‘Cascade Gold’ Raspberry

Patrick P. Moore², Wendy Hoashi-Erhardt, Bruce Barritt¹,
Thomas Sjulín¹, and Jo Ann Robbins¹

Washington State University Puyallup Research and Extension Center, 2606
W Pioneer, Puyallup, WA 98371

Chad E. Finn and Robert R. Martin

U.S. Department of Agriculture-Agricultural Research Service, Horticultural
Crops Research Unit, 3420 NW Orchard Avenue, Corvallis, OR 97730

Michael Dossett

Pacific Agri-Food Research Centre, Agriculture and Agri-Food Canada,
Agassiz, British Columbia, Canada, V0M 1A0

Additional index words. fruit breeding, raspberry bushy dwarf virus, *Rubus idaeus*, yield

‘Cascade Gold’ is a new gold-fruited, florican fruiting raspberry cultivar (*Rubus idaeus* L.) jointly released by Washington State University (WSU), Oregon State University, and the U.S. Department of Agriculture. It has been evaluated at Puyallup, WA, in plantings from 1988 to 2008. In general, ‘Cascade Gold’ has produced large, firm, early-season fruit. In some plantings, ‘Cascade Gold’ was among the highest yielding clones, but in others, yield has been relatively low, especially on sites with root rot. On sites where yield was reduced, the fruit was still among the largest and firmest of the clones in the planting. The fruit is glossy, firm, large-sized, and longer than wide. The fruit has moderate to high soluble solids, low pH, and high titratable acidity, resulting in tart but well-balanced flavor. The fruit releases easily from the receptacle at a light yellow stage of development, but for optimum flavor, the fruit should be more mature (Fig. 1). It is best suited to fresh market use because of its large size, attractive appearance, and firmness.

Origin

The cross which produced ‘Cascade Gold’ was made in 1979 at the Washington State University Puyallup Research and Extension Center (WSU Puyallup) between ‘Malling Delight’ as the female parent and a pollen parent recorded as SHRI 6820/41. In 1989, the identity of the pollen parent of ‘Cascade Gold’ was determined to be incorrect (R.J. McNichol, personal communication) and remains unknown. ‘Cascade Gold’

Received for publication 12 Dec. 2013. Accepted for publication 20 Dec. 2013.

This research was partially funded by the Washington Red Raspberry Commission, the Oregon Raspberry and Blackberry Commission, and the Northwest Center for Small Fruits Research. This work was partially funded by USDA/NIFA through Hatch Project #WNP0640 Breeding Superior Raspberry Cultivars for the Pacific Northwest.

¹Retired.

²To whom reprint requests should be addressed; e-mail moorepp@wsu.edu.

was selected from seedlings in 1983 and designated as WSU 79111-36 for use in breeding but not propagated for further tests. Favorable observations made in 1987 led to a decision to propagate WSU 79111-36 as WSU 991 and evaluate it in replicated plots. In 1992, a decision was made to release ‘Cascade Gold’ based on its high yield and excellent fruit quality, but an unknown virus was detected in all plants of ‘Cascade Gold’ that delayed its release. The unknown virus was subsequently identified as raspberry leaf mottle virus. Plants testing virus-negative were eventually planted in replicated plots at WSU Puyallup in 2007 and plots harvested in 2009 and 2010.

Performance

Fruit of ‘Cascade Gold’ was harvested from replicated plantings at WSU Puyallup planted from 1988 to 2008. Plantings were

arranged in randomized complete block designs with three replications of plots consisting of three plants with 0.9 m between plants and 2.4 m between rows. The plots were not sprayed for disease or insect control. Fruit was harvested one or two times a week depending on environmental conditions and rate of ripening. The weight of sound fruit and fruit with rot (mainly botrytis) was determined at each harvest. The average fruit weight for the season is a weighted mean based on the weight of a randomly selected 25-fruit subsample from each plot from each harvest and the yield for each harvest. Fruit firmness was measured as the force required to close the opening of gold-colored fruit using a Hunter Spring Mechanical Force Gauge (Series L; Ametek, Hatfield, PA) and was calculated as a weighted mean based on a randomly selected five-fruit subsample from each plot from each harvest.

