FINAL PROJECT REPORT

Project Title: Streamlining the Pacific Northwest sweet cherry breeding program

PI: Cameron Peace
Organization: WSU-Horticulture
Telephone: 509 335 6899
Email: cpeace@wsu.edu
Address: Dept. of Horticulture
City/State/Zip: Pullman/WA/99164

Co-PI (2): Bernardita Sallato
Organization: WSU-Horticulture
Telephone: 509 439 8542
Email: b.sallatocarmona@wsu.edu
Address: 24106 N. Bunn Rd.
City/State/Zip: Prosser/WA/99350

Cooperators: WSU Cherry Breeding Program Advisory Committee (BPAC), OSU-MCAREC

Total Project Request: **Year 1:** $150,000

Budget 1
Organization Name: Washington State University
Telephone: (509) 335 4564
Contract Administrator: Carrie Johnston
Email address: carriej@wsu.edu

Item	2017
Salaries	27,000
Benefits	8,964
Wages	29,370
Benefits	6,168
Fruit lab supplies & maintenance	2,367
Field supplies & maintenance	32,350
Analytical services	10,000
Travel	4,031
Plot fee	4,750
Total	125,000

Budget 2
Organization Name: OSU-MCAREC
Telephone: (541) 737 3228
Contract Administrator: Russell Karow
Email address: Russell.Karow@oregonstate.edu

Item	2017
Salaries	4,357
Benefits	3,006
Wages	13,000
Benefits	333
Equipment	
Fees and Supplies	4,304
Travel	
Miscellaneous	
Total	25,000

OBJECTIVES

Overall goal

Create a robust foundation for Pacific Northwest sweet cherry breeding within an objective, resource-driven, protocol-based framework that quantitatively targets industry priorities.

Specific objectives

1) Establish and deploy a robust **horticultural management** system that efficiently raises and maintains **healthy plant materials** at all breeding stages

2) Establish and deploy a robust **performance evaluation** system that effectively targets the **Early and Late Mahogany market classes**

SIGNIFICANT FINDINGS

- Much streamlining of the breeding orchard and activities was achieved, and evaluation of breeding germplasm identified and confirmed the most promising material.

- The breeding orchard's physical footprint was significantly reduced, with removal of 10 acres (45% of total), ~3500 Phase 1 trees (50% of total), 11 Phase 2 selections no longer to be considered, and two acres (30%) of parent blocks – totaling an estimated $36,000 in annual maintenance and evaluation costs.

- The breeding orchard condition was improved and maintained by applying best horticultural management practices and diligent observation throughout the season.

- Virus identification led to removal of two advanced selections and prompted evaluation of alternative strategies to efficiently detect and deal with virus presence in breeding trees

- Several promising Phase 2 selections stood out in 2017 evaluations: R1, R3, R17, R19, and especially R29. R29 was large, firm, sweet, and had good storability, but low acidity.

- In Phase 1, 13% of ~700 fruiting seedlings were considered worthwhile for lab-based fruit quality evaluation (77% mahogany-type and 23% blush-type). Two promising seedling in previous years continued to stand out, and should receive extra attention in 2018.

- The PNW sweet cherry breeding program is in good shape for a new permanent breeder

RESULTS & DISCUSSION

Objective 1: Establish and deploy a robust **horticultural management** system that efficiently raises and maintains **healthy plant materials** at all breeding stages

1a: Reduce physical footprint
The physical footprint across Phase 2, Phase 1, and Parent blocks was significantly decreased, capping previously escalating costs and dilution of attention. In total, 10 acres of trees were removed

in 2017 (8 acres of Phase 1 F block and 2 acres of parent blocks), 3560 Phase 1 trees were removed (~3000 of F block and ~560 in C block), and 11 selections in Phase 2 were removed from ongoing consideration. These reductions eliminate $36,000 from ongoing orchard maintenance costs and evaluation, and provide greater efficiencies in allocation of breeding attention. Details for each level of breeding germplasm are described below.

- Phase 2: The WSU team with BPAC advice discarded nine advanced selections (out of a total of 24 going into 2017) considered not promising enough in fruit quality and/or productivity or that exhibited fatal flaws, according to established PNW industry needs and priorities. Trees of these nine discarded selections (R2, R4, R7B, R8, R9B, R13, R14, R15, and R25, where "B" specifies blush-type) were not physically removed from the block, to avoid spacing disturbance and to re-utilize clean existing trees as rootstocks for future advanced material. Two further advanced selections had to be removed due to virus (PDV) presence (R18B at Prosser and R24 at Prosser and Pasco).

