'Finnberry' (OBS)** showed poor plant health and lower productivity in 2021 trial planting.

By the Numbers: Crosses, Seedlings & Selections

- Attempted 36 red raspberry crosses including 16 floricane-fruiting and 20 primocane-fruiting families.
- Planted 1,975 red raspberry seedlings from 2022 crosses including 1,110 floricane-fruiting and 865 primocane-fruiting.
- ***No selections were made* – due to absence of breeder for guiding crosses in 2020, no 2021 seedlings were planted for evaluation in 2023.**

Progress - Black Raspberry

We are pursuing black raspberry ("blackcap") breeding with the aim of addressing the issues of plant health, life-span and long-term durability of this crop in Northwest grower fields. Our goal is to develop less thorny selections with the machine-harvested fruit quality of varieties like 'Munger', but with lower susceptibility to diseases and viruses that quickly erode plant health and yield potential in the years following planting. Cooperating with the USDA-ARS-NCGR, we have incorporated marker-assisted selection for aphid resistance as a key component of this program in order to focus on selections with a reduced likelihood of accumulating aphid-vectored viruses. We are also attempting to use "purple raspberry" hybrids with other raspberry species backgrounds to incorporate broader genetic diversity into the blackcap germplasm for improving plant vigor, adaptability, and potential for disease resistance.

Cultivar Releases

None.

Future Releases

- **ORUS 3381-3** – A late season variety, as late as 'MacBlack' but with better fruit size and quality. Yield comparable to or slightly less than 'Munger' but starts ripening 12 d later. Targeted for fresh market.
- **ORUS 4179**-1 – A thornless "purple raspberry" hybrid for homeowners.

Nursery/Propagation List

In addition to any above current/future variety releases, the following have been/are being propagated for grower trials:

- ****ORUS 4820-1*** – Particularly interesting due to it being comparable to 'Munger' for yield and fruit size but ripens 5-9 d ahead of 'Munger'. An early cultivar could be advantageous to avoid the higher mid-summer temperatures that cause black raspberry fruit to "stick" during machine harvesting. In 2022 repeated as similar-to-better yielding than 'Munger' in replicated trials. *Processing*.
- ****ORUS 4310-1*** – Can be higher yielding than 'Munger', vigorous, plants visibly healthier and more robust than others in field. Contains aphid resistance genetics. Fruit size on smaller side, dark purple. *Processing*.
- ****ORUS 4833-1*** – Significantly higher yielding than 'Munger' in 2017 replicated trial. Machine harvests well with few stems, fruit are on larger side, firm and glossy. Very consistent across replicates. *Processing*.
- ***ORUS 4499-1** –Excellent yield and fruit quality. Machines well. Excellent root rot tolerance in WSU-Puyallup trials. *Processing*.
- ****ORUS 4179-1*** – Unique thornless "purple" raspberry resulting from hybrid of black raspberry with red raspberry. Fruit are purple with strong pubescence. Not yet tested for machine harvestability.

**Available for trial at North American Plants, Inc.*

Grower Trials – Oregon (OSU-NWREC)

The two current standouts in the trials at OSU-NWREC are ORUS 4820-1 and ORUS 5308-2, which have both shown productivity on par with 'Munger' in addition to other beneficial traits. ORUS 4820-1 is very early ripening, approximately a week earlier than 'Munger', which we feel may carry some benefit of harvesting with a lower likelihood of heat events impacting yields or fruit quality. ORUS 4820-1 was also high yielding in previous trials at OSU-NWREC (2018), providing evidence of above-average performance in multiple trial plantings. ORUS 5308-2 is a newer selection in the program that has stood out for its plant health and vigor, in addition to yielding on par with or better than 'Munger' over the last two seasons. Like ORUS 4820-1, ORUS 5308-2 will be re-planted in REP trial at OSU-NWREC and maintained in long-term plots at Lewis Brown Farm in Corvallis to monitor its performance and plant health.

<u>2020 Black Raspberry Trials (Table BRy 1)</u>

- **ORUS 4820-1 (REP)** previously looked good enough in OSU-NWREC trials to be placed back into replication and repeated in this planting as being similar yielding to 'Munger' while ripening 5-9 d ahead, which may be useful for earlier machine harvest and avoiding heat.
- **ORUS 5308-2 (REP)** shows excellent plant health and vigor so far, possibly possessing some *Verticillium* wilt resistance. Plants in Corvallis plots also stood out for health. Yields

were only slightly lower yielding than ‘Munger’ in 2022 but yielded 68% more in 2023. Will continue testing in REP and introduce for grower trial if repeats performance.

2021 Black Raspberry Trials (Table BRy 2)

- **ORUS 5291-2 (OBS)** was the only selection to show yields close to ‘Munger’. Machine harvested well with good dark color for processing.

By the Numbers: Crosses, Seedlings & Selections

- Attempted 22 black raspberry crosses including 15 floricane-fruiting, 2 floricane “purple hybrid”, and 5 primocane “purple hybrid”.
- Planted 411 black raspberry seedlings from 2022 crosses including 313 floricane-fruiting, 91 primocane-fruiting, and 7 wild seedlings. Additional 179 wild hybrids from Michael Dossett program in British Columbia.
- ***No selections were made* – due to absence of breeder for guiding crosses in 2020, no 2021 seedlings were planted for evaluation in 2023.**

<PRODUCTION TABLES BELOW>

Table Bk-TR 1. Fruit size and yield of trailing blackberry genotypes tested in OSU-NWREC 2019 trial planting, harvested from 2021-23.

	Berry Size (g)	Yield (tons·a-1)		
Annual Mean [a]				
2021	5.42	5.26		
2022	6.32	4.50		
2023	5.96	4.48		
Genotype	2021-23	2022	2023	2021-23
Replicated [z]				
Black Diamond	**5.86 a**	**4.28**	**7.55**	**5.56 a**
[*]*ORUS 5037-1*	5.70 a	4.92	3.06	4.77 ab
Columbia Star	**6.14 a**	**4.31**	**2.84**	**3.91 b**
Nonreplicated				
[*]*ORUS 5014-1*	6.00	5.97	3.27	5.17
Zodiac	**4.70**	**4.11**	**4.03**	**4.96**
Marion	**5.27**	**3.67**	**5.03**	**3.88**
ORUS 4535-2	5.53	2.81	3.34	3.83
ORUS 5031-1	9.73	3.71	2.44	3.52
Kotata	**5.63**	**3.46**	**2.34**	**2.51**

[a] Annual means based on replicated plot samples.
[z] Groups determined by t-Test (LSD) of replicated plot means, $p \leq 0.05$.
[*]Nursery list – available at nurseries for grower trial by request.

Table Bk-TR 2. Fruit size and yield of trailing blackberry genotypes tested in OSU-NWREC 2020 trial planting, harvested from 2022-23.

	Berry Size (g)	Yield (tons·a-1)		
Annual Mean [a]				
2022	7.76	5.31		
2023	7.13	3.94		
Genotype	2022-23	2022	2023	2022-23
Replicated [z]				
Black Diamond	**5.20 c**	**4.67**	**8.39**	**6.53 a**
[*]*ORUS 5148-2*	10.55 a	6.62	1.92	4.27 b
Columbia Star	**6.58 b**	**4.64**	**1.51**	**3.07 b**
Nonreplicated				
ORUS 5016-1	6.85	7.47	3.83	5.65
Marion	**5.50**	**6.41**	**4.60**	**5.50**
ORUS 5041-1	7.30	4.77	5.75	5.26
ORUS 4663-4	12.55	7.28	1.93	4.61
ORUS 5133-2	4.35	5.67	1.08	3.37
ORUS 5127-1	5.15	4.96	1.43	3.20
ORUS 5129-1	4.90	4.29	1.90	3.09
ORUS 5041-2	5.35	3.46	1.28	2.37
ORUS 5138-1	5.20	2.93	0.52	1.72

[a] Annual means based on replicated plot samples.
[z] Groups determined by t-Test (LSD) of replicated plot means, $p \leq 0.05$.
[*]Nursery list – available at nurseries for grower trial by request.

Table Bk-TR 3. Fruit size and yield of trailing blackberry genotypes tested in OSU-NWREC 2021 trial planting, harvested from 2023.

	Berry Size (g)	Yield (tons·a-1)
Annual Mean [a]		
2023	6.80	5.96
Genotype	2023	2023
Replicated [z]		
Black Diamond	**5.17 a**	**11.24 a**
ORUS 5138-2	8.73 a	3.86 b
Columbia Star	**6.50 a**	**2.78 b**
Nonreplicated		
ORUS 5265-3	4.20	8.19
ORUS 5253-3	5.80	7.12
ORUS 5259-4	7.50	6.41
**ORUS 4663-1*	5.60	6.05
Marion	**4.50**	**5.93**
ORUS 5263-3	3.80	5.39
**ORUS 4892-1*	8.20	4.45
ORUS 5271-1	5.00	4.38
ORUS 5259-1	7.50	4.19
Zodiac	**4.10**	**4.16**
ORUS 5270-3	5.80	4.00
ORUS 4893-4	8.90	3.82
ORUS 5271-3	4.10	3.30
ORUS 5263-4	4.50	3.29
ORUS 5253-2	4.20	2.88
ORUS 5263-2	3.60	2.61
ORUS 5265-2	4.60	2.58
ORUS 5033-1	8.00	2.56
ORUS 5260-1	5.30	2.00
ORUS 5272-2	4.70	1.93
ORUS 5259-3	5.30	1.84
ORUS 5271-2	6.10	1.84
ORUS 5270-2	6.10	1.58
ORUS 5262-1	2.70	1.52
ORUS 5272-1	4.10	1.31

ORUS 4425-1	5.70	1.03

[a] Annual means based on replicated plot samples.
[z] Groups determined by t-Test (LSD) of replicated plot means, $p \leq 0.05$.
[*]Nursery list – available at nurseries for grower trial by request.

Table Bk-SE 1. Fruit size and yield of erect/semi-erect blackberry genotypes tested in OSU-NWREC 2019-21 trial plantings, harvested from 2021-23.

	Berry Size (g)	Yield (tons·a-1)		
Genotype	2021-23	2022	2023	2021-23
Nonreplicated (2019)				
Chester	**5.13**	**9.98**	**13.14**	**11.33**
ORUS 5057-1	6.83	8.65	11.71	10.07
Triple Crown	**7.33**	**7.56**	**11.34**	**8.85**
ORUS 5067-1	7.33	7.03	4.76	6.60
Caddo	**6.23**	**3.39**	**5.52**	**5.87**
Nonreplicated (2020)				
Celestial	**5.95**	**5.64**	**9.33**	**7.49**
Chester	**4.65**	**5.89**	**7.38**	**6.63**
ORUS 5165-1	4.95	4.00	8.86	6.43
Triple Crown	**5.75**	**6.65**	**5.18**	**5.92**
ORUS 5168-1	6.35	5.05	3.72	4.38
ORUS 5168-2	6.25	4.80	3.24	4.02
Nonreplicated (2021)				
ORUS 5276-1	5.90	-	8.18	8.18
Chester	**4.90**	**-**	**7.89**	**7.89**
Triple Crown	**5.30**	**-**	**5.77**	**5.77**
ORUS 5277-1	5.50	-	5.36	5.36
Twilight	**6.50**	**-**	**4.34**	**4.34**
Ouachita	**6.20**	**-**	**3.78**	**3.78**
Celestial	**5.40**	**-**	**3.45**	**3.45**
ORUS 5275-1	4.40	-	1.64	1.64

Table Bk-PF 1. Fruit size and yield of primocane-fruiting blackberry genotypes tested in OSU-NWREC 2019 trial planting, harvested from 2021-23.

	Berry Size (g)	Yield (tons·a-1)		
Genotype	2021-23	2022	2023	2021-23
Replicated				
Thunderhead	**7.52 a**	**12.69**	**9.17**	**9.70 a**
Prime-Ark 45	**7.34 a**	**5.88**	**2.45**	**4.46 b**
Nonreplicated				
ORUS 5173-4	7.73	1.24	0.66	1.17

Table Bk-PF 2. Fruit size and yield of primocane-fruiting blackberry genotypes tested in OSU-NWREC 2020 trial planting, harvested from 2022-23.

	Berry Size (g)	Yield (tons·a-1)		
Genotype	2022-23	2022	2023	2022-23
Replicated				
Prime-Ark 45	**5.18**	**1.81**	**2.91**	**2.36**
Nonreplicated				
Thunderhead	**8.15**	**8.94**	**7.58**	**8.26**
ORUS 5173-3	6.70	0.43	-	0.43
ORUS 5173-1	8.95	0.13	0.42	0.28

Table Bk-PF 3. Fruit size and yield of primocane-fruiting blackberry genotypes tested in OSU-NWREC 2021 trial planting, harvested from 2023.

	Berry Size (g)	Yield (tons·a-1)
Genotype	2023	2023
Replicated		
Prime-Ark 45	**5.13**	**2.91**
Nonreplicated		
Thunderhead	**5.00**	**3.40**
ORUS 4545-2	3.30	2.56

Table Ry-FL 1. Fruit size and yield of floricane-fruiting red raspberry genotypes tested in OSU-NWREC 2020 trial planting, harvested from 2022-23. Yield measurements are based on twice-weekly machine harvests performed using an Oxbo 7450 Harvester.

