December 2022

2022-2023

(FY 2021-2022 Funded Projects)

Research Progress Reports

for the

OREGON
RASPBERRY & BLACKBERRY COMMISSION

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ORBC Research Report
FY2022-23

Title: Irrigation Strategies for Optimizing Water Use Efficiency and Improving Fruit Quality and Cold Hardiness in Trailing Blackberry

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Cooperators: Jesse Carroll, OSU, Dept. Horticulture; Amanda Vance, OSU, Dept. Horticulture

Objectives:
1. Develop crop coefficients to determine irrigation water requirements in trailing blackberry.
2. Develop remote sensing techniques to monitor growth and quickly assess plant health and water stress in blackberry.
3. Evaluate the effects of postharvest deficit irrigation on water productivity, fruit quality, and cold hardiness of blackberry.

Practical and Economic Impact:
The lysimeters are being used to develop accurate coefficient curves for blackberry and will be ultimately integrated into a mobile irrigation app for convenient use by growers. The result will increase yield with less water. Remote imaging with a drone will be used to develop robust field-specific and regional estimates of canopy cover, which in turn will serve to improve estimates of crop growth stages and water use in various growing regions. Thermal imaging will provide a rapid means to assess spatial variability in the water status of the plants and to adjust irrigation as needed. Information on how to use deficit irrigation will lead to immediate water savings and increase fruit quality and cold hardiness.

Procedures:
Crop coefficients. Two, large weighing lysimeters were fabricated and installed in a 0.4-acre field at NWREC in Sept. 2019. The lysimeters are currently in operation, and both consist of an inner tank (3.25-ft wide × 5-ft long × 5.5-ft deep) resting within an outer tank on four shear beam load cells (Fig. 1A–D). Walls and floors of the tanks are constructed from 0.48-cm steel plate. To prevent bending, the walls of the tanks are reinforced with 10-cm steel structural channel, and the bottom of the tanks are supported with 15-cm steel structural channel. A 10-cm-diameter steel access pipe enters each outer tank near a lower corner to route cables from the load cells to the soil surface. The tanks and enclosures are coated with coal tar epoxy paint to protect them from rust. The drainage system includes an arrangement of mesh fabric-covered perforated PVC pipe on the inner tank floor, with a standpipe to pump out the water as needed (Fig. 1E). The lysimeters are very sensitive and capable of measuring weight changes in the soil tank equivalent to 0.001 in. of water. The soil in and around the lysimeters has excellent drainage and is much sandier at deeper depths (> 4 ft.) than it is near the soil surface (Table 1).

The field and lysimeters were planted with 'Columbia Star' blackberry in Apr. 2020. Plants are spaced 5 × 10 ft. apart and trained on a two-wire trellis system (Fig. 1F). To avoid interfering with the weight measurements, trellises on the lysimeters are isolated from the trellises in the row. Data obtained from the lysimeters include weight loss resulting from crop evapotranspiration (ET_c) and soil drainage, and weight gain resulting from rain and irrigation. Weight changes are recorded every 15-minutes using a data logger. Irrigation is applied using a single lateral of drip tubing with 0.5 gph in-line emitters every 2 ft. and measured using a flow meter. Drainage water is collected from the perforated manifold in the bottom of the soil tanks and measured using water level sensors. Soil moisture sensors are installed at depths of 6, 12, 24, 36, and 48 inches to monitor changes in soil water content in the tanks and to estimate the effective rooting depth. Crop coefficients are calculated by dividing ET_c by potential evapotranspiration (ET_o) obtained from an AgriMet weather station located at NWREC (U.S. Department of the Interior, 2013). The results will be entered into an easy water management app called *Irrigation Scheduler* (Peters, 2015). The app allows users to download, store, and analyze irrigation water usage and helps them make informed decisions on when and how much water to apply at each irrigation.

Remote sensing. A small, unmanned aerial system (UAS or drone) with a multispectral camera mounted on the bottom is flown in the field each month to monitor canopy development. Digital images are captured every second as the UAS moved back and forth across the field, with a 75% overlap on each pass to minimize error. Geospatial software is used to stitch the individual images into a complete aerial picture of the field (orthomosaic image). Plant health indices including normalized difference vegetation index (NDVI) and the triangular greenness index (TGI), are calculated on each date. The number of pixels that are occupied by the plants is multiplied by the ground resolution to determine percent canopy cover. We are also monitoring canopy temperature with a thermal camera on the UAS and are using the images to develop a crop water stress index for blackberry. This index will be useful for identifying water deficits or irrigation issues in commercial fields.

Deficit irrigation. Deficit irrigation is a promising technique for increasing water use efficiency in many crops, including blackberries. We previously found in an organic planting of 'Marion' that withholding irrigation after harvest had no effect on yield but reduced winter cold injury the plants and saved over 50,000 gallons of water per acre each year. We are building on these findings in the present study and developing effective deficit irrigation strategies for 'Columbia Star'. Treatments, including irrigation and no irrigation after harvest, are arranged in a randomized complete block design with four plants in each treatment plot and four replicates per treatment. These treatments were initiated in Aug. 2022 and will continue for two growing seasons. Yield and fruit quality will be measured in each treatment plot in 2023 and 2024.

We are also testing whether post-harvest water deficits have any effect on cold hardiness in 'Black Diamond'. Single canes will be cut from each replication of the deficit treatments and evaluated for cold hardiness. The canes will be exposed to six test temperatures (a 40 °F control and 15, 10, 5, 0, and -5 °F) in a programmable freezer, defrosted, and visually inspected for tissue browning. Additional samples will be frozen and evaluated for percent budbreak.

Results and Discussion:
The lysimeters were recalibrated in 2022 to convert the load cell outputs to ET units. In both instances, there was a strong linear relationship between the total load cell output and the changes in total lysimeter mass (Fig. 2). The slopes of the calibration curves were 0.000839 and 0.000881 $mV \cdot V^{-1} \cdot kg^{-1}$ for lysimeter 1 and 2, respectively.

Hourly rates of ET_c measured with the lysimeters are illustrated in Fig. 3. As expected, ET_c increased with canopy development and was greater on warm, sunny days than on cooler, cloudy days (e.g., June 25-27 vs. June 28-30). Each day, irrigation was applied automatically at midnight based on total ET_c measurements from the previous day. Soil water content readings indicated that the plants were extracting water from the top 2 feet of soil on cooler days and up to 4 feet deep on warmer days. We initiated the lysimeter measurement during establishment in 2020 and will continue them for at least three years of full production (2022-2024). Next year, we will withhold irrigation after harvest in one of the lysimeters in order to evaluate its effect on ET_c. The information will be useful for understanding how blackberry plants responds to soil water deficits.

Daily rates of ET_c are illustrated in Fig. 4. Once again, the measurements reflected the changes in weather conditions and followed a similar pattern as ET_o obtained from AgriMet (Fig. 4). On select dates in 2022, ET_c ranged from 0.10 to 0.23 inches of water per day during the week prior to harvest in late June, 0.08 to 0.22 inches of water per day during the first week of harvest in early July, and 0.08 to 0.19 inches of water per day after harvest in mid-August. At first glance, it appeared that ET_c declined over the course of the summer and was considerably lower after harvest. However, K_c values from each week reveal a different story (Fig. 5). As mentioned, K_c is the ratio of ET_c to ET_o and, therefore, adjusts for weather and different site conditions. Last summer, K_c increased from average of 0.49 in late June to 0.79 in mid-August. This means that under the same weather conditions, ET_c would have been 60% higher after harvest than it was prior to harvest. The only reason it was lower after harvest was due to cooler weather conditions in August 2022. However, ET_c is relatively higher after harvest due to production and growth of new primocanes. Consequently, primocane growth could be affected considerably when irrigation is withheld after harvest, particularly in years where the weather is warmer than usual in late summer. Again, we will have an opportunity to investigate the impact of withholding irrigation after harvest in one of the lysimeters next summer.

We are now in the process of developing relationships among NDVI, canopy cover, and K_c for blackberry using the multispectral images that we are collected last summer. An example of a set of images is illustrated in Fig. 6. These images were collected shortly after planting in 2020. The procedure is very accurate and is being used to measure canopy cover in the lysimeters, as well as the water deficit treatment plots. We are also measuring canopy temperatures with a thermal imaging camera on the UAS and are using it to monitor water status of the plants. We expect to finish analyzing the images from 2022 by February. The results will be shared next summer at Cane Field Day.

Table 1. Soil texture at various depths in a field of 'Columbia Star' blackberry.[z]

	Soil texture		
Soil depth (classification)[y]	Sand (%)	Silt (%)	Clay (%)
0–1 ft. (loam)	49.4	33.7	17.0
1–2 ft. (sandy loam)	49.4	31.6	19.0
2–3 ft. (sandy loam)	54.7	27.2	18.1
3–4 ft. (sandy loam)	59.3	24.6	16.2
4–5 ft. (sandy loam)	69.4	20.1	10.4
5–8 ft. (loamy sand)	82.0	13.7	4.3

[z]Soil was sampled when it was removed for installation of the lysimeters in Sept. 2019.
[y]USDA soil texture classification.

Fig. 1. (**A-D**) Installation of the weighing lysimeters for 'Columbia Star' blackberry. (**E**) Installing the drainage system. (**F**) Crop evapotranspiration is measured continuously in both lysimeters using data loggers (bottom right; year 1).

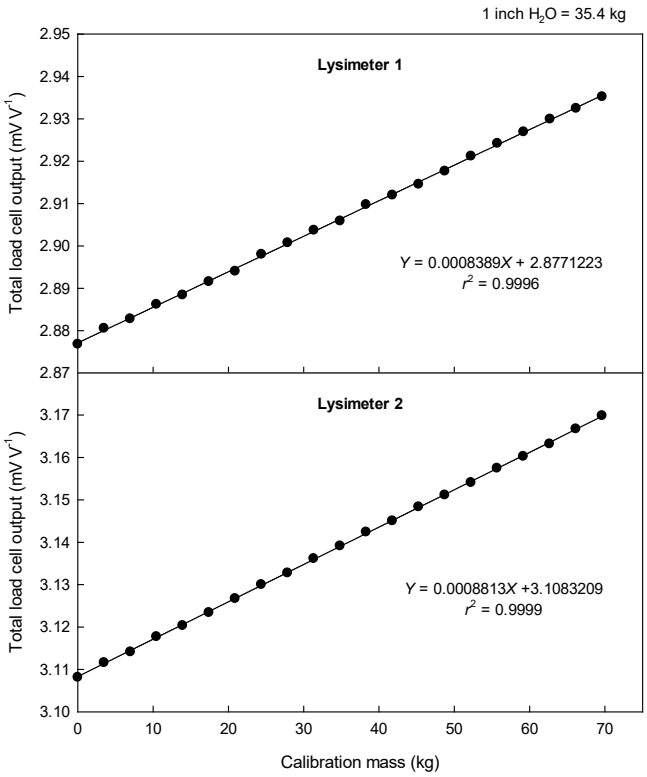

Fig. 2. Calibration of the lysimeters at the North Willamette Research and Extension Center in Aurora, OR. Total output is the sum of the four load cells in each lysimeter (see Fig. 1D).

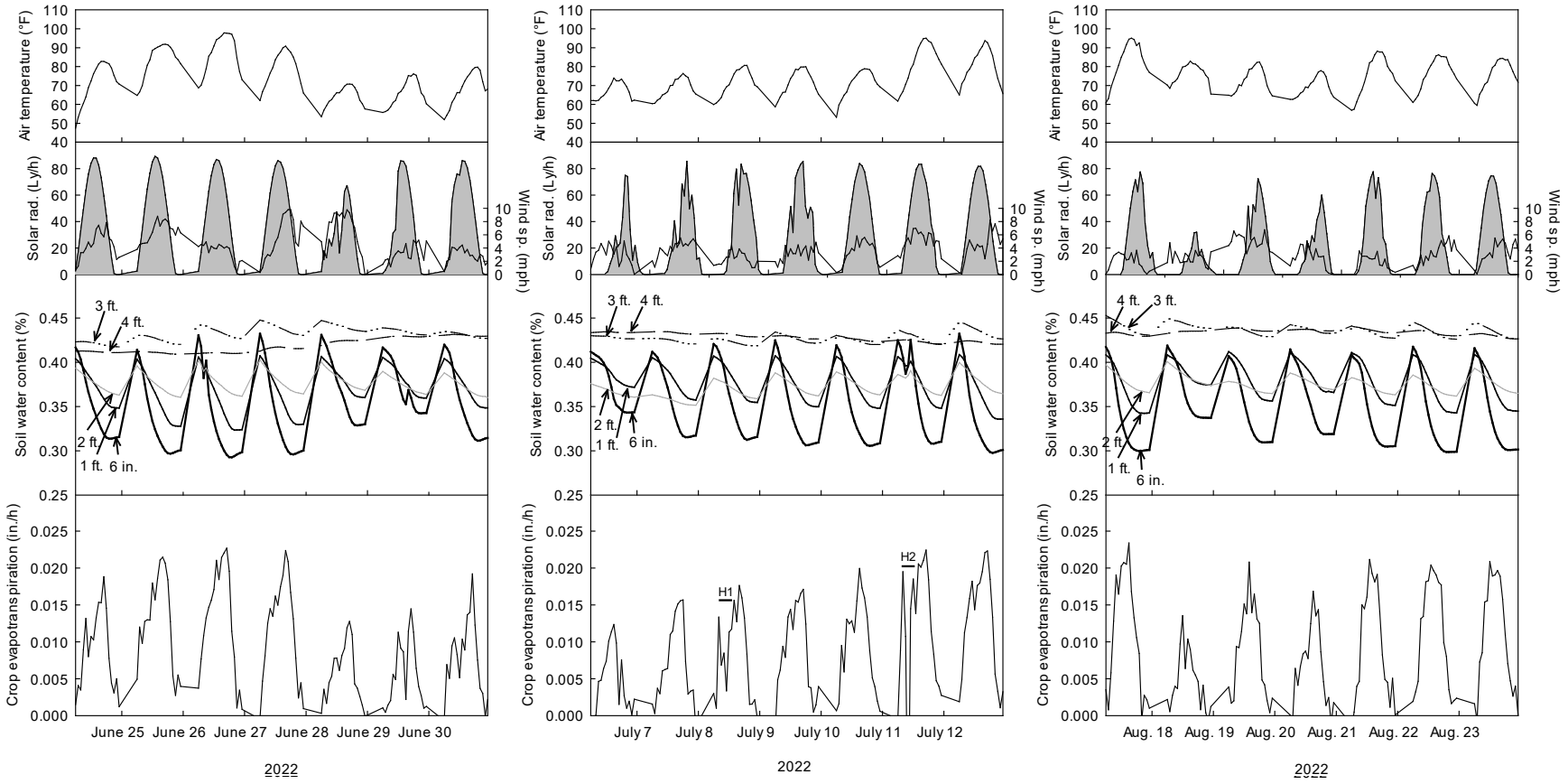

Fig. 3. Air temperature (top set of panels), solar radiation and wind speed (second set panels from the top), soil water content (third set panels from the top), and hourly rates of crop evapotranspiration (bottom set of panels) of 'Columbia Star' blackberry. Data was collected before (June), during (July), and after (August) harvest in 2022. Soil water content was measured at five depths (6 inches, 1 ft., 2 ft., 3 ft., and 4 ft.). H1 and H2 indicate the first two of five harvest dates.