- Phase 1: The complete F block (8 acres, 3176 seedlings) was removed in March, removing 45% in acreage and 50% in tree number of the Phase 1 physical footprint. This provides a reduction of $32,000 in what would have been additional orchard maintenance costs. In the remaining C block of seedlings, we identified unwanted trees (redundant, weak, virus-infected, consistent poor fruit quality, fatal flaws, etc.) using 2015 and 2016 phenotypic data and health assessments. These unwanted trees were removed between May and August. This thinning of approximately every second tree in the first nine rows of C block removed a total of 560 trees, which was 28% of Phase 1 seedlings in C block, and resulted in improved health and evaluation efficiency of remaining trees.

- Parents: Two inefficient blocks of trees being maintained in past years as parents (totaling 2 acres, 30% of acreage of parent trees) will be removed by the end of the year. This planned removal was the result of identification of redundant trees concentrated in the two blocks, with very few non-redundant potential parents within. Parents that were considered valuable to retain within these to-be-removed blocks were tested for viruses. Two out of 13 parents tested were positive to PDV and were discarded (BB and HH). Clean material was collected and propagated into virus-free rootstock (Gisela 6). The propagation procedure and clean rootstocks were generously provided by Scott Harper, Director of the Clean Plant Center, and propagated trees are currently being maintained at the PNW Clean Plant Center in Prosser.

1b: Renew and protect the parent block

In 2017, we did not propagate a select set of parents for future crossings due to a lack of virus-free rootstocks available this year and the fact that the hiring of a cherry breeder was approved for early 2018. The decisions of whether and how to establish a protected parent block are therefore left to the new breeder. Instead, valuable information is being obtained on the available parents to support the breeders' decisions: virus status and genetic contributions to the next generation according to DNA profile. Maps of parent block trees were also updated.

- Virus status: Tissue samples from one tree of each replicated parent in the main parent block (B53) were collected and are currently being tested efficiently for PDV and PNRSV viruses using the grafting technique of bud chips into a *Prunus tomentosa* indicator. The procedure and resources were generously provided by Dr. Lauri Guerra, WSDA plant pathologist. Results are expected by the end of this year. This procedure is expected to reduce greatly the number of samples to be subsequently evaluated for other viruses.

- DNA profiles: Leaf samples were obtained for each parent (as well as all current P2 and P1.5 selections, which are also potential parents) for whole-genome DNA profiling supported by the RosBREED project. For this DNA profiling, an expanded genome-scanning tool was developed in the RosBREED project in 2017, with the first data on cherry breeding individuals expected to arrive in November. (The resulting descriptions of genetic potential will be described as "genomic predictions" as well as visualized as "haplotype mosaics" that show ancestry and valuable genetic factors across the chromosomes of each individual, to be available for the new breeder.)

1c: Horticultural management

Horticultural practices were constantly improved and supervised during 2017. Some of the incorporated practices during 2017 were:

- Pruning, training, and tree thinning: Because of observations of excessive shading and blind wood, trees in the first nine rows of C-block Phase 1 seedlings were pruned in early spring to modify the current training system. Also, about half the trees in these rows were removed (as described above in *Reduced physical footprint: Phase 1*). Light penetration into the block was greatly improved. Trees have been lowered in size which improved efficiency of orchard activities such as sprays and harvest. Following the heavy pruning in spring, trees were summer-pruned to improve architecture and encourage fruiting wood for subsequent seasons (Figure 1).

- Irrigation: Using the irrigation scheduler software developed by WSU and with guidance from Troy Peters, WSU specialist, we modified the irrigation programing according to soil type, irrigation system, and water-withholding capacity of each area. Continued irrigation monitoring led to removal of an additional drip line in a shallow row of the Roza Phase 2 block, improving tree health. The irrigation system in C block was also modified from spaghetti tube irrigation to sprinklers to allow establishment of a cover crop next season and improve root lateral growth.

- Nutrient management: Standard soil and foliage analyses were developed for nutrient diagnostics in the breeding orchard. The subsequent fertilization program was based on tree demand and soil supply. The biggest challenge has been to manage soil and root growth variability across C block of Phase 1 seedlings.

