

Progress Report to the Agricultural Research Foundation 2018-2019

Title: Cooperative breeding program - Strawberries

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Objectives:

- To develop, in cooperation with Oregon State University, Washington State University, and Agriculture and Agri-Foods Canada, June-bearing strawberry cultivars that are suitable for processing and that are adapted to the Pacific Northwest.
- To similarly develop cultivars that are either June-bearing or day-neutral and are suited for fresh market. While this is a serious goal, first priority is still given to processing types.
- To collect, evaluate and incorporate new *Fragaria* germplasm

Breeding new cultivars

The breeding program continues with the primary objective of developing processing cultivars that are improvements over 'Totem'. 'Sweet Sunrise' and 'Charm' have been released and look excellent as processing and fresh market cultivars. 'Marys Peak' was recently released for processing and fresh applications. Plants of all three are available at Lassen Canyon Nursery for 2019 planting as will be three of the selections marked for grower trials. With the support of the Commission, working with Lassen Canyon Nursery, there have been thousands of plants of several selections planted in grower trials the past few years. Overall we had a successful year. Forty (30 short day and 10 day-neutral) were attempted and ~3,800 seedlings from 2017 crosses were planted and 59 selections (33 SD, 26 DN) were made in 2018.

We are working hard to include commissioners interested in cultivar development or research in our cutting evaluation of the fruit as a frozen, thawed product each November-December. A few years back, four genotypes were identified as strong, potential replacements for 'Hood' or 'Totem' for ice cream applications, 'Charm', and 'Marys Peak' were among these.

Germplasm

- Strawberry was one of the five fruit crops included in the USDA-funded multi-institutional and trans-disciplinary project, "RosBREED: Enabling Marker-Assisted Breeding in Rosaceae" that is coordinated out of Michigan State University in collaboration with many research institutions. Funding was sought and received from the USDA-SCRI for a follow up of this study "RosBREED: Combining disease resistance with horticultural quality in new

rosaceous cultivars”. In this new project, strawberries have been continued and blackberries added to the mix of rosaceous crops. We are taking previously identified markers in for disease resistance, perpetual flowering (day-neutrality, maybe primocane fruiting) and fruit quality (soluble solids) in strawberry and blackberry and using them to screen populations generated in the breeding program to validate that the markers identify the individuals with either improved traits or trait levels that are unacceptable and would have allowed us to discard the seedling before planting them. Disease screening has been ongoing in Florida (Vance Whitaker) and California (Cal-Poly, Kelly Ivors [since left for Driscolls]; Cal-Davis, Steve Knapp). Whitaker has had success with screening for aroma compounds and disease resistance. In screening for remontancy, the markers seemed to work about 80% of the time in Michigan (20% false positive) with seedlings in the greenhouse. In Oregon, with a field planting the results were much less successful. We are trying to figure out why.

New cultivars

- **‘Sweet Sunrise’ (USPP 25,223) released in 2016 and is doing well as an early season cultivar for fresh or processed markets**
- **‘Charm’ (USPP 25,300) released in 2016 has had excellent yields of very good fruit. While mostly released as potential ice cream berry it has been popular for farmer’s market sales.**
- **‘Marys Peak’ (PPAF; ORUS 2427-4) recently released.** It typically has great yields of large, with excellent fruit quality. ‘Marys Peak’ is later than ‘Totem’, which may be undesirable as it starts to push up against the first harvests of ‘Duke’ blueberry. Outstanding processing potential, high yields of large fruit borne on plants with an open architecture making the fruit easy to pick.

Grower Trials

The following are currently in grower trials or being propagated for grower trial. Grower trial plant material has been difficult to get propagated but Lassen Canyon Nursery is hopeful that they will have material for Peerbolt Crop Management to put in trial next spring.