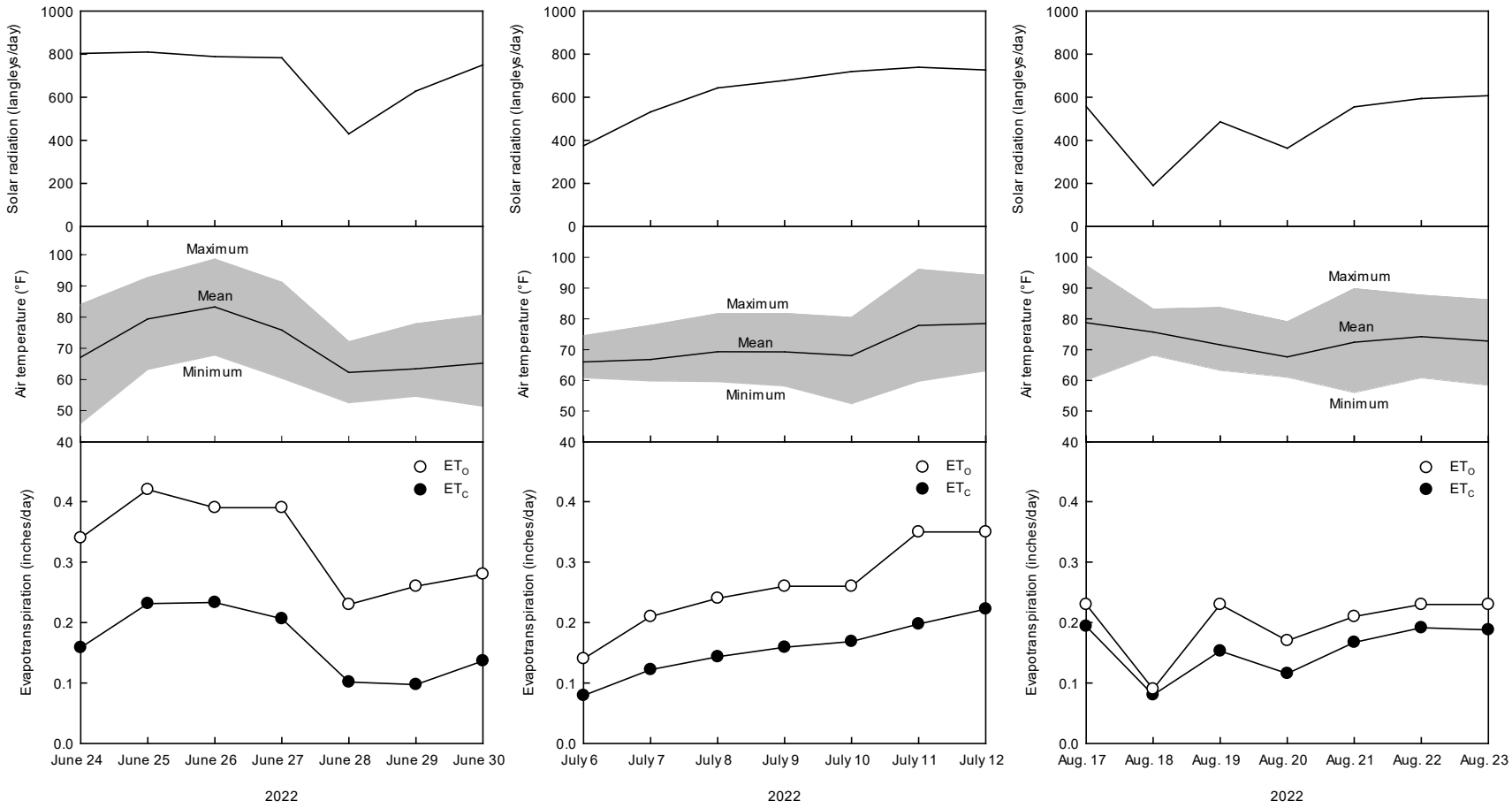

Fig. 4. Solar radiation (top set of panels), maximum, mean, and minimum daily air temperatures (middle set of panels), and daily rates of potential evapotranspiration (ET_o) and crop evapotranspiration (ET_c) of 'Columbia Star' blackberry (lower set of panels). Data were collected before (June), during (July), and after (August) harvest in 2022.

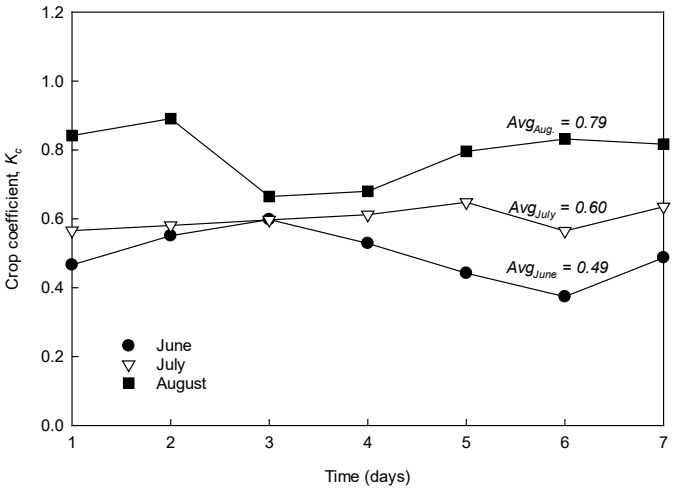

Fig. 5. Daily crop coefficients (K_c) and vegetative ground cover for 'Columbia Star' blackberry during the first year full production (2022).

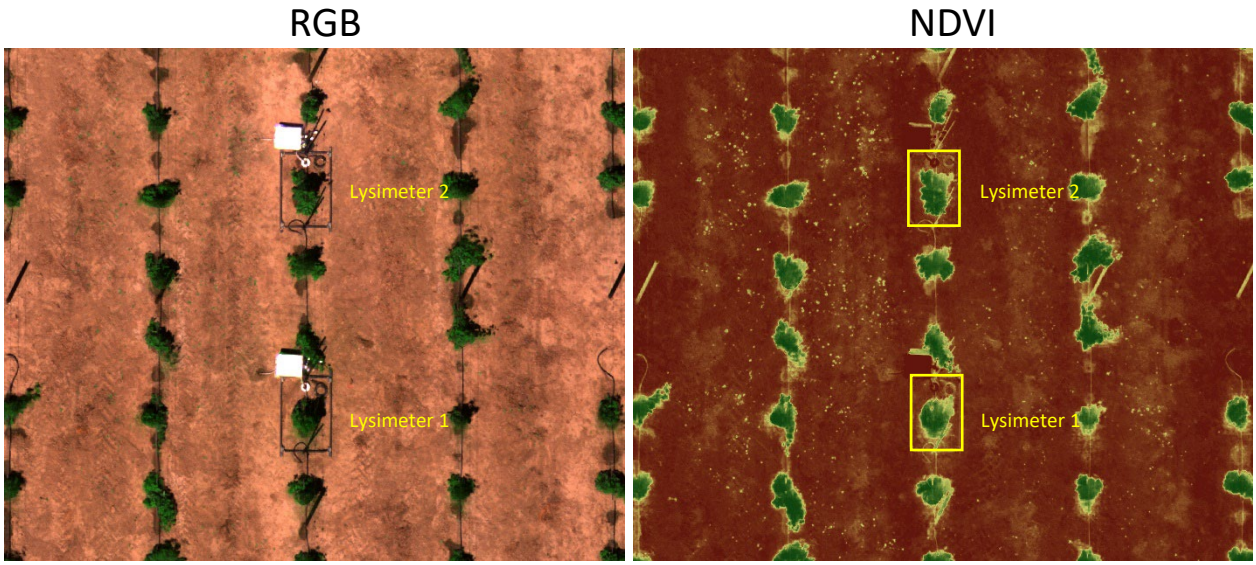

Fig. 6. Red-green-blue (RGB) image and the corresponding normalized difference vegetation index (NDVI) of 'Columbia Star' blackberry plants in and around the weighing lysimeters. The images were captured at an altitude of 50 feet.

Research Report to the Oregon Raspberry and Blackberry Commission and the Agricultural Research Foundation: 2022-2023

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

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

Treatments:

- In-row spacing: 5 ft spacing or high density 2.5 ft
- Pruning/training method: August training or a "new-over-old" system (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.

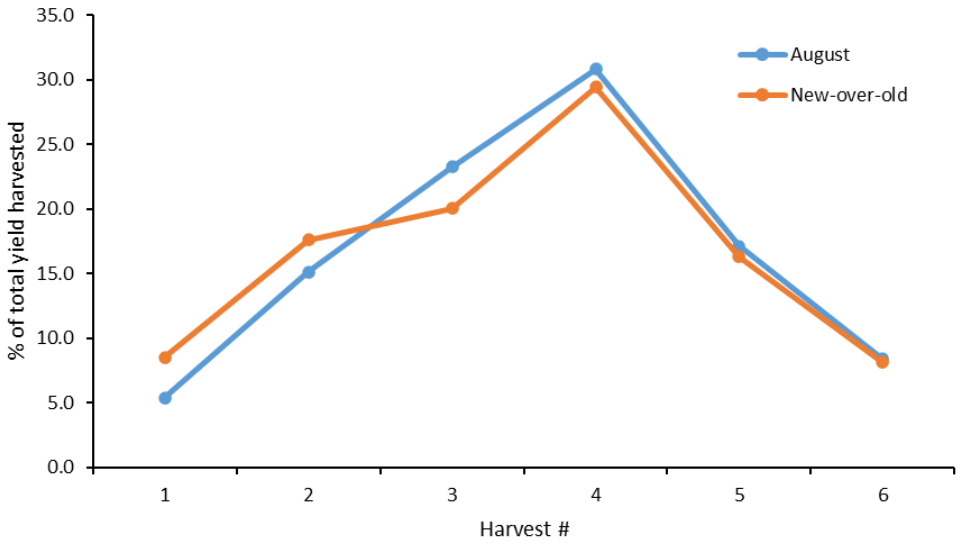
Study design: The planting design was a split-split plot with spacing as the main plot effect (whole rows), pruning/training treatment as sub-plot (half rows) and primocane suppression as sub-sub plots. There were four replicates of each treatment (32 plots). Each experimental plot was 20 ft long with 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 was 10 ft. Aisles were maintained weed free using tillage (planting year only) and herbicides as needed. The planting was flanked by guard rows. Plants were irrigated by drip and fertigated. Primocane suppression occurred once each year in late April, when canes averaged 12" (timing has not been affected by plant spacing or other treatments to date).

2022 Results:

Yield and fruit quality: 2022 was the second harvest year, with six harvests between July 8 and July 25. Yield per plant was higher for 5 ft spacing (16.0 lb) compared to 2.5 ft, however at the higher density yield per plant was higher with August training (9.9 lbs) than with new-over-old (8.6 lb). Yield per acre was higher at 2.5 ft spacing (averaged 8.0 tons) compared to the lower density spacing (7.0 tons), but as with yield per plant, August training at 2.5 ft plant spacing had higher yield per acre (8.6 tons) than new-over-old (7.4 tons). The amount of fruit dropped on the ground during harvest and culled (non-marketable, sorted out on the machine harvester conveyer belt) were both higher with new-over-old training due to the wide canopy size which prevents closure of the catcher plates and likely increases disease and insect pressure. Primocane suppression reduced cull but increased the percentage of dropped fruit, and had no effect on yield per plant, yield per acre, or the total amount of fruit produced per plant (which includes harvested yield, dropped fruit, and cull) despite increasing the number of primocanes per plant in 2021.

Berry weight was not affected by training technique, but primocane suppression had opposite effects on berry weight depending on plant spacing. At high density, suppression increased berry weight from 7.4 g/berry to 7.7 g/berry while at lower density, berry weight was higher without suppression (7.7 g) than with suppression (7.4 g).

New-over-old plants ripened slightly faster than august trained (Figure 1), but plant spacing only effected the first harvest (7.4% of total yield harvested for 5 ft spacing vs 6.5% for 2.5 ft). Primocane suppression had little effect on the rate of ripening overall, but slightly hastened ripening at high density, resulting in more harvested fruit on the 2nd harvest (17% of total yield vs 14% without suppression) and less fruit on the 4th harvest (29% vs 32% with suppression).



Cane growth and fruiting components: Plants were caned out (August training only) and trained in mid-August and number of primocanes counted and measured for all treatments. In 2021, plants grown at 5 ft spacing had more primocanes per plant (15/plant) than at 2.5 ft (9/plant), as did those that received the primocane suppression treatment (14/plant compared to 10/plant with no suppression). In 2022, we saw a similar trend for both plant spacing (P = 0.0729) and primocane suppression (P = 0.0802) with nearly identical numbers of primocanes as in 2021. Primocane length was not affected by spacing or primocane

suppression treatment in 2021 or 2022 (averaged 16 ft in 2021 and 10 ft in 2022). August trained plants had longer primocanes in 2022 (11ft) compared to new-over-old (9ft), but this could have been due to cane selection during the measurement process as it is difficult to accurately measure the primocanes in a new-over-old system. Canes were likely shorter in 2022 at the time of measurement due to the cool, wet spring that delayed phenology and measuring earlier in August compared to 2021.

In addition to primocanes, we measured floricane fruiting lateral length and number of berries per lateral. Lateral length was not affected by side of the canopy (5 were selected from the east and west sides of each plot), averaging 13 inches with little to no treatment effects. Berry number increased from an average of 4 per lateral in 2021 to 4.8 in 2022 (we suspected the dense wildfire smoke in September 2020 may have reduced flower bud development). New-over-old generally had more berries per lateral (5) than august trained (4.6), but this was particularly true at 5 ft spacing or in plants without primocane suppression. At 2.5 ft spacing and those with suppression, training did not have an effect.

Training time: 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 (3.6 min/ft compared to 2.2 min/ft), but less time per plant (8.9 min/plant compared to 11.1 min. at 5 ft). New-over-old training required more time per linear ft for 2.5 ft spacing (11 seconds/linear ft) than for 5 ft spacing (8 seconds/ linear ft) but slightly less time per plant (0.5 min/plant compared to 0.7 min/plant for 5 ft). As expected, new-over-old required significantly less time than August training and, interestingly, was faster in 2022 than in 2021 because there was a larger existing canopy for primocanes to grow into during the spring and summer, thus requiring less labor later in the season. Primocane suppression reduced training time by approximately 0.4 min/plant (24 seconds) at both planting densities. We also observed that primocane management in the new-over-old system was much easier (thus requiring less time) when combined with primocane suppression due to delayed cane growth prior to harvest. 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.

Summary:

During the second fruiting season, plants grown at high density spacing produced higher yield per acre and similar berry size compared to those grown at a typical plant spacing of 5 ft. New-over-old training increased cull and dropped fruit during harvest, but only enough to reduce yield per acre at the high density spacing. Using the traditional august training method and high-density planting resulted in the highest yield and harvest efficiency, but also required significantly higher labor costs for training. We hope to continue this study to better understand multi-year treatment effects on mature yield and cost of production for each of these treatment combinations, especially given the volatility in weather over the past two growing seasons.

Research Report to the Oregon Raspberry and Blackberry Commission
and the Agricultural Research Foundation
2022-2023

TITLE: Caneberry Pesticide Registration, Tracking, and New Chemistries

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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:

Objective 1: A special local needs label (SLN: OR-220001) became available in early 2022 for the herbicide Stinger (clopyralid), for control of broadleaf weeds and Canada thistle. A variety of other materials continue to move through the EPA pipeline. Table 1 details changes and pesticide registration activity that may be of interest to the caneberry industry.