- Disease management: Standard pest management practices were conducted by the Roza orchard crew starting on March 30. Only the P2 selection block received treatment to control powdery mildew (PM). Other blocks were not controlled for PM because evaluation of PM resistance/susceptibility is required for Phase 1 seedlings and was also being evaluated in 2017 in a parallel project in the genetic stock C53 block and parents. Dr. Claudia Probst, WSU pathologist, reported the first signs of PM in the second week of June. The high pressure observed during the 2017 season enabled an efficient and accurate evaluation of foliar susceptibility and some evaluation of fruit susceptibility in Phase 1. To reduce the detrimental pressure on vegetative growth and fruit quality for next year, we used a fall control spray. Aaron Avila, G.S. Long, generously provided product and advice for this fall application.

- Virus control and monitoring: In collaboration with members of the Clean Plant Center and WSDA experts, blocks were monitored starting in April for identification of virus-related symptoms. In Phase 2 blocks, we evaluated all trees of all selections and standard cultivars for PNRSV and PDV. Two selections showed virus symptoms and tested positive to PDV: R18B and R24B. These selections were immediately removed. To avoid such wasteful elimination of Phase 2 selections and to maintain orchard health, for future years we propose routine, random virus-testing of 20% of seedlings.

Figure 1. Pruning, training, and tree thinning in Phase 1. Top: Seedlings before (left) and after (right) spring pruning. Bottom: summer pruning in C52 block.

- Propagation: Two previously advanced selections, propagated by Willow Drive Nursery, were planted in the Phase 2 block at Roza (B48) in April: R29 and R45. For other material, a different propagation system was used. To ensure we efficiently retain good performers and potential parents, we trialed the method of grafting into existing established trees that are otherwise discarded. Two sets of the most promising Phase 1 F-block seedlings from 2015 and 2016 evaluations, as described in last year's report, were propagated in this manner. The first set (new R46–R51 selections: 3x Early Mahogany, 3x Late Mahogany) were grafted onto trees of previously discarded selections in the B48 Phase 2 block. The second set (potential new parents) were grafted onto some scaffolds of other parent trees on the edge of the genetic stock block (C53). The grafting service was generously donated to the breeding program by Mike Argo Grafting. The method showed great success in terms of tree growth and propagation efficiency. We will monitor effects on precocity and fruit quality to inform a cost:benefit consideration of this propagation method as a standard practice.

Because of strong pressure applied for PM, foliar PM-resistant seedlings were readily distinguished from susceptible ones (Figure 2). Some seedlings susceptible to fruit PM were also able to be detected, although absence of fruit infection did not mean resistance because fruit incidence was much lower across the block than foliar incidence.

Figure 2. Seedlings new shoot with evident foliar PM resistance CR11T64 (left) and a neighboring tree susceptible to PM, CR11T63 (right).

Activity 2: Establish and deploy a robust **performance evaluation** system that effectively targets the **Early and Late Mahogany market classes**

2a: Performance evaluation
A streamlined protocol was used for performance evaluations efficiently targeting industry priority traits. Activities were synchronized across all locations, including full bloom timing observation, green fruit thinning, netting, and fruit quality evaluation at harvest and post-storage. In-field Phase 1and Phase 2 evaluations were conducted at a minimum of twice per week throughout the harvest season. At least once per week we walked the blocks with BPAC members and other industry visitors. Special emphasis was placed on flavor and overall appreciation of the fruit of selections and promising seedlings, for which was incorporated a weekly evaluation by BPAC members and collaborators.

Phase 2
Overview
Several promising Phase 2 selections stood out in 2017 evaluations: R1, R3, R17, R19, and especially R29. R19 is Early Mahogany, four days after Chelan and 10 days before Bing in both 2016 and 2017, while the other four selections are Mid-season Mahogany from approximately one week before to four days after Bing timing. R19 and R29 were evaluated for the first time in Phase 2 this year and only in Pasco. R29 was the most exceptional selection (large, firm, sweet, and good storability, but low acidity).