Fruit samples collected during the 1992 harvest season were analyzed for pH, titratable acidity, and soluble solids. The pH of the juice was measured with a Corning 430 pH meter (Corning, NY), titratable acidity by titration to pH 8.1 with 0.1 N NaOH, and soluble solids with a Goldberg T/C refractometer (American Optical, Buffalo, NY). Fruit samples of ‘Cascade Gold’, ‘Anne’, and ‘Goldenwest’ were collected in 2010 for fruit color and fruit measurements. Color of fruit was measured using a tristimulus colorimeter (Minolta CR-400; Konica Minolta Sensing Americas, Inc., Ramsey, NJ). Measurements were recorded in L*, a*, b* (McGuire, 1992) based on calibration to a standard white reflective plate and the CIE Illuminant C (Commission Internationale de l’Eclairage, Vienna, Austria).

Total yield, percent fruit rot, individual fruit weight, midpoint of harvest, and length of harvest season were analyzed as a randomized

Fig. 1. Fruit of ‘Cascade Gold’ showing color changes with increased maturity.

block design using analysis of variance and Tukey's Studentized range test or Fisher's protected least significant difference for mean separation (SAS 8.1; SAS Inst. Inc., Cary, NC).

'Cascade Gold' was tested in replicated plantings at WSU Puyallup established in 1988, 1991, 1992, 2007, and 2008. 'Cascade Gold' was also evaluated in plantings established in 1992 at WSU Vancouver Research and Extension Unit (WSU Vancouver), Vancouver, WA, and WSU-Mount Vernon Research Center (WSU Mt. Vernon) and in 1991 and 2005 at North Willamette Research and Extension Center (NWREC) of Oregon State University at Aurora, OR, and in 1991 at Pacific Agri-Food Research Center (PARC), Agriculture and Agri-Food Canada Research Substation, Abbotsford, British Columbia, Canada.

In general, in plantings at WSU, 'Cascade Gold' has produced large, firm, early-season fruit. In some of the plantings, yield has been high. In other plantings, especially on sites with root rot, yield has been lower than other cultivars. In most years, the differences among cultivars for yield were not statistically significant (data not shown). In the 14 harvest seasons in WSU trials, the yield of 'Cascade Gold' was greater than the planting mean for five seasons, below average for eight, and equal to the average in one season (data not shown). Although the yield was low in some harvest seasons, the fruit was still larger and firmer than other cultivars measured in these plantings (data not shown). Performance in the 2008 WSU Puyallup planting is given in Table 1. The fruit weight, firmness, and fruit rot for 'Cascade Gold' were the highest of the cultivars measured in this study. The harvest season for 'Cascade Gold' was early, similar to 'Willamette'. In a non-replicated plot at NWREC, 'Cascade Gold' had yields intermediate between 'Meeker' and 'Coho' in 2007 and 2008. The fruit weight averaged 5.0 g, larger than 'Meeker' (3.1 g) and 'Coho' (3.7 g). 'Cascade Gold' was planted at PARC in 1991. Performance in the 1994 season is given in Table 2. 'Cascade Gold' was the earliest ripening, had higher yield than 'Chilliwack' and 'Meeker', and similar yield to 'Tulameen'. 'Cascade Gold' fruit were larger than all cultivars in this trial.

Fruit Description

Measurements were made of fruit of 'Cascade Gold', 'Anne', and 'Goldenwest' harvested on 16 July 2010 $\approx$ 1 week after the midpoint of harvest of 'Cascade Gold'. 'Anne' is a yellow-colored primocane-fruited raspberry released in 1999 (Daubeney, 1999). Floricane fruit of 'Anne' may not have the same fruit characteristics of the primocane fruit. 'Goldenwest' is a gold-fruited cultivar released by WSU in 1953 (Brooks and Olmo, 1972). Fruit of 'Cascade Gold' were much larger than 'Anne' and 'Goldenwest', and all of the fruit measures reflect this (Table 3). The 'Cascade Gold' fruit were longer than