Objective 2: The pesticide MRL charts were updated June 2022, and again in December 2022. The registration chart was updated in March 2022. 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

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 iprodione. EPA proposed revocation of the use of iprodione in caneberry production; a comment was submitted emphasizing the importance of iprodione as a rotational material for botrytis control and requesting continued access to the material.

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 2021 that is relevant to the caneberry industry.

Active ingredient	**Trade name**	**Type of material / use**	**Status**
*Clopyralid	Stinger	Herbicide	Use allowed under Oregon SLN OR-220001
Difenoconazole	Component of several premixes	Fungicide	EPA PRIA date was May 2022; tolerance not yet set
Flonicamid	Beleaf	Insecticide	Submitted to EPA; EPA PRIA date set for September 2023
Pydiflumetofen	Miravis	Fungicide	Submitted to EPA; EPA PRIA date set for September 2022 and tolerance not yet set
Pyraziflumid	Parade	Fungicide	EPA PRIA date August 2022; tolerance not yet set
Saflufenacil	Treevix	Herbicide	Tolerance set; waiting for new label to be available
Trifloxystrobin	Flint	Fungicide	Tolerance set January 2022

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

Insecticide & Miticide Registrations in Oregon Caneberries – March 2022

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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				✓					
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			✓			✓				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 – March 2022

Dani Lightle, Pesticide Registration Research Leader, Oregon State University
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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		✓		✓			✓	
Pyraclostrobin	Cabrio	11	12	0	✓	✓	✓	✓	✓		✓	
Pyriofenone	Prolivo	50	4	0		✓						
Reynoutria sachalinensis	Regalia	P5	4	0	✓	✓	✓				✓	
Streptomyces lydicus	Actinovate	?	4	0			✓					
Sulfur	Microthiol sp, etc	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 – March 2022

Dani Lightle, Pesticide Registration Research Leader, Oregon State University
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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
Benefin	Surflan	3	24	365 (non-bearing)	✓		✓	✓	
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	Fusilade	1	12	1		✓	✓		
Flumioxazin	Chateau	14	12	7	✓			✓	some grasses
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
Paraquat	Gramoxone	22	24	Avoid new shoots		✓	✓	✓	

Active Ingredient	Example Trade Name	HRG[1]	REI[2] (hours)	PHI[3] (days)	PRE	POST	Grass	Broadleaf	Others
Pelargonic acid	Scythe	17	12	1		✓	✓	✓	
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	✓		✓	✓	

[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.

Misc.

Active Ingredient	Example Trade Name	REI[1] (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]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.

[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.

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

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Current as of: November 30, 2022

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}	{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}	---	{0.2}	{1.5}	{1.5}	---	{0.2}	{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}	{0.1}	---	---	{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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--- = no MRL established in that market

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

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Current as of: November 30, 2022

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}	{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}	---	{0.01}	{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}	{0.1}	---	---	{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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--- = no MRL established in that market

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

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Current as of: November 30, 2022

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}	---
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	---	{0.01}	{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	{0.01}	---
		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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--- = no MRL established in that market

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

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Current as of: November 30, 2022

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	---	{0.01}	{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	{0.2}	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: November 30, 2022

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}	---
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	---	---	0.05	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}	---	{0.01}	{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: November 30, 2021

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}	---
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	---	---	0.05	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, 2022-2023

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
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 on par with 'Munger' with improved yield and 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. Through a historic cooperation with the Oregon State University Department of Horticulture, we are able to conduct on-farm trials to screen new and promising selections at the North Willamette Research and Extension Center (OSU-NWREC; Aurora, OR). We are developing thornless, machine harvestable blackberry cultivars for Pacific Northwest (PNW) growers. These have historically included trailing blackberry varieties, and more recently we have begun to incorporate genetics from eastern US varieties. Our current 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'. We are continuing efforts to adapt eastern US erect, semi-erect, and primocane-fruiting blackberry material to the PNW as well as incorporating their genetics into PNW trailing types, with promising results. We are also attempting to identify varieties with improved hardiness under high and low temperature stress, as well as improved fresh quality and shelf life. 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.

The USDA approved releases and granted patents in 2022 for three new blackberry varieties developed by the USDA/OSU cooperative breeding program. The three blackberry varieties being released are '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 in 2023)** – 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 in 2023)** – 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 fruit size to 'Chester' but typically shows better firmness with lower UV damage, fewer defects, and much better flavor. The fruit have at least as good post-harvest quality as 'Chester' if not better. *Fresh or processing*.
- **'Thunderhead' (USPP app. 17/697,907; available in 2023)** – 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 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.
- **ORUS 4928-1** – A sterile, ornamental pink flowering semi-erect blackberry of interest to cut flower industry.

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 – Northern Washington

Since 2001, we have actively trialed OR blackberry selections at Enfield Farms (Lynden, WA), which sits on the Canadian border, to evaluate winter hardiness and machine harvestability in a commercial setting. Most but not all selections have been machine harvestable. Due to back-to-back heat damage followed by winter injury in 2021-22, many blackberry selections lacked fruit in 2022.

- **ORUS 5148-2** was noted for its size and fruit quality in 2022 while many other blackberries produced no fruit. Looked good at OSU-NWREC in 2022 as well.
- **ORUS 5014-1 (nursery list)** performed well in WA and OR trials, with low winter injury and good machine harvest fruit release in WA, and high yields in OR.
- **ORUS 5023-1** showed good machine harvest fruit release and flavor, low acid and high sugar, low winter injury.
- **'Twilight'**, released in 2019, performed well in northern WA trials with high plant vigor, low winter injury, and high machine harvestable yield in 2021. 'Twilight' is of interest as a possible dual-purpose variety due to its apparent machine harvestability combined with high firmness, sweetness, post-harvest, and both frozen as well as fresh market quality.

Grower Trials – Oregon (OSU-NWREC)

Due to the combination of the 2021 "heat dome," and extended cold and wet weather in Spring of 2022 followed by multiple weeks of temperatures reaching the upper 90s (ºF), we observed significant impacts on ripening time and potentially on yields compared to previous growing seasons. Despite the massive reduction in fruit yields caused by the 2021 "heat dome" in Oregon, replicated plot yields in the 2018 blackberry trial planting improved by only 13% in 2022 compared to 2021, after suffering a 46% reduction from 2020. In the 2019 blackberry trial planting, replicated plot yields were 17% lower in 2022 compared to 2021. Potential stresses include lingering damage to overwintering primocanes exposed to high temperatures in 2021, late frosts in April 2022 during lateral bud break, or extended cool and rainy weather during flowering impacting pollination. **Floricane-fruiting blackberries at the OSU-NWREC ripened on average 14 days later in 2022 than their mean ripening dates from the previous five years.**

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.

2018 Trailing Blackberry (Table Bk-TR 1)

- **'Columbia Star'** and **'Black Diamond'** suffered severe fruit damage in this trial in 2021, and their 2022 yields did not recover as well as **ORUS 4344-3** or **ORUS 4892-1**.
- **ORUS 4344-3 (REP)** was the top performer in all three trial years, producing 50% more yield than 'Columbia Star' in 2020, 41% more in 2021, and 52% in 2022. A late trailing type with very good fruit quality, it also showed greater heat tolerance than any trailing blackberry selection in 2021.
- **ORUS 4892-1 (REP)** looked tremendous in 2022, rebounding well from the heat damage it experienced in 2021 with yields similar to ORUS 4344-3. Excellent lateral fruit presentation and ease of detachment, firmness, and flavor. Large fruit with quality similar to 'Columbia Star', has been consistently as high or higher yielding.

2019 Trailing Blackberry (Table Bk-TR 2)

- **'Black Diamond'**, **'Columbia Star'** and **'Zodiac'** performed similarly, and each had lower yields in 2022 than in 2021.
- **ORUS 5037-1 (REP)** shows excellent yield potential with 38% higher yield than 'Columbia Star' in 2021 and 14% higher yield than 'Columbia Star' in 2022. Fruit show very good flavor, however, firmness and skin toughness are slightly lower than 'Columbia Star'.
- **ORUS 5014-1 (OBS)** showed higher yield potential than cultivar standards due to big late season picks of large, beautiful fruit with very good flavor. Would like to see if machine picks in grower trials.

2020 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 5148-2 (REP)** showed exceptionally late season and exceptionally large fruit, with 43% higher yields than 'Columbia Star' and 55% larger fruit size in 2022. Ripened alongside early-to-mid-season semi-erect varieties in 2022. Despite massive size the fruit showed excellent firmness, skin toughness, texture, and flavor. Uniform, firm, low reversion. Tart

aromatic, nice to bite into. Could easily replace 'Columbia Giant'. With late window could extend season for trailing fruit well beyond 'Columbia Star' and 'Columbia Giant'.

- **ORUS 4767-1 (REP)** has potential as a high yielding processing berry. Among best trailing selections tested at Enfield's in 2018-19 so is likely to machine harvest well. It showed 31% higher yields than 'Columbia Star' in 2022 with 43% smaller fruit size. Good flavor and aroma. Lower firmness and skin toughness, most likely only be suitable for processing.
- **ORUS 5016-1 (OBS)** was the highest yielding trailing blackberry selection in 2022, although not replicated. This selection has both 'Newberry' and 'Tayberry' in its pedigree, combining the 'Boysen-type' and 'Tay-type' genetics in its respective maternal and paternal backgrounds. Excellent and unique flavor/aroma in fruit that are dark, glossy, and firm. Keeping an eye on as a possible new thornless, machine harvestable 'Boysen-type' plant. Size was similar to 'Columbia Star', yield was 61% higher.

2018-20 Semierect Blackberry Trials (Table Bk-SE 1)

- **'Chester Thornless'** remains the yield standard for our program, consistently produces large quantities of edible fruit each trial year. **'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 'Chester Thornless' in 2021-22 with larger, more attractive fruit, however fruit showed similar firmness only slightly better than 'Triple Crown' and may be soft for fresh market. Thawed IQF fruit had some leakage but were consistent and dark, looked good.
- **2019 – ORUS 5058-2 (OBS)** produced similar yields to 'Triple Crown' in 2021 but did not recover well after heat dome in 2022. Fruit are larger with very high firmness and skin toughness for their size, high gloss, and are sweet with low acidity and a perfume-like aroma.
- **2019 – ORUS 5067-1 (OBS)** had decent yield and good flavor, very good firmness and skin toughness.

2018 Primocane Blackberry Trials (Table Bk-PR 1)

- **ORUS 5068-3 (REP)** has good yields but is not competitive with 'Thunderhead'. It has excellent fruit quality; berries are firm, uniform, and glossy with a citrusy flavor and reduced bitterness compared to many primocane-fruiting types. Parental material.
- **ORUS 5069-1 (OBS)** stands out for producing larger numbers of smaller berries that combine exceptional firmness with good sweetness and reduced bitter aftertaste.

2019 Primocane Blackberry Trials (Table Bk-PR 2)

- **'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.
- **ORUS 5173-1 (OBS)** was thornless and smaller in stature with smaller numbers of larger sized berries; possibly of interest for growers who want a less vigorous and more manageable, albeit lower yielding, primocane-fruiter than 'Thunderhead'.

2020 Primocane Blackberry Trials (Table Bk-PR 3)

- **'Thunderhead' (OBS)** produced the equivalent of 13.40 tons/acre yield with high fruit quality.

By the Numbers: Crosses, Seedlings & Selections

- Attempted 59 blackberry crosses including 25 trailing, 18 erect/semi-erect, 7 primocane, 5 "east x west hybrid", and 4 dwarf experimental families.
- Identified 71 new blackberry selections from the 2020 seedling populations to be planted in the 2023 field trials at OSU-NWREC.

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 both 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 base of raspberry material that is machine-harvestable, high-yielding, winter hardy, and with superior processed fruit quality. We are also actively 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 selection 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 approved the release and granted a patent in 2022 for 'Finnberry' (formerly ORUS 4716-1), a primocane-fruiting red raspberry with excellent yields and fresh fruit quality.

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). 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. This year we observed three newer WSU selections performed particularly well, with high machine harvestable yields and/or fruit quality: WSU 2087, WSU 2069, WSU 2516. Among the USDA selections, ORUS 4974-1 and ORUS 4715-2 have respectively shown the highest and second highest yields in the 2019-planted trial; both selections appeared to have somewhat better stress tolerance and fruit quality than other selections and varieties including 'Meeker' under high temperatures, and appear to be machine-harvestable. The selection ORUS 5106-1 has also shown good performance, with better machine harvestable yields than 'Meeker' and similar fruit quality, as well as previously performing well at Enfield's in Washington. These selections are being made available for propagation at North American Plants, Inc. We have several selections in machine harvest trials in northern Washington and a few of these are promising. 'Finnberry' is a new variety release from the breeding program, tested as ORUS 4716-1, it is a primocane-fruiting cultivar with good yields of fruit with excellent flavor and fresh market quality.

Cultivar Releases

Patents Approved

- **'Finnberry' (USPP app. 17/829,023; available in late 2023)** – Formerly ORUS 4716-1. A primocane-fruiting selection with good firmness and flavor. The fruit can be picked at a range of colors from light pink to full red 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 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; Enfield Farms
Since 2001, we have actively trialed OR red raspberry selections at Enfield Farms (Lynden, WA), which sits on the Canadian border, to evaluate winter hardiness and machine harvestability in a commercial setting. Most but not all selections have been machine harvestable. Due to back-to-back heat damage followed by winter injury in 2021-22, many raspberry selections showed lower yields in 2022.

- **ORUS 5106-1** produced first-year yields similar to 'Meeker' with small, firm fruit that machine harvested well.
- **ORUS 4089-2** produced attractive orange primocane fruit that were too soft for machine harvest.

Grower Trials – Washington; Honcoop Machine Harvest
Since 2001, we have actively trialed OR red raspberry selections at Enfield Farms (Lynden, WA), which sits on the Canadian border, to evaluate winter hardiness and machine harvestability in a commercial setting. Most but not all selections have been machine harvestable. Due to back-to-back heat damage followed by winter injury in 2021-22, many raspberry selections showed lower yields in 2022.

- **ORUS 5104-2** has shown good plant health, vigor, and high yields of fruit that machine harvest well. Main drawback is fruit are on the lighter-colored side.
- **ORUS 4846-1** also has very nice plant health and vigor and good yields, fruit are large with good color, flavor, and attractive appearance. Better potential for fresh; fruit released on machine harvester but showed some fruit collapse and stem contamination as result.