A total of 12 selections were evaluated in Phase 2 in 2017. These selections consisted of one Early Mahogany (EM – R19), two Early Blush (EB – R16B, R28B), four Mid-season Mahogany (MM – R1, R3, R17, R29), one mid-to-late Mahogany depending on location (MM/LM – R6), and four Late Blush (LB – R5B, R10B, R11B, R12B). The number of selections evaluated at each Phase 2 trial location (Prosser, Pasco, and Hood River) was reduced by at least 40% compared to 2016. Nine selections were evaluated at Prosser, five at Pasco, and four at Hood River, along with the standard cultivars of Chelan (Prosser, Pasco), Early Robin (all locations), Bing (Prosser, Pasco), Rainier (Prosser, Hood River), and Sweetheart (all locations).

Phenology

Starting the season, phenological development from bud break to green fruit was recorded for every advanced selection at the three locations. Bloom time in Pasco occurred April 13 to 25. Maximal temperatures during bloom were between 55 and 65 º F and the accumulated degree days (base 50 ºF) were between 24 and 38. Similar observations were made at Prosser a week later, where bloom was spread from April 17 to May 2, maximal temperatures were 55–65º F, and accumulated degree days were 24–44. In Hood River, the bloom time was April 20–28, with temperatures of 42–47 º F. These cooler conditions during bloom at Hood River compared to 2016 permitted an extended bloom period that overlapped among selections. At all sites, the standard cultivar Chelan was the first to bloom, followed a couple of days later by Early Robin, Rainier, R1, R3, and R11B. Five days after Chelan were Bing, Selah, Sweetheart, and the selections R16B and R6. The later selections to bloom were R10B a couple of days after Bing and R5B and R12B 4–5 days after Bing. In Pasco, we were able to evaluate for the first time the selections R19, R21B, R24B, R28B, and R29. The selection R28B bloomed at the same time as Chelan and selections R10B, R21B, and R24B three days later. The mahogany R29 had its full bloom at the same time as Bing and R19 was the last to reach full bloom, 4 days later.

Four weeks after bloom, trees were thinned to 30 fruit per foot of fruiting wood and all selections were rated for crop load levels, doubles, and other observed defects. The selections R3, R6, and R10B had high crops, equivalent to Sweetheart, Bing, and Chelan, so they all needed intense thinning. The selections R1 and R17 were the opposite, with low crops and no need to thin, equivalent to Early Robin. This season, only Early Robin and Sweetheart (and no selections) showed some doubles, but in both cases it was below 5%.

At the onset of harvest, we recognized a lack of objective indicators to guide the assessment of an adequate harvest date for each selection. In contrast with standard cultivars for which we have expectations of fruit size, sweetness, acidity, and color, such parameters for advanced selections (and seedlings) have not yet been established and this could lead to mistakes in harvest timing. To mitigate this uncertainty, we performed multiple harvest times and used the resulting fruit quality data to attempt to characterize each selection for fruit maturity. This information will serve as a guide for future accurate evaluations and more accurate allocation to market class.

At the Roza orchard in Prosser we recorded only one rain event of 0.11 inches within 14 days of harvest. However, we did not observe cracking issues in any current Phase 2 selections. Nevertheless, the already-discarded selection R4 had > 90% cracking (and had 100% cracking on 2016).

Performance

All fruit of Phase 2 selections were evaluated for fruit size, firmness, soluble solids content (SSC), titratable acidity (TA), and general sensory flavor, with target trait thresholds of row 10 size, 10 g weight, and 300g/mm firmness for early and late-season selections, and better than 9.0 row and more than 11 g weight for mid-season selections. For those selections with enough fruit, additional evaluations were performed for pedicel-fruit retention force (PFRF) and post-storage performance (after three weeks of regular-atmosphere cold storage: firmness, SSC, TA, luster, pitting, shrivel, and stem browning).

Selections R1, R3, R17, and R29 had better performance in several aspects of harvest fruit quality and post-storage condition than the standard Bing in Prosser and Pasco (Tables 1–4), although R17 was only grown in Prosser and R29 was only evaluated in Pasco. The selections R1 and R3 were reclassified from Early Mahogany to Mid-season Mahogany because at Prosser they were harvested on the same day as Bing.

Table 1. Harvest performance of Phase 2 selections at Prosser in 2017 (averaged over five trees). Values in shaded boxes are better than standards. Values in parentheses are well below those of standards and below thresholds.

