

Cascade Premier

I am recommending the release of the raspberry (*Rubus idaeus* L) selection WSU 2166 as a new floricane fruiting red raspberry cultivar.

A. Pedigree and experimental designation

WSU 2166 was selected from the cross of WSU 1447 x WSU 0697 (Figure 1) made by Patrick P Moore in 2007 at Washington State University Puyallup Research and Extension Center (WSU Puyallup).

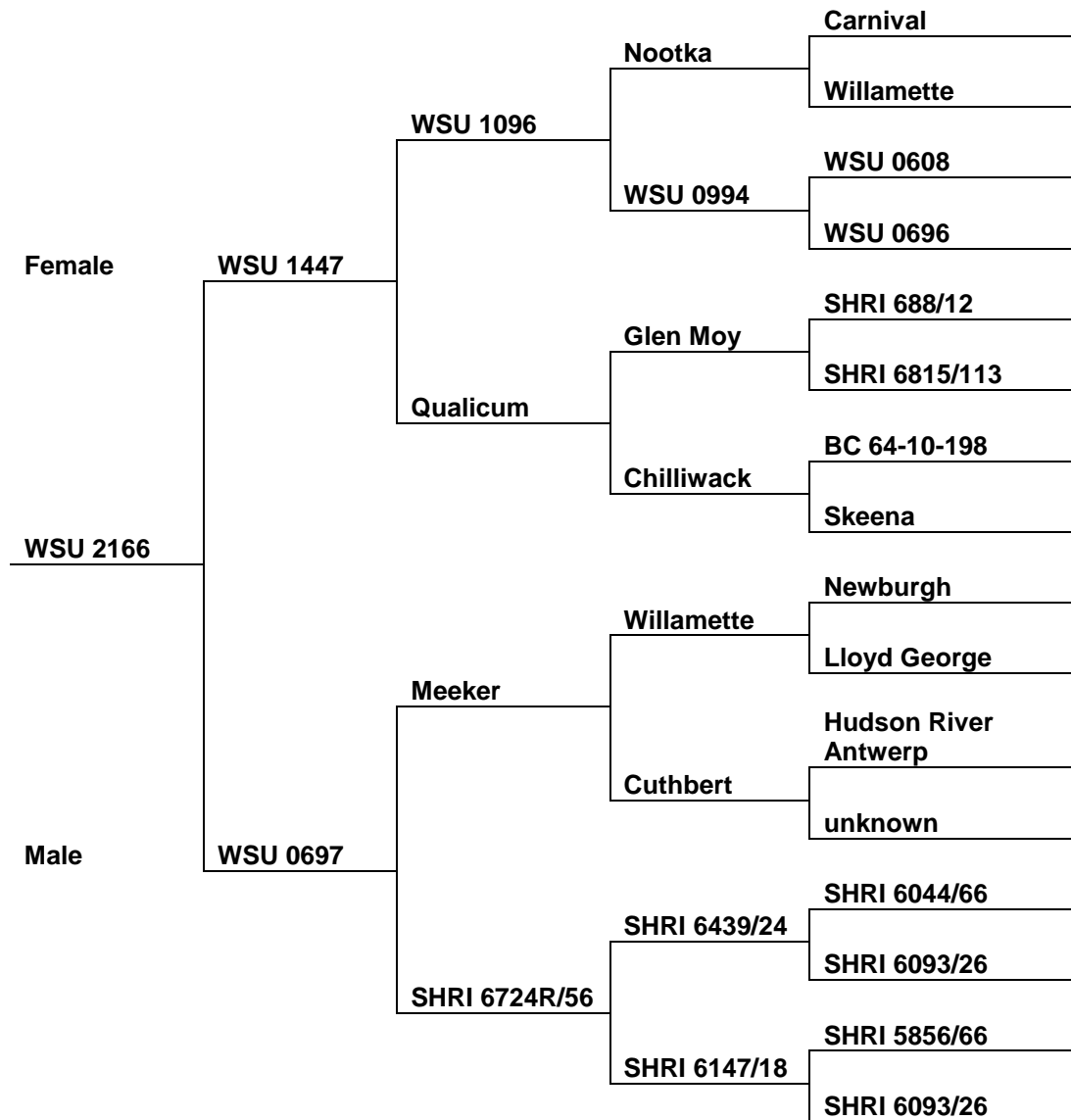


Figure 1. Pedigree of WSU 2166

C. Performance data

Seedlings from the cross of WSU 1447 x WSU 0697 were planted at Sakuma Brothers Farm, Burlington, WA in 2008. WSU 2166 was selected in 2010, as the plants were being machine harvested. WSU 2166 was selected because of large fruit size, firm fruit and apparent adaptation to mechanical harvest. After WSU 2166 was selected, it was propagated by tissue culture from primocane shoot tips at WSU Puyallup. It was planted in non-replicated plots with cooperating growers (with testing agreements). In 2011 it was planted at the Randy Honcoop Farm and in 2014 at Maberry Packing, Lynden, WA. These plantings were maintained by the growers using typical commercial methods. The plantings were subjectively evaluated for adaptation to machine harvesting weekly during the