Grower Trials – Oregon (OSU-NWREC)

Similar to what we observed in the blackberry trials, the yields of many replicated red raspberry selections we similar or even lower in 2022 compared to the 2021 "heat dome" season, possibly indicating lingering impacts on plant health or additional effects of the extended cold and wet Spring season we experienced in 2022. The USDA selections ORUS 4974-1 and ORUS 4715-2, which demonstrated the lowest heat damage in 2021, repeated as the best yielding selections in the 2019 planting in 2022, but each was lower yielding in 2022 than in 2021. **Similar to the blackberries, floricane-fruiting red raspberries at the OSU-NWREC ripened on average 14 days later in 2022 than their mean ripening dates from the previous five years.**

2019 Floricane Red Raspberry Trials (Table Ry-FL 1)

- **WSU 2516 (REP)** had similar yield to other top WA selections but stood out for showing much better plant health and fruit quality in a very hot 2021 season, with good machine harvest quality, fruit are a bright glossy color with good flavor. Thawed IQF quality looked excellent.
- **ORUS 4715-2 (REP)** showed very good fruit release, nice glossy ruby color, had best machine harvest fruit quality of any OR selection under high temperatures.
- **ORUS 4974-1 (REP)** machine harvested well with slightly higher beater speed, fruit looked great on belt with good color, firmness, consistency.
- **ORUS 5106-1 (REP)** has looked better than 'Meeker' for 2 years with better flavor, has **firm fruit that machine harvested well in both OR and northern WA trials**. Contains 1/8 *R. leucodermis* genetics.
- **'AAC Eden' (OBS)** from Andrew Jamieson's breeding program showed tremendous yields of very large fruit that released well during machine harvest, but lacked the firmness and durability required for a machine harvested fresh or processed variety.

2020 Floricane Red Raspberry Trials (Table Ry-FL 2)

- **WSU 2087 (REP)** was the best yielding replicated selection in 2022. Fruit are dark, round and firm, better than 'Wakefield'. Some stems came off with fruit.
- **WSU 2069 (REP)** was the second-best yielding replicated selection in 2022. Very pretty fruit with good color and great flavor. Quality was overall quite good but observed that firmness and coherence tailed off on warmer days, fruit took a dusty appearance if left to hang.
- **ORUS 4607-2 (OBS)** was the best yielding observation selection in 2022, matching WSU 2087. Has been high yielding and looked good in OR and WA, but feedback indicates may be too soft for cultivar release.
- **ORUS 4371-4 (OBS)** was the second-best yielding observation selection in 2022. Previously showed high machine-harvestable yields and winter tolerance in WA, bit light but fruit quality is good.

2019 Primocane Red Raspberry Trials (Table Ry-PR 1)

- **ORUS 5209-1 (REP)** showed excellent yields last 2 years, sturdy erect canes with fruiting laterals that hang very nicely even on hot days, large semi-conical and uniform w/ coherent drupelets, low rough/UV, firm when picked light, intense flavor, and tremendous aroma. Prioritizing for grower trials.
- **ORUS 5250-1 (REP)** shows a nice combination of very high yields and very early ripening season for primocane-fruiting type, followed by a wide ripening window. Fruit flavor and

quality are good, not quite great, but combined with its yield and earliness are more than acceptable.

2020 Primocane Red Raspberry Trials (Table Ry-PR 2)

- **'Finnberry' (REP)** appeared to be negatively impacted by the odd seasonal effects in 2022, with leggier/less sturdy canes, and with fruit beginning to set and ripen very late to a degree that many did not ripen during the regular harvest season. Fruit quality and flavor were very good as usual.
- **ORUS 4487-1 (OBS)** has consistently looked 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.

By the Numbers: Crosses, Seedlings & Selections

- Attempted 55 red raspberry crosses including 22 floricane-fruiting and 23 primocane-fruiting families.
- Identified 51 new red raspberry selections from the 2020 seedling populations to be planted in the 2023 field trials at OSU-NWREC.

Progress - Black Raspberry

We are pursuing black raspberry ("blackcap") breeding with the aim of addressing the issues of limited life-span and long-term field durability of this crop in Northwest grower fields. Our goal is to develop less thorny selections with the machine-harvested fruit quality of older 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.

We observed significant frost damage to early breaking lateral shoots caused by the cold snap in early April 2022. The program had essentially no black raspberry trial data from 2021 as a result of the "heat dome" which impacted blackcaps most heavily and caused most to dry up and/or refuse to machine harvest. As a result, the 2019-planted trial will be retained for an additional year and harvested in 2023 with the goal of recovering more representative yield data from these plots.

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.

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)

2019 Black Raspberry Trials (Table BRy 1)

- The replicated selections in this trial were significantly impacted by frost damage in 2022 and none performed better than **'Munger' (REP)**
- **ORUS 5188-1 (OBS)** shows good yields and fruit quality, will likely test in REP.
- **ORUS 5090-4 (OBS)** is a half-thornless selection with "purple raspberry" background, multiple sources of aphid resistance, and good yields. Needs improved machine harvestable fruit quality but it does come off on machine.

2020 Black Raspberry Trials (Table BRy 2)

- **ORUS 4820-1 (REP)** previously looked good in OSU-NWREC trials and repeated in this planting as being similar-to-better yielding than 'Munger' while ripening 5-9 d ahead, which may be useful for earlier machine harvest and avoiding heat.
- **ORUS 5299-1 (OBS)** showed the best looking fruit on the machine harvest belt and in flats after harvest, very high fruit quality looked even better than 'Munger'.

By the Numbers: Crosses, Seedlings & Selections

- Attempted 16 black raspberry crosses.
- Identified 16 new black raspberry selections from the 2020 seedling populations to be planted in the 2023 field trials at OSU-NWREC.

Table Bk-TR 1. Fruit size and yield of trailing blackberry genotypes tested in OSU-NWREC 2018 trial planting, harvested from 2020-22.

	Berry Size (g)	Yield (tons·a^{-1})		
Annual Mean [a]				
2020	7.49	6.67		
2021	5.18	3.58		
2022	5.42	4.06		
Genotype	2020-22	2021	2022	2020-22
Replicated [z]				
*ORUS 4344-3	6.04 b	4.16 a	4.92 a	5.72 a
Black Diamond	**4.83 c**	**3.57 ab**	**3.24 ab**	**4.89 b**
ORUS 4892-2	5.23 c	3.66 ab	4.07 ab	4.81 b
*ORUS 4892-1	8.17 a	3.57 ab	4.83 ab	4.59 b
Columbia Star	**5.87 b**	**2.95 b**	**3.23 b**	**3.85 c**

[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 2019 trial planting, harvested from 2021-22.

	Berry Size (g)	Yield (tons·a^{-1})		
Annual Mean [a]				
2021	5.20	5.06		
2022	6.03	4.31		
Genotype	2021-22	2021	2022	2021-22
Replicated [z]				
*ORUS 5037-1	5.57 b	6.32 a	4.92 a	5.62 a
Black Diamond	**5.57 b**	**4.87 b**	**4.28 a**	**4.57 b**
Columbia Star	**6.48 a**	**4.59 b**	**4.31 a**	**4.45 b**
ORUS 4535-2	4.83 c	4.46 b	3.74 a	4.10 b
Nonreplicated				
*ORUS 5014-1	6.70	6.27	5.97	6.12
Zodiac	4.45	6.75	4.11	5.43
ORUS 5031-1	8.75	4.42	3.71	4.06
ORUS 5010-1	5.85	4.29	3.70	3.99
Marion	**4.90**	**2.94**	**3.67**	**3.31**
ORUS 5023-2	3.90	3.13	2.23	2.68
Kotata	**4.85**	**1.72**	**3.46**	**2.59**
ORUS 5023-1	5.20	3.30	1.69	2.49
ORUS 4902-1	4.45	2.68	1.89	2.29

[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 2020 trial planting, harvested from 2022.

	Berry Size (g)	Yield (tons·a^{-1})
Annual Mean [a]		
2022	6.57	5.26
Genotype	2022	2022
Replicated [z]		
ORUS 5148-2	10.27 a	6.62 a
ORUS 4767-1	3.77 c	6.09 ab
Black Diamond	**4.50 c**	**4.67 b**
Columbia Star	**6.63 b**	**4.64 b**
ORUS 5133-1	7.70 b	4.30 b
Nonreplicated		
ORUS 5016-1	6.8	7.47
ORUS 4663-4	11.7	7.28
Marion	**5.4**	**6.41**
ORUS 5133-2	3.8	5.67
ORUS 5127-1	4.6	4.96
ORUS 5041-1	7.7	4.77
ORUS 5129-1	5.1	4.29
ORUS 5132-1	6.4	3.95
Columbia Giant	**7.8**	**3.93**
ORUS 4762-1	4.9	3.73
ORUS 5129-2	4.4	3.49
ORUS 5041-2	5.3	3.46
ORUS 5138-1	5.3	2.93
ORUS 5148-1	6.6	0.46

[a] Annual means based on replicated plot samples.
[z] Groups determined by t-Test (LSD) of replicated plot means, $p \leq 0.05$.

Table Bk-SE 1. Fruit size and yield of erect/semi-erect blackberry genotypes tested in OSU-NWREC 2018-20 trial plantings, harvested from 2020-22.

	Berry Size (g)	Yield (tons·a^{-1})		
Genotype	2020-22	2021	2022	2020-22
Nonreplicated (2018)				
Chester Thornless	**4.98**	**10.39**	**10.56**	**9.68**
ORUS 4273-2	4.53	4.75	5.89	6.55
ORUS 4453-1	6.65	5.25	6.07	5.66
Triple Crown	**7.20**	**6.91**	**5.91**	**5.09**
Black Jack	**6.68**	**3.71**	**3.52**	**4.13**
Nonreplicated (2019)				
Chester Thornless	**5.00**	**10.87**	**9.98**	**10.43**
ORUS 5057-1	6.62	9.86	8.65	9.26
Triple Crown	**7.32**	**7.63**	**7.56**	**7.60**
ORUS 5067-1	7.10	8.01	7.03	7.52
ORUS 5049-1	3.89	8.57	6.17	7.37
ORUS 5056-2	4.72	7.14	6.82	6.98
Caddo	**5.66**	**8.72**	**3.39**	**6.05**
ORUS 5058-2	7.20	7.37	4.60	5.99
Nonreplicated (2020)				
ORUS 5163-2	7.02	-	7.44	7.44
ORUS 5156-1	8.89	-	7.04	7.04
Triple Crown	**5.77**	**-**	**6.65**	**6.65**
Chester Thornless	**4.05**	**-**	**5.89**	**5.89**
Celestial	**5.63**	**-**	**5.64**	**5.64**
ORUS 5168-1	6.09	-	5.05	5.05
ORUS 5161-1	5.24	-	4.95	4.95
ORUS 5168-2	6.45	-	4.80	4.80
ORUS 5165-1	4.34	-	4.00	4.00
ORUS 5167-1	4.82	-	3.68	3.68
ORUS 5163-1	4.48	-	1.63	1.63
ORUS 5151-1	7.01	-	0.77	0.77

Table Bk-PF 1. Fruit size and yield of primocane-fruiting blackberry genotypes tested in OSU-NWREC 2018 trial planting, harvested from 2020-22.

	Berry Size (g)	Yield (tons·a^{-1})		
Annual Mean [a]				
2020	8.13	1.22		
2021	7.50	5.41		
2022	8.13	5.43		
Genotype	2020-22	2021	2022	2020-22
Replicated [z]				
Prime-Ark 45	**8.56 a**	**6.06 a**	**5.06 a**	**4.18 a**
ORUS 5068-3	7.29 b	4.74 a	5.81 a	3.86 a
Nonreplicated				
ORUS 5069-1	6.39	7.68	8.51	5.85
ORUS 5068-5	9.70	3.34	6.19	4.26
ORUS 5068-1	8.04	3.57	4.00	2.84

[a] Annual means based on replicated plot samples.
[z] Groups determined by t-Test (LSD) of replicated plot means, $p \leq 0.05$.

Table Bk-PF 2. Fruit size and yield of primocane-fruiting blackberry genotypes tested in OSU-NWREC 2019 trial planting, harvested from 2021-22.

	Berry Size (g)	Yield (tons·a^{-1})		
Annual Mean [a]				
2021	7.40	5.99		
2022	8.67	8.59		
Genotype	2021-22	2021	2022	2021-22
Replicated [z]				
Thunderhead	**7.75 a**	**7.23 a**	**12.69 a**	**9.96 a**
ORUS 5174-2	8.35 a	5.70 a	7.20 b	6.45 b
Prime-Ark 45	**8.00 a**	**5.24 a**	**5.88 b**	**5.56 b**
Nonreplicated				
ORUS 5174-1	7.65	3.22	3.77	3.49
ORUS 5173-4	7.69	2.44	1.85	2.15
ORUS 5174-3	5.61	2.20	1.14	1.67
ORUS 5173-1	12.70	-	1.50	1.50
ORUS 5175-1	5.28	0.95	-	0.95

[a] Annual means based on replicated plot samples.
[z] Groups determined by t-Test (LSD) of replicated plot means, $p \leq 0.05$.

Table Bk-PF 3. Fruit size and yield of primocane-fruiting blackberry genotypes tested in OSU-NWREC 2020 trial planting, harvested from 2022.

	Berry Size (g)	Yield (tons·a^{-1})
Annual Mean [a]		
2022	6.19	1.26
Genotype	2022	2022
Replicated [z]		
Prime-Ark 45	**5.23 a**	**1.83 a**
ORUS 5284-1	6.40 a	1.81 a
ORUS 5173-1	6.93 a	0.12 b
Nonreplicated		
Thunderhead	**8.97**	**13.40**
ORUS 5173-3	6.67	0.64

[a] Annual means based on replicated plot samples.
[z] Groups determined by t-Test (LSD) of replicated plot means, $p \leq 0.05$.

Table Ry-FL 1. Fruit size and yield of floricane-fruiting red raspberry genotypes tested in OSU-NWREC 2019 trial planting, harvested from 2021-22. Yield measurements are based on machine picking using a Littau Harvester.

	Berry Size (g)	Yield (tons·a^{-1})		
Annual Mean [a]				
2021	2.86	3.16		
2022	2.40	2.89		
Genotype	2021-22	2021	2022	2021-22
Replicated [z]				
ORUS 4974-1	2.72 ab	3.93 a	3.54 a	3.74 a
*ORUS 4715-2	2.77 ab	3.78 a	3.10 ab	3.44 ab
WSU 2516	3.05 a	3.06 ab	2.69 ab	2.87 bc
*ORUS 5106-1	2.35 c	2.68 b	3.00 ab	2.84 bc
WSU 2605	2.28 c	3.18 ab	2.36 b	2.77 c
Meeker	**2.62 bc**	**2.35 b**	**2.67 ab**	**2.51 c**
Nonreplicated				
AAC Eden	**3.96**	**4.81**	**5.48**	**5.15**
ORUS 5102-2	2.55	2.86	4.35	3.61
ORUS 5106-3	1.80	3.26	2.96	3.11
ORUS 5105-1	1.97	3.25	2.96	3.10
ORUS 5104-2	2.43	3.72	2.27	3.00
WSU 2481	3.02	2.69	2.95	2.82
ORUS 5108-3	2.88	2.53	2.62	2.58
ORUS 5099-1	2.39	2.62	2.22	2.42
ORUS 4965-3	2.60	2.65	2.05	2.35
ORUS 4843-1	2.69	2.48	1.87	2.18
ORUS 5094-1	3.04	2.09	2.25	2.17

[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 2020 trial planting, harvested from 2022. Yield measurements are based on machine picking using a Littau Harvester.