- ORUS 2486-1. Outstanding fresh fruit qualities especially flavor. Yield and fruit size are usually higher but statistically similar to ‘Totem’. Would be more exciting but probably best for fresh market.
- ORUS 2678-1. Very late season, high quality and yield but probably too light for processing
- ORUS 2780-4. Probably only a fresh market type. Outstanding flavor and yield. Bit soft and is size big enough?
- ORUS 3009-1. Very good yield of high quality fruit that is sweet and nice to eat.
- ORUS 3088-1. Outstanding fruit quality especially flavor. Very good yield.
- ORUS 3750-1. Wow. Early in evaluation process but the yields and fruit size have been excellent in the first year with much more of a NW type of berry. Has been very difficult to get runners so may be discarded based on poor propagation.

Ornamental pink/red flowering selections

- Several selections have been identified that are superb for landscaping but finding a nursery has been challenging. All of our selections are incredibly vigorous with glossy thick leaves

and can be invasive. While producing a crop the fruit is sparse with small, soft, tasty berries. I see the target market as the groundcover not hanging basket market.

Yield trials.

2016 planting (Tables SY1 and SY3)

- ORUS 2780-1 did well in this trial as did ORUS 3009-1 which are both earmarked for grower trials. Main concern with ORUS 2780-1 is its less than ideal capping.
- ORUS 2678-1 is always one of the largest fruited genotypes, is late ripening, with fantastic flavor and is suited for the fresh market. Unfortunately it is not usually high yielding.
- WSU 3199 had good yields but tended to be mild flavored and looked seedy.
- A number of newer cultivars were included in the observation plots. While several of them had very good yields, above 'Totem' but similar to or less than the other standards, they tend not to have the quality we are looking for in the northwest, at least not for processing.

2017 planting (Tables SY2 and SY3)

- "Spartan Splash" in the planting year severely damaged the establishing young plants. We could not harvest a rep trial. Thinks if it looked good that is promising, but not sure whether poor performance is meaningful.
- WSU 3214 was impressive for yield, caps well and had relatively good size but it is a very dark berry
- WSU 3211 did not cap well and while it was very firm it was very mild flavored.
- ORUS 3604-2 was poor yielding but mostly due to "Spartan Splash". The fruit were large and really nice. Hope when replanted will have a nice yield.
- ORUS 3616-3 similarly was marked as outstanding for size and yield.

Seedlings

- The crosses of Fronteras x ORUS 3088-1, Stella x Sweet Bliss, and especially Lucia x Marys Peak each produced multiple very impressive selections. Excellent example of combining poorly adapted material that have great commercial traits with material adapted to your environment.

Publications:

Hancock, J.F., P.P. Edger, P.W. Callow, T. Herlache, and C.E. Finn. 2018. Generating a unique germplasm base for the breeding of day-neutral strawberry cultivars. *HortScience* 53:1069-1071 <https://doi.org/10.21273/HORTSCI12840-18>.

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Iezzoni, A., Peace, C., Main, D., Bassil, N.V., Coe, M., Finn, C.E., Gasic, K., Luby, J., Hokanson, S.C., McFerson, J., Norelli, J.L., Olmstead, M., Whitaker, V., Yue, C. 2017. RosBREED2: Progress and future plans to enable DNA-informed breeding in the Rosaceae. *Acta Hort.* 1172:115-118. <https://doi.org/10.17660/ActaHortic.2017.1172.20>.

Verma, S., J.D. Zurn, N. Salinas, M. M. Mathey, B. Denoyes, J.F. Hancock, C.E. Finn, N.V. Bassil, and V.M. Whitaker. 2017. Clarifying sub-genomic positions of QTLs for flowering habit and fruit quality in strawberry (*Fragaria xananassa*) breeding populations using pedigree-based QTL analysis. *Hortic. Res.* 4:17062 doi:10.1038/hortres.2017./62.

Table SY1. Yield, fruit weight, and fruit rot for strawberry genotypes harvested in 2017-18 and planted in 2016 at OSU-NWREC.