	Berry Size (g)	Yield (tons·a-1)		
Annual Mean [a]				
2022	1.91	2.83		
2023	3.09	4.84		
Genotype	2022-23	2022	2023	2022-23
Replicated [z]				
WSU 2087	2.55 bc	4.11	4.59	4.35 a
WSU 2472	2.95 a	2.45	6.16	4.30 ab
WSU 2069	2.35 cd	3.32	5.23	4.28 ab
WSU 2425	2.25 d	2.61	5.28	3.95 ab
ORUS 5195-2	2.13 d	2.67	5.08	3.87 ab
ORUS 4600-1	2.60 b	2.78	4.60	3.69 ab
Meeker	**2.27 d**	**2.39**	**4.09**	**3.24 ab**
WSU 2481	2.88 a	2.33	3.72	3.03 b
Nonreplicated				
ORUS 5199-1	2.85	2.30	5.22	3.76
ORUS 5205-1	2.80	2.18	5.13	3.65
ORUS 4371-4	2.85	3.19	3.17	3.18
[*]*ORUS 4607-2*	2.45	4.11	1.53	2.82
ORUS 5198-3	2.70	2.04	3.16	2.60
ORUS 5198-1	2.40	1.97	1.89	1.93
WSU 2577	2.40	2.19	1.65	1.92

[a] Annual means based on replicated plot samples.
[z] Groups determined by t-Test (LSD) of replicated plot means, $p \leq 0.05$.
[*]Nursery list – available at nurseries for grower trial by request.

Table Ry-FL 2. Fruit size and yield of floricane-fruiting red raspberry genotypes tested in OSU-NWREC 2021 trial planting, harvested from 2023. Yield measurements are based on twice-weekly machine harvests performed using an Oxbo 7450 Harvester.

	Berry Size (g)	Yield (tons·a-1)
Annual Mean [a]		
2023	2.93	4.10
Genotype	2023	2023
Replicated [z]		
Meeker	**2.47 c**	**4.89 a**
ORUS 4843-2	3.67 a	4.86 a
WSU 2001	3.23 b	4.34 a
ORUS 4462-2	2.80 c	3.93 a
ORUS 4692-4	2.00 d	3.76 a
ORUS 4373-1	3.40 ab	2.85 a
Nonreplicated		
ORUS 5310-1	3.90	7.23
ORUS 5309-1	3.40	6.34
ORUS 5309-2	3.30	6.06
ORUS 5329-1	4.30	5.61
ORUS 5323-2	3.40	5.47
ORUS 5315-1	4.70	5.34
[*]ORUS 4600-1	2.50	5.23
ORUS 5320-3	4.00	5.23
ORUS 5322-2	2.60	5.19
ORUS 5328-1	3.50	5.10
ORUS 5328-3	3.30	4.98
ORUS 5309-3	2.60	4.97
ORUS 4692-1	3.50	4.92
ORUS 5324-2	3.30	4.84
ORUS 5323-1	2.30	4.84
ORUS 5315-3	2.90	4.76
ORUS 5318-2	2.60	4.69
ORUS 5320-2	2.60	4.40
ORUS 5317-3	2.70	4.40
ORUS 5328-2	3.70	4.40
ORUS 5319-3	2.00	4.34
ORUS 5325-2	3.60	4.25

ORUS 5321-1	2.40	4.13
ORUS 4371-4	3.60	4.06
ORUS 5317-2	2.90	4.05
ORUS 5318-5	2.60	4.04
ORUS 5315-5	3.30	3.96
ORUS 5322-1	2.20	3.96
ORUS 5316-1	2.30	3.93
ORUS 5325-1	3.00	3.74
ORUS 5319-4	2.00	3.69
ORUS 5321-2	2.60	3.63
ORUS 5315-2	3.60	3.62
ORUS 5313-1	3.10	3.53
ORUS 5318-1	2.90	3.46
ORUS 5315-4	2.40	3.39
ORUS 5310-3	3.80	3.17
ORUS 5319-2	2.30	3.01
ORUS 5318-3	3.00	2.96
ORUS 5321-3	2.10	2.92
ORUS 5319-1	2.40	2.88
ORUS 4698-3	2.30	2.84
ORUS 5327-1	3.00	2.62
ORUS 5324-1	2.70	2.21
ORUS 5323-3	1.80	2.02
ORUS 5311-1	2.20	1.88
ORUS 4607-2	2.30	1.23
ORUS 5312-1	2.10	1.12
ORUS 5324-3	2.30	0.99

[a] Annual means based on replicated plot samples.
[z] Groups determined by t-Test (LSD) of replicated plot means, $p \leq 0.05$.
[*]Nursery list – available at nurseries for grower trial by request.

Table Ry-PF 1. Fruit size and yield of primocane-fruiting red raspberry genotypes tested in OSU-NWREC 2020 trial planting, harvested from 2021-23.

	Berry Size (g)	Yield (tons·a-1)		
Genotype	2021-23	2022	2023	2021-23
Replicated [z]				
Finnberry	**2.40**	**2.83**	**2.38**	**2.50**
Nonreplicated				
ORUS 5345-1	2.37	3.88	3.12	3.11
[*]*ORUS 4487-1*	1.77	2.73	2.96	2.48
ORUS 5467-2	2.20	2.36	2.55	2.24
ORUS 5347-1	3.37	2.41	1.62	1.87
ORUS 5332-2	2.90	1.40	2.29	1.63
ORUS 5465-1	2.97	1.74	1.73	1.63
Heritage	**1.80**	**1.53**	**1.53**	**1.40**
ORUS 5465-2	2.77	1.59	0.65	1.09
Polka	**2.03**	**0.99**	**0.21**	**1.08**

[z] Groups determined by t-Test (LSD) of replicated plot means, $p \leq 0.05$.
[*]Nursery list – available at nurseries for grower trial by request.

Table Ry-PF 2. Fruit size and yield of primocane-fruiting red raspberry genotypes tested in OSU-NWREC 2021 trial planting, harvested from 2022-23.

	Berry Size (g)	Yield (tons·a-1)		
Genotype	2022-23	2022	2023	2022-23
Replicated [z]				
Kokanee	**2.47 a**	**1.31**	**3.49**	**2.40 a**
Heritage	**1.70 b**	**2.58**	**2.12**	**2.35 a**
Nonreplicated				
Crimson Treasure	**2.20**	**2.35**	**3.26**	**2.80**
ORUS 5467-1	2.60	2.93	2.01	2.47
Finnberry	**2.60**	**1.52**	**2.59**	**2.05**
[*]*ORUS 4487-1*	1.55	1.02	2.09	1.56
ORUS 4981-1	2.10	0.13	1.49	0.81

[z] Groups determined by t-Test (LSD) of replicated plot means, $p \leq 0.05$.
[*]Nursery list – available at nurseries for grower trial by request.

Table BRy 1. Fruit size and yield of black raspberry genotypes tested in OSU-NWREC 2020 trial planting, harvested from 2022-23. Yield measurements are based on twice-weekly machine harvests performed using an Oxbo 7450 Harvester.

	Berry Size (g)	Yield (tons·a-1)		
Annual Mean [a]				
2022	1.35	2.55		
2023	1.52	3.80		
Genotype	2022-23	2022	2023	2022-23
Replicated [z]				
ORUS 5308-2	1.33 c	2.58	6.02	4.30 a
Munger	**1.47 b**	**2.87**	**3.58**	**3.22 b**
[*]*ORUS 4820-1*	1.23 d	3.09	3.07	3.08 bc
ORUS 5302-1	1.70 a	1.68	2.52	2.10 c
Nonreplicated				
ORUS 5304-2	1.05	2.64	3.13	2.89
ORUS 5292-1	1.20	1.69	4.05	2.87
ORUS 5192-2	1.25	1.73	3.79	2.76
ORUS 5304-1	1.00	1.27	3.22	2.25
ORUS 4833-1	1.30	1.42	2.78	2.10
ORUS 5299-1	1.30	1.79	2.37	2.08
ORUS 5300-1	1.40	1.24	2.42	1.83
ORUS 4304-13	1.40	0.86	2.31	1.59
ORUS 5308-1	1.30	1.29	1.47	1.38
ORUS 5304-3	1.00	1.59	1.01	1.30

[a] Annual means based on replicated plot samples.
[z] Groups determined by t-Test (LSD) of replicated plot means, $p \leq 0.05$.
[*]Nursery list – available at nurseries for grower trial by request.

Table BRy 2. Fruit size and yield of black raspberry genotypes tested in OSU-NWREC 2021 trial planting, harvested from 2023. Yield measurements are based on twice-weekly machine harvests performed using an Oxbo 7450 Harvester.

	Berry Size (g)	Yield (tons·a-1)
Annual Mean [a]		
2023	1.60	3.12
Genotype	2023	2023
Replicated [z]		
Munger	**1.60 ab**	**5.03 a**
ORUS 4677-1	1.60 ab	3.43 ab
ORUS 4942-4	1.60 ab	3.20 ab
ORUS 4818-2	1.60 ab	3.09 b
ORUS 4821-2	1.83 a	2.68 b
ORUS 4412-2	1.57 ab	2.26 b
ORUS 4833-1	1.40 b	2.17 b
Nonreplicated		
ORUS 5291-2	1.20	4.48
ORUS 5291-1	1.10	3.90
ORUS 5090-1	1.60	3.37
[*]ORUS 4310-1	1.20	3.10
ORUS 5296-1	1.20	2.95
ORUS 5306-1	1.10	1.89
[*]ORUS 3381-3	1.30	1.37
ORUS 4566-3	1.70	1.37
ORUS 4401-1	1.90	1.07

[a] Annual means based on replicated plot samples.
[z] Groups determined by t-Test (LSD) of replicated plot means, $p \leq 0.05$.
[*]Nursery list – available at nurseries for grower trial by request.

Table Bk-Season. Ripening season of all blackberry genotypes tested in recent OSU-NWREC trial plantings (averaged across trial plots and years).

		Ripening Date		
Cultivar	Type[y]	5%	50%	95%
ORUS 4425-1	TRL	6/14	6/23	6/28
ORUS 4753-1	TRL	6/18	6/25	6/25
ORUS 5271-3	TRL	6/22	6/27	7/3
ORUS 5133-1	TRL	6/27	6/27	6/27
ORUS 5133-2	TRL	6/27	6/27	6/27
ORUS 5033-1	TRL	6/27	6/27	7/3
ORUS 5271-1	TRL	6/27	6/27	7/3
ORUS 5262-1	TRL	6/27	6/27	7/11
ORUS 5023-1	TRL	6/22	6/29	7/6
ORUS 5028-1	TRL	6/22	6/29	7/13
ORUS 5043-1	TRL	6/22	6/29	7/13
Columbia Sunrise	**TRL**	**6/22**	**6/29**	**7/3**
ORUS 4767-1	TRL	6/25	6/30	7/2
[*]ORUS 4892-1	TRL	6/24	7/1	7/11
ORUS 5263-4	TRL	6/27	7/3	7/3
ORUS 5271-2	TRL	6/27	7/3	7/3
ORUS 4893-4	TRL	6/27	7/3	7/11
ORUS 5041-1	TRL	6/27	7/3	7/11
ORUS 5129-1	TRL	6/27	7/3	7/11
ORUS 5259-3	TRL	6/27	7/3	7/11
ORUS 5259-4	TRL	6/27	7/3	7/11
ORUS 4663-1	TRL	7/3	7/3	7/11
ORUS 5138-1	TRL	7/3	7/3	7/11
ORUS 5253-2	TRL	7/3	7/3	7/11
ORUS 5263-2	TRL	7/3	7/3	7/11
ORUS 5272-1	TRL	7/3	7/3	7/11
ORUS 5253-3	TRL	7/3	7/3	7/18
ORUS 5031-1	TRL	6/27	7/4	7/8
Columbia Star	**TRL**	**6/27**	**7/5**	**7/12**
ORUS 5037-2	TRL	7/1	7/5	7/8
ORUS 5014-2	TRL	6/29	7/6	7/13
ORUS 5010-1	TRL	7/6	7/6	7/13
ORUS 5011-1	TRL	7/6	7/6	7/20
ORUS 5023-2	TRL	7/6	7/6	7/20

**ORUS 4892-2*	TRL	6/29	7/6	7/13
**ORUS 4344-3*	TRL	6/29	7/6	7/20
Hall's Beauty	**TRL**	**7/3**	**7/6**	**7/13**
Black Diamond	**TRL**	**6/24**	**7/6**	**7/17**
Marion	**TRL**	**6/30**	**7/7**	**7/14**
Zodiac	**TRL**	**6/29**	**7/8**	**7/17**
Kotata	**TRL**	**7/1**	**7/8**	**7/12**
ORUS 4535-2	TRL	7/4	7/8	7/19
ORUS 4778-3	TRL	7/2	7/9	7/15
Columbia Giant	**TRL**	**7/6**	**7/10**	**7/13**
ORUS 5265-3	TRL	6/27	7/11	7/11
ORUS 5270-2	TRL	6/27	7/11	7/11
ORUS 5270-3	TRL	6/27	7/11	7/18
ORUS 5260-1	TRL	7/3	7/11	7/11
ORUS 4663-4	TRL	7/3	7/11	7/18
ORUS 5016-1	TRL	7/3	7/11	7/18
ORUS 5041-2	TRL	7/3	7/11	7/18
ORUS 5138-2	TRL	7/3	7/11	7/18
ORUS 5259-1	TRL	7/3	7/11	7/18
ORUS 5263-3	TRL	7/3	7/11	7/18
ORUS 5265-2	TRL	7/3	7/11	7/18
ORUS 5272-2	TRL	7/3	7/11	7/18
ORUS 5127-1	TRL	7/11	7/11	7/18
ORUS 5276-1	ESE	7/11	7/11	7/25
**ORUS 4024-3*	TRL	7/8	7/11	7/14
**ORUS 5037-1*	TRL	7/4	7/12	7/22
ORUS 5019-1	TRL	6/22	7/13	7/20
ORUS 4902-1	TRL	6/29	7/13	7/13
ORUS 5008-1	TRL	7/13	7/13	7/20
ORUS 5066-1	ESE	7/13	7/13	7/27
ORUS 4743-1	ESE	7/7	7/14	7/14
ORUS 4762-1	TRL	7/7	7/14	7/21
**ORUS 5014-1*	TRL	7/8	7/15	7/22
ORUS 4273-2	ESE	7/10	7/17	7/24
ORUS 5165-1	ESE	7/11	7/18	8/1
**ORUS 5148-2*	TRL	7/18	7/18	8/1
ORUS 4453-1	ESE	7/13	7/20	7/20
ORUS 5056-2	ESE	7/13	7/20	8/3
ORUS 5049-1	ESE	7/13	7/20	8/17

