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‘Hall’s Beauty’ Thornless Trailing Blackberry

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‘Hall’s Beauty’ is a new, early-ripening, high-quality, firm, and sweet thornless trailing blackberry (*Rubus* subg. *Rubus* Watson) cultivar with extremely large and attractive double flowers from the U.S. Department of Agriculture, Agricultural Research Service (USDA-ARS) breeding program in Corvallis, OR, released in cooperation with Oregon State University’s Agricultural Experiment Station. Mr. Harvey Hall (Shekinah Berries Ltd., Pyes Pa, New Zealand), with New Zealand HortResearch, the forerunner of The New Zealand Institute Plant & Food Research, originally incorporated the source of thornlessness used in ‘Hall’s Beauty’ into useful germplasm. The collaborative effort between him and USDA-ARS breeders in exchanging *Rubus* germplasm was critical to the current success of both programs; the name of the cultivar reflects gratitude for this relationship and Hall’s tremendous contributions, with his spouse Robyn Hall’s support, to blackberry breeding worldwide. ‘Hall’s Beauty’ is introduced as a machine harvestable, high-quality blackberry that has extremely large, attractive, and ornamental double flowers, which have many more petals than typical blackberries and that produce large, well-formed berries for the fresh or the processed fruit market. ‘Hall’s Beauty’ should be adapted to areas where other trailing blackberries can be grown successfully. A U.S. Plant Patent has been applied for (USPPAF 15/330,950).

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Origin

‘Hall’s Beauty’, tested as ORUS 3453-2, was selected in Corvallis, OR in 2008 from a cross made during 2005 between NZ 9629R-1 and ORUS 1939-4 (Fig. 1). ‘Hall’s Beauty’ shares two grandparents with ‘Columbia Star’ and ‘Columbia Giant’ and all four grandparents with ‘Columbia Sunrise’ (Finn et al., 2014, 2018a, 2018b). ‘Hall’s Beauty’ has the ‘Lincoln Logan’ source of thornlessness (botanically “spineless” but commonly referred to as “thornless” in industry and research communities) through NZ 9629R-1 (Hall et al., 1986). The parent ORUS 1939-4 was thorny, productive, and vigorous with large, glossy, very firm, uniformly conic-shaped fruit with excellent skin “toughness” and very good flavor. In a previous era, this selection would have been released for its yield and outstanding quality, but its thorniness made it commercially inviable. The other parent, NZ 9629R-1, was thornless, very productive and vigorous with small to medium-sized outstanding flavored, uniformly shaped, conic fruit. Gorgeous, extremely large, double flowers that progress to early ripening, consistently sweet, medium-large fruit with a tough skin, are the primary factors that distinguish ‘Hall’s Beauty’ from other trailing cultivars.

‘Hall’s Beauty’ was evaluated most extensively in trials at Oregon State University’s North Willamette Research and Extension Center (OSU-NWREC; Aurora, OR), USDA-ARS (Corvallis, OR), and Enfield Farms Inc. (Lynden, WA). In the Oregon trial plantings, standard cultural practices for trailing blackberry production were used, including annual pre- and postemergent herbicide applications, spring nitrogen fertilization (78 kg N/ha), postharvest removal of floricanes, training of primocanes to a two-wire trellis, and application of 2.5 to 5.0 cm of irrigation per week during the growing season, depending on rainfall. Delayed dormant applications of liquid lime sulfur and copper hydroxide were made to control leaf and cane spot (*Septoria rubi* Westend), purple blotch [*Sphaerulina westendorpii* (Westendrop) Verkley, Quaedvlieg & Crous (formerly *Septoria rubi* Westend)], rust [*Kuehneola uredinis* (Link) Arth.], and anthracnose [*Elsinoe veneta* (Burkholder) Jenk.] as a standard practice without any knowledge of the susceptibility of the selections in trial to these diseases. The cooperating grower in Washington is primarily a red raspberry (*Rubus idaeus* L.) grower and even though plants were spaced and trained similarly to those in the Oregon trials, they were irrigated and received nitrogen fertilizer rates that were standard for red raspberry but greater than typical for blackberry. At OSU-NWREC, ‘Hall’s Beauty’ was planted in a