wide, whereas those of 'Anne' and 'Goldenwest' were approximately as long as wide. 'Cascade Gold' and 'Goldenwest' fruit were darker (greater L*) than 'Anne' (smaller L*) and 'Cascade Gold' was redder (greater a*) than 'Anne' but not as red as 'Goldenwest' (Table 3). 'Anne' and 'Goldenwest' fruit were more yellow (greater b*) than 'Cascade Gold'. Fruit were stored for 4 d at 4 °C before post-harvest measurements of weight loss, firmness, and color change. All three cultivars darkened and became redder, less yellow, and

softer with storage (data not shown). The fruit of 'Cascade Gold' remained acceptable after storage.

'Cascade Gold' fruit samples collected during the 1992 harvest season were compared with 'Chilliwack', 'Comox', 'Meeker', and 'Willamette' for pH, titratable acidity, and soluble solids (Table 4). 'Chilliwack' had the highest soluble solids, 'Willamette' had the lowest, and 'Cascade Gold' was intermediate. 'Comox' had the highest titratable acidity, 'Meeker' the lowest, and 'Cascade Gold'

Table 1. Yield, fruit weight, percent fruit rot, fruit firmness, and harvest season for 'Cascade Gold' and three other raspberry cultivars planted in 2008 at Puyallup, WA, in replicated plots and harvested in 2010 and 2011.^z

		Cultivar				Overall mean
		Cascade Bounty	Cascade Gold	Meeker	Willamette	
Yield (kg/plant)	2011	2.77 a ^y	4.18 a	4.15 a	3.77 a	3.72
	2010	1.50 a	3.03 a	3.15 a	1.57 a	2.31
	Total	4.27 b	7.21 a	7.31 a	5.35 ab	6.03
Fruit weight (g)	2011	3.71 b	6.26 a	3.52 b	3.48 b	3.50
	2010	3.18 b	5.12 a	2.99 b	2.95 b	2.97
Fruit rot (%)	2011	18.8 a	20.4 a	8.6 b	6.6 b	7.6
	2010	6.5 b	17.1 a	5.9 b	5.8 b	5.8
Fruit firmness (N)	2011	0.68 b	1.22 a	0.70 b	0.82 b	0.76
	2010	0.74 b	1.42 a	1.16 ab	1.09 ab	1.12
Date for midpoint of harvest	2011	18 July ab	16 July b	23 July a	16 July b	19 July
	2010	10 July b	10 July b	21 July a	6 July b	14 July
Length of harvest	2011	23 a	23 a	22 a	22 a	22
Season (d)	2010	30 a	24 a	32 a	29 a	30

^zBased on the means of three replications of three plants.

^yMeans within a row followed by the same letter are not significantly different at $P \leq 0.05$ by Tukey's Studentized range test.

Table 2. Yield, percent fruit rot, fruit weight, and harvest season for raspberries planted in 1991 and harvested in 1994 at Abbotsford, British Columbia, Canada.^z

Cultivar	Yield (kg/plant)	Fruit rot (%)	Fruit wt (g)	Dates for midpoint of harvest	Length of harvest season (d)
Chilliwack	2.39	1.0	2.4	9 July	41
Meeker	2.25	0.1	2.3	12 July	42
Tulameen	3.71	1.8	3.6	13 July	52
Cascade Gold	3.47	0.6	4.1	6 July	44
LSD ^y	0.5	0.6	0.2	3	4

^zBased on the means of three replications of three plants.

^yMean separation within columns with least significant difference (LSD), $P = 0.05$.