ORUS 5058-1	ESE	7/20	7/20	8/3
ORUS 5050-1	ESE	7/20	7/20	8/10
ORUS 5056-1	ESE	7/20	7/20	8/10
Black Jack	**ESE**	**7/10**	**7/20**	**8/3**
Eclipse	**ESE**	**7/20**	**7/24**	**8/10**
ORUS 4926-1	ESE	7/24	7/24	8/7
Ouachita	**ESE**	**7/25**	**7/25**	**8/8**
ORUS 5277-1	ESE	7/25	7/25	8/15
Caddo	**ESE**	**7/15**	**7/26**	**8/16**
ORUS 5067-1	ESE	7/19	7/26	8/8
ORUS 5058-2	ESE	7/20	7/27	8/10
ORUS 5065-2	ESE	7/20	7/27	8/10
ORUS 5045-1	ESE	7/20	7/27	8/17
ORUS 5065-1	ESE	7/20	7/27	8/17
Galaxy	**ESE**	**7/20**	**7/27**	**8/7**
ORUS 5057-1	ESE	7/15	7/29	8/19
ORUS 2816-3	ESE	7/24	7/31	8/14
ORUS 4370-2	ESE	7/24	7/31	8/14
ORUS 4928-2	ESE	7/24	7/31	8/17
ORUS 4929-1	ESE	7/24	7/31	8/21
Twilight	**ESE**	**7/24**	**7/31**	**8/9**
Celestial	ESE	7/25	8/1	8/15
ORUS 5168-1	ESE	7/25	8/1	8/15
ORUS 5168-2	ESE	7/25	8/1	8/15
Triple Crown	**ESE**	**7/23**	**8/2**	**8/13**
ORUS 4929-2	ESE	7/31	8/10	8/28
Chester	**ESE**	**7/26**	**8/13**	**8/28**
ORUS 5275-1	ESE	8/1	8/15	8/15
ORUS 5174-1	EPF	7/20	8/17	9/7
ORUS 5068-5	EPF	7/27	8/17	9/7
ORUS 5173-1	EPF	8/15	8/22	8/22
ORUS 5068-1	EPF	7/27	8/24	9/21
ORUS 5173-4	EPF	7/26	8/30	9/9
ORUS 5068-3	EPF	7/27	8/31	9/14
ORUS 5174-3	EPF	7/27	8/31	9/14
ORUS 4939-6	EPF	8/3	8/31	9/21
ORUS 5069-1	EPF	8/10	8/31	9/21
ORUS 4939-4	EPF	8/17	9/4	9/7
Thunderhead	**EPF**	**8/19**	**9/5**	**9/20**

ORUS 4545-2	EPF	8/22	9/6	9/19
Prime-Ark 45	**EPF**	**8/16**	**9/6**	**9/16**
ORUS 5174-2	EPF	7/27	9/7	9/21
ORUS 4939-3	EPF	8/3	9/7	9/21
ORUS 5175-1	EPF	8/24	9/7	9/14

[y] TRL=Trailing; ESE=Erect/Semi-Erect; EPF=Erect primocane-fruiting.
[*]Nursery list – available at nurseries for grower trial by request.

Table Ry-Season. Ripening season of all red raspberry genotypes tested in recent OSU-NWREC trial plantings (averaged across trial plots and years).

		Ripening Date		
Cultivar	Type [y]	5%	50%	95%
ORUS 4837-2	FL	6/13	6/23	7/7
ORUS 4837-1	FL	6/13	6/25	7/10
WSU 2511	FL	6/20	6/25	7/11
[*]*ORUS 4089-2*	FL	6/25	6/25	6/25
ORUS 4692-1	FL	6/18	6/26	7/9
Wakefield	**FL**	**6/23**	**6/26**	**7/14**
WSU 2130	FL	6/20	6/26	7/10
ORUS 4846-1	FL	6/20	6/26	7/12
ORUS 4961-1	FL	6/19	6/27	7/13
ORUS 4698-3	FL	6/22	6/27	7/11
WSU 2506	FL	6/22	6/27	7/13
ORUS 5108-3	FL	6/30	6/27	7/23
Georgia	**FL**	**6/18**	**6/28**	**7/14**
ORUS 4692-2	FL	6/20	6/28	7/10
WSU 2205	FL	6/20	6/28	7/10
WSU 2421	FL	6/20	6/28	7/15
ORUS 4641-3	FL	6/21	6/28	7/13
WSU 2505	FL	6/15	6/28	7/13
WSU 2298	FL	6/19	6/28	7/13
Cascade Harvest	**FL**	**6/22**	**6/29**	**7/13**
ORUS 4465-2	FL	6/22	6/29	7/13
ORUS 5100-1	FL	6/22	6/29	7/13
Wakehaven	**FL**	**6/22**	**6/29**	**7/13**
WSU 2268	FL	6/22	6/29	7/13
WSU 2277	FL	6/22	6/29	7/13
WSU 2605	FL	6/18	6/30	7/15
WSU 2191	FL	6/20	6/30	7/12
WSU 2472	FL	6/22	6/30	7/11
ORUS 5309-1	FL	6/22	6/30	7/14
ORUS 5315-3	FL	6/22	6/30	7/14
ORUS 5315-4	FL	6/22	6/30	7/14
ORUS 5317-2	FL	6/22	6/30	7/14
ORUS 5317-3	FL	6/22	6/30	7/14
ORUS 5318-5	FL	6/22	6/30	7/14

WSU 2069	FL	6/22	6/30	7/14
WSU 2425	FL	6/22	6/30	7/14
ORUS 4713-1	FL	6/23	6/30	7/12
WSU 1914	FL	6/23	6/30	7/14
ORUS 4843-1	FL	6/25	6/30	7/17
WSU 2377	FL	6/19	6/30	7/13
WSU 2437	FL	6/22	6/30	7/13
WSU 2299	FL	6/22	7/1	7/14
WSU 2123	FL	6/21	7/1	7/15
ORUS 5099-1	FL	6/21	7/1	7/19
ORUS 4713-2	FL	6/23	7/1	7/13
WSU 2202	FL	6/23	7/1	7/15
WSU 2366	FL	6/23	7/1	7/15
ORUS 4603-2	FL	6/20	7/2	7/12
ORUS 4600-2	FL	6/25	7/2	7/16
ORUS 4965-3	FL	6/27	7/2	7/11
WSU 2087	FL	6/22	7/2	7/12
**ORUS 4715-2*	FL	6/27	7/2	7/18
ORUS 4690-1	FL	6/23	7/3	7/13
ORUS 4707-1	FL	6/23	7/3	7/13
ORUS 4851-2	FL	6/23	7/3	7/15
WSU 2188	FL	6/23	7/3	7/15
**ORUS 4974-1*	FL	6/25	7/3	7/15
ORUS 4692-4	FL	6/24	7/3	7/15
ORUS 4851-1	FL	6/23	7/3	7/15
WSU 2195	FL	6/23	7/3	7/15
ORUS 5104-2	FL	6/25	7/3	7/17
ORUS 5106-3	FL	6/28	7/3	7/17
**ORUS 4371-4*	FL	6/25	7/3	7/15
**ORUS 4600-1*	FL	6/25	7/3	7/16
WSU 2088	FL	6/22	7/3	7/14
ORUS 4640-1	FL	6/19	7/4	7/13
ORUS 4965-1	FL	6/22	7/4	7/11
ORUS 1154R-3	FL	6/24	7/4	7/18
ORUS 3959-1	FL	6/24	7/4	7/18
ORUS 4715-1	FL	6/24	7/4	7/18
ORUS 4607-2	FL	6/24	7/4	7/15
ORUS 4600-3	FL	6/21	7/4	7/14
Meeker	**FL**	**6/24**	**7/4**	**7/15**

ORUS 5205-1	FL	6/22	7/5	7/14
ORUS 5320-3	FL	6/22	7/5	7/14
ORUS 5322-1	FL	6/22	7/5	7/14
ORUS 5323-2	FL	6/22	7/5	7/14
ORUS 5329-1	FL	6/22	7/5	7/14
ORUS 4843-2	FL	6/22	7/5	7/17
ORUS 5322-2	FL	6/22	7/5	7/17
ORUS 5325-1	FL	6/22	7/5	7/17
WSU 2234	FL	6/22	7/5	7/14
ORUS 4707-2	FL	6/23	7/5	7/13
WSU 2162	FL	6/23	7/5	7/13
WSU 2481	FL	6/24	7/5	7/18
ORUS 4603-1	FL	6/25	7/5	7/16
AAC Eden	**FL**	**6/25**	**7/5**	**7/19**
ORUS 5198-3	FL	6/27	7/5	7/14
ORUS 5315-2	FL	6/27	7/5	7/14
ORUS 5319-4	FL	6/27	7/5	7/14
ORUS 5328-1	FL	6/27	7/5	7/14
ORUS 5328-3	FL	6/27	7/5	7/14
ORUS 5195-2	FL	6/27	7/5	7/17
ORUS 5199-1	FL	6/27	7/5	7/17
ORUS 5309-2	FL	6/27	7/5	7/17
ORUS 5310-1	FL	6/27	7/5	7/17
ORUS 5318-3	FL	6/27	7/5	7/17
ORUS 5320-2	FL	6/27	7/5	7/17
ORUS 5325-2	FL	6/27	7/5	7/17
ORUS 5321-2	FL	6/30	7/5	7/14
ORUS 4961-5	FL	6/15	7/5	7/13
ORUS 4961-3	FL	6/22	7/5	7/13
ORUS 4971-2	FL	6/22	7/5	7/13
WSU 2348	FL	6/22	7/5	7/13
WSU 2357	FL	6/22	7/5	7/13
WSU 2376	FL	6/22	7/5	7/13
WSU 2432	FL	6/22	7/5	7/13
WSU 2442	FL	6/22	7/5	7/13
WSU 2510	FL	6/22	7/5	7/13
ORUS 4971-1	FL	6/23	7/5	7/13
ORUS 4971-3	FL	6/23	7/5	7/13
ORUS 4972-1	FL	6/23	7/5	7/13

ORUS 4978-1	FL	6/23	7/5	7/13
ORUS 4978-2	FL	6/23	7/5	7/13
ORUS 4978-3	FL	6/23	7/5	7/13
WSU 2278	FL	6/23	7/5	7/13
WSU 2372	FL	6/23	7/5	7/13
ORUS 4975-1	FL	6/25	7/5	7/13
ORUS 5105-1	FL	6/28	7/5	7/19
ORUS 5106-1	FL	6/28	7/5	7/19
ORUS 5107-1	FL	6/25	7/6	7/13
ORUS 4373-1	FL	6/24	7/7	7/17
WSU 2516	FL	6/25	7/7	7/19
ORUS 4462-2	FL	6/27	7/7	7/17
ORUS 5315-1	FL	6/27	7/7	7/17
ORUS 5315-5	FL	6/27	7/7	7/17
ORUS 5318-2	FL	6/27	7/7	7/17
ORUS 5319-1	FL	6/27	7/7	7/17
ORUS 5319-3	FL	6/27	7/7	7/17
ORUS 5321-1	FL	6/27	7/7	7/17
ORUS 5321-3	FL	6/27	7/7	7/17
ORUS 5311-1	FL	6/30	7/7	7/14
ORUS 5309-3	FL	6/30	7/7	7/17
ORUS 5313-1	FL	6/30	7/7	7/17
ORUS 5323-1	FL	6/30	7/7	7/17
WSU 2385	FL	6/22	7/7	7/16
ORUS 4690-3	FL	6/24	7/8	7/18
ORUS 4694-1	FL	6/24	7/8	7/18
ORUS 4715-3	FL	6/24	7/8	7/18
ORUS 5106-2	FL	6/22	7/9	7/13
ORUS 4845-2	FL	6/22	7/9	7/13
ORUS 5094-2	FL	6/22	7/9	7/13
ORUS 5104-4	FL	6/22	7/9	7/13
ORUS 4845-3	FL	6/25	7/9	7/13
ORUS 5105-2	FL	6/25	7/9	7/13
ORUS 4463-1	FL	6/25	7/9	7/13
ORUS 5319-2	FL	6/27	7/11	7/17
ORUS 5324-1	FL	6/27	7/11	7/17
ORUS 5324-2	FL	6/27	7/11	7/17
WSU 2001	FL	6/27	7/11	7/20