replicated trial in 2009 and again in 2014, along with other selections and the standards 'Marion', 'Black Diamond', and 'Columbia Star' in a randomized complete block design with three replications. Each experimental unit consisted of three plants. Each replication was harvested once a week to determine harvest season, yield, and average fruit weight (based on a randomly selected subsample from each harvest) (Finn et al., 1997, 2005; Finn and Strik, 2014). 'Marion' accounts for the largest blackberry acreage in the Pacific Northwest, 'Black Diamond' accounts for the greatest number of blackberry plants established in the Pacific Northwest since 2005, and 'Columbia Star' has been the second most planted cultivar since 2014 (USDA-National Agricultural Statistics Service, 2017; P.P. Moore, personal communication). The average fruit weight for a season was calculated as a weighted mean based on the weight of a randomly selected subsample of 25 fruit from each harvest. The weighted mean was calculated by multiplying average berry weight for each week of harvest by the proportion of total yield picked that week; the values were then summed. These data, collected from 2011 to 2013 and 2016 to 2017, were separately analyzed as a split-plot in time with a fixed effect model with cultivar as the main plot and year as the subplot with mean separation by least significant difference (LSD; SAS PROC GLM, Cary, NC). LSD was only applied when there were significant differences for the trait. Of the multiple genotypes harvested from this replicated trial, only the data from 'Hall's Beauty' and the named cultivars were included in the analysis. The cultivar × year interaction was significant for yield but not for fruit weight and the means for yield in each year are presented and compared (Table 1).

Fruit evaluations were made during the harvest seasons using a 1 to 9 scale (9 = the best expression of each trait). The subjective fruit ratings included drupelet fertility (rating of drupelet set), firmness (as evaluated by hand in the field on six to eight fruit), color (ideal is a solid, dark black), shape (with a uniform, long conic berry being ideal), texture (as rated when chewed while tasting berries in the field), separation (how easily the ripe fruit were separated from the plant), and flavor (rated by tasting fruit in the field) (Table 2). Fruit glossiness (ideal is glossy), skin toughness (while holding fruit, thumb was rubbed across the fruit surface and ideally the skin surface did not break and "bleed"), and tolerance of heat/ultraviolet light damage (when fruit were fully ripe, the incidence of bleached or sunburned fruit was scored where 9 = no evidence of injury) were rated in 2016–17. The number of fruit per lateral was determined based on counting the fruit on five typical fruiting laterals in each plot once during the season in 2016–17. Some of the fruit harvested in 2013 were frozen, puréed, and assessed in a blind evaluation by a blackberry panel composed of growers, packers, processors, and researchers as described in Yorgey and Finn (2005) (Table 3). Titratable acidity, percent soluble solids, and pH were determined from harvested fruit (Table 4). Fruit samples of 'Black Diamond', 'Chester Thornless', 'Columbia Star', 'Columbia Sunrise', 'Hall's Beauty', and 'Marion' were analyzed for the

Fig. 1. Pedigree for 'Hall's Beauty'. The female parent is shown on top.

Table 1. Berry weight and yield in 2014–16 for 'Black Diamond', 'Columbia Star', 'Hall's Beauty', and 'Marion' blackberry at Oregon State University's North Willamette Research and Extension Center (Aurora, OR); planted in replicated trial (three plots of three plants each) in 2009 and 2014.