	Berry Size (g)	Yield (tons·a^{-1})
Annual Mean [a]		
2022	1.89	2.70
Genotype	2022	2022
Replicated [z]		
WSU 2087	2.10 abc	4.11 a
WSU 2069	1.77 bcd	3.32 ab
*ORUS 4600-1	2.33 a	2.78 ab
ORUS 5195-2	1.77 bcd	2.66 ab
WSU 2425	1.50 d	2.61 ab
WSU 2472	1.67 cd	2.45 ab
Meeker	**1.97 abcd**	**2.39 ab**
WSU 2481	2.17 ab	2.33 ab
ORUS 4462-2	1.70 bcd	1.67 b
Nonreplicated		
*ORUS 4607-2	2.18	4.11
*ORUS 4371-4	2.36	3.19
ORUS 5195-3	1.76	2.53
ORUS 5199-1	2.58	2.30
WSU 2577	2.21	2.19
ORUS 5205-1	2.12	2.18
ORUS 5198-3	2.36	2.04
ORUS 5198-1	2.39	1.97
ORUS 5206-2	2.28	1.76
ORUS 3702-3	2.67	1.71
ORUS 5205-2	2.12	1.25
ORUS 5200-1	2.92	1.08
ORUS 5201-2	0.86	0.93
ORUS 5195-1	1.53	0.83

[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 2019 trial planting, harvested from 2020-22.

	Berry Size (g)	Yield (tons·a^{-1})		
Annual Mean [a]				
2020	3.12	1.59		
2021	2.46	1.72		
2022	2.80	2.90		
Genotype	2020-22	2021	2022	2020-22
Replicated [z]				
*ORUS 5209-1	3.1 a	2.09 a	3.73 a	2.77 a
ORUS 5250-1	3.26 a	1.83 a	3.61 a	2.45 b
ORUS 5248-1	3.19 a	2.17 a	2.49 b	1.89 c
Kokanee	**2.09 b**	**1.70 a**	**2.49 b**	**1.86 c**
*ORUS 4725-1	2.33 b	0.80 b	2.21 b	1.39 d
Nonreplicated				
ORUS 5248-3	4.32	3.02	2.21	2.59
Polka	**2.31**	**1.82**	**2.53**	**2.11**
ORUS 5211-1	2.56	2.15	2.14	1.96
ORUS 5209-2	2.00	1.39	2.95	1.94
ORUS 5218-1	2.96	1.10	2.54	1.58
ORUS 5220-1	1.82	1.84	1.58	1.40
*ORUS 4858-2	2.10	1.83	0.78	1.30
ORUS 5248-2	2.99	1.25	1.30	1.03
ORUS 5227-2	3.79	1.35	0.66	0.86

[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 2. Fruit size and yield of primocane-fruiting red raspberry genotypes tested in OSU-NWREC 2020 trial planting, harvested from 2021-22.

	Berry Size (g)	Yield (tons·a^{-1})		
Annual Mean [a]				
2021	2.03	2.27		
2022	2.63	2.83		
Genotype	2021-22	2021	2022	2021-22
Replicated				
Finnberry	**2.33**	**2.27**	**2.83**	**2.55**
Nonreplicated				
ORUS 5345-1	2.42	2.31	3.88	3.10
*ORUS 4487-1	1.91	1.76	2.73	2.24
ORUS 5467-2	2.40	1.81	2.36	2.09
ORUS 5347-1	3.43	1.57	2.41	1.99
ORUS 5465-1	3.24	1.43	1.74	1.58
Polka	**2.07**	**2.05**	**0.99**	**1.52**
ORUS 5201-2	1.91	1.27	1.72	1.49
Heritage	**1.74**	**1.15**	**1.53**	**1.34**
ORUS 5465-2	3.14	1.04	1.59	1.32
ORUS 5332-2	2.80	1.21	1.40	1.30
ORUS 5332-1	1.85	1.19	1.34	1.26
Addison	**1.03**	**1.18**	**0.15**	**0.66**
ORUS 5345-2	1.50	0.51	0.59	0.55

[a] Annual means based on replicated plot samples.
*Nursery list – available at nurseries for grower trial by request.

Table Ry-PF 3. Fruit size and yield of primocane-fruiting red raspberry genotypes tested in OSU-NWREC 2021 trial planting, harvested from 2022.

	Berry Size (g)	Yield (tons·a^{-1})
Annual Mean [a]		
2022	2.44	1.47
Genotype	2022	2022
Replicated [z]		
Heritage	**1.63 b**	**2.58 a**
Kokanee	**2.6 a**	**1.31 ab**
ORUS 4723-2	3.1 a	0.54 b
Nonreplicated		
ORUS 5467-1	2.97	2.93
Crimson Treasure	**2.68**	**2.35**
[*]ORUS 4487-1	1.84	1.02
ORUS 4981-1	2.00	0.13

[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 1. Fruit size and yield of black raspberry genotypes tested in OSU-NWREC 2019 trial planting, harvested from 2022. Yield measurements are based on machine picking using a Littau Harvester.

	Berry Size (g)	Yield (tons·a^{-1})
Annual Mean [a]		
2022	1.00	1.35
Genotype	2022	2022
Replicated [z]		
Munger	**1.37 a**	**1.98 a**
ORUS 5190-1	1.23 ab	1.57 ab
ORUS 5094-2	0.83 b	1.53 ab
ORUS 5088-2	0.93 ab	1.48 ab
ORUS 5186-1	0.83 b	1.20 ab
ORUS 5088-1	1.00 ab	1.16 ab
ORUS 5185-1	0.97 ab	0.99 b
ORUS 5185-2	0.87 ab	0.85 b
Nonreplicated		
ORUS 5188-2	1.09	1.99
ORUS 5075-1	0.62	1.90
ORUS 5090-4	1.04	1.88
ORUS 5185-3	1.51	1.67
ORUS 5090-1	1.17	1.65
*ORUS 3217-1	1.35	1.57
ORUS 5188-1	1.13	1.51
ORUS 5182-2	1.49	1.47
ORUS 5179-1	1.27	1.45
ORUS 5089-1	1.03	1.42
ORUS 5191-1	0.98	1.42
ORUS 5180-2	1.31	1.38
ORUS 5092-5	0.60	1.27
ORUS 5091-2	0.63	1.25
ORUS 5180-3	1.25	1.25
ORUS 5092-1	0.63	1.24
ORUS 5180-1	1.04	1.24
ORUS 5092-3	0.71	1.15
ORUS 5186-2	1.04	1.13
ORUS 5090-3	1.33	1.13

ORUS 5192-1	1.16	1.11
ORUS 5090-2	1.02	1.02
ORUS 5091-5	0.52	0.94
ORUS 5091-3	0.53	0.94
ORUS 5091-4	0.73	0.94
ORUS 4945-3	0.94	0.86
ORUS 5092-2	0.90	0.80
ORUS 5182-1	1.13	0.79
ORUS 4952-3	0.96	0.79
ORUS 4812-4	0.82	0.78
ORUS 5091-1	0.82	0.77
*ORUS 3013-1	1.59	0.77
ORUS 5176-1	0.74	0.76
ORUS 5186-3	1.30	0.73
ORUS 5074-1	1.35	0.59
ORUS 4828-2	1.16	0.45

[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 2020 trial planting, harvested from 2022. Yield measurements are based on machine picking using a Littau Harvester.

	Berry Size (g)	Yield (tons·a^{-1})
Annual Mean [a]		
2022	1.35	2.55
Genotype	2022	2022
Replicated [z]		
*ORUS 4820-1	1.23 b	3.09 a
Munger	**1.33 b**	**2.87 a**
ORUS 5308-2	1.23 b	2.58 a
ORUS 5302-1	1.60 a	1.68 b
Nonreplicated		
ORUS 5304-2	0.97	2.64
ORUS 5299-1	1.15	1.79
ORUS 5192-2	1.22	1.73
ORUS 5292-1	1.07	1.69
ORUS 5304-3	0.89	1.59
*ORUS 4833-1	1.32	1.42
ORUS 5308-1	1.13	1.29
ORUS 5304-1	1.02	1.27
ORUS 5300-1	1.22	1.24
ORUS 4304-136	1.48	0.86

[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 OSU-NWREC trial plantings in 2022, including comparisons to average ripening dates from previous five years.

		Current Year (2022)			Previous Five Years [x]		
Cultivar	Type [y]	5%	50%	95%	5%	50%	95%
ORUS 5037-2	TRL	5-Jul	5-Jul	12-Jul	6-Jul	13-Jul	20-Jul
ORUS 5023-1	TRL	5-Jul	12-Jul	12-Jul	22-Jun	29-Jun	6-Jul
*ORUS 4892-1	TRL	5-Jul	12-Jul	26-Jul	23-Jun	30-Jun	9-Jul
Columbia Star	**TRL**	**5-Jul**	**12-Jul**	**19-Jul**	**26-Jun**	**2-Jul**	**12-Jul**
Columbia Giant	**TRL**	**5-Jul**	**12-Jul**	**26-Jul**	**6-Jul**	**10-Jul**	**13-Jul**
ORUS 5041-1	TRL	5-Jul	12-Jul	19-Jul	-	-	-
ORUS 5129-1	TRL	5-Jul	12-Jul	19-Jul	-	-	-
ORUS 5133-1	TRL	5-Jul	12-Jul	19-Jul	-	-	-
ORUS 5133-2	TRL	5-Jul	12-Jul	19-Jul	-	-	-
ORUS 5138-1	TRL	12-Jul	12-Jul	19-Jul	-	-	-
ORUS 4767-1	TRL	5-Jul	19-Jul	26-Jul	25-Jun	30-Jun	2-Jul
ORUS 4663-4	TRL	12-Jul	19-Jul	26-Jul	25-Jun	2-Jul	9-Jul
Black Diamond	**TRL**	**12-Jul**	**19-Jul**	**24-Jul**	**23-Jun**	**5-Jul**	**16-Jul**
Kotata	**TRL**	**12-Jul**	**19-Jul**	**2-Aug**	**29-Jun**	**6-Jul**	**6-Jul**
ORUS 5010-1	TRL	12-Jul	19-Jul	26-Jul	6-Jul	6-Jul	13-Jul
ORUS 5023-2	TRL	12-Jul	19-Jul	9-Aug	6-Jul	6-Jul	20-Jul
ORUS 5031-1	TRL	12-Jul	19-Jul	2-Aug	22-Jun	6-Jul	6-Jul
Marion	TRL	12-Jul	19-Jul	22-Jul	29-Jun	6-Jul	13-Jul
*ORUS 4892-2	TRL	12-Jul	19-Jul	26-Jul	29-Jun	6-Jul	13-Jul
Zodiac	**TRL**	**12-Jul**	**19-Jul**	**2-Aug**	**28-Jun**	**7-Jul**	**17-Jul**
ORUS 4902-1	TRL	12-Jul	19-Jul	19-Jul	29-Jun	13-Jul	13-Jul
ORUS 4762-1	TRL	12-Jul	19-Jul	2-Aug	7-Jul	14-Jul	21-Jul
ORUS 5016-1	TRL	12-Jul	19-Jul	26-Jul	-	-	-
ORUS 5041-2	TRL	12-Jul	19-Jul	26-Jul	-	-	-
ORUS 5132-1	TRL	12-Jul	19-Jul	26-Jul	-	-	-
ORUS 4535-2	TRL	19-Jul	19-Jul	26-Jul	2-Jul	7-Jul	16-Jul
ORUS 5148-1	TRL	19-Jul	19-Jul	19-Jul	-	-	-
*ORUS 4344-3	TRL	19-Jul	26-Jul	9-Aug	29-Jun	6-Jul	20-Jul
*ORUS 5014-1	TRL	19-Jul	26-Jul	2-Aug	6-Jul	13-Jul	20-Jul
*ORUS 5037-1	TRL	19-Jul	26-Jul	2-Aug	6-Jul	13-Jul	20-Jul
ORUS 5127-1	TRL	19-Jul	26-Jul	2-Aug	-	-	-
ORUS 5129-2	TRL	19-Jul	26-Jul	26-Jul	-	-	-
ORUS 5161-1	ESE	26-Jul	26-Jul	30-Aug	-	-	-
ORUS 4273-2	ESE	26-Jul	2-Aug	9-Aug	10-Jul	17-Jul	24-Jul

Caddo	**ESE**	**26-Jul**	**2-Aug**	**23-Aug**	**13-Jul**	**20-Jul**	**10-Aug**
ORUS 5056-2	ESE	26-Jul	2-Aug	16-Aug	13-Jul	20-Jul	3-Aug
Black Jack	**ESE**	**26-Jul**	**2-Aug**	**9-Aug**	**10-Jul**	**20-Jul**	**3-Aug**
ORUS 5067-1	ESE	26-Jul	2-Aug	16-Aug	13-Jul	27-Jul	10-Aug
*ORUS 4535-1	TRL	26-Jul	2-Aug	16-Aug	-	-	-
ORUS 5148-2	TRL	26-Jul	2-Aug	16-Aug	-	-	-
ORUS 5163-2	ESE	2-Aug	2-Aug	23-Aug	-	-	-
ORUS 5049-1	ESE	26-Jul	9-Aug	30-Aug	13-Jul	20-Jul	17-Aug
ORUS 5165-1	ESE	26-Jul	9-Aug	30-Aug	-	-	-
Celestial	**ESE**	**2-Aug**	**9-Aug**	**23-Aug**	**19-Jul**	**2-Aug**	**20-Aug**
ORUS 5168-1	ESE	2-Aug	9-Aug	16-Aug	-	-	-
ORUS 5151-1	ESE	9-Aug	9-Aug	16-Aug	-	-	-
ORUS 5163-1	ESE	9-Aug	9-Aug	16-Aug	-	-	-
Triple Crown	**ESE**	**4-Aug**	**11-Aug**	**23-Aug**	**22-Jul**	**31-Jul**	**9-Aug**
ORUS 5057-1	ESE	26-Jul	16-Aug	30-Aug	13-Jul	27-Jul	17-Aug
ORUS 5168-2	ESE	2-Aug	16-Aug	23-Aug	-	-	-
ORUS 5156-1	ESE	9-Aug	16-Aug	30-Aug	-	-	-
ORUS 5058-2	ESE	9-Aug	23-Aug	13-Sep	20-Jul	27-Jul	10-Aug
ORUS 5167-1	ESE	16-Aug	23-Aug	30-Aug	-	-	-
Chester Thornless	**ESE**	**16-Aug**	**27-Aug**	**11-Sep**	**24-Jul**	**11-Aug**	**27-Aug**
ORUS 5068-5	EPF	23-Aug	30-Aug	13-Sep	27-Jul	17-Aug	7-Sep
ORUS 5174-1	EPF	23-Aug	30-Aug	13-Sep	20-Jul	17-Aug	7-Sep
ORUS 5068-1	EPF	23-Aug	30-Aug	13-Sep	27-Jul	24-Aug	21-Sep
ORUS 5173-4	EPF	23-Aug	30-Aug	7-Sep	20-Jul	24-Aug	7-Sep
ORUS 5173-1	EPF	30-Aug	30-Aug	23-Sep	20-Jul	10-Aug	7-Sep
ORUS 5174-2	EPF	23-Aug	7-Sep	20-Sep	27-Jul	7-Sep	21-Sep
ORUS 5284-1	EPF	23-Aug	7-Sep	13-Sep	-	-	-
ORUS 5069-1	EPF	30-Aug	7-Sep	27-Sep	10-Aug	31-Aug	21-Sep
ORUS 5174-3	EPF	30-Aug	7-Sep	13-Sep	27-Jul	31-Aug	14-Sep
Thunderhead	**EPF**	**30-Aug**	**7-Sep**	**20-Sep**	**17-Aug**	**4-Sep**	**22-Sep**
ORUS 5068-3	EPF	30-Aug	13-Sep	27-Sep	27-Jul	31-Aug	14-Sep
Prime-Ark 45	**EPF**	**4-Sep**	**13-Sep**	**27-Sep**	**17-Aug**	**9-Sep**	**24-Sep**

[x] Five-year ripening date based on average of plot dates from up to five previous seasons.
[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 OSU-NWREC trial plantings in 2022, including comparisons to average ripening dates from previous five years.