ORUS 5310-3	FL	6/30	7/11	7/14
ORUS 5318-1	FL	6/30	7/11	7/17
ORUS 5323-3	FL	6/30	7/11	7/17
ORUS 5328-2	FL	6/30	7/11	7/20
ORUS 5198-1	FL	7/5	7/11	7/17
ORUS 5316-1	FL	7/5	7/11	7/17
ORUS 5327-1	FL	7/5	7/11	7/17
WSU 2577	FL	7/5	7/11	7/17
ORUS 5102-2	FL	6/28	7/12	7/19
ORUS 5094-1	FL	6/30	7/12	7/19
ORUS 5312-1	FL	7/5	7/14	7/14
ORUS 5324-3	FL	7/5	7/14	7/17
ORUS 4840-1	FL	6/28	7/15	7/18
ORUS 4988-2	PF	7/17	7/24	7/24
ORUS 4988-1	PF	7/17	7/24	8/14
ORUS 4988-3	PF	7/17	8/7	8/14
Amaranta	**PF**	**7/17**	**8/7**	**8/28**
ORUS 4864-1	PF	7/24	8/7	8/21
ORUS 5218-1	PF	7/27	8/7	8/24
ORUS 5250-1	PF	7/27	8/7	8/31
**ORUS 4291-1*	PF	7/30	8/7	8/25
ORUS 5005-3	PF	7/31	8/7	8/28
ORUS 4981-2	PF	7/31	8/7	9/4
Polka	**PF**	**7/28**	**8/10**	**8/26**
ORUS 4725-1	PF	7/27	8/10	8/24
ORUS 5211-1	PF	7/27	8/10	8/28
ORUS 5005-1	PF	8/1	8/13	8/29
BP-1	**PF**	**7/24**	**8/14**	**9/4**
ORUS 4858-3	PF	7/31	8/14	8/28
ORUS 4873-1	PF	7/31	8/14	8/28
ORUS 4872-1	PF	7/31	8/14	9/18
ORUS 4988-5	PF	8/3	8/14	8/27
ORUS 4988-4	PF	8/7	8/14	8/21
Lagorai Plus	**PF**	**8/7**	**8/14**	**8/28**
ORUS 5248-3	PF	8/14	8/14	9/7
ORUS 5005-2	PF	8/1	8/15	9/1
ORUS 5201-2	PF	8/3	8/17	9/7
ORUS 4289-4	PF	8/3	8/17	8/21

ORUS 5209-2	PF	8/3	8/17	8/28
ORUS 5248-1	PF	8/3	8/17	8/31
ORUS 4858-1	PF	8/4	8/18	8/28
Imara	**PF**	**8/6**	**8/20**	**9/11**
ORUS 5109-2	PF	8/9	8/20	8/25
**ORUS 5209-1*	PF	8/3	8/21	9/7
ORUS 4494-3	PF	8/7	8/21	9/11
ORUS 5004-2	PF	8/14	8/21	8/21
ORUS 4289-3	PF	8/14	8/21	9/4
ORUS 4856-1	PF	8/14	8/21	9/11
ORUS 5467-1	PF	8/8	8/22	9/6
**ORUS 4487-1*	PF	8/3	8/22	9/9
ORUS 5465-1	PF	7/29	8/23	9/9
ORUS 5118-1	PF	8/6	8/23	9/6
ORUS 5243-1	PF	8/11	8/23	8/30
ORUS 5345-2	PF	8/3	8/24	8/31
ORUS 5332-1	PF	8/3	8/24	9/7
ORUS 4858-2	PF	8/5	8/24	9/10
Kweli	**PF**	**8/6**	**8/24**	**9/11**
ORUS 4874-1	PF	8/10	8/24	9/7
ORUS 5220-1	PF	8/14	8/24	9/7
ORUS 5114-1	PF	8/9	8/25	9/6
ORUS 5114-2	PF	8/16	8/25	8/30
Heritage	**PF**	**8/16**	**8/25**	**9/7**
ORUS 4985-1	PF	8/19	8/26	9/6
ORUS 5467-2	PF	8/2	8/26	9/9
ORUS 5345-1	PF	8/12	8/26	9/16
Kokanee	**PF**	**8/7**	**8/26**	**9/12**
Vintage	**PF**	**8/10**	**8/27**	**9/10**
ORUS 4857-1	PF	8/14	8/28	9/4
ORUS 5227-2	PF	8/14	8/28	9/7
ORUS 5248-2	PF	8/14	8/28	9/7
ORUS 5227-3	PF	8/14	8/28	9/11
Crimson Treasure	**PF**	**8/1**	**8/29**	**9/19**
Finnberry	**PF**	**8/18**	**8/29**	**9/14**
ORUS 5347-1	PF	8/16	8/30	9/13
ORUS 4990-1	PF	8/14	8/31	9/22
Kwanza	**PF**	**8/17**	**8/31**	**9/15**

ORUS 5243-2	PF	8/23	9/1	9/15
ORUS 4981-1	PF	8/29	9/6	9/19
ORUS 5243-3	PF	8/18	9/6	9/15
ORUS 5332-2	PF	8/23	9/6	9/20
ORUS 4722-2	PF	8/25	9/9	9/21
ORUS 5465-2	PF	8/26	9/9	9/16
ORUS 4989-1	PF	9/3	9/14	9/22
ORUS 5004-3	PF	9/3	9/14	9/22
ORUS 4722-1	PF	8/28	9/18	9/26
ORUS 4861-1	PF	9/18	9/18	9/26
ORUS 5465-3	PF	9/12	9/19	9/19
ORUS 5344-1	PF	9/21	9/21	9/21
ORUS 5004-5	PF	9/18	9/26	9/26

[y] FL=Floricane-fruiting; PF=Primocane-fruiting.
[*]Nursery list – available at nurseries for grower trial by request.

Table BRy-Season. Ripening season of all black raspberry genotypes tested in recent OSU-NWREC trial plantings (averaged across trial plots and years).

	Ripening Date		
Cultivar	5%	50%	95%
ORUS 5090-2	6/15	6/15	6/29
ORUS 5090-4	6/15	6/22	6/29
ORUS 5190-1	6/15	6/22	6/29
ORUS 3013-1	6/22	6/22	6/29
ORUS 3217-1	6/22	6/22	6/29
ORUS 4154-1	6/22	6/22	6/29
ORUS 4828-2	6/22	6/22	6/29
ORUS 4945-3	6/22	6/22	6/29
ORUS 4952-3	6/22	6/22	6/29
ORUS 5074-1	6/22	6/22	6/29
ORUS 5088-1	6/22	6/22	6/29
ORUS 5088-2	6/22	6/22	6/29
ORUS 5090-3	6/22	6/22	6/29
ORUS 5091-1	6/22	6/22	6/29
ORUS 5091-2	6/22	6/22	6/29
ORUS 5091-4	6/22	6/22	6/29
ORUS 5091-5	6/22	6/22	6/29
ORUS 5092-1	6/22	6/22	6/29
ORUS 5092-5	6/22	6/22	6/29
ORUS 5093-1	6/22	6/22	6/29
ORUS 5094-2	6/22	6/22	6/29
ORUS 5176-1	6/22	6/22	6/29
ORUS 5179-1	6/22	6/22	6/29
ORUS 5180-1	6/22	6/22	6/29
ORUS 5180-2	6/22	6/22	6/29
ORUS 5182-1	6/22	6/22	6/29
ORUS 5185-1	6/22	6/22	6/29
ORUS 5185-2	6/22	6/22	6/29
ORUS 5185-3	6/22	6/22	6/29
ORUS 5186-1	6/22	6/22	6/29
ORUS 5188-1	6/22	6/22	6/29
ORUS 5188-2	6/22	6/22	6/29
ORUS 5192-1	6/22	6/22	6/29
ORUS 4686-1	6/22	6/22	7/2

ORUS 4818-1	6/21	6/23	7/4
**ORUS 4820-1*	6/18	6/23	7/3
ORUS 4833-2	6/20	6/24	7/1
ORUS 4942-1	6/20	6/24	7/1
ORUS 4942-2	6/20	6/24	7/1
ORUS 4942-5	6/20	6/24	7/1
ORUS 4305-74	6/18	6/25	6/25
ORUS 4679-1	6/18	6/25	7/2
ORUS 4681-1	6/18	6/25	7/2
ORUS 5090-1	6/21	6/25	7/2
ORUS 4305-51	6/25	6/25	6/25
ORUS 4304-5	6/25	6/25	7/2
Jewel	**6/22**	**6/26**	**7/2**
ORUS 3032-3	6/22	6/26	7/2
ORUS 3843-1	6/22	6/26	7/2
ORUS 4110-2	6/22	6/26	7/2
ORUS 4306-1	6/22	6/26	7/2
ORUS 4395-1	6/22	6/26	7/2
**ORUS 4499-1*	6/22	6/26	7/2
ORUS 4952-2	6/22	6/26	7/2
ORUS 5076-1	6/22	6/26	7/2
ORUS 5078-1	6/22	6/26	7/2
ORUS 3219-2	6/23	6/26	7/4
Munger	**6/23**	**6/26**	**7/3**
ORUS 4820-2	6/21	6/27	7/4
ORUS 4836-1	6/21	6/27	7/4
ORUS 4831-2	6/21	6/27	7/7
ORUS 4944-4	6/21	6/27	7/7
**ORUS 4401-1*	6/23	6/27	7/4
ORUS 4818-2	6/23	6/27	7/4
ORUS 3038-1	6/22	6/27	7/5
ORUS 4304-156	6/20	6/28	7/8
ORUS 4305-88	6/20	6/28	7/8
ORUS 4411-3	6/20	6/28	7/8
ORUS 4944-1	6/20	6/28	7/8
ORUS 4944-3	6/20	6/28	7/8
ORUS 4956-1	6/20	6/28	7/8
ORUS 5308-2	6/22	6/28	7/5
**ORUS 4412-1*	6/24	6/28	7/8

ORUS 4827-1	6/24	6/28	7/8
ORUS 4828-3	6/24	6/28	7/8
ORUS 4830-1	6/24	6/28	7/8
ORUS 4943-1	6/24	6/28	7/8
ORUS 4566-3	6/28	6/28	7/5
ORUS 5192-2	6/28	6/28	7/5
ORUS 5292-1	6/28	6/28	7/5
ORUS 5302-1	6/28	6/28	7/5
ORUS 5304-2	6/28	6/28	7/5
ORUS 5304-3	6/28	6/28	7/5
ORUS 5308-1	6/28	6/28	7/5
ORUS 4304-136	6/28	6/28	7/10
ORUS 5299-1	6/28	6/28	7/10
ORUS 5300-1	6/28	6/28	7/10
ORUS 5304-1	6/28	6/28	7/10
ORUS 4829-2	6/21	6/29	7/4
Basha	**6/21**	**6/29**	**7/7**
**ORUS 3021-1*	6/21	6/29	7/7
ORUS 4554-1	6/21	6/29	7/7
ORUS 4808-1	6/21	6/29	7/7
ORUS 4808-2	6/21	6/29	7/7
ORUS 4809-1	6/21	6/29	7/7
ORUS 4812-1	6/21	6/29	7/7
ORUS 4812-3	6/21	6/29	7/7
ORUS 4815-1	6/21	6/29	7/7
ORUS 4821-1	6/21	6/29	7/7
ORUS 4824-1	6/21	6/29	7/7
ORUS 4825-2	6/21	6/29	7/7
ORUS 4826-1	6/21	6/29	7/7
ORUS 4828-1	6/21	6/29	7/7
ORUS 4829-1	6/21	6/29	7/7
ORUS 4829-3	6/21	6/29	7/7
ORUS 4831-1	6/21	6/29	7/7
ORUS 4833-3	6/21	6/29	7/7
ORUS 4834-1	6/21	6/29	7/7
ORUS 4835-1	6/21	6/29	7/7
ORUS 4944-2	6/21	6/29	7/7
ORUS 4951-1	6/21	6/29	7/7
ORUS 4951-2	6/21	6/29	7/7

ORUS 4952-1	6/21	6/29	7/7
ORUS 4956-2	6/21	6/29	7/7
ORUS 4957-1	6/21	6/29	7/7
ORUS 4812-4	6/22	6/29	6/29
ORUS 5089-1	6/22	6/29	6/29
ORUS 5182-2	6/22	6/29	6/29
ORUS 5186-2	6/22	6/29	6/29
ORUS 5191-1	6/22	6/29	6/29
ORUS 4957-2	6/22	6/29	7/2
ORUS 4074-3	6/23	6/29	7/7
ORUS 4948-1	6/23	6/29	7/7
ORUS 4954-1	6/23	6/29	7/7
ORUS 4310-1	6/24	6/29	7/5
ORUS 4412-2	6/24	6/29	7/5
ORUS 5075-1	6/29	6/29	6/29
ORUS 5091-3	6/29	6/29	6/29
ORUS 5092-2	6/29	6/29	6/29
ORUS 5092-3	6/29	6/29	6/29
ORUS 5180-3	6/29	6/29	6/29
ORUS 5186-3	6/29	6/29	6/29
ORUS 4833-1	6/24	6/29	7/7
ORUS 4677-1	6/24	6/29	7/6
ORUS 4304-65	6/23	6/30	7/7
ORUS 4945-2	6/23	6/30	7/7
ORUS 4946-1	6/23	6/30	7/7
ORUS 5070-1	6/23	6/30	7/7
ORUS 5085-1	6/23	6/30	7/7
ORUS 5086-1	6/23	6/30	7/7
ORUS 4942-3	6/23	6/30	7/7
ORUS 4821-2	6/23	7/1	7/8
ORUS 4497-1	6/24	7/1	7/8
ORUS 4825-1	6/24	7/1	7/8
ORUS 4942-4	6/25	7/1	7/8
ORUS 4585-1	6/15	7/2	7/2
ORUS 4304-192	6/25	7/2	7/2
ORUS 4305-66	6/25	7/2	7/2
ORUS 4686-3	6/25	7/2	7/2
ORUS 3381-3	7/3	7/3	7/13
ORUS 5291-1	6/28	7/5	7/10

ORUS 5291-2	6/28	7/5	7/10
ORUS 5296-1	6/28	7/5	7/10
ORUS 5306-1	7/5	7/5	7/10
ORUS 3412-1	7/4	7/7	7/15
Mac Black	**7/4**	**7/15**	**7/18**

*Nursery list – available at nurseries for grower trial by request.