Cultivar	Berry wt (g)	Yield (kg/plant)			
2009 planting	2011–13	2011	2012	2013	2011–13
Black Diamond	6.0 bc[z]	7.02 ab	2.09 c	3.17 c	4.09 c
Columbia Star	7.6 a	7.48 a	5.92 a	8.18 a	7.19 a
Hall's Beauty	6.5 b	4.68 b	3.59 bc	6.07 b	4.78 bc
Marion	5.5 c	6.44 ab	4.75 ab	4.92 bc	5.37 b
2014 planting	2016–17		2016	2017	2016–17
Black Diamond	6.6 a		6.73 a	6.32 a	6.53 a
Columbia Star	6.9 a		7.24 a	6.92 a	7.08 a
Hall's Beauty	6.9 a		7.40 a	6.21 a	6.81 a
Marion	5.7 a		4.50 b	4.72 a	4.61 b

[z]Means within a column followed by the same letter are not significantly different, $P > 0.05$, by least significant difference test.

Table 2. Subjectively evaluated fruit quality traits for 'Black Diamond', 'Chester Thornless', 'Columbia Star', 'Hall's Beauty', and 'Marion' blackberry in two replicated trials (three plots of three plants each) planted in 2009 and 2014 for drupelet fertility, firmness, color, shape, texture, separation, and flavor (2011–13 and 2016–17) and the number of fruit per lateral, heat/ultraviolet light injury symptoms, skin toughness and glossiness were evaluated at Oregon State University's North Willamette Research and Extension Center (2016–17; Aurora, OR).[z]

Cultivar	Drupelet fertility	Firmness	Color	Shape	Texture	Separation	Flavor	Fruit/lateral	Heat/ultraviolet damage	Skin toughness	Glossiness
Black Diamond	7.0 b[y]	6.7 b	8.0 b	7.3 b	6.7 b	8.2 ab	6.3 c	10.4 ab	6.3 d	6.6 b	7.5 b
Chester Thornless	6.4 c	7.5 a	8.9 a	5.7 c	5.3 c	7.6 c	5.4 d	11.8 a	5.7 e	6.4 b	8.4 a
Columbia Star	8.6 a	7.9 a	8.2 b	8.5 a	8.1 a	8.4 a	8.2 a	7.8 c	8.4 a	8.1 a	7.1 b
Hall's Beauty	7.6 b	8.0 a	8.3 b	7.2 b	7.8 a	8.0 bc	7.6 b	7.8 c	7.8 b	8.0 a	8.3 a
Marion	5.9 d	4.6 c	7.4 c	5.3 c	8.1 a	8.4 a	8.3 a	8.6 bc	6.9 c	4.5 c	7.3 b

[z]A 1 to 9 scale was used where 9 = the best expression of each trait and 1 = the worst for all traits except for fruit/lateral, which was a count.
[y]Means within a column followed by the same letter are not significantly different, $P > 0.05$, by least significant difference test.

concentration of anthocyanins using previously described separation and identification procedures (Finn et al., 2014, 2018a; Lee and Finn, 2007) with a longer high-performance liquid chromatography analytical column (Synergi Hydro-RP 80Å, 250 mm × 2 mm, 4 µm; Phenomenex, Inc., Torrance, CA) fitted with a guard column in front (Table 4).

In 2009, 'Hall's Beauty' was planted along with a number of other genotypes in plots at Enfield Farms Inc. (Lynden, WA) to assess cold hardiness and suitability for machine harvest. An over-the-row Littau Harvester with a horizontal (Christy) head (Littau Harvester Inc., Stayton, OR) was used in 2010–11 at Enfield Farms Inc. (Lynden, WA) to harvest plots to determine machine harvestability. Plants were observed for any evidence of cold injury in 2010–11, but the winters were relatively mild (minimum temperature –9.0 to –8.9 °C in Dec. 2009, Nov. 2010, and Feb. 2011). Although the winters in Oregon from Fall 2009 through late Winter 2017 were also relatively mild, an unusual cold event in Dec. 2013 provided some insight into what conditions can cause damage in 'Hall's Beauty' as temperatures at the OSU-NWREC were –12.7 to –13.3 °C over 2 nights; on those same 2 nights it was –16.0 to –16.6 °C in Corvallis.