Selection or standard cultivar	Market class	Harvest date	Harvest date vs. Bing (days)	Fruit Wt. (g)	Fruit row size	Fruit width (mm)	Fruit firmness (g/mm)	Skin color (1-7)	Juice SSC (ºBrix)	Juice TA (%)
Chelan	EM	20-Jun	-7	7.7	11.2	24.3	303	6.0	20.3	0.92
Early Robin	EM	21-Jun	-6	11.5	9.6	28.6	401	B	20.3	0.57
R16B	EB	22-Jun	-5	10.6	10.0	27.3	313	B	19.6	0.89
Bing	MM	27-Jun		8.2	10.7	25.6	261	5.2	23.6	0.96
R3	MM	27-Jun	0	9.5	10.2	26.8	315	5.9	21.7	0.74
R1	MM	27-Jun	0	11.4	9.6	28.6	298	5.3	24.1	1.13
R17	MM	27-Jun	0	9.7	10.2	26.8	315	5.1	22.8	0.89
Rainier	LB	27-Jun	0	7.7	10.7	25.7	260	B	25.1	0.73
R5B	LB	3-Jul	+6	8.3	11.2	24.2	281	B	(19.2)	1.03
R10B	LB	7-Jul	+10	12.4	9.8	28.1	(226)	B	25.7	0.77
R11B	LB	7-Jul	+10	(6.7)	11.0	24.7	300	B	23.4	1.14
R12B	LB	7-Jul	+10	9.8	10.4	26.5	251	B	24.6	0.92
Sweetheart	LM	7-Jul	+10	8.5	11.0	24.7	288	5.3	25.9	0.92
R6	LM*	12-Jul	+15	12.0	9.7	28.3	260	5.0	23.2	1.22

* In 2017, R6 was LM in Prosser but MM in Hood River; it has also varied in past years

Selections R19, R28B, and R29 were evaluated for the first time in Phase 2 and only in Pasco (Table 2). Selection R24B also had its first crop but had to be discarded due to virus presence, as mentioned earlier. Selection R19 had better performance than its standard Chelan. Selection R28B was only as good as its standard Early Robin. Selection R29 showed particularly promising characteristics compared to its standard Bing, with R29 having substantially larger and firmer fruit. Selection R29 has a sweet flavor and an attractive appearance (shiny luster and good color development) at harvest and post-storage. However, it has low acidity compared to Bing. In 2018 we expect enough crop for R29 in Pasco for a full harvest and storage evaluation. Additional trees of this selection were replanted in 2017 in the Phase 2 block at Roza, from which we expect enough of a crop for a partial evaluation in 2019 and 2020 and for a full harvest evaluation in 2021.

Selections R5B, R6, R10B, R11B, R12B, and R16B did not perform better than the standards in fruit size and/or firmness wherever they were grown, and were often worse (Tables 1–4).

Table 2. Harvest performance of Phase 2 selections at Pasco in 2017 (averaged over five trees). Values in shaded boxes are better than standards. Values in parentheses are well below those of standards and below thresholds.

Selection or standard cultivar	Market class	Harvest date	Harvest date vs. Bing (days)	Fruit Wt. (g)	Fruit row size	Fruit width (mm)	Fruit firmness (g/mm)	Skin color (1-7)	Juice SSC (ºBrix)	Juice TA (%)
Chelan	EM	12-Jun	-14	8.0	11.0	25	297	3.67	15.9	0.74
R19	EM	16-Jun	-10	10.2	9.5	29	437	4.64	25.7	1.10
Early Robin	EB	19-Jun	-7	10.9	9.7	28	322	B	16.9	0.51
R28B	EB	19-Jun	-7	11.0	9.6	29	357	B	18.4	0.85
Bing	MM	26-Jun		9.4	10.3	27	250	5.97	24.0	1.05
R3	MM	19-Jun	-7	12.5	9.1	30	336	5.26	20.6	0.82
R1	MM	26-Jun	0	13.0	9.1	30	315	5.22	23.3	1.11
R29	MM	30-Jun	+4	14.8	8.7	32	321	4.65	19.9	0.51

Table 3. Harvest performance of Phase 2 selections at Hood River in 2017 (averaged over five trees). Values in shaded boxes are better than standards. Values in parentheses are well below those of standards and below thresholds.