The Northwest Berry Foundation
1100 NE 28th Ave, Ste 204, Portland, OR 97232
503-504-2977 & info@nwberries.org
www.nwberryfoundation.org

Small Fruit Update Progress Report

As of November 2023

Objectives:

- Increase industry communication.
- Increase grower knowledge of IPM strategies.
- Accelerate the dissemination of pesticide information, such as label changes to growers.
- Facilitate real-time pest alerts to growers throughout the growing season.
- Inform industry personnel of upcoming meetings as well as other relevant commission news such as elections, seat vacancies and/or legislative activities.

Overview

The Small Fruit Update (SFU) is released via email weekly during the growing season and shifts to bimonthly during the winter months (October – February). Our overall audience has grown though in different ways than just email subscriptions. Total social media audience has grown. While we are seeing a slight decrease in overall net subscriptions to the emailed newsletter, the email newsletter subscribers are far more engaged. This indicates that the social media platforms are indeed reaching the remaining audience, and that our subscriber base is choosing their preferred platform to engage with us rather than relying on the newsletter as the sole source of SFU news and updates. Our email subscribers demographic are showing an older engagement whereas the younger demographic are more social media inclined. There are currently **1,408** email subscribers. **75% percent of subscribers are engaged**, a six percent increase from 2022, interacting with the newsletter. Of note, data analytics have undergone significant metrics reporting changes by Instagram, X (formerly Twitter), and our eNewsletter management platform Mailchimp. While NBF has worked to ensure data accuracy, modifying reports to fit the new system changes is an ongoing process. If future reports indicate discrepancies between these metrics and future reports, we will reissue this report with updated data analytics.

Peerbolt Crop Management provided a weekly emailed Small Fruit Update (SFU) to an increasing number of growers, industry personnel, and researchers since February 2000. Nine years ago, the SFU was taken over by Northwest Berry Foundation. In late 2022, Peerbolt Crop Management closed and therefore no longer provides assistance with the SFU. As several recipients regularly pass it on to others, we estimate the total number receiving the Update to be well over 1,700 people. Additionally, considering the movement of sharing this with social media platforms over the last couple years, readership has increased but just in a different format.

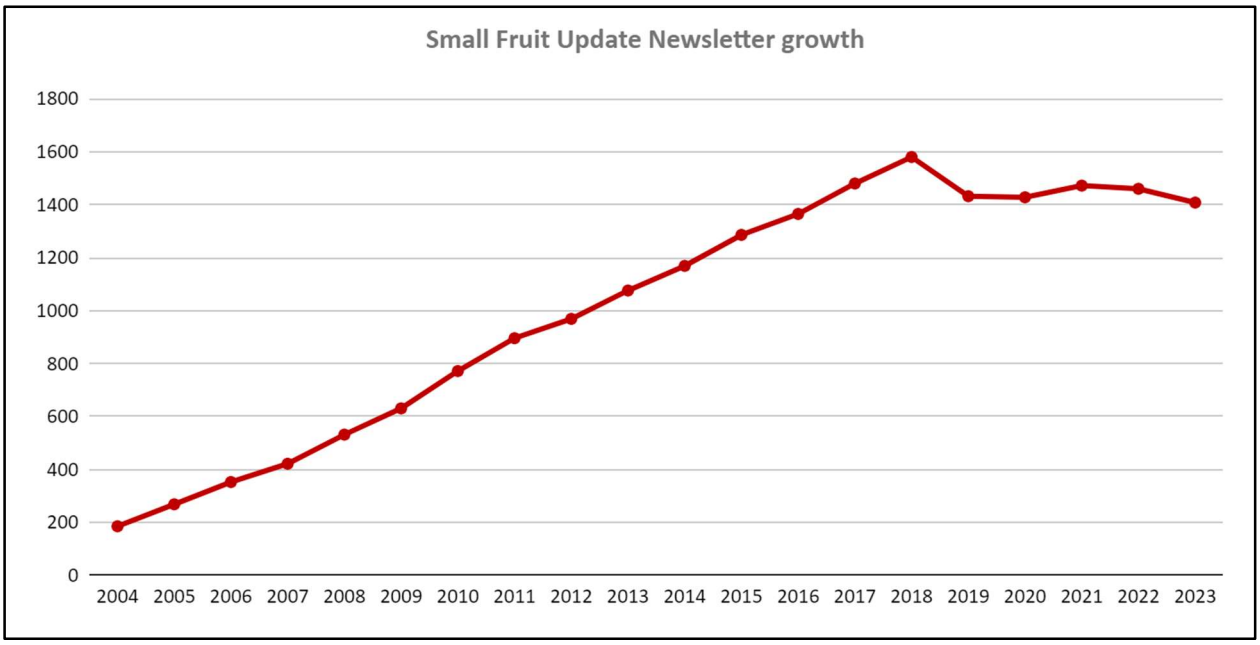
Of the subscribers:

- 229 are in BC, 557 in Oregon, 323 in Washington, and 299 located elsewhere or chose not to answer.
- 672 are growers, 561 are industry members, and 155 are public researchers
- Of growers who reported what they produce: 256 Blackberry, 563 Blueberry, 210 Strawberries, 294 Raspberry

While the newsletter *primarily targets regional producers and processors*, it is regularly *forwarded to buyers to boost sales*. Our readership count is artificially low, as we are unable to directly track readership outside subscription. In addition to email, NBF has been expanding the dissemination of the Small Fruit Update through various social media platforms. The demographics and way people receive the SFU is shifting so we are adjusting to that shift.

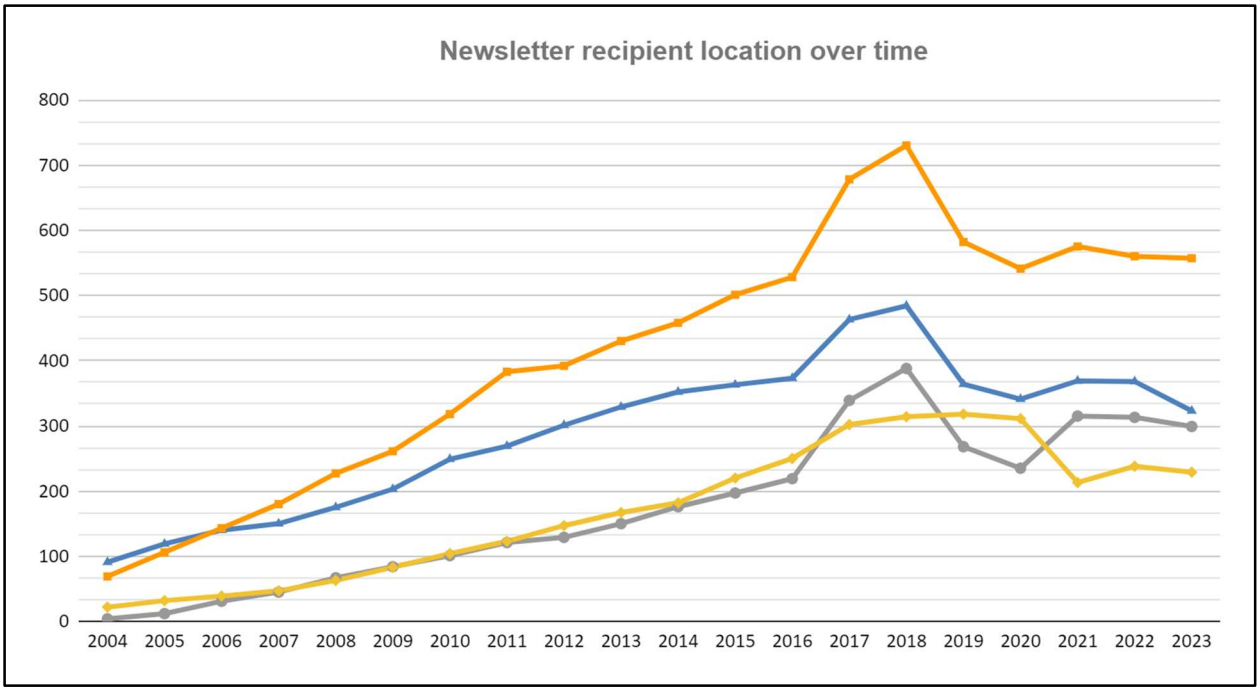
The following charts illustrate the profile of the Small Fruit Update recipients in our email Mailchimp database as of the date of this report.

2023 Profile of the Small Fruit Update in Mailchimp

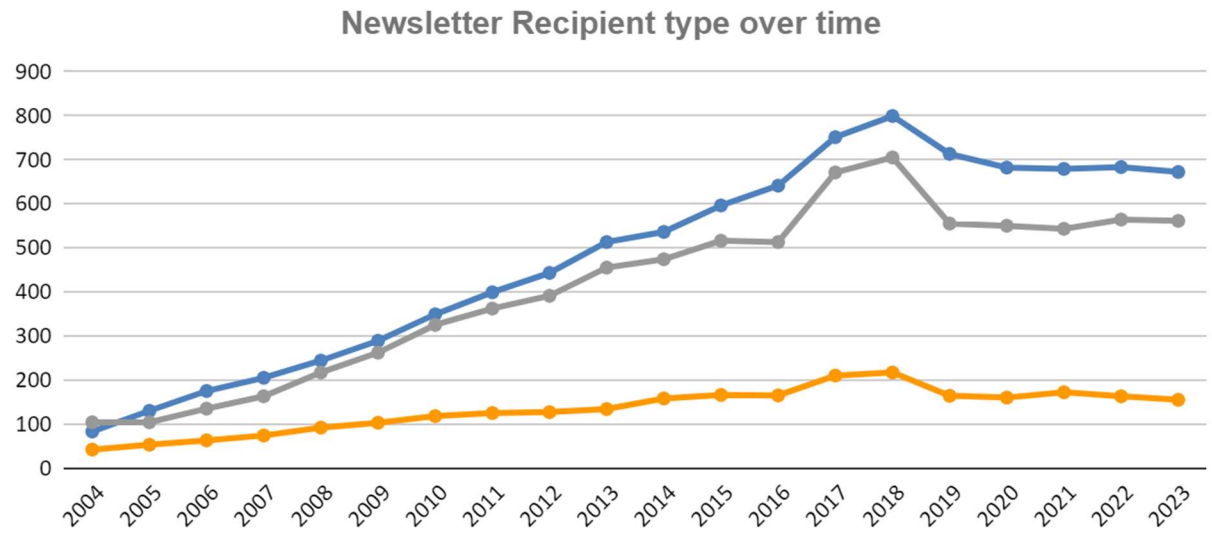


NBF makes every effort to provide you with accurate information, however we do not mandate those who sign up for the SFU to give any information beyond their email address, name, address, and phone number. We also request that growers note what crops they grow, but this is also optional. This means that our annual demographic reports often change previous report's numbers. Also note that each year we lose a certain number of recipients. Some drop out because of a job change, but there are always a few dropped simply because their email address no longer works, and we are unable to rectify the situation after attempting to contact them. In the last couple years, we have made an effort to clean up the mailing list to better reflect actual active recipients.

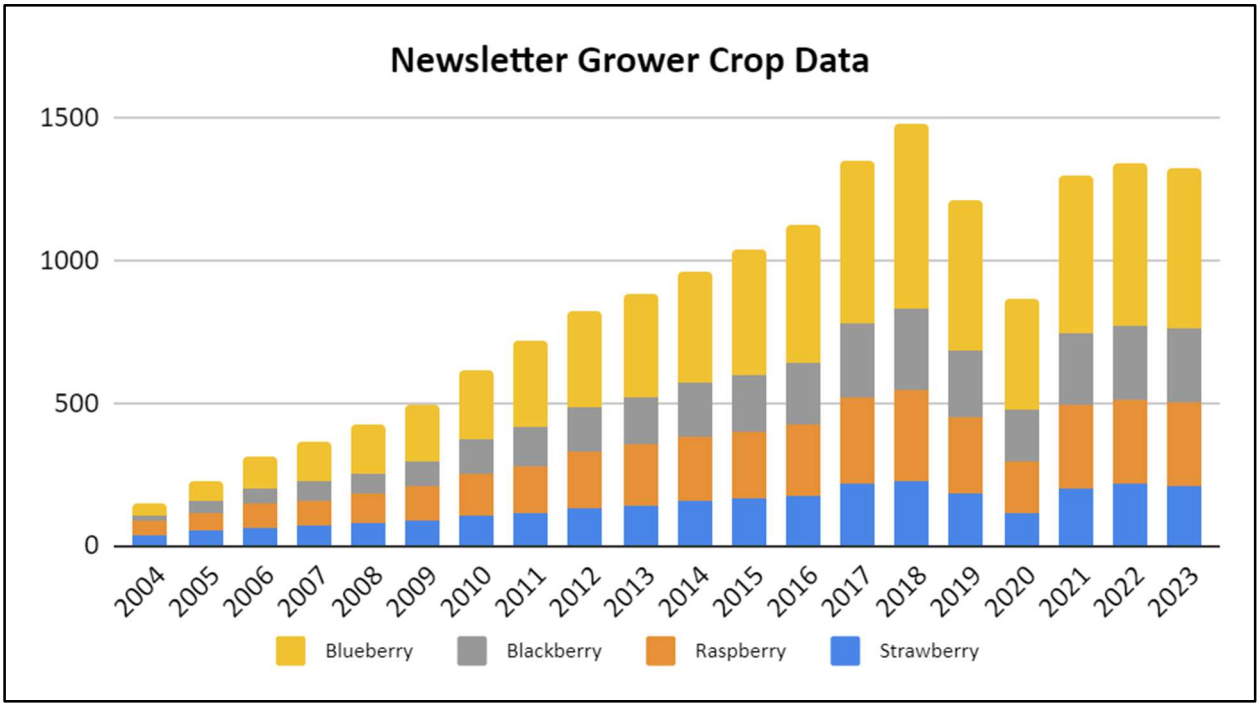
Since the beginning of the year, there has been a subscriber decrease of 9 recipients in BC and a decrease of 4 in Oregon and 5 in Washington. The remaining recipients are located throughout the U.S., Canada, and the rest of the world. That segment decreased by three subscribers.