		Current Year (2022)			Previous Five Years [x]		
Cultivar	Type [y]	5%	50%	95%	5%	50%	95%
ORUS 5099-1	FF	28-Jun	8-Jul	26-Jul	15-Jun	25-Jun	13-Jul
WSU 2425	FF	28-Jun	8-Jul	22-Jul	-	-	-
WSU 2605	FF	28-Jun	8-Jul	22-Jul	8-Jun	22-Jun	9-Jul
ORUS 4843-1	FF	5-Jul	8-Jul	22-Jul	15-Jun	22-Jun	13-Jul
ORUS 5195-1	FF	5-Jul	8-Jul	22-Jul	-	-	-
WSU 2472	FF	5-Jul	8-Jul	22-Jul	-	-	-
ORUS 5195-3	FF	28-Jun	12-Jul	22-Jul	-	-	-
WSU 2069	FF	28-Jun	12-Jul	22-Jul	-	-	-
*ORUS 4371-4	FF	5-Jul	12-Jul	22-Jul	23-Jun	1-Jul	13-Jul
ORUS 4462-2	FF	5-Jul	12-Jul	22-Jul	-	-	-
*ORUS 4715-2	FF	5-Jul	12-Jul	26-Jul	23-Jun	28-Jun	14-Jul
ORUS 4965-3	FF	5-Jul	12-Jul	26-Jul	23-Jun	27-Jun	4-Jul
ORUS 4974-1	FF	5-Jul	12-Jul	26-Jul	22-Jun	30-Jun	11-Jul
ORUS 5104-2	FF	5-Jul	12-Jul	22-Jul	15-Jun	25-Jun	13-Jul
ORUS 5105-1	FF	5-Jul	12-Jul	26-Jul	22-Jun	29-Jun	13-Jul
*ORUS 5106-1	FF	5-Jul	12-Jul	26-Jul	22-Jun	29-Jun	13-Jul
ORUS 5106-3	FF	5-Jul	12-Jul	22-Jul	22-Jun	25-Jun	13-Jul
ORUS 5195-2	FF	5-Jul	12-Jul	22-Jul	-	-	-
ORUS 5205-1	FF	5-Jul	12-Jul	26-Jul	-	-	-
WSU 2087	FF	5-Jul	12-Jul	22-Jul	23-Jun	1-Jul	12-Jul
AAC Eden	FF	5-Jul	15-Jul	26-Jul	15-Jun	25-Jun	13-Jul
Meeker	FF	5-Jul	15-Jul	26-Jul	22-Jun	2-Jul	14-Jul
ORUS 3702-3	FF	5-Jul	15-Jul	26-Jul	23-Jun	1-Jul	12-Jul
*ORUS 4600-1	FF	5-Jul	15-Jul	26-Jul	23-Jun	1-Jul	15-Jul
*ORUS 4607-2	FF	5-Jul	15-Jul	26-Jul	20-Jun	2-Jul	12-Jul
ORUS 5102-2	FF	5-Jul	15-Jul	26-Jul	22-Jun	9-Jul	13-Jul
ORUS 5108-3	FF	5-Jul	15-Jul	26-Jul	25-Jun	9-Jul	20-Jul
ORUS 5199-1	FF	5-Jul	15-Jul	22-Jul	-	-	-
ORUS 5200-1	FF	5-Jul	15-Jul	22-Jul	-	-	-
ORUS 5205-2	FF	5-Jul	15-Jul	26-Jul	-	-	-
WSU 2481	FF	5-Jul	15-Jul	26-Jul	15-Jun	25-Jun	13-Jul
WSU 2516	FF	5-Jul	15-Jul	26-Jul	15-Jun	29-Jun	13-Jul
ORUS 5094-1	FF	8-Jul	15-Jul	26-Jul	22-Jun	9-Jul	13-Jul
ORUS 5198-3	FF	8-Jul	15-Jul	26-Jul	-	-	-

WSU 2577	FF	5-Jul	19-Jul	26-Jul	-	-	-
ORUS 5198-1	FF	8-Jul	19-Jul	26-Jul	-	-	-
ORUS 5206-2	FF	8-Jul	19-Jul	26-Jul	-	-	-
ORUS 5206-1	FF	15-Jul	19-Jul	26-Jul	-	-	-
ORUS 5201-2	PF	26-Jul	3-Aug	23-Aug	3-Aug	17-Aug	7-Sep
ORUS 5250-1	PF	9-Aug	23-Aug	13-Sep	20-Jul	3-Aug	31-Aug
ORUS 5218-1	PF	16-Aug	23-Aug	13-Sep	20-Jul	3-Aug	31-Aug
Polka	PF	12-Aug	26-Aug	13-Sep	20-Jul	10-Aug	31-Aug
*ORUS 4725-1	PF	9-Aug	30-Aug	20-Sep	20-Jul	10-Aug	31-Aug
*ORUS 5209-1	PF	16-Aug	30-Aug	13-Sep	3-Aug	24-Aug	14-Sep
ORUS 5209-2	PF	16-Aug	30-Aug	13-Sep	3-Aug	24-Aug	7-Sep
ORUS 5211-1	PF	16-Aug	30-Aug	13-Sep	20-Jul	10-Aug	7-Sep
ORUS 5248-1	PF	16-Aug	30-Aug	13-Sep	27-Jul	10-Aug	31-Aug
ORUS 5332-1	PF	16-Aug	30-Aug	13-Sep	3-Aug	24-Aug	7-Sep
ORUS 5345-2	PF	16-Aug	30-Aug	7-Sep	3-Aug	24-Aug	31-Aug
ORUS 5465-1	PF	16-Aug	30-Aug	7-Sep	27-Jul	17-Aug	7-Sep
*ORUS 4487-1	PF	19-Aug	30-Aug	20-Sep	27-Jul	20-Aug	10-Sep
ORUS 5345-1	PF	23-Aug	30-Aug	20-Sep	3-Aug	24-Aug	14-Sep
ORUS 5467-2	PF	16-Aug	7-Sep	20-Sep	3-Aug	24-Aug	7-Sep
Crimson Treasure	PF	23-Aug	7-Sep	20-Sep	-	-	-
ORUS 5248-2	PF	23-Aug	7-Sep	20-Sep	3-Aug	24-Aug	14-Sep
ORUS 5248-3	PF	23-Aug	7-Sep	13-Sep	17-Aug	24-Aug	14-Sep
ORUS 5347-1	PF	23-Aug	7-Sep	27-Sep	24-Aug	31-Aug	14-Sep
ORUS 5465-2	PF	23-Aug	7-Sep	27-Sep	3-Aug	31-Aug	14-Sep
Kokanee	PF	26-Aug	10-Sep	27-Sep	3-Aug	24-Aug	14-Sep
Finnberry	PF	26-Aug	10-Sep	27-Sep	16-Aug	27-Aug	15-Sep
ORUS 5467-1	PF	23-Aug	13-Sep	27-Sep	-	-	-
ORUS 4723-2	PF	30-Aug	13-Sep	20-Sep	14-Aug	28-Aug	18-Sep
ORUS 5220-1	PF	30-Aug	13-Sep	20-Sep	3-Aug	24-Aug	14-Sep
ORUS 5227-2	PF	7-Sep	13-Sep	27-Sep	3-Aug	24-Aug	14-Sep
Heritage	PF	7-Sep	16-Sep	27-Sep	14-Aug	27-Aug	11-Sep
ORUS 5332-2	PF	30-Aug	20-Sep	27-Sep	24-Aug	7-Sep	21-Sep
Addison	PF	13-Sep	20-Sep	20-Sep	24-Aug	31-Aug	7-Sep
ORUS 4981-1	PF	27-Sep	27-Sep	27-Sep	-	-	-

[x] Five-year ripening date based on average of plot dates from up to five previous seasons.
[y] FF=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 OSU-NWREC trial plantings in 2022.

Cultivar	5%	50%	95%
*ORUS 4820-1	28-Jun	7-Jul	11-Jul
Munger	7-Jul	7-Jul	18-Jul
*ORUS 3013-1	7-Jul	7-Jul	7-Jul
*ORUS 3217-1	7-Jul	7-Jul	7-Jul
ORUS 5074-1	7-Jul	7-Jul	12-Jul
ORUS 5088-1	7-Jul	7-Jul	18-Jul
ORUS 5090-1	7-Jul	7-Jul	18-Jul
ORUS 5090-2	7-Jul	7-Jul	12-Jul
ORUS 5090-4	7-Jul	7-Jul	18-Jul
ORUS 5091-4	7-Jul	7-Jul	18-Jul
ORUS 5179-1	7-Jul	7-Jul	18-Jul
ORUS 5180-2	7-Jul	7-Jul	18-Jul
ORUS 5182-1	7-Jul	7-Jul	18-Jul
ORUS 5182-2	7-Jul	7-Jul	18-Jul
ORUS 5185-3	7-Jul	7-Jul	18-Jul
ORUS 5186-1	7-Jul	7-Jul	18-Jul
ORUS 5188-1	7-Jul	7-Jul	18-Jul
ORUS 5190-1	7-Jul	7-Jul	18-Jul
ORUS 5192-1	7-Jul	7-Jul	18-Jul
ORUS 5192-2	7-Jul	7-Jul	18-Jul
ORUS 5292-1	7-Jul	7-Jul	18-Jul
ORUS 5302-1	7-Jul	7-Jul	11-Jul
ORUS 5304-2	7-Jul	7-Jul	18-Jul
ORUS 5304-3	7-Jul	7-Jul	18-Jul
ORUS 5308-2	7-Jul	7-Jul	18-Jul
ORUS 4304-136	7-Jul	11-Jul	11-Jul
*ORUS 4833-1	7-Jul	11-Jul	18-Jul
ORUS 5299-1	7-Jul	11-Jul	11-Jul
ORUS 5300-1	7-Jul	11-Jul	11-Jul
ORUS 5304-1	7-Jul	11-Jul	11-Jul
ORUS 5308-1	7-Jul	11-Jul	11-Jul
ORUS 4812-4	7-Jul	12-Jul	18-Jul
ORUS 4828-2	7-Jul	12-Jul	12-Jul
ORUS 4945-3	7-Jul	12-Jul	18-Jul
ORUS 4952-3	7-Jul	12-Jul	18-Jul

ORUS 5088-2	7-Jul	12-Jul	18-Jul
ORUS 5089-1	7-Jul	12-Jul	18-Jul
ORUS 5090-3	7-Jul	12-Jul	18-Jul
ORUS 5091-1	7-Jul	12-Jul	18-Jul
ORUS 5091-2	7-Jul	12-Jul	18-Jul
ORUS 5091-3	7-Jul	12-Jul	18-Jul
ORUS 5091-5	7-Jul	12-Jul	18-Jul
ORUS 5092-1	7-Jul	12-Jul	18-Jul
ORUS 5092-2	7-Jul	12-Jul	18-Jul
ORUS 5092-3	7-Jul	12-Jul	18-Jul
ORUS 5092-5	7-Jul	12-Jul	18-Jul
ORUS 5094-2	7-Jul	12-Jul	18-Jul
ORUS 5176-1	7-Jul	12-Jul	18-Jul
ORUS 5180-1	7-Jul	12-Jul	18-Jul
ORUS 5180-3	7-Jul	12-Jul	18-Jul
ORUS 5185-1	7-Jul	12-Jul	18-Jul
ORUS 5185-2	7-Jul	12-Jul	18-Jul
ORUS 5186-2	7-Jul	12-Jul	18-Jul
ORUS 5186-3	7-Jul	12-Jul	18-Jul
ORUS 5188-2	7-Jul	12-Jul	18-Jul
ORUS 5191-1	7-Jul	12-Jul	18-Jul
ORUS 5075-1	12-Jul	18-Jul	2-Aug

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

The Northwest Berry Foundation
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www.nwberryfoundation.org

Small Fruit Update Progress Report

As of November, 2022

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 SFU, Small Fruit Update, is released via email weekly during the growing season and shifts to bimonthly during the winter months (October – February). There are currently **1,460** subscribers**.** Sixty-nine percent of subscribers are engaged, reading each week.

Peerbolt Crop Management has been providing a weekly emailed Small Fruit Update (SFU) to an increasing number of growers, industry personnel, and researchers since February 2000. Eight years ago, the SFU was taken over by Northwest Berry Foundation. 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.

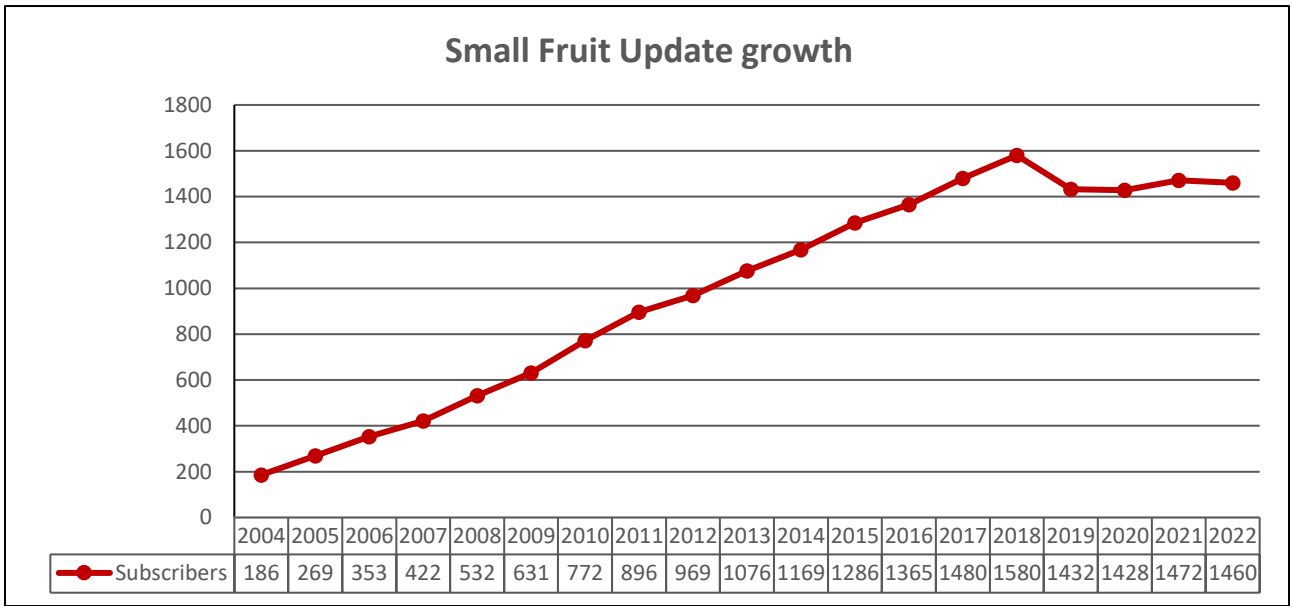
Of the subscribers:

- 238 are in BC, 560 in Oregon, 368 in Washington, and 313 located elsewhere
- 683 are growers, 564 are industry members, and 163 are public researchers
- Of growers who reported what they produce: 261 Blackberry, 570 Blueberry, 213 Strawberries, 298 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.