Selection or standard cultivar	Market class	Harvest date	Harvest date vs. Bing (days)	Fruit Wt. (g)	Fruit row size	Fruit width (mm)	Fruit firmness (g/mm)	Skin color (1-7)	Juice SSC (ºBrix)	Juice TA (%)
Early Robin	EB	7-Jul	-4	10.6	9.4	29	341	B	16.8	0.62
R16B	EB	7-Jul	-4	11.3	9.3	30	344	B	18.1	0.62
Rainier	LB	7-Jul	-4	10.4	9.4	29	280	B	17.7	0.60
R12B	LB	19-Jul	8	11.2	9.4	29	277	B	20.5	0.56
R5B	LB	28-Jul	17	10.7	9.5	29	263	B	18.1	0.68
Bing	MM	11-Jul		9.4	10.3	27	250	5.97	24.0	1.05
R6	MM*	11-Jul	0	11.5	9.2	30	334	4.70	(18.4)	0.89
Sweetheart	LM	28-Jul	17	9.6	9.8	28	305	4.47	18.3	0.79

* In 2017, R6 was LM in Prosser but MM in Hood River; it has also varied in past years

Table 4. Post-storage performance of Phase 2 selections at Prosser and Pasco in 2017 (averaged over five trees). Values in shaded boxes are better than standards. Values in parentheses are well below those of standards and below thresholds.

Selection or standard cultivar	Trial location	Market class	Firmness (g/mm)	SSC (°Brix)	TA %	Luster (1-3)	Natural pitting (%)	Induced pitting (%)	Shrivel (%)	Stem browning (1-4)
Chelan	Prosser	EM	321	20.5	0.73	2	10	5	13	2
Early Robin	Prosser	EB	342	21.3	0.51	3	6	5	5	2
R16B	Prosser	EB	302	21.2	0.72	3	10	9		1
Bing	Prosser	MM	286	25.0	0.71	3	12	25	7	4
R3	Prosser	MM	311	23.5	(0.49)	3	10	5	10	2
R1	Prosser	MM	344	25.3	0.91	2	10	25	20	2
R17	Prosser	MM	337	23.8	0.70	3	9	9		2
Rainier	Prosser	LB	273	26.7	0.53	3	12	50		2
R5B	Prosser	LB	(228)	20.5	0.73	3	38	26		2
R10B	Prosser	LB	(238)	25.3	0.62	2	14	50	5	2
R11B	Prosser	LB	313	23.6	0.99	3	14	22		3
R12B	Prosser	LB	258	24.4	0.69	3	22	50		3
Sweetheart	Prosser	LM	346	25.9	0.78	3	11	20		3
R6	Prosser	LM	272	23.7	0.96	3	26	39		1
Chelan	Pasco	EM	294	16.4	0.59	2	8	5	10	2
R19	Pasco	EM	383	24.9	0.89	3	30		5	2
Early Robin	Pasco	EB	342	21.3	0.51	3	6	5	5	2
R28B	Pasco	EB	334	20.1	0.68	3	0			3
Bing	Pasco	MM	286	25.0	0.71	3	12	25	7	4
R3	Pasco	MM	307	(19.6)	0.60	3	10	5	23	2
R1	Pasco	MM	323	21.9	1.03	2	20	25	20	4
R29	Pasco	MM	356	21.5	(0.43)	3	10	15	10	4

Phase 1

Few exceptional Phase 1 seedlings stood out in 2017. Fruit size was difficult to evaluate this season as it was generally low including for the standard cultivars. Those rare seedling that did have particularly large fruit were too soft. Traits evaluated in the field were fruit size then firmness then flavor, and a visual estimation of whether the proportion of visual defects was too high. Of a total of ~700 fruiting seedlings, almost 100 (13%) were considered worthwhile for lab-based fruit quality evaluation, of which 77% were mahogany-type and 23% blush-type. The same selection thresholds as Phase 2 were used, by sensory evaluation in the field and with both instrumental measures in the lab. Seedlings with fruit averages meeting the first two essential trait thresholds of fruit size and firmness were evaluated for further traits of SSC, TA, PFRF, and post-storage performance. 2017 was the first year that fruit were evaluated for storage potential in Phase 1. During the weekly BPAC visit, fruit of the most promising Phase 1 seedlings in cold storage was available for inspection and sensory evaluation.