harvest season for two fruiting seasons. Plantings were harvested beginning two years after planting. In all of the harvest seasons WSU 2166 machine harvested well and was productive with large fruit size.

At the Maberry Packing planting, yield was measured each harvest date for each plot in both harvest years. Cumulative yields were calculated for each harvest date to estimate the yield and midpoint of harvest (Table 1). WSU 2166 was compared to the cultivars 'Cascade Harvest', 'Meeker' and 'Willamette'. WSU 2166 had lower yield than 'Cascade Harvest' in 2016, but greater than 'Meeker' and 'Willamette'. In 2017, WSU 2166 had similar yield as 'Willamette', but less than 'Cascade Harvest' and 'Meeker'. WSU 2166 had greater 2016-17 total yield than 'Meeker' and 'Willamette', but less than 'Cascade Harvest'. The midpoint of harvest for WSU 2166 was very similar to 'Willamette' and earlier than 'Cascade Harvest' and 'Meeker' (Figure 2).

Table 1. Yield and midpoint of harvest at Willey's Lake planting

Machine Harvest yield (t/a)				Midpoint of harvest	
	2016	2017	total	2016	2017
C Harvest	9.3	7.5	16.8	7/1	7/17
WSU 2166	8.1	5.8	13.9	6/24	7/11
Meeker	6.1	7.3	13.4	7/3	7/12
Willamette	6.4	5.8	12.2	6/24	7/19
	7.5	6.6	14.1	6/28	7/14