The “Growers” category decreased by 5 individual subscribers. The “Researchers” category includes anyone associated with USDA, ARS, a college, or university, as well as state or federal departments of agriculture, and others who work for public agencies. Over the past year, researchers receiving the Small Fruit Update decreased by 9 individuals. The category “Industry” includes suppliers, newspaper reporters, propagators, processors, nurseries, fruit buyers, manufacturers, sales reps, and even bankers. This year the number of industry recipients decreased by 8 individual subscribers.

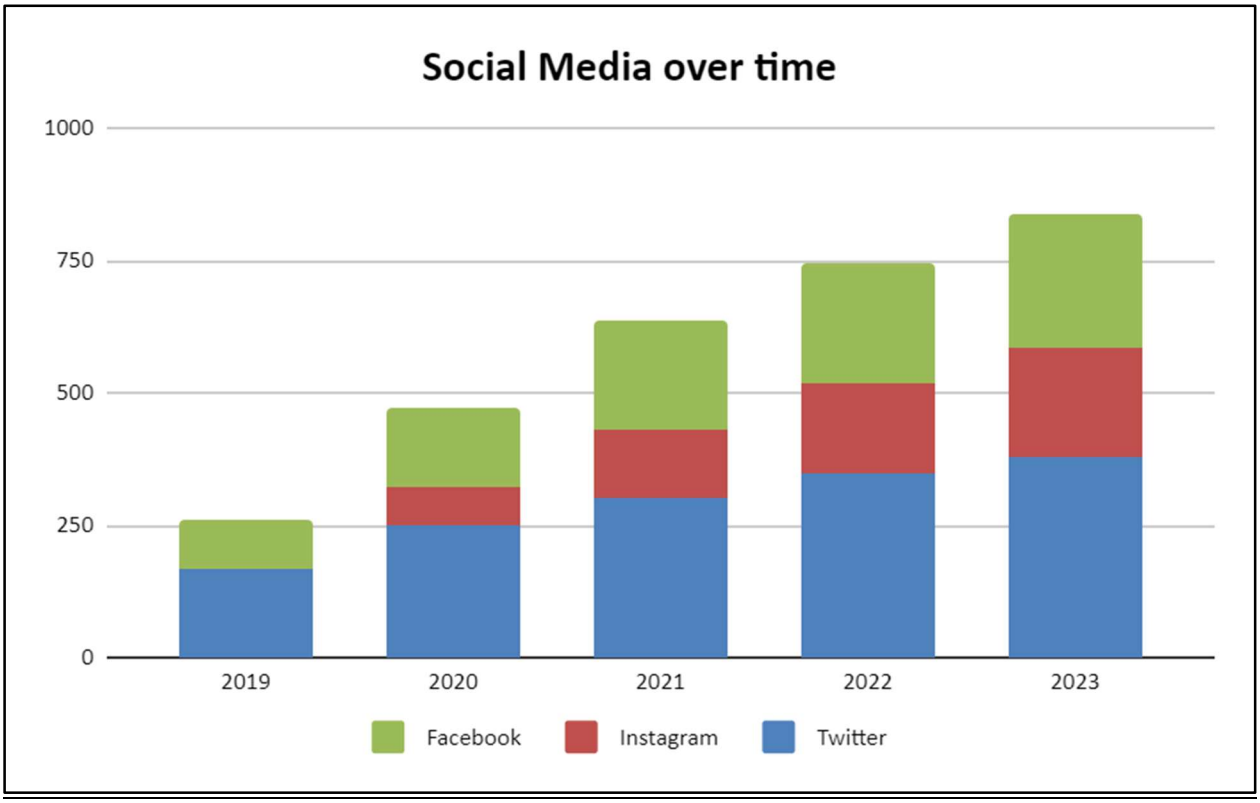


In general, the trend over the past 10 years is that strawberry, blackberry, and raspberry recipients have grown at near parallel rates. (Note: counts from 2020 in this segment were miscounted at time of 2020 reporting). The number of recipients identifying themselves as strawberry growers decreased by 5 , raspberry growers decreased by 7, blackberry growers decreased by 3, and blueberry growers decreased by 4 from 2022.



Our signup form encourages those wanting the Update to give us demographic information. The crop data presented above reflects the fact that some growers do not indicate what crop they grow, and many growers are harvesting more than one small fruit.

Social Media Report



Facebook

The NW Berry Foundation Facebook page was created in 2019 to direct people back to the NW Berry Website. Individuals using the Facebook platform searched and found our page using the terms "NW Berry Foundation" and "berry u-picks." In July of 2019, we had a small audience of **90 followers**. As of November 2023, our **followers have increased to 253**. The majority of our current Facebook followers are *vegetable farmers, berry growers, and regional food service organizations.* Beginning July 2019, the SFU was unofficially released via Facebook. In 2023, the SFU newsletters shared on Facebook receive up to 1074 impressions* and up to 10 engagements** with an average reach of 53. *Impressions: the number of times a post is displayed. **Engagement: the number of likes, shares and comments. This social media platform has been successful at direct newsletter clicks and directing readers to the SFU Newsletter webpage.

X (Formerly Twitter)

Beginning in September 2019, a NW Berry Foundation's X account (#NWBerryFdn) was established to provide an additional outlet for quickly releasing berry news and the Small Fruit Update. As of November 2023, our followers have **increased to 380 followers, up by 31 followers from one year ago**. Multiple news and event postings have been retweeted including conference announcements, berry research articles, and ag policy news. The quality of followers is high with retweets from the Packer and WSU/OSU professors and likes primarily from graduate students and industry researchers. X impressions* over a period of 90 days average to 38 depending on post content. *Impressions is the number of times posts have been seen. High impressions occurred at the beginning of the growing

season (Feb. and March) as well as at the end of the season in October. This social media platform has been successful at gaining industry members and researcher followers.

Instagram
The Northwest Berry Foundation established an Instagram account (@northwestberryfoundation) in September 2019. Starting in January 2020, Instagram was used as an avenue for sharing the Small Fruit Update. Relevant SFU photos were shared and linked to our SFU newsletter webpage (i.e. Link in Bio). As of November 2023, our Instagram followers have **increased by 33 people to total 203 followers since last year**. This social media platform has been successful at gaining local grower engagement as well as small farms and farm related industry across the Pacific Northwest.

Strategy for 2024

Expanding SFU Audience
In 2020 we cleaned up our 20-year-old mailing list. We have had a reduction in our SFU mailing list subscribers, with 382 unsubscribed and 580 cleaned contacts*. *Cleaned contacts occur when email addresses are no longer valid, or the recipient has not opened emails in over a year. We've started gaining more engaging subscribers in 2021 and started building more interactive content in 2022. In 2023, we established more consistency across platforms and included more project-related content and more NBF-branded content.

47% percent of the SFU eNewsletter subscribers are over the age of 65 and 22% below the age of 44. By targeting the various social media platforms, we hope to continue to diversify the demographics of our readers and establish a strong social media presence for disseminating the SFU.

Plan to scale in future
Based on the data points collected from surveys, in-person interactions and analytics studied for 2023, We intend to look into continuing to increase the visibility of the SFU and the NBF as well as awareness through social media regarding the mission of both. As PCM is no longer a part of the SFU, emphasis will be placed on the fact that the SFU is solely supported through nonprofit efforts. Due to the analytics recording changes in both MailChimp, X and Instagram, we will also work to create consistent reports either within the social media and eNewsletter management systems. As this component is ongoing, we will update the commission on any changes to the numbers based on more accurate data should it become available and if data comparisons show discrepancies between this report and any future reporting numbers.

RESEARCH REPORT
TO THE
OREGON RASPBERRY AND BLACKBERRY COMMISSION
AND THE
AGRICULTURAL RESEARCH FOUNDATION
2023-2024

Title: **Evaluation of processing quality of advanced caneberry breeding selections**

Investigator: Zak Wiegand, Faculty Research Assistant
Food Science & Technology, OSU

Cooperators: Dr. Michael Hardigan, USDA-ARS HCRU, Corvallis
Dr. Wendy Hoashi-Erhardt, Washington State University, Puyallup

Objectives:
1. Evaluate advanced caneberry breeding selections from NWREC and USDA for objective attributes related to processing potential
2. Process samples of advanced selections, selected field crosses, and standard varieties for display to and evaluation by growers, breeders, and processors

Project Duration: July 1, 2023, through June 30, 2024

Funding Requested for 2023-2024: $ 10,777

Results:

Caneberry cultivars and ORUS breeding selections from the North Willamette Research and Extension Center's Blueberry Test Blocks were sent to the OSU Department of Food Science & Technology Pilot Plant for processing and analysis from June 22nd through September 19th, 2023.

Processing:
During the 2023 season, a total of 16 commercial cultivars, 62 ORUS selections, and 6 WSU selections were processed with multiple harvest dates when appropriate and available. With plantings of new selections producing fruit, we're seeing many promising new lines coming through the program.

<u>Blackberries</u>
- 9 commercial cultivars
- 32 ORUS selections

Red Raspberry

- 4 commercial cultivars
- 34 ORUS selections
- 6 WSU selections

Black Raspberry

- 3 commercial cultivars
- 18 ORUS Selections

Evaluations:

ORBC Annual Meeting – 12/12/22

All cultivars and selections of blackberry, red raspberry, and black raspberry processed during the 2021 growing season were displayed for evaluation. This display was limited to the USDA to allow the new breeders to review all material processed through the program. The event was limited due to pandemic conditions and the attendees were kept strictly to USDA breeding staff.

USDA/OSU Caneberry Research Evaluation – 3/7/23

All cultivars and selections of blackberry, red raspberry, and black raspberry processed during the 2022 growing season were displayed for evaluation. This display brought stakeholders together to provide valuable feedback to the USDA breeder.

Chemistry:

Basic chemical analysis was performed for samples collected during the 2023 processing season and the results for those samples are attached in Tables 1-6. (°brix, pH, and TA)

Research Evaluation Preference Data:

Summaries from the data collected during the USDA/OSU Caneberry Research Evaluation is attached for the Blackberries, Red Raspberries, and Black Raspberries that were displayed at the event in March of 2023.