Genotype	Berry size (g)	Fruit rot (%)	Yield (tons·a ⁻¹)		
	2017-18	2017-18	2017	2018	2017-18
2017	11.5 a	5.2 a			10.92 a
2018	9.4 b	3.5 b			10.19 a
<i>Replicated</i>					
ORUS 2780-1	11.8 b	4.7 b	13.87 ab	14.99 a	14.43 a
Tillamook	11.5 b	2.8 b	15.81 a	9.59 b-d	12.70 ab
Sweet Sunrise	10.8 b	3.5 b	12.13 a-c	11.99 ab	12.06 ab
Marys Peak	11.1 b	2.9 b	12.23 a-c	11.08 bc	11.65 ab
ORUS 3009-1	10.3 b	4.3 b	12.03 a-c	10.82 bc	11.43 bc
ORUS 3467-3	12.2 b	4.8 b	8.61 cd	12.05 ab	10.33 bc
ORUS 2678-1	13.9 a	4.9 b	9.68 b-d	10.49 b-d	10.09 bc
Totem	7.5 c	7.1 a	9.91 b-d	7.31 cd	8.61 cd
ORUS 2486-1	7.7 c	4.3 b	7.63 cd	6.73 d	7.18 d
Hood	8.0 c	4.0 b	7.30 d	6.88 d	7.09 d
<i>Observation</i>					
Honeoye	10.7	4.7	21.90	18.23	20.06
Stella	11.3	5.6	18.54	13.39	15.97
WSU 3199	12.2	6.1	10.50	19.24	14.87
Charm	8.7	2.7	11.61	15.91	13.76
Rutgers Scarlet	12.4	4.5	11.17	12.71	11.94
Shuksan	14.1	5.8	-	10.98	10.98
Fronteras	13.2	4.7	13.57	7.77	10.67
Puget Crimson	10.5	2.4	-	8.56	8.56
WSU 3164	10.1	3.5	5.30	11.71	8.51
Petaluma	13.1	3.5	10.00	2.41	6.21
ORUS 3088-1	13.5	5.3	4.06	7.04	5.55
Grenada	12.5	3.7	7.32	0.56	3.94

Mean separation within columns by LSD p<0.05.

Table SY2. Yield, fruit weight, and percent fruit rot in 2018 for strawberry genotypes in trial at Oregon State University N. Willamette Research and Extension Center. Planted in 2017.

Genotype	Fruit size (g)	Fruit rot (%)	Yield (tons·a ⁻¹)
WSU 3214	14.7	1.8	13.27
Totem	9.5	18.7	12.98
WSU 3211	11.6	6.7	11.83
Tillamook	12.1	4.6	10.67
Yambu	13.8	6.5	10.28
Sweet Sunrise	14.0	0.8	10.20
ORUS 2678-1	17.0	1.6	9.96
ORUS 3602-2	20.7	0.8	9.46
NCS 10-038	16.3	1.7	8.91
WSU 3205	11.2	2.7	8.89
NCS 10-156	13.1	3.8	8.88
ORUS 3633-2	15.9	8.2	7.75
ORUS 3592-1	11.7	7.0	6.45
ORUS 3600-2	19.6	2.0	6.33
ORUS 3595-1	13.7	1.6	6.14
Hood	8.7	8.4	6.13
ORUS 3616-3	2.6	1.2	6.12
ORUS 3600-1	15.7	0.0	6.08
ORUS 3608-1	12.0	0.0	5.47
ORUS 3599-1	15.9	4.5	5.05
ORUS 3633-4	16.5	4.4	4.82
ORUS 3591-3	8.0	8.5	4.81
ORUS 3630-1	12.3	1.1	4.56
ORUS 2486-1	10.5	0.9	4.11
ORUS 3591-2	5.4	3.4	3.14
ORUS 3604-2	17.1	4.1	2.94
Archer	14.1	19.2	2.79
ORUS 3608-1	13.2	0.0	2.39
ORUS 3591-1	8.0	5.2	2.28

Table SY3. Ripening season (dates at which yield passed given percentage) for strawberry genotypes at OSU-NWREC in 2017-18