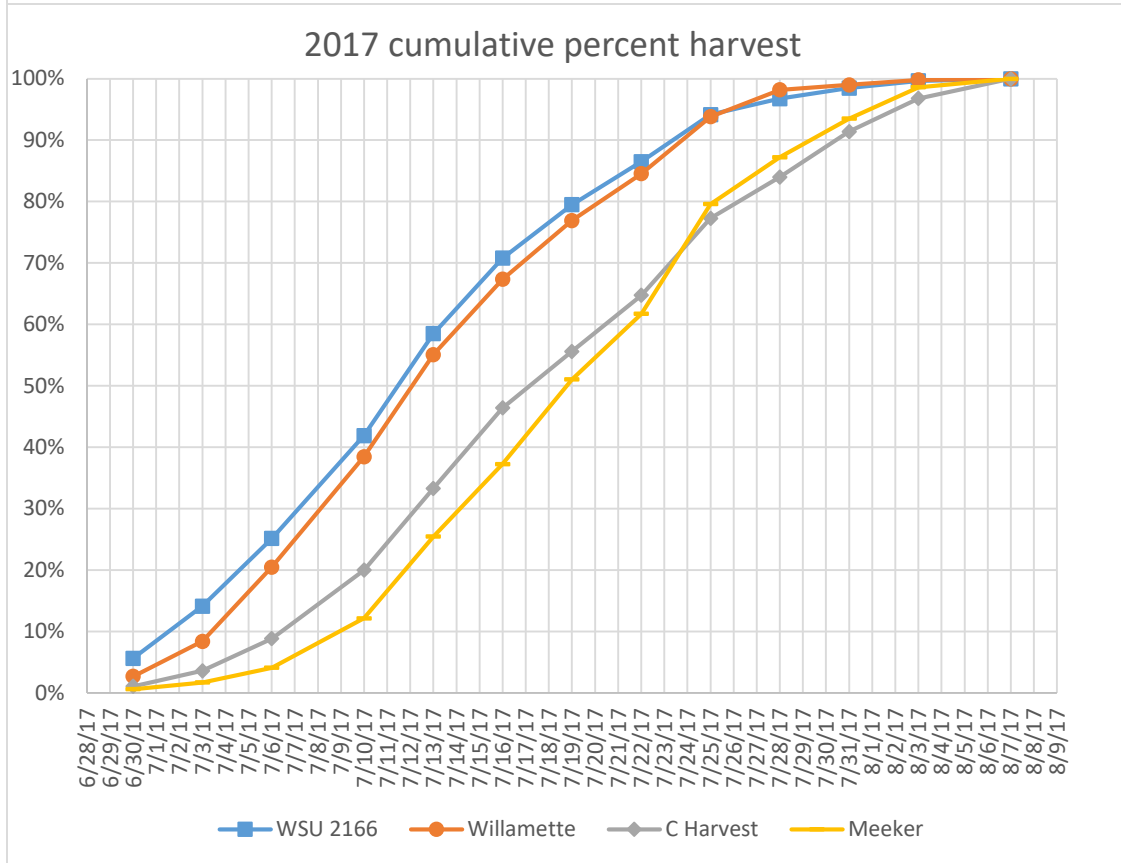
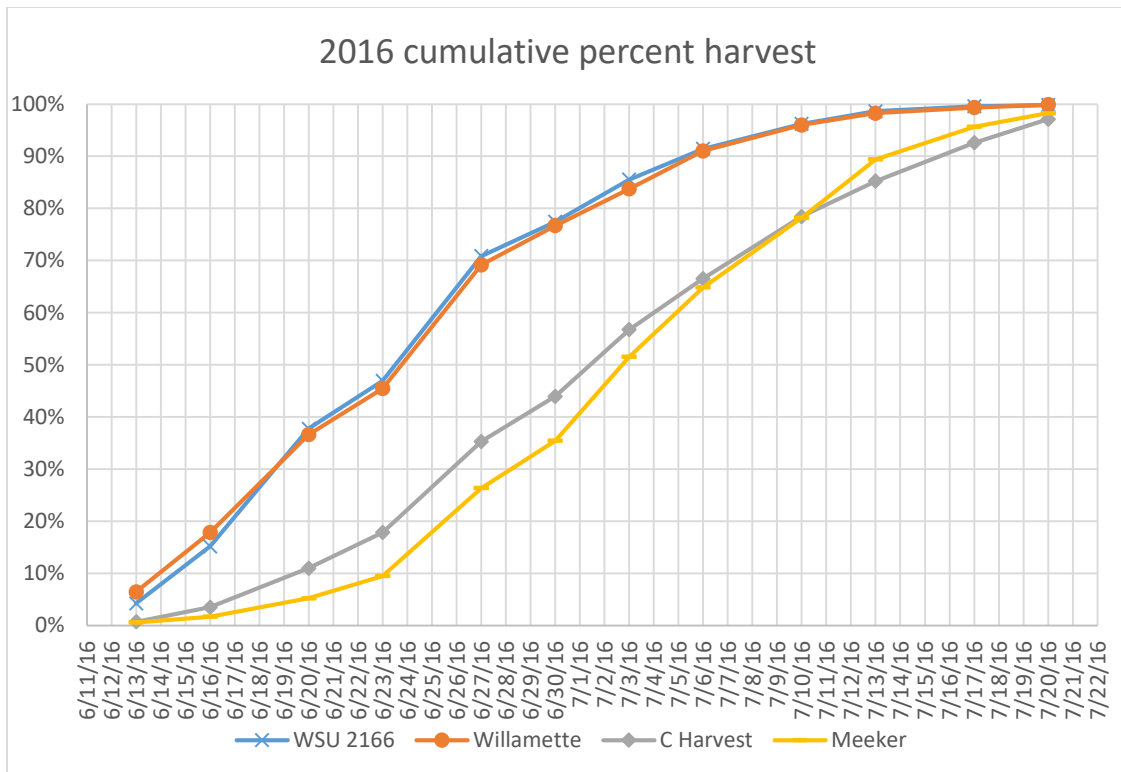


Figure 2. Cumulative percent harvest 2016, 2017.