The fruit-ripening season in Oregon was characterized by the dates on which 5%, 50%, and 95% of the total fruit were harvested (Table 5). Plant ratings were conducted once each year during the fruiting season for primocane and floricane vigor, spines (9 = spineless; 1 = numerous, large spines), flowering or fruiting lateral length (1 = very short; 5 = very long) and strength (1 = weak, droopy; 5 = stiff, sturdy), and damage due to winter injury (9 = no injury; 1 = dead) (Table 6).

Description and Performance

In spring, 'Hall's Beauty' was truly remarkable in bloom (Figs. 2 and 3). For a blackberry, the flowers were extremely large, averaging 4.9 cm in diameter, with an average of 15.2 petals/flower (data not shown) compared with about five in standard cultivars. The flowers have an attractive pink color as the buds swell and a bright and attractive white petal color when fully unfurled.

In both trials, 'Hall's Beauty' had moderate yields, comparable to the other commercial cultivars in trial (Table 1). When grown under optimal conditions, 'Hall's Beauty' will usually have a higher yield than 'Marion' and comparable yield to 'Black Diamond' and 'Columbia Star'. There was year-to-year variability for yield in the 2009 planting with the highest mean cultivar yield in 2011 (6.80 kg/plant) and lowest in 2012 (4.52 kg/plant). In the 2014 planting, yields were comparable across years. The greater average yield in the 2014 trial vs. the 2011 trial was most likely due to better plant quality when the trial was established (Table 1).

There were cultivar effects but no significant year effects or an interaction between fruit weight and year. 'Hall's Beauty' fruit are usually heavier than those of 'Marion' and 'Black Diamond' and lighter than those of 'Columbia Star', but these differences were not always significant (Table 1). 'Hall's Beauty' has an excellent size for clamshell packaging because it looks large but is not so large that packers would have difficulty making their stated unit weight. The number of fruit per lateral can be one indicator of potential yield and 'Hall's Beauty' had fewer fruit per lateral than 'Black Diamond' or 'Chester Thornless' but was similar to the other cultivars in trial. Fruit shape was affected by the semierect or trailing genetic background and drupelet set, with the semierect cultivar 'Chester Thornless' tending to have rounder and less uniformly shaped fruit whereas the trailing cultivars 'Black Diamond', 'Columbia Star', and 'Hall's Beauty' tended to be more conical and uniformly shaped. The combination of good drupelet set and genetic background also affected fruit shape scores (Strik et al., 1996). 'Hall's Beauty' was rated as having a very good fruit shape and high drupelet set comparable to 'Black Diamond', as less symmetrical and uniform than 'Columbia Star', but as more attractive and a higher drupelet set than 'Chester Thornless' or 'Marion' (Figs. 4 and 5; Table 2). 'Hall's Beauty' has excellent fruit color comparable to the other thornless trailing cultivars; it is not as dark as 'Chester Thornless' but blacker/less purple than 'Marion'. Fresh fruit of 'Hall's Beauty' were rated as having better firmness than 'Marion' and 'Black Diamond' and being as firm as 'Columbia Star' and 'Chester Thornless' (Table 2). Since 'Columbia Star's release, it has proven to be firm and have few problems with "bleeding" in the local fresh market (Finn et al., 2014). Bleeding is largely due to poor drupelet skin toughness. 'Hall's Beauty' was rated similarly to 'Columbia Star' for skin toughness and better than 'Chester Thornless' and 'Black Diamond', and much tougher than the tender-skinned 'Marion' (Table 2). When eaten, 'Hall's Beauty' fruit texture was rated very good and comparable to 'Columbia Star' and 'Marion', more desirable than 'Black Diamond', and much more desirable than 'Chester Thornless' (Table 2). 'Hall's Beauty' was picked easily

Table 3. Fruit percent soluble solids, pH, and titratable acidity for 'Black Diamond', 'Chester Thornless', 'Columbia Star', 'Columbia Sunrise', 'Hall's Beauty', and 'Marion' blackberry grown at Oregon State University's North Willamette Research and Extension Center (Aurora, OR). Harvested in 2011–13 and 2016–17 (n = 3).