Table 1. Chemistry analysis for 2023 blackberry advanced selections and commercial cultivars by harvest date

Selection/Cultivar	Planting Year	Harvest Date	Titratable Acidity[a]	Soluble Solids[b]	pH
Black Diamond	2019	6/27/23	1.15	12.70	3.63
	2020	6/27/23	1.15	12.61	3.61
	2021	6/27/23	1.07	12.53	3.63
		7/11/23	0.75	10.51	3.87
Chester Thornless	2019	8/8/23	1.28	12.09	3.31
	2020	8/8/23	1.10	13.64	3.58
		8/15/23	1.51	14.82	3.48
	2021	8/8/23	1.21	12.27	3.50
Columbia Star	2019	7/3/23	1.36	13.58	3.52
		7/11/23	1.46	17.26	3.59
	2020	7/3/23	1.33	14.10	3.52
		7/11/23	1.46	17.11	3.44
	2021	7/3/23	1.33	13.83	3.58
		7/11/23	1.35	16.38	3.56
Marion	2019	7/11/23	1.10	15.09	3.68
	2020	7/3/23	1.31	13.95	3.49
		7/11/23	1.09	14.82	3.66
	2021	7/11/23	1.32	14.49	3.61
Prime-Ark 45	2020	8/29/23	0.67	16.19	3.87
Triple Crown	2019	7/25/23	0.98	13.81	3.64
	2020	7/25/23	0.91	17.34	3.71
	2021	8/8/23	1.02	17.53	3.71
ORUS 4222-1	2019	7/11/23	0.99	14.37	3.79
	2021	7/11/23	1.28	15.22	3.72
ORUS 4535-2	2019	7/11/23	1.65	15.34	3.53
ORUS 4663-1	2021	7/11/23	1.15	16.19	3.71
ORUS 4670-1	2020	7/25/23	0.89	14.45	3.79
	2021	7/25/23	1.02	16.67	3.70
ORUS 4892-1	2021	7/3/23	1.07	14.16	3.70
		7/11/23	0.86	17.47	3.88
ORUS 4999-2	2019	8/29/23	0.64	13.61	3.96
	2020	8/29/23	0.67	14.01	3.93
		9/6/23	0.59	13.25	3.93
ORUS 5014-1	2019	7/18/23	1.36	13.18	3.54
ORUS 5016-1	2020	7/11/23	1.03	14.99	3.85
ORUS 5037-1	2019	7/11/23	0.91	15.08	3.86
ORUS 5041-1	2020	7/3/23	1.05	14.08	3.71
		7/11/23	0.70	16.86	4.03
ORUS 5057-1	2019	7/18/23	0.74	14.03	4.03
		8/8/23	0.60	13.56	4.01
ORUS 5148-2	2020	7/18/23	1.35	14.75	3.67
		7/25/23	1.25	14.63	3.62
ORUS 5168-1	2020	7/25/23	0.49	16.85	4.18
ORUS 5168-2	2020	8/8/23	1.28	15.76	3.60
ORUS 5253-2	2021	7/11/23	1.01	18.70	3.87

ORUS 5253-3	2021	7/3/23	1.68	13.90	3.45
ORUS 5263-2	2021	7/3/23	1.07	14.22	3.77
ORUS 5263-3	2021	7/11/23	1.16	13.49	3.78
ORUS 5265-3	2021	7/3/23	1.30	13.12	3.60
ORUS 5271-1	2021	7/3/23	1.07	12.79	3.75

[a] g citric acid/100g fruit

[b] ^{o}Brix

Table 2. Chemistry analysis for 2023 blackberry advanced selections and commercial cultivars by harvest date

Selection/Cultivar	Planting Year	Titratable Acidity[a]	Soluble Solids[b]	pH
Black Diamond	2019	1.15	12.70	3.63
	2020	1.15	12.61	3.61
	2021	0.81	10.88	3.82
Chester Thornless	2019	1.28	12.09	3.31
	2020	1.26	14.11	3.54
	2021	1.21	12.27	3.50
Columbia Star	2019	1.43	15.93	3.56
	2020	1.38	15.26	3.49
	2021	1.34	15.35	3.57
Marion	2019	1.10	15.09	3.68
	2020	1.17	14.53	3.60
	2021	1.32	14.49	3.61
Prime-Ark 45	2020	0.67	16.19	3.87
Triple Crown	2019	0.98	13.81	3.64
	2020	0.91	17.34	3.71
	2021	1.02	17.53	3.71
ORUS 4222-1	2019	0.99	14.37	3.79
	2021	1.28	15.22	3.72
ORUS 4535-2	2019	1.65	15.34	3.53
ORUS 4663-1	2021	1.15	16.19	3.71
ORUS 4670-1	2020	0.89	14.45	3.79
	2021	1.02	16.67	3.70
ORUS 4892-1	2021	0.94	16.27	3.81
ORUS 4999-2	2019	0.64	13.61	3.96
	2020	0.63	13.65	3.93
ORUS 5014-1	2019	1.36	13.18	3.54
ORUS 5016-1	2020	1.03	14.99	3.85
ORUS 5037-1	2019	0.91	15.08	3.86
ORUS 5041-1	2020	0.92	15.14	3.83
ORUS 5057-1	2019	0.66	13.77	4.02
ORUS 5148-2	2020	1.31	14.70	3.65
ORUS 5168-1	2020	0.49	16.85	4.18
ORUS 5168-2	2020	1.28	15.76	3.60
ORUS 5253-2	2021	1.01	18.70	3.87
ORUS 5253-3	2021	1.68	13.90	3.45
ORUS 5263-2	2021	1.07	14.22	3.77
ORUS 5263-3	2021	1.16	13.49	3.78
ORUS 5265-3	2021	1.30	13.12	3.60
ORUS 5271-1	2021	1.07	12.79	3.75

[a] g citric acid/100g fruit

[b] ^{o}Brix

Table 3. Chemistry analysis for 2023 black raspberry advanced selections and commercial cultivars by harvest date

Selection/Cultivar	Planting Year	Harvest Date	Titratable Acidity[a]	Soluble Solids[b]	pH
Munger	2020	6/28/23	0.94	13.52	3.87
		7/5/23	1.10	23.99	4.14
	2021	6/28/23	0.90	13.62	3.93
		7/5/23	1.03	21.21	4.23
ORUS 4412-2	2021	6/28/23	0.89	13.89	3.94
		7/5/23	1.00	20.29	4.16
ORUS 4818-2	2021	6/28/23	0.93	13.87	3.96
ORUS 4820-1	2020	6/22/23	1.15	11.90	3.67
		6/28/23	1.00	13.00	3.83
ORUS 4821-2	2021	7/5/23	0.77	19.99	4.32
ORUS 4833-1	2020	6/28/23	1.00	13.91	3.83
	2021	6/28/23	0.98	14.35	3.87
		7/5/23	1.14	22.04	4.14
ORUS 4942-4	2021	6/28/23	0.89	13.77	3.93
		7/5/23	0.90	18.38	4.22
ORUS 5190-1	2019	6/22/23	1.05	12.87	3.74
ORUS 5192-2	2020	6/28/23	0.84	13.90	4.01
ORUS 5300-1	2020	6/28/23	0.81	13.49	3.95
ORUS 5302-1	2020	6/28/23	0.86	15.00	3.95
		7/5/23	0.92	23.95	4.10
ORUS 5304-1	2020	6/28/23	0.93	13.31	3.93
ORUS 5308-2	2020	6/28/23	0.94	12.90	3.84
		7/5/23	0.97	19.23	4.08

[a] g citric acid/100g fruit

[b] ^{o}Brix

Table 4. Weighted chemistry analysis for 2023 black raspberry advanced selections and commercial cultivars

Selection/Cultivar	Planting Year	Titratable Acidity[a]	Soluble Solids[b]	pH
Munger	2020	0.99	16.79	3.95
Munger	2021	0.96	17.06	4.06
ORUS 4412-2	2021	0.95	17.16	4.05
ORUS 4818-2	2021	0.93	13.87	3.96
ORUS 4820-1	2020	1.03	12.80	3.80
ORUS 4821-2	2021	0.77	19.99	4.32
ORUS 4833-1	2020	1.00	13.91	3.83
ORUS 4833-1	2021	1.06	18.07	4.00
ORUS 4942-4	2021	0.89	16.82	4.12
ORUS 5190-1	2019	1.05	12.87	3.74
ORUS 5192-2	2020	0.84	13.90	4.01
ORUS 5300-1	2020	0.81	13.49	3.95
ORUS 5302-1	2020	0.88	17.71	3.99
ORUS 5304-1	2020	0.93	13.31	3.93
ORUS 5308-2	2020	0.96	15.45	3.93

[a] g citric acid/100g fruit

[b] ^{o}Brix

Table 5. Chemistry analysis for 2023 red raspberry advanced selections and commercial cultivars by harvest date

Selection/Cultivar	Planting Year	Harvest Date	Titratable Acidity[a]	Soluble Solids[b]	pH
Heritage	2020	9/6/23	2.10	12.03	3.22
	2021	8/29/23	1.93	14.03	3.29
Kokanee	2021	8/29/23	1.67	13.08	3.45
Meeker	2020	7/5/23	1.43	16.76	3.61
		7/11/23	1.12	15.65	3.69
	2021	7/5/23	1.78	16.06	3.52
		7/11/23	1.05	15.36	3.65
ORUS 4462-2	2021	7/5/23	1.56	15.93	3.54
		7/11/23	1.06	13.88	3.75
ORUS 4600-1	2020	7/5/23	1.23	14.88	3.77
ORUS 4692-4	2021	7/5/23	1.72	15.21	3.64
ORUS 4716-1	2020	8/29/23	1.89	11.66	3.30
ORUS 5195-2	2020	6/27/23	1.12	13.69	3.73
		7/5/23	1.33	15.20	3.49
ORUS 5309-1	2021	6/27/23	0.97	12.81	3.72
ORUS 5309-3	2021	7/18/23	1.34	15.26	3.66
ORUS 5323-2	2021	6/27/23	1.15	12.87	3.67
ORUS 5329-1	2021	6/27/23	1.88	12.34	3.43
WSU 2001	2021	7/11/23	1.25	14.77	3.58
WSU 2069	2020	6/22/23	1.42	12.50	3.45
		6/27/23	1.54	12.67	3.51
WSU 2087	2020	6/22/23	1.23	12.69	3.53
		7/5/23	1.53	14.44	3.52
WSU 2425	2020	6/22/23	1.48	11.87	3.45
		6/27/23	1.39	11.93	3.59
WSU 2472	2020	6/27/23	1.25	12.19	3.59
WSU 2481	2020	6/27/23	1.68	12.93	3.50
		7/11/23	1.81	14.04	3.34

[a] g citric acid/100g fruit

[b] ^{o}Brix

Table 6. Weighted chemistry analysis for 2023 red raspberry advanced selections and commercial cultivars

Selection/Cultivar	Planting Year	Titratable Acidity[a]	Soluble Solids[b]	pH
Heritage	2020	2.10	12.03	3.22
	2021	1.93	14.03	3.29
Kokanee	2021	1.67	13.08	3.45
Meeker	2020	1.31	16.34	3.64
	2021	1.48	15.78	3.57
ORUS 4462-2	2021	1.32	14.95	3.64
ORUS 4600-1	2020	1.23	14.88	3.77
ORUS 4692-4	2021	1.72	15.21	3.64
ORUS 4716-1	2020	1.89	11.66	3.30
ORUS 5195-2	2020	1.25	14.64	3.58
ORUS 5309-1	2021	0.97	12.81	3.72
ORUS 5309-3	2021	1.34	15.26	3.66
ORUS 5323-2	2021	1.15	12.87	3.67
ORUS 5329-1	2021	1.88	12.34	3.43
WSU 2001	2021	1.25	14.77	3.58
WSU 2069	2020	1.49	12.59	3.48
WSU 2087	2020	1.41	13.74	3.52
WSU 2425	2020	1.44	11.90	3.51
WSU 2472	2020	1.25	12.19	3.59
WSU 2481	2020	1.75	13.47	3.42