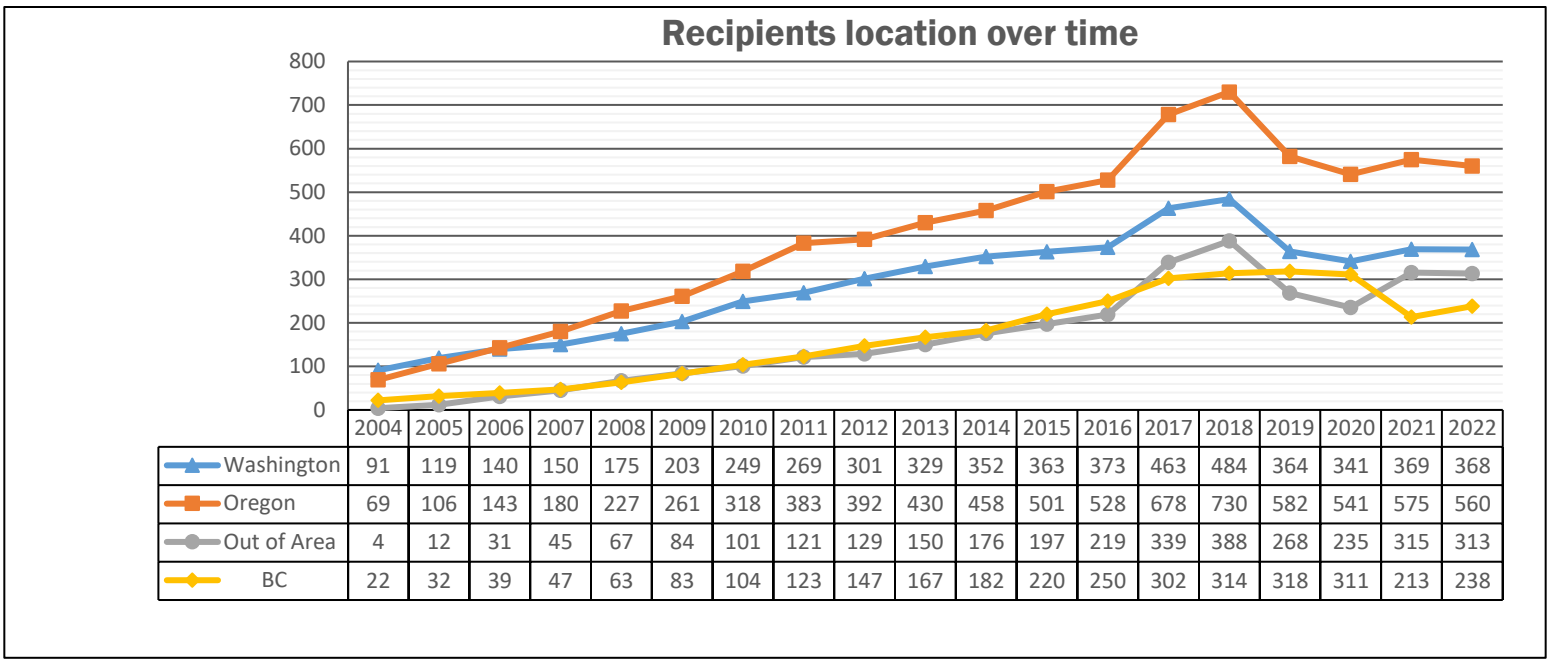
The following charts illustrate the profile of the Small Fruit Update recipients in our database as of the date of this report.

2021 Profile of the Small Fruit Update



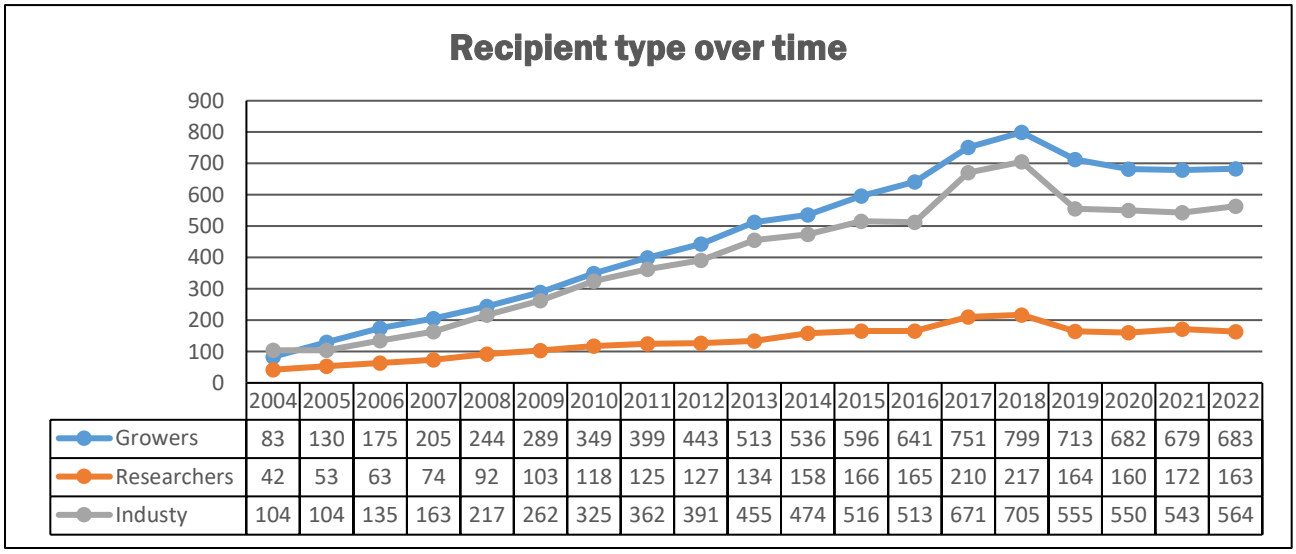
We make every effort to provide you with accurate information. We don't mandate those who sign up for the SFU to give any information beyond their email address, name, address, and phone number. We also request that growers note what crops they grow. Sometimes they do, and sometimes they do not. This 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 increase of 25 recipients in BC and a decrease of 15 in Oregon and one in Washington. The remaining recipients are located throughout the U.S., Canada, and the rest of the world. That segment decreased by two subscribers.



	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Washington	91	119	140	150	175	203	249	269	301	329	352	363	373	463	484	364	341	369	368
Oregon	69	106	143	180	227	261	318	383	392	430	458	501	528	678	730	582	541	575	560
Out of Area	4	12	31	45	67	84	101	121	129	150	176	197	219	339	388	268	235	315	313
BC	22	32	39	47	63	83	104	123	147	167	182	220	250	302	314	318	311	213	238

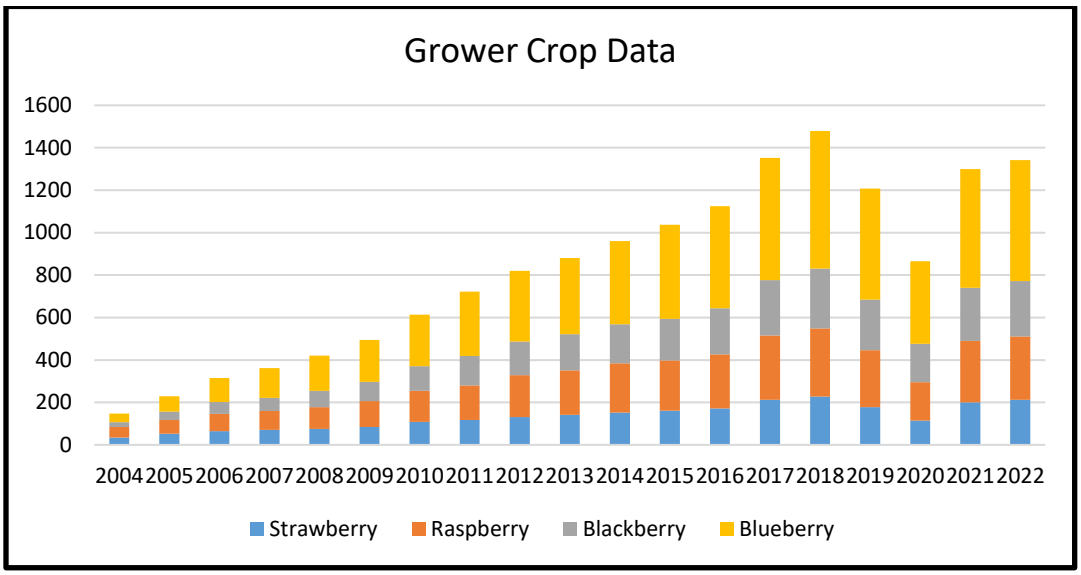
The “Growers” category increased by 4 individual subscribers. The “Researchers” category includes anyone associated with USDA, ARS, a college, or university, as well as state or federal departments of agriculture, and others who work for public agencies. Over the past year, researchers receiving the 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 increased by 21 individual subscribers.



	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Growers	83	130	175	205	244	289	349	399	443	513	536	596	641	751	799	713	682	679	683
Researchers	42	53	63	74	92	103	118	125	127	134	158	166	165	210	217	164	160	172	163
Industy	104	104	135	163	217	262	325	362	391	455	474	516	513	671	705	555	550	543	564

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 increased by 13,

raspberry growers increased by 8, blackberry growers increased by 11, and blueberry growers increased by 10 since 2019.



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 2022, our **followers have increased to 228**. 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 2022, the SFU newsletters shared on Facebook receive up to 722 impressions* and up to 11 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.

Twitter

Beginning in September 2019, a NW Berry Foundation Twitter account (#NWBerryFdn) was established to provide an additional outlet for quickly releasing berry news and the Small Fruit Update. As of November 2022, our followers have **increased to 349 followers, up by 50 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. Twitter impressions* over a period of 90 days range from 192-722 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 2021, our Instagram followers have **increased by 41 people to total 170 followers**. 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 2023

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 267 unsubscribed and 386 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.

47% percent of the SFU 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 2022, we intend to maintain the production of the SFU as is; however, we will have higher emphasis on post **consistency** across platforms, include more *NBF branded content*, project-related content including research (and not just industry or crop announcements), and video content.

RESEARCH REPORT
TO THE
OREGON RASPBERRY AND BLACKBERRY COMMISSION
AND THE
AGRICULTURAL RESEARCH FOUNDATION
2022-2023

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, 2022, through June 30, 2023

Funding Requested for 2022-2023: $ 9793

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 July 5th through September 20th, 2022.

Processing:
During the 2022 season, a total of 16 commercial cultivars, 120 ORUS selections, and 8 WSU selections were processed with multiple harvest dates when appropriate and available. There was a significant increase in selections processed and evaluated in the 2022 season. With plantings of new selections producing fruit, we're seeing many promising new lines coming through the program.

<u>Blackberries</u>
- 10 commercial cultivars
- 54 ORUS selections

Red Raspberry

- 5 commercial cultivars
- 35 ORUS selections
- 8 WSU selections

Black Raspberry

- 1 commercial cultivars
- 31 ORUS Selections

Evaluations:

USDA/OSU Caneberry Research Evaluation – 3/18/22

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.

As things change with the pandemic and opportunities to connect and share space for events we will return to in-person evaluations showing the annual collection of all cultivars and selections for comparison. Dates for this event are forthcoming and will be announced soon.

Chemistry:

Basic chemical analysis was performed for samples collected during the 2022 processing season and the results for those samples are attached in Tables 1-6. (°brix, pH, and TA)

Table 1. Weighted chemistry analysis for 2022 blackberry advanced selections and commercial cultivars

Selection/Cultivar	Planting Year	Titratable Acidity[a]	Soluble Solids[b]	pH
Black Diamond	2018	1.44	11.56	3.44
Black Diamond	2019	1.54	11.76	3.49
Black Diamond	2020	1.62	11.95	3.68
Caddo	2019	1.35	12.03	3.44
Chester Thornless	2018	1.41	10.58	3.21
Chester Thornless	2019	1.34	10.58	3.13
Chester Thornless	2020	1.43	11.58	3.33
Columbia Giant	2020	1.23	12.15	3.60
Columbia Star	2018	-	13.42	3.39
Columbia Star	2019	-	14.23	3.28
Columbia Star	2020	1.65	12.96	3.41
Kotata	2019	1.23	12.33	3.51
Marion	2019	1.65	12.56	3.44
Marion	2020	1.56	12.89	3.25
Prime-Ark 45	2018	1.14	16.09	3.74
Prime-Ark 45	2019	0.86	14.87	3.49
Prime-Ark 45	2020	0.54	16.68	3.64
Triple Crown	2018	1.17	13.72	3.36
Triple Crown	2019	1.41	14.15	3.37
Triple Crown	2020	0.85	15.16	3.64
ORUS 4222-1	2019	1.61	12.59	3.36
ORUS 4273-2	2018	1.03	12.13	3.66
ORUS 4344-3	2018	1.13	12.17	3.67
ORUS 4453-1	2018	1.28	14.61	3.43
ORUS 4535-2	2019	2.07	14.05	3.19
ORUS 4663-4	2020	1.68	10.41	3.24
ORUS 4670-1	2020	1.14	14.24	3.51
ORUS 4762-1	2020	2.09	11.95	3.23
ORUS 4767-1	2020	1.39	11.58	3.58
ORUS 4892-1	2018	1.32	12.13	3.74
ORUS 4892-2	2018	1.13	12.06	3.81
ORUS 4902-1	2019	-	16.37	3.44
ORUS 4999-2	2019	0.74	13.10	4.00
ORUS 4999-2	2020	0.68	13.47	3.99
ORUS 5010-1	2019	-	16.23	3.06
ORUS 5014-1	2019	1.64	12.31	3.26
ORUS 5016-1	2020	1.49	11.35	3.46
ORUS 5023-1	2019	0.89	14.96	4.05
ORUS 5023-2	2019	1.18	15.82	3.60
ORUS 5031-1	2019	1.49	15.66	3.56
ORUS 5037-1	2019	1.48	13.73	3.38
ORUS 5037-2	2019	1.42	13.93	3.80
ORUS 5041-1	2020	1.24	13.14	3.73
ORUS 5041-2	2020	1.68	13.42	3.29

ORUS 5049-1	2019	1.09	11.09	3.42
ORUS 5056-2	2019	1.53	11.40	3.27
ORUS 5057-1	2019	1.00	11.80	3.69
ORUS 5058-2	2019	1.67	13.93	3.30
ORUS 5067-1	2019	1.35	13.70	3.62
ORUS 5068-3	2018	0.71	17.33	3.91
ORUS 5068-5	2018	0.99	13.52	3.85
ORUS 5069-1	2018	0.49	15.75	3.91
ORUS 5127-1	2020	1.40	12.41	3.38
ORUS 5129-1	2020	1.81	13.15	3.31
ORUS 5129-2	2020	1.28	14.63	3.68
ORUS 5132-1	2020	1.69	12.64	3.51
ORUS 5133-1	2020	1.21	12.96	3.61
ORUS 5133-2	2020	1.57	12.03	3.41
ORUS 5148-2	2020	1.48	10.64	3.29
ORUS 5161-1	2020	1.20	15.87	3.74
ORUS 5163-1	2020	1.39	15.03	3.86
ORUS 5163-2	2020	1.03	11.70	3.67
ORUS 5165-1	2020	0.74	15.27	4.06
ORUS 5168-1	2020	0.57	13.55	3.88
ORUS 5168-2	2020	0.96	17.18	3.71
ORUS 5174-2	2019	0.88	14.35	3.70

Note: All reported values are weighted averages based on the number of harvests and samples tested.