Despite the most attention given to the Early and Late Mahogany market classes, most of the promising seedlings evaluated in 2017 were Mid-season Mahogany, several of which exhibited better

fruit quality than Bing, and two Late Blush seedlings type equivalent to Early Robin (Table 5). Seedling CR01T78 was previously noted for its promising performance in 2016 and 2014 and CR05T59 was also promising in 2016. Storage evaluation of these seedlings was considered insufficient in 2017 and so they should be closely monitored in 2018.

Table 5. Phase 1 promising seedlings from 2017 evaluation. Values in shaded boxes exceed thresholds. Values in parentheses are well below thresholds.

Selection or standard cultivar	Market class	Harvest date	Harvest date vs. Bing (days)	Fruit weight (g)	Fruit row size	Fruit width (mm)	Fruit firmness (g/mm)	Skin color (1-7)	Juice SSC (ºBrix)	Juice TA (%)
Mahogany types										
Chelan	EM	20-Jun	-13	9.4	11.1	24.5	335	5.14	19.2	1.06
CR03T035	MM	27-Jun	-6	9.7	9.9	28.0	403	5.90	21.5	
Bing	MM	3-Jul	0	(8.4)	(11.0)	24.7	(238)	5.80	23.8	1.02
CR01T078*	MM	3-Jul	0	11.2	9.7	28.4	376	5.26	23.7	1.02
Sweetheart	LM	25-Jul	+22	(7.1)	(11.9)	22.6	299	4.36	20.8	0.84
Blush types										
Early Robin	EB	27-Jun	-6	10.9	9.6	28.7	353	blush	21.4	0.54
Rainier	LB	3-Jul	0	10.1	10.2	26.9	271	blush	25.4	0.93
CR05T059*	LB	3-Jul	0	11.1	9.6	28.8	317	blush	21.0	1.20
CR15T046	LB	3-Jul	0	10.7	9.8	28.1	304	blush	23.3	

* Selections considered promising in previous years

Further Breeding Program Advisory Committee engagement

A BPAC meeting was held on May 11, 2017, and another will be held on November 8. Prior to these meetings, summarized data, recommendations by Peace and Sallato, information on orchard status and planned interventions, and breeding operation streamlining initiatives and outcomes were distributed for discussion in the meetings. Meeting minutes, a pre-season update, an early-season update, and a post-season update were also shared by email. BPAC members advised on various decisions in horticultural management and performance evaluation, including critical decisions about which selections to retain for evaluation in the 2017 season and which ones to discard from further consideration.

EXECUTIVE SUMMARY

Breeding-based genetic solutions provide long-term economic sustainability. The Pacific Northwest Sweet Cherry Breeding Program was re-established in 2004 to develop superior new cultivars for the Washington and Oregon industries. Extensive breeding resources, including a diverse germplasm base, laboratory and cold storage facilities, evaluation protocols and equipment, and expertise have been established. A continuum of genetically improved plant material now exists in the breeding orchard, from parents to seedlings to selections. The overall goal for 2017 was to ensure a robust foundation for the new permanent breeder. Specific objectives, and major outcomes achieved for each, are described below.

1) Establish and deploy a robust **horticultural management** system that efficiently raises and maintains healthy plant materials at all breeding stages

    - The breeding orchard condition was improved and maintained by applying best horticultural management practices and diligent observation throughout the season.

    - The breeding orchard's physical footprint was significantly reduced, with removal of 10 acres (45% of total), ~3500 Phase 1 trees (50% of total), 11 Phase 2 selections no longer to be considered, and two acres (30%) of parent blocks – totaling an estimated $36,000 in annual maintenance and evaluation costs.

    - Virus identification led to removal of two advanced selections and prompted evaluation of alternative strategies to efficiently detect and deal with virus presence in breeding trees

2) Establish and deploy a robust **performance evaluation** system that effectively targets the Early and Late Mahogany market classes

    - Several promising Phase 2 selections stood out in 2017 evaluations: R1, R3, R17, R19, and especially R29. R29 was large, firm, sweet, and had good storability, but low acidity.

    - In Phase 1, 13% of ~700 fruiting seedlings were considered worthwhile for lab-based fruit quality evaluation (77% mahogany-type and 23% blush-type). Two promising seedling in previous years continued to stand out, and should receive extra attention in 2018.

The Pacific Northwest sweet cherry breeding program is in good shape for a new permanent breeder from 2018 onward.