[a] g citric acid/100g fruit

[b] ^{o}Brix

USDA Blackberry Evaluation Data 2023

2022 Fruit 3/7/2023

	Average Quality Scores					Scoring Count			% Count		
Selection/Cultivar	**Appearance**	**Texture**	**Sweetness**	**Flavor**	**N**	**Worse**	**Similar**	**Better**	**% Worse**	**% Similar**	**% Better**
Columbia Star	4.04	3.67	2.63	3.54	23	2	6	15	8.7%	26.1%	65.2%
Marion	3.37	3.24	3.62	3.79	27	2	9	16	7.4%	33.3%	59.3%
ORUS 5161-1	3.45	3.15	3.33	3.19	26	6	7	13	23.1%	26.9%	50.0%
ORUS 5168-2	3.85	3.00	3.12	3.00	25	4	9	12	16.0%	36.0%	48.0%
ORUS 5138-1	3.14	2.95	3.35	3.38	20	5	6	9	25.0%	30.0%	45.0%
ORUS 4999-2	3.88	3.35	3.25	3.08	25	5	9	11	20.0%	36.0%	44.0%
ORUS 4670-1	3.57	3.29	3.49	3.29	33	11	8	14	33.3%	24.2%	42.4%
ORUS 4344-3	4.04	3.46	3.15	2.62	26	9	6	11	34.6%	23.1%	42.3%
ORUS 4222-1	3.20	3.29	2.96	3.29	24	3	11	10	12.5%	45.8%	41.7%
ORUS 4453-1	3.42	3.31	3.31	3.33	34	8	12	14	23.5%	35.3%	41.2%
Prime-Ark 45	3.42	3.42	3.33	3.08	23	5	9	9	21.7%	39.1%	39.1%
ORUS 5014-1	3.48	3.17	2.38	2.79	24	7	8	9	29.2%	33.3%	37.5%
ORUS 5069-1	3.43	2.90	3.52	2.57	22	5	9	8	22.7%	40.9%	36.4%
ORUS 5148-2	3.70	3.23	2.32	2.50	22	8	6	8	36.4%	27.3%	36.4%
ORUS 4902-1	3.14	3.30	3.15	2.95	20	5	8	7	25.0%	40.0%	35.0%
ORUS 5168-1	4.15	3.36	2.92	2.60	24	7	9	8	29.2%	37.5%	33.3%
ORUS 5023-1	3.61	3.36	3.36	2.77	23	6	10	7	26.1%	43.5%	30.4%
ORUS 5058-2	3.22	2.90	2.73	2.77	30	13	8	9	43.3%	26.7%	30.0%
ORUS 5023-2	3.48	3.40	2.70	3.00	20	5	9	6	25.0%	45.0%	30.0%
ORUS 5041-2	3.50	2.90	2.71	2.76	20	6	8	6	30.0%	40.0%	30.0%
ORUS 5129-1	3.36	3.00	2.29	2.33	21	8	7	6	38.1%	33.3%	28.6%
ORUS 5010-1	2.45	2.39	2.67	2.94	19	11	3	5	57.9%	15.8%	26.3%
Kotata	3.18	3.00	2.19	2.69	27	11	9	7	40.7%	33.3%	25.9%
ORUS 5156-1	3.35	2.76	2.72	2.62	28	8	13	7	28.6%	46.4%	25.0%
ORUS 5167-1	3.37	3.08	3.24	3.08	24	9	9	6	37.5%	37.5%	25.0%
ORUS 4535-2	3.44	3.21	2.67	3.04	24	5	13	6	20.8%	54.2%	25.0%
ORUS 4892-1	3.78	3.23	2.36	2.32	20	10	5	5	50.0%	25.0%	25.0%
ORUS 5067-1	3.47	3.10	2.90	2.63	29	10	12	7	34.5%	41.4%	24.1%
ORUS 5068-3	3.65	3.04	2.83	2.67	25	8	11	6	32.0%	44.0%	24.0%
ORUS 5016-1	3.33	2.52	2.30	2.60	21	10	6	5	47.6%	28.6%	23.8%
ORUS 5127-1	3.73	3.00	2.95	2.52	21	6	10	5	28.6%	47.6%	23.8%
Triple Crown	3.30	3.08	3.42	3.29	34	10	16	8	29.4%	47.1%	23.5%
Caddo	3.85	3.36	3.05	2.87	36	16	12	8	44.4%	33.3%	22.2%
ORUS 5031-1	2.92	2.52	2.72	2.40	24	12	7	5	50.0%	29.2%	20.8%
ORUS 5037-1	2.76	2.30	3.00	2.75	20	9	7	4	45.0%	35.0%	20.0%
ORUS 5173-4	3.59	2.85	2.70	1.85	21	9	8	4	42.9%	38.1%	19.0%
ORUS 5057-1	3.53	2.94	2.68	2.56	33	15	12	6	45.5%	36.4%	18.2%
ORUS 5068-5	3.57	3.19	2.81	2.41	22	9	9	4	40.9%	40.9%	18.2%
ORUS 5132-1	3.22	2.64	2.32	2.45	22	10	8	4	45.5%	36.4%	18.2%
ORUS 4273-2	3.11	3.19	2.72	2.69	34	16	12	6	47.1%	35.3%	17.6%
ORUS 5068-1	2.88	2.95	3.05	2.41	24	9	11	4	37.5%	45.8%	16.7%
Black Diamond	2.97	2.74	2.59	2.89	24	5	15	4	20.8%	62.5%	16.7%
Black Jack	3.84	3.43	3.00	3.00	39	15	18	6	38.5%	46.2%	15.4%
ORUS 5174-2	2.76	2.42	2.37	2.00	20	13	4	3	65.0%	20.0%	15.0%
ORUS 5041-1	2.90	2.70	2.55	2.70	20	6	11	3	30.0%	55.0%	15.0%
ORUS 5049-1	3.58	3.03	2.64	2.53	35	16	14	5	45.7%	40.0%	14.3%
ORUS 5129-2	3.59	2.95	2.48	2.48	21	4	14	3	19.0%	66.7%	14.3%
ORUS 5174-1	3.43	2.76	2.52	2.00	22	14	5	3	63.6%	22.7%	13.6%
Columbia Giant	2.96	2.68	2.76	2.56	23	8	12	3	34.8%	52.2%	13.0%
ORUS 5065-1	3.00	2.52	2.38	2.48	27	13	11	3	48.1%	40.7%	11.1%
ORUS 5165-1	3.23	2.64	2.79	2.36	28	16	9	3	57.1%	32.1%	10.7%
ORUS 5163-1	3.03	2.23	2.03	1.97	31	19	9	3	61.3%	29.0%	9.7%
ORUS 5284-1	2.48	2.05	2.00	1.55	21	18	1	2	85.7%	4.8%	9.5%
ORUS 5133-1	3.14	2.14	2.10	2.14	21	12	7	2	57.1%	33.3%	9.5%
Chester Thornless	3.10	2.97	2.58	2.71	35	13	19	3	37.1%	54.3%	8.6%
ORUS 4663-4	3.08	2.86	1.64	2.05	24	17	5	2	70.8%	20.8%	8.3%

ORUS 5163-2	3.68	3.14	2.90	2.38	28	11	15	2	39.3%	53.6%	7.1%
ORUS 4892-2	3.10	2.70	1.90	1.95	19	16	2	1	84.2%	10.5%	5.3%
ORUS 4767-1	3.68	2.52	2.24	2.10	22	12	9	1	54.5%	40.9%	4.5%
ORUS 5056-2	2.91	2.45	1.88	1.91	29	19	9	1	65.5%	31.0%	3.4%
ORUS 4762-1	3.29	2.95	2.00	2.14	20	13	7	0	65.0%	35.0%	0.0%
ORUS 5133-2	2.14	2.37	2.05	2.11	20	13	7	0	65.0%	35.0%	0.0%

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	Average Quality Scores					Scoring Count			% Count		
Selection/Cultivar	**Appearance**	**Texture**	**Sweetness**	**Flavor**	**N**	**Worse**	**Similar**	**Better**	**% Worse**	**% Similar**	**% Better**
ORUS 5209-1	4.00	2.87	3.74	3.26	20	4	1	15	20.0%	5.0%	75.0%
ORUS 4725-1	3.32	3.14	3.27	3.18	19	3	3	13	15.8%	15.8%	68.4%
Kokanee	3.76	3.13	3.38	3.29	21	4	5	12	19.0%	23.8%	57.1%
ORUS 4487-1	2.18	2.68	3.71	3.48	19	3	6	10	15.8%	31.6%	52.6%
Crimson Treasure	4.04	3.44	3.32	3.44	23	2	9	12	8.7%	39.1%	52.2%
ORUS 4858-2	3.97	3.50	3.13	3.20	28	4	10	14	14.3%	35.7%	50.0%
ORUS 5218-1	3.00	2.82	3.68	3.59	20	4	6	10	20.0%	30.0%	50.0%
ORUS 5209-2	3.10	2.75	3.15	3.30	17	2	7	8	11.8%	41.2%	47.1%
ORUS 5195-2	3.63	2.89	2.93	2.96	24	7	6	11	29.2%	25.0%	45.8%
ORUS 5467-2	2.65	2.91	3.50	3.27	20	3	8	9	15.0%	40.0%	45.0%
ORUS 4371-4	2.69	2.90	3.48	3.52	29	4	12	13	13.8%	41.4%	44.8%
WSU 2087	3.12	2.88	2.84	2.58	23	5	8	10	21.7%	34.8%	43.5%
ORUS 4716-1	4.17	3.18	2.64	3.18	19	4	7	8	21.1%	36.8%	42.1%
ORUS 5206-2	3.15	2.63	3.04	3.11	24	7	7	10	29.2%	29.2%	41.7%
ORUS 4600-1	2.76	2.81	3.19	2.82	25	8	7	10	32.0%	28.0%	40.0%
ORUS 5248-1	3.22	3.04	2.70	3.04	20	6	6	8	30.0%	30.0%	40.0%
ORUS 5347-1	2.52	2.64	3.59	3.59	20	5	7	8	25.0%	35.0%	40.0%
WSU 2069	2.63	2.56	3.26	3.19	24	5	10	9	20.8%	41.7%	37.5%
Meeker	2.66	2.84	3.30	3.31	26	3	15	8	11.5%	57.7%	30.8%
Heritage	3.43	3.04	3.09	3.08	20	3	11	6	15.0%	55.0%	30.0%
ORUS 5108-3	2.54	2.70	2.78	2.79	24	7	10	7	29.2%	41.7%	29.2%
ORUS 4607-2	4.06	2.97	2.55	2.73	28	11	9	8	39.3%	32.1%	28.6%
ORUS 5465-1	2.36	2.76	3.28	3.24	21	6	9	6	28.6%	42.9%	28.6%
ORUS 5106-1	2.70	2.46	2.00	2.46	26	13	6	7	50.0%	23.1%	26.9%
ORUS 5105-1	2.85	2.38	2.65	2.38	24	11	7	6	45.8%	29.2%	25.0%
ORUS 5198-1	2.67	2.67	2.64	2.86	25	11	8	6	44.0%	32.0%	24.0%
WSU 2577	4.21	2.75	2.46	2.54	21	8	8	5	38.1%	38.1%	23.8%
Polka	3.25	3.00	3.46	3.13	21	6	10	5	28.6%	47.6%	23.8%
ORUS 5199-1	2.89	2.68	3.14	3.11	24	5	14	5	20.8%	58.3%	20.8%
WSU 2481	2.43	2.43	2.52	2.57	20	8	8	4	40.0%	40.0%	20.0%
WSU 2425	2.63	2.57	2.83	2.78	21	8	9	4	38.1%	42.9%	19.0%
ORUS 4462-2	2.38	2.36	2.93	2.86	27	12	10	5	44.4%	37.0%	18.5%
ORUS 4715-2	1.85	2.15	3.00	3.27	24	7	14	3	29.2%	58.3%	12.5%
ORUS 5345-1	2.62	2.60	2.75	2.85	17	6	9	2	35.3%	52.9%	11.8%
ORUS 5102-2	3.03	2.48	2.21	2.86	27	13	11	3	48.1%	40.7%	11.1%
ORUS 5467-1	2.76	2.55	2.60	2.38	19	11	6	2	57.9%	31.6%	10.5%
WSU 2605	2.19	2.14	2.19	1.95	20	14	4	2	70.0%	20.0%	10.0%
ORUS 4974-1	2.79	2.48	2.30	2.29	25	13	10	2	52.0%	40.0%	8.0%
ORUS 5250-1	1.86	1.95	2.33	2.33	18	13	4	1	72.2%	22.2%	5.6%
WSU 2516	2.41	2.05	1.68	1.68	19	13	5	1	68.4%	26.3%	5.3%
ORUS 5248-3	3.23	2.82	2.32	2.23	19	10	8	1	52.6%	42.1%	5.3%
WSU 2472	3.05	2.41	2.13	2.13	20	8	11	1	40.0%	55.0%	5.0%
ORUS 5211-1	2.78	2.09	2.13	2.35	20	12	7	1	60.0%	35.0%	5.0%
ORUS 5106-3	2.50	2.15	1.76	1.88	24	18	5	1	75.0%	20.8%	4.2%

USDA Black Raspberry Evaluation Data 2023

2022 Fruit 3/7/2023

	Average Quality Scores					Scoring Count			% Count		
Selection/Cultivar	**Appearance**	**Texture**	**Sweetness**	**Flavor**	**N**	**Worse**	**Similar**	**Better**	**% Worse**	**% Similar**	**% Better**
ORUS 5075-1	1.86	2.10	2.48	2.33	18	10	1	7	55.6%	5.6%	38.9%
ORUS 5179-1	3.37	2.05	2.37	2.26	17	9	2	6	52.9%	11.8%	35.3%
ORUS 5300-1	3.14	2.50	2.64	2.50	12	1	7	4	8.3%	58.3%	33.3%
ORUS 5302-1	3.36	2.50	2.21	2.21	12	4	4	4	33.3%	33.3%	33.3%
ORUS 5299-1	3.71	2.64	2.93	2.57	13	3	6	4	23.1%	46.2%	30.8%
ORUS 5188-2	3.19	2.19	2.38	2.19	14	8	2	4	57.1%	14.3%	28.6%
ORUS 5190-1	2.94	2.38	2.19	2.19	14	6	4	4	42.9%	28.6%	28.6%
ORUS 5192-2	3.35	2.29	2.29	2.29	15	6	5	4	40.0%	33.3%	26.7%
ORUS 5092-4	3.00	2.27	2.00	1.93	13	9	1	3	69.2%	7.7%	23.1%
ORUS 5185-1	3.24	2.18	2.65	2.18	14	5	6	3	35.7%	42.9%	21.4%
ORUS 4833-1	3.48	1.96	2.17	1.96	20	10	6	4	50.0%	30.0%	20.0%
ORUS 5304-2	2.36	2.36	2.21	2.14	12	5	5	2	41.7%	41.7%	16.7%
ORUS 5088-1	2.91	2.14	2.09	2.09	20	10	7	3	50.0%	35.0%	15.0%
ORUS 5308-2	2.87	2.20	2.13	2.20	14	7	5	2	50.0%	35.7%	14.3%
ORUS 5292-1	2.71	2.50	3.00	2.36	12	3	8	1	25.0%	66.7%	8.3%
ORUS 5092-1	2.75	1.75	1.94	1.69	13	9	3	1	69.2%	23.1%	7.7%
ORUS 5188-1	3.06	1.75	1.56	1.50	14	11	2	1	78.6%	14.3%	7.1%
ORUS 5185-2	2.65	1.71	1.82	1.88	15	9	5	1	60.0%	33.3%	6.7%
ORUS 5186-1	2.94	2.11	1.83	2.00	16	9	6	1	56.3%	37.5%	6.3%
ORUS 5089-1	3.00	2.11	2.11	2.05	17	9	7	1	52.9%	41.2%	5.9%
ORUS 5088-2	2.67	1.90	2.05	1.86	19	10	8	1	52.6%	42.1%	5.3%
ORUS 4820-1	3.12	2.16	1.67	1.54	21	17	3	1	81.0%	14.3%	4.8%
Munger	2.88	2.16	2.20	2.08	22	12	10	0	54.5%	45.5%	0.0%
ORUS 3217-1	2.62	1.62	1.54	1.58	23	20	3	0	87.0%	13.0%	0.0%
ORUS 5090-4	2.53	1.76	1.31	1.69	15	13	2	0	86.7%	13.3%	0.0%
ORUS 5092-5	2.94	2.13	1.69	1.63	14	9	5	0	64.3%	35.7%	0.0%
ORUS 5185-3	2.94	1.83	1.72	1.72	15	9	6	0	60.0%	40.0%	0.0%