WSU 2166 was planted in replicated plots at WSU Puyallup Goss Farm in 2014 and hand harvested in 2016 and 2017 (Table 2). In 2016, WSU 2166 had the lowest yield. When yield was expressed as yield per fruiting cane, WSU 2166 was not significantly less than the three cultivars. In 2017, the yield of WSU 2166 was similar to 'Meeker' and 'Willamette'. The fruit of WSU 2166 was larger than both 'Meeker' and 'Willamette', and was numerically slightly greater than 'Cascade Harvest'. Fruit firmness of WSU 2166 was greater than the cultivars. The midpoint of harvest for WSU 2166 was earlier than 'Meeker' and 'Cascade Harvest' and similar to 'Willamette'. Fruit of WSU 2166 is attractive and easily visible (Figure 3).



Figure 3. Fruit of WSU 2166

Table 2. 2016-2017 harvest, WSU Research and Extension Center Goss Farm

	Yield (t/a)			Rot (%)		Fruit weight (g)		Firmness (g)		Midpoint of harvest	
	2016	2017	total	2016	2017	2016	2017	2016	2017	2016	2017
Willamette	7.8	6.3	14.2	7.2%	6.6%	3.06	3.37	74.2	122.0	6/19	7/6
WSU 2166	3.7	5.1	8.7	4.4%	5.4%	4.30	3.84	101.2	136.6	6/19	7/8
Meeker	11.0	6.5	17.5	9.8%	10.6%	4.16	3.19	90.0	106.5	6/23	7/9
C Harvest	6.8	7.0	13.8	11.4%	14.5%	3.10	3.54	73.8	106.1	6/23	7/12

WSU 2166 was planted in larger plantings with commercial growers in 2014 for Grower Trials (with testing agreements). WSU 2166 machine harvested well and was productive with large fruit size.

WSU 2166 WAS EVALUATED FOR SUSCEPTIBILITY TO ROOT ROT IN PLOTS AT WSU PUYALLUP IN PLANTINGS ESTABLISHED IN 2014. THE PRESENCE OF *PHYTOPHTHORA RUBI* IN THESE PLOTS WAS VERIFIED VIA PCR. FOUR PLANTS OF EACH CLONE WERE PLANTED IN THIS AREA. PLANTS WERE SUBJECTIVELY RATED FOR VIGOR IN THE FALL OF EACH YEAR FROM 0 TO 5, WITH 0 BEING DEAD AND 5 A HEALTHY AND VIGOROUS PLANT. IN THE FALL OF THE 2017, THE FOUR PLANTS OF WSU 2166 HAD AN AVERAGE RATING OF 3.5, WHILE 'MEEKER' AVERAGED 2.5, 'CASCADE HARVEST' 1.0, AND 'LEWIS' AND 'VINTAGE' 0.75 (TABLE 3). THERE WERE 32 RASPBERRY CLONES IN THIS PLANTING AND WSU 2166 HAD THE SIXTH HIGHEST RATING (20TH PERCENTILE) AND 'MEEKER' HAD THE 13TH HIGHEST RATING. THE OVERALL AVERAGE OF ALL 32 RASPBERRIES IN 2015 WAS 3.54, 3.74 IN 2016 AND IN 2017 WAS 2.18.

Table 3 Root rot evaluation

	11/6/15	11/4/16	9/13/17	2017 rank/32
WSU 2166	2.50	4.50	3.50	#6
Meeker	4.00	4.67	2.50	#13
C Harvest	4.33	5.00	1.00	#24
Lewis	4.25	2.50	0.75	#26
Vintage	4.33	1.33	0.75	#26
Overall average	3.54	3.74	2.18	

Subjectively rated 0-5. 0 = dead, 5=healthy and vigorous

One of the Grower Trial sites established in 2014 had high levels of root rot. In this field, a few plants of WSU 2166 exhibited some root rot damage in 2017, but less than 'Cascade Harvest' and 'Meeker'. Based on the root rot trial at the Goss Farm and the performance in the Grower Trial site, WSU 2166 is not immune, but has a good level of root rot tolerance.