[a] g citric acid/100g fruit

[b] ^{o}Brix

Table 2. Chemistry analysis for 2022 blackberry advanced selections and commercial cultivars by harvest date

Selection/Cultivar	Planting Year	Harvest Date	Titratable Acidity[a]	Soluble Solids[b]	pH
Black Diamond	2018	7/12/2022	1.44	11.56	3.44
Black Diamond	2019	7/12/2022	1.49	12.71	3.64
Black Diamond	2019	7/19/2022	1.57	11.16	3.40
Black Diamond	2020	7/12/2022	1.51	12.43	3.72
Black Diamond	2020	7/19/2022	1.70	11.64	3.66
Caddo	2019	7/26/2022	1.35	12.03	3.44
Chester Thornless	2018	8/16/2022	-	10.70	3.26
Chester Thornless	2018	8/23/2022	1.41	10.48	3.16
Chester Thornless	2019	8/23/2022	1.34	10.58	3.13
Chester Thornless	2020	8/16/2022	1.39	11.88	3.40
Chester Thornless	2020	8/23/2022	1.47	11.27	3.26
Columbia Giant	2020	7/12/2022	1.23	12.15	3.60
Columbia Star	2018	7/12/2022	-	13.42	3.39
Columbia Star	2019	7/12/2022	-	13.82	3.32
Columbia Star	2019	7/19/2022	-	14.68	3.23
Columbia Star	2020	7/12/2022	1.75	12.99	3.49
Columbia Star	2020	7/19/2022	1.55	12.92	3.33
Kotata	2019	7/19/2022	1.23	12.33	3.51
Marion	2019	7/12/2022	2.16	13.75	3.24
Marion	2019	7/19/2022	1.34	11.86	3.56
Marion	2020	7/12/2022	1.80	13.12	3.15
Marion	2020	7/19/2022	1.40	12.74	3.33
Prime-Ark 45	2018	9/7/2022	1.14	16.09	3.74
Prime-Ark 45	2019	9/7/2022	0.93	15.40	3.76
Prime-Ark 45	2019	9/13/2022	0.83	14.63	3.38
Prime-Ark 45	2020	9/13/2022	0.54	16.68	3.64
Triple Crown	2018	8/23/2022	1.17	13.72	3.36
Triple Crown	2019	8/9/2022	1.20	13.88	3.36
Triple Crown	2019	8/16/2022	1.60	14.41	3.39
Triple Crown	2020	8/9/2022	0.85	15.16	3.64
ORUS 4222-1	2019	7/19/2022	1.59	13.25	3.46
ORUS 4222-1	2019	7/26/2022	1.64	11.80	3.24
ORUS 4273-2	2018	7/26/2022	0.91	12.57	3.71
ORUS 4273-2	2018	8/2/2022	1.11	11.82	3.62
ORUS 4344-3	2018	7/19/2022	1.37	12.17	3.63
ORUS 4344-3	2018	7/26/2022	0.76	12.17	3.74
ORUS 4453-1	2018	8/2/2022	1.28	14.61	3.43
ORUS 4535-2	2019	7/19/2022	2.08	13.61	3.14
ORUS 4535-2	2019	7/26/2022	2.07	14.84	3.27
ORUS 4663-4	2020	7/12/2022	1.99	11.55	3.30
ORUS 4663-4	2020	7/19/2022	1.54	9.90	3.21
ORUS 4670-1	2020	8/9/2022	1.14	14.24	3.51
ORUS 4762-1	2020	7/19/2022	2.09	11.95	3.23
ORUS 4767-1	2020	7/5/2022	1.39	11.84	3.45
ORUS 4767-1	2020	7/12/2022	1.39	11.51	3.62

ORUS 4767-1	2020	7/19/2022	1.30	10.63	3.60
ORUS 4892-1	2018	7/5/2022	1.31	11.80	3.63
ORUS 4892-1	2018	7/12/2022	1.33	12.32	3.81
ORUS 4892-2	2018	7/12/2022	1.17	12.18	3.88
ORUS 4892-2	2018	7/26/2022	1.08	11.93	3.74
ORUS 4902-1	2019	7/19/2022	-	16.37	3.44
ORUS 4999-2	2019	8/30/2022	0.79	13.39	3.99
ORUS 4999-2	2019	9/7/2022	0.71	12.90	4.01
ORUS 4999-2	2020	8/30/2022	0.83	12.99	3.98
ORUS 4999-2	2020	9/7/2022	0.60	13.73	4.01
ORUS 5010-1	2019	7/19/2022	-	16.23	3.06
ORUS 5014-1	2019	7/19/2022	1.67	13.20	3.30
ORUS 5014-1	2019	7/26/2022	1.63	11.78	3.25
ORUS 5016-1	2020	7/12/2022	1.59	11.17	3.49
ORUS 5016-1	2020	7/19/2022	1.40	11.54	3.43
ORUS 5023-1	2019	7/12/2022	0.89	14.96	4.05
ORUS 5023-2	2019	7/19/2022	1.18	15.82	3.60
ORUS 5031-1	2019	7/12/2022	1.61	15.91	3.51
ORUS 5031-1	2019	7/19/2022	1.38	15.41	3.61
ORUS 5037-1	2019	7/19/2022	1.72	14.05	3.36
ORUS 5037-1	2019	7/26/2022	1.26	13.45	3.41
ORUS 5037-2	2019	7/12/2022	1.42	13.93	3.80
ORUS 5041-1	2020	7/12/2022	1.11	12.75	3.84
ORUS 5041-1	2020	7/19/2022	1.42	13.71	3.56
ORUS 5041-2	2020	7/19/2022	1.68	13.42	3.29
ORUS 5049-1	2019	8/2/2022	1.09	11.09	3.42
ORUS 5056-2	2019	7/26/2022	1.45	11.93	3.22
ORUS 5056-2	2019	8/2/2022	1.58	11.07	3.31
ORUS 5057-1	2019	8/2/2022	0.75	11.76	3.83
ORUS 5057-1	2019	8/16/2022	1.39	11.85	3.47
ORUS 5058-2	2019	8/9/2022	1.67	13.93	3.30
ORUS 5067-1	2019	8/2/2022	1.35	13.70	3.62
ORUS 5068-3	2018	9/7/2022	0.71	17.33	3.91
ORUS 5068-5	2018	8/30/2022	1.35	12.13	3.65
ORUS 5068-5	2018	9/7/2022	0.54	15.28	4.11
ORUS 5069-1	2018	9/7/2022	0.45	15.76	3.92
ORUS 5069-1	2018	9/13/2022	0.54	15.72	3.89
ORUS 5127-1	2020	7/19/2022	1.48	11.92	3.33
ORUS 5127-1	2020	7/26/2022	1.33	12.83	3.43
ORUS 5129-1	2020	7/12/2022	-	12.67	3.32
ORUS 5129-1	2020	7/19/2022	1.81	14.09	3.28
ORUS 5129-2	2020	7/19/2022	1.33	14.65	3.66
ORUS 5129-2	2020	7/26/2022	1.23	14.61	3.69
ORUS 5132-1	2020	7/19/2022	1.69	12.64	3.51
ORUS 5133-1	2020	7/5/2022	1.17	13.17	3.63
ORUS 5133-1	2020	7/12/2022	1.25	12.74	3.60
ORUS 5133-2	2020	7/5/2022	1.82	11.26	3.24

ORUS 5133-2	2020	7/12/2022	1.37	12.64	3.55
ORUS 5148-2	2020	7/26/2022	1.90	10.95	3.23
ORUS 5148-2	2020	8/2/2022	1.22	10.45	3.33
ORUS 5161-1	2020	7/26/2022	1.20	15.87	3.74
ORUS 5163-1	2020	8/9/2022	1.39	15.03	3.86
ORUS 5163-2	2020	8/2/2022	1.10	11.49	3.70
ORUS 5163-2	2020	8/9/2022	0.85	12.21	3.60
ORUS 5165-1	2020	7/26/2022	0.78	14.99	4.08
ORUS 5165-1	2020	8/9/2022	0.69	15.58	4.03
ORUS 5168-1	2020	8/2/2022	0.65	13.70	3.90
ORUS 5168-1	2020	8/9/2022	0.52	13.44	3.86
ORUS 5168-2	2020	8/9/2022	0.96	17.18	3.71
ORUS 5174-2	2019	8/23/2022	0.77	14.80	3.63
ORUS 5174-2	2019	8/30/2022	0.97	14.00	3.75

[a] g citric acid/100g fruit

[b] ^{o}Brix

Table 3. Weighted chemistry analysis for 2022 red raspberry advanced selections and commercial cultivars

Selection/Cultivar	Planting Year	Titratable Acidity[a]	Soluble Solids[b]	pH
Heritage	2019	2.11	12.70	3.16
Kokanee	2019	1.74	13.66	3.71
Meeker	2019	2.14	11.92	3.61
Meeker	2020	1.45	13.44	3.44
ORUS 4600-1	2020	1.35	11.84	3.71
ORUS 4715-2	2019	1.93	10.14	3.49
ORUS 4716-1	2020	2.03	11.59	3.25
ORUS 4725-1	2019	1.72	13.86	3.33
ORUS 4858-2	2019	-	14.25	3.76
ORUS 4974-1	2019	1.82	10.26	3.48
ORUS 5106-1	2019	2.12	10.24	3.37
ORUS 5195-2	2020	1.44	11.64	3.73
ORUS 5199-1	2020	1.92	12.24	3.22
ORUS 5206-2	2020	1.80	12.94	3.36
ORUS 5209-1	2019	1.17	14.63	3.69
ORUS 5220-1	2019	1.39	15.08	4.01
ORUS 5248-1	2019	1.60	11.54	3.38
ORUS 5250-1	2019	1.67	10.39	3.33
ORUS 5465-2	2020	1.52	13.01	3.50
ORUS 5467-1	2021	-	13.28	4.47
ORUS 5467-2	2020	1.66	16.68	3.66
WSU 2069	2020	2.26	11.48	3.42
WSU 2472	2020	1.72	9.95	3.58
WSU 2481	2020	2.70	11.69	3.35
WSU 2516	2019	1.52	11.43	3.66

Note: All reported values are weighted averages based on the number of harvests and samples tested.

[a] g citric acid/100g fruit

[b] ^{o}Brix

Table 4. Chemistry analysis for 2022 red raspberry advanced selections and commercial cultivars by harvest date

Selection/Cultivar	Planting Year	Harvest Date	Titratable Acidity[a]	Soluble Solids[b]	pH
Heritage	2019	9/13/2022	2.11	12.70	3.16
Kokanee	2019	8/30/2022	1.74	13.66	3.71
Meeker	2019	7/12/2022	2.14	11.00	3.62
Meeker	2019	7/19/2022	-	12.64	3.61
Meeker	2020	7/19/2022	1.45	13.44	3.44
ORUS 4600-1	2020	7/19/2022	1.35	11.84	3.71
ORUS 4715-2	2019	7/12/2022	1.93	10.14	3.49
ORUS 4716-1	2020	8/30/2022	1.99	11.23	3.29
ORUS 4716-1	2020	9/13/2022	2.06	11.91	3.22
ORUS 4725-1	2019	8/16/2022	1.58	13.67	3.41
ORUS 4725-1	2019	8/23/2022	1.83	14.00	3.28
ORUS 4725-1	2019	8/30/2022	1.42	14.65	3.41
ORUS 4858-2	2019	8/30/2022	-	14.25	3.76
ORUS 4974-1	2019	7/12/2022	1.83	9.68	3.47
ORUS 4974-1	2019	7/19/2022	1.80	11.30	3.51
ORUS 5106-1	2019	7/12/2022	2.12	10.24	3.37
ORUS 5195-2	2020	7/12/2022	1.53	11.06	3.73
ORUS 5195-2	2020	7/19/2022	1.28	12.67	3.74
ORUS 5199-1	2020	7/12/2022	1.92	12.24	3.22
ORUS 5206-2	2020	7/12/2022	1.80	12.94	3.36
ORUS 5209-1	2019	8/23/2022	1.17	14.54	3.61
ORUS 5209-1	2019	8/30/2022	-	14.72	3.77
ORUS 5220-1	2019	9/7/2022	1.39	15.08	4.01
ORUS 5248-1	2019	8/16/2022	1.56	11.87	3.52
ORUS 5248-1	2019	8/23/2022	1.63	11.28	3.27
ORUS 5248-1	2019	8/30/2022	1.70	13.04	3.70
ORUS 5250-1	2019	8/9/2022	1.84	9.84	3.24
ORUS 5250-1	2019	8/16/2022	1.56	10.71	3.39
ORUS 5465-2	2020	9/13/2022	1.52	13.01	3.50
ORUS 5467-1	2021	9/7/2022	-	13.28	4.47
ORUS 5467-2	2020	9/7/2022	1.66	16.68	3.66
WSU 2069	2020	7/12/2022		10.84	3.45
WSU 2069	2020	7/19/2022	2.26	12.35	3.37
WSU 2472	2020	7/12/2022	1.72	9.95	3.58
WSU 2481	2020	7/12/2022	2.70	11.69	3.35
WSU 2516	2019	7/19/2022	1.52	11.43	3.66

[a] g citric acid/100g fruit

[b] ^{o}Brix

Table 5. Weighted chemistry analysis for 2022 black raspberry advanced selections and commercial cultivars

Selection/Cultivar	Planting Year	Titratable Acidity[a]	Soluble Solids[b]	pH
Munger	2019	0.89	11.50	4.10
Munger	2020	0.85	11.66	4.01
ORUS 4820-1	2020	0.90	11.29	4.07
ORUS 5092-4	2019	0.86	12.38	4.11
ORUS 5186-1	2019	0.79	12.87	4.26
ORUS 5190-1	2019	0.86	13.12	4.30
ORUS 5302-1	2020	0.89	13.98	4.11
ORUS 5308-2	2020	0.95	12.28	4.00

Note: All reported values are weighted averages based on the number of harvests and samples tested.

[a] g citric acid/100g fruit

[b] ^{o}Brix

Table 6. Chemistry analysis for 2022 black raspberry advanced selections and commercial cultivars by harvest date

Selection/Cultivar	Planting Year	Harvest Date	Titratable Acidity[a]	Soluble Solids[b]	pH
Munger	2019	7/7/2022	0.89	11.50	4.10
Munger	2020	7/7/2022	0.85	10.95	4.02
Munger	2020	7/12/2022	-	13.52	3.99
ORUS 4820-1	2020	7/7/2022	0.90	11.29	4.07
ORUS 5092-4	2019	7/7/2022	0.86	12.38	4.11
ORUS 5186-1	2019	7/7/2022	0.79	12.87	4.26
ORUS 5190-1	2019	7/7/2022	0.86	13.12	4.30
ORUS 5302-1	2020	7/7/2022	0.89	12.11	4.09
ORUS 5302-1	2020	7/12/2022	-	17.19	4.15
ORUS 5308-2	2020	7/7/2022	0.95	10.97	4.06
ORUS 5308-2	2020	7/12/2022	-	14.50	3.90

[a] g citric acid/100g fruit

[b] ^{o}Brix