Table 3. Fruit measurements of raspberry fruit comparing yellow and gold fruited cultivars Cascade Gold, Anne, and Goldenwest harvested 16 July 2010, Puyallup, WA.^z

	Cascade Gold	Anne	Goldenwest
Fruit weight (g)	7.4 ^y a	4.2 b	2.4 c
Fruit length (mm)	28.8 a	21.9 b	17.9 c
Fruit diameter (mm)	23.8 a	20.7 b	18.1 c
Fruit Length/width	1.21 a	1.05 b	0.99 b
Drupelet length (mm)	6.50 a	6.22 a	4.50 b
Drupelet width (mm)	3.7 a	4.1 a	3.6 a
Number of drupelets/fruit	106 a	65 b	59 b
Drupelet weight (mg)	69.6 a	64.2 a	41.9 b
Individual seed weight (mg)	2.41 a	2.11 b	1.64 c
Total seed weight (g/fruit)	0.26 a	0.14 b	0.10 c
Fruit color ^x			
L*	47.16 b	51.20 a	48.37 b
a*	7.03 b	3.47 c	10.45 a
b*	25.64 b	29.78 a	28.90 a

^zFruit measurements made on five fruit, except for fruit color measurements, which were made on 12 fruit.

^yMeans within a row followed by the same letter are not significantly different at $P \leq 0.05$, by Tukey's Studentized range test.

^xColor measured with a Minolta CR-400 colorimeter (Konica Minolta Sensing Americas, Inc., Ramsey, NJ) using L*a*b* color coordinates. L* is a measure of darkness/lightness with values ranging from 0 (pure black) to 100 (pure white); a* is a measure of red (a* = +100) to green (a* = -100); b* is a measure of yellow (b* = +100) to blue (b* = -100).

Table 4. Fruit analysis of raspberry fruit from the 1992 harvest season, Puyallup, WA.^z

Cultivar	pH	Soluble solids (%)	Titrateable acidity as percent citric acid
Meeker	3.09 ^a	11.8 ab	0.95 b
Chilliwack	3.01 b	12.3 a	1.22 ab
Cascade Gold	2.95 bc	10.8 bc	1.27 a
Willamette	2.93 c	8.7 d	1.27 a
Comox	2.86 d	9.7 cd	1.47 a
Average	2.97	10.7	1.23

^aValues are means of five 10-g fruit samples.^bMeans within columns followed by the same letter are not statistically different using Duncan's multiple range test at $P = 0.05$.

was similar to 'Willamette'. 'Cascade Gold' has moderate to high soluble solids and high titrateable acidity, resulting in tart but well-balanced flavor. Non-replicated samples of 'Cascade Gold', 'Anne', and 'Goldenwest' fruit harvested 22 July 2010 were compared. 'Cascade Gold' had lower soluble solids and higher titrateable acidity than 'Anne' and 'Goldenwest' (data not shown) but had a tart, well-balanced flavor.

Disease and Pest Reaction

'Cascade Gold' is susceptible to root rot [*Phytophthora rubi* (W.F. Wilcox & J.M. Duncan) W.A. Man in 't Veld.] (Moore and Hoashi-Erhardt, 2012). 'Cascade Gold' had high levels of preharvest fruit rot from *Botrytis cinerea* L. in harvests in WSU-Puyallup plots (Table 1). Grafting tests indicated that 'Cascade Gold' was resistant to raspberry bushy dwarf virus. The unknown virus that was detected in 'Cascade Gold' in

1992 was identified as raspberry leaf mottle virus, a virus previously thought to occur only in Europe, but which has since been detected in northern Washington (McGavin and MacFarlane, 2010; Tzanetakis et al., 2007). In the PARC trial, 'Cascade Gold' supported few aphids (*Amphorophora agathonica* Hottes). In more recent testing, 'Cascade Gold' was determined to be resistant to aphid biotypes A to D and susceptible to E and F (Dossett and Kempler, 2012).

Uses

The fruit of 'Cascade Gold' is large, glossy, and firm with excellent flavor. The fruit releases easily from the receptacle at a very firm and lightly colored stage of development, allowing for successful long-distance transport. 'Cascade Gold' has been successfully grown in western Washington and shipped to eastern U.S. markets. It is best suited to fresh market use.

Availability

Names of propagators with certified 'Cascade Gold' plants will be supplied on request. The Washington Agricultural Research Center does not have plants for sale. Plant Patent protection will not be sought for 'Cascade Gold'.

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