Fruit samples for WSU 2166 and 'Cascade Harvest' were harvested on July 3, 2017 from plots at WSU Puyallup, stored for seven days at 4°C, then held at room

temperature (21°C) for four hours. Measurements were taken on twelve fruit prior to storage and after storage. At harvest time the fruit weight of WSU 2166 was 5.87g and 5.24g for 'Cascade Harvest'. After storage the fruit weight of WSU 2166 was 5.20g and for 'Cascade Harvest' 4.47g. Firmness was measured as the grams required to close the opening of the fruit and is a destructive measurement. For firmness measurements, one set of 12 fruit were measured before storage and a second set of 12 fruit after storage. Firmness for fruit that had not been stored for WSU 2166 was 131.7g and 66.3g for 'Cascade Harvest'. Firmness for fruit that had been stored was 88.3 for WSU 2166 and 42.1 for 'Cascade Harvest'. The fruit of 'Cascade Harvest' was lighter colored than WSU 2166 going into storage. The degree of color changes during storage were similar for both WSU 2166 and 'Cascade Harvest' samples. WSU 2166 had acceptable storage characteristics.

Fruit samples were collected from machine harvest plots at the Randy Honcoop Farm in 2013. Samples of approximately 300 g were collected from selected clones. The samples were analyzed for total anthocyanins, soluble solids, pH, and titratable acidity (Table 4). 'Willamette' had the highest total anthocyanins, and WSU 2166 had slightly less than 'Meeker'. WSU 2166 had lower soluble solids than 'Meeker' and slightly higher soluble solids than 'Willamette'. WSU 2166 had higher titratable acidity than 'Meeker' and 'Willamette', and lower pH.

Table 4. Fruit analysis from 2013 harvested raspberry selections

Clone	Soluble solids (deg Brix)	pH	Titratable acidity (% citric acid)	Total Anthocyanins (mg C-3-G/ 100 g FW)
Meeker	9.3	3.54	1.40	57
Willamette	8.0	3.34	1.83	95
WSU 2166	8.2	3.31	2.00	52

Additional data was collected of canes, leaves and plant to support a patent application.

D. Availability of plant material, including virus status.

Certified plants from virus tested plants are available from commercial propagators. Virus tested material is maintained by the clean plant program, USDA, Corvallis, OR.

E. Whether or not a plant patent or other protection is proposed. Countries for which patent protection should be sought.

WSU 2166 should be protected by US plant patent and Canadian Plant Breeder's Rights. Licensing also should be considered for areas outside of North America. Time for evaluation in other countries is limited. Plant Breeder's Rights cannot be obtained if it has been commercialized for over four years anyplace.

F. Justification for cultivar release

WSU 2166 combines several valuable production attributes.

It is machine harvestable. Virtually all commercial raspberry production in Washington, except for the very small amount for fresh use, is machine harvested.

WSU 2166 had a midpoint of harvest similar to 'Willamette' in plots at Lynden and Puyallup. There currently are few options for early season cultivars and WSU 2166 may provide an additional option.

It has better resistance to *Phytophthora* root rot than 'Meeker' and 'Cascade Harvest'. There are limited chemical and cultural controls for *Phytophthora* root rot and these controls are expensive and not consistently effective. Planting tolerant cultivars is the preferred control option.

The fruit characteristics should be suitable for the PNW processing industry and could also be used for fresh market. The fruit of WSU 2166 has soluble solids and titratable acidity similar to 'Willamette' and anthocyanin levels similar to 'Meeker'. The flavor of CASCADE PREMIER fruit is tart, but well balanced. The fruit of WSU 2166 is firmer than 'Cascade Harvest', 'Meeker' and 'Willamette'.

G. Proposed name of new cultivar

I am proposing 'Cascade Premier' as a possible name for WSU 2166. (one of the definitions of Premier is "first in time: earliest")

Timeline

WSU 2166

2007 Make cross

2008 Plant seedlings – Burlington

2010 Machine harvest seedlings

Make selections

2011 Plant in MH trial (Honcoop)

2013 Harvest MH trial

Analysis of fruit (Honcoop)

2014 Harvest MH trial

Plant in 2nd MH trial (Maberry)

Plant in replicated plots - Puyallup

Plant in root rot plots – Puyallup

Plant in Grower Trials

2016 Harvest 2nd MH trial

Harvest replicated plots – Puyallup

Evaluate root rot plots

Harvest Grower Trials

2017 Harvest 2nd MH trial

Harvest replicated plots – Puyallup

Evaluate root rot plots

Analysis of fruit (Maberry)

Harvest Grower Trials

Release



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