Genotype	Mean harvest season			Years harvested	Rep or Obsv
	5%	50%	95%		
ORUS 3604-2	22-May	29-May	5-Jun	1	Obsv
ORUS 3608-1	22-May	29-May	5-Jun	1	Obsv
ORUS 3608-1	22-May	29-May	5-Jun	1	Obsv
ORUS 3591-1	22-May	29-May	12-Jun	1	Obsv
ORUS 3591-2	22-May	29-May	12-Jun	1	Obsv
ORUS 3591-3	22-May	29-May	12-Jun	1	Obsv
WSU 3205	22-May	29-May	12-Jun	1	Obsv
Yambu	22-May	29-May	12-Jun	1	Obsv
NCS 10-156	22-May	29-May	19-Jun	1	Obsv
Sweet Sunrise	22-May	29-May	19-Jun	1	Obsv
Archer	29-May	29-May	5-Jun	1	Obsv
ORUS 2486-1	29-May	29-May	12-Jun	1	Obsv
Petaluma	26-May	29-May	5-Jun	2	Obsv
Grenada	26-May	2-Jun	9-Jun	2	Obsv
Sweet Sunrise Hood	26-May	2-Jun	16-Jun	2	Rep
Hood	29-May	5-Jun	12-Jun	1	Obsv
ORUS 3595-1	29-May	5-Jun	12-Jun	1	Obsv
ORUS 3599-1	29-May	5-Jun	12-Jun	1	Obsv
WSU 3214	29-May	5-Jun	12-Jun	1	Obsv
ORUS 3630-1	29-May	5-Jun	19-Jun	1	Obsv
NCS 10-038	29-May	5-Jun	19-Jun	1	Obsv
ORUS 3602-2	29-May	5-Jun	19-Jun	1	Obsv
ORUS 3633-4	29-May	5-Jun	19-Jun	1	Obsv
Tillamook	29-May	5-Jun	19-Jun	1	Obsv
WSU 3211	29-May	5-Jun	19-Jun	1	Obsv
ORUS 3633-2	29-May	5-Jun	23-Jun	1	Obsv
ORUS 3600-1	5-Jun	5-Jun	12-Jun	1	Obsv
Honeoye	26-May	5-Jun	19-Jun	2	Obsv
Charm	29-May	5-Jun	16-Jun	2	Rep
ORUS 2486-1	29-May	5-Jun	16-Jun	2	Rep
WSU 3164	2-Jun	5-Jun	19-Jun	2	Obsv
Hood	26-May	9-Jun	16-Jun	2	Rep
ORUS 3009-1	26-May	9-Jun	23-Jun	2	Rep
Fronteras	29-May	9-Jun	19-Jun	2	Obsv
ORUS 2780-1	2-Jun	9-Jun	19-Jun	2	Rep
Rutgers Scarlet™	2-Jun	9-Jun	19-Jun	2	Obsv
ORUS 3467-3	2-Jun	9-Jun	23-Jun	2	Rep
Tillamook	2-Jun	9-Jun	23-Jun	2	Rep
Stella	2-Jun	9-Jun	23-Jun	2	Obsv
ORUS 2678-1	29-May	12-Jun	19-Jun	1	Obsv
Totem	29-May	12-Jun	19-Jun	1	Obsv
Puget Crimson	5-Jun	12-Jun	19-Jun	1	Obsv
Shuksan	5-Jun	12-Jun	19-Jun	1	Obsv
ORUS 3592-1	5-Jun	12-Jun	19-Jun	1	Obsv

ORUS 3616-3	5-Jun	12-Jun	19-Jun	1	Obsv
Totem	2-Jun	12-Jun	19-Jun	2	Rep
ORUS 3088-1	2-Jun	12-Jun	19-Jun	2	Obsv
Marys Peak	2-Jun	12-Jun	23-Jun	2	Rep
WSU 3199	2-Jun	12-Jun	23-Jun	2	Obsv
ORUS 2678-1	5-Jun	16-Jun	23-Jun	2	Rep
ORUS 3600-2	12-Jun	19-Jun	19-Jun	1	Obsv
Totem	6-Jun	20-Jun	27-Jun	1	Rep
WSU 3199	6-Jun	20-Jun	27-Jun	1	Obsv
ORUS 2678-1	13-Jun	20-Jun	27-Jun	1	Rep