Cultivar	Soluble solids (%)	pH	Titratable acidity (g·L^{-1} as citric acid)
Black Diamond	10.20 d [z]	3.39 b	12.56 b
Chester Thornless	11.72 c	3.30 bc	10.41 c
Columbia Star	12.64 b	3.26 c	14.80 a
Columbia Sunrise	13.41 a	3.69 a	7.61 d
Hall's Beauty	12.84 ab	3.33 bc	13.77 ab
Marion	12.43 b	3.23 c	15.07 a

[z]Means within a column followed by the same letter are not significantly different, $P > 0.05$, by least significant difference test.

Table 5. Ripening season estimated as the date at which yield passed the given percentage of total yield for 'Black Diamond', 'Chester Thornless', 'Columbia Giant', 'Columbia Star', 'Hall's Beauty', and 'Marion' blackberry in trials planted in 2009 and 2014 and harvested in 2011–13 and 2016–17, respectively at Oregon State University's North Willamette Research and Extension Center (Aurora, OR).

	Harvest season		
Cultivar	5%	50%	95%
2009 planting			
Hall's Beauty	3 July	10 July	24 July
Columbia Star	3 July	12 July	24 July
Columbia Giant	3 July	15 July	19 July
Marion	8 July	15 July	24 July
Black Diamond	3 July	17 July	26 July
Chester Thornless	5 Aug.	28 Aug.	25 Sept.
2014 planting			
Hall's Beauty	24 June	28 June	12 July
Columbia Star	18 June	1 July	8 July
Marion	24 June	1 July	15 July
Black Diamond	18 June	4 July	18 July
Triple Crown	18 July	5 Aug.	12 Aug.
Chester Thornless	22 July	8 Aug.	26 Aug.

Table 4. Anthocyanin concentrations (milligrams of cyanidin-3-glucoside/100 g) of 'Black Diamond', 'Chester Thornless', 'Columbia Star', 'Hall's Beauty', and 'Marion' blackberry harvested in 2017 from trials at Oregon State University's North Willamette Research and Extension Center (Aurora, OR).[z]

Cultivar	Cyanidin-3-glucoside	Cyanidin-3-rutinoside	Cyanidin-3-xyloside	Cyanidin-3-malonylglucoside	Cyanidin-3-dioxalylglucoside[y]	Total
Black Diamond	139.1 (79)	33.0 (19)	2.7 (1)	2.3 (1)	Not detected	177.1
Chester Thornless	266.7 (89)	1.4 (0)	11.1 (4)	7.6 (3)	11.7 (4)	298.6
Columbia Star	168.3 (75)	53.4 (24)	1.0 (0)	2.1 (1)	Not detected	224.8
Hall's Beauty	242.2 (73)	78.8 (24)	1.0 (0)	3.3 (1)	5.6 (2)	330.9
Marion	261.5 (80)	54.9 (17)	2.2 (<1)	3.0 (<1)	5.1 (2)	326.7

[z]Anthocyanin listed in the order of high-performance liquid chromatography elution. Values in parentheses are percentages of the total anthocyanins.
[y]Possibly cyanidin-hydroxymethylglutaroylglucoside (Jordheim et al., 2011).

Table 6. Subjectively evaluated plant traits for 'Black Diamond', 'Chester Thornless', 'Columbia Star', 'Hall's Beauty', and 'Marion' blackberry in a replicated trial (three, three-plant plots) planted in 2009 and 2012 for primocane vigor and spines, floricane vigor, lateral length and strength, and winter injury at Oregon State University's North Willamette Research and Extension Center (Aurora, OR).

	Primocane		Floricane	Lateral		Winter
Cultivar	Vigor[z]	Spine	Vigor	Length	Strength	Injury
Black Diamond	7.5 c	8.0 b	6.6 d	2.1 d	3.8 a	8.1 b
Chester Thornless	8.9 a	9.0 a	8.9 a	5.0 a	2.0 c	9.0 a
Columbia Star	8.4 b	9.0 a	8.4 b	4.4 b	2.7 b	8.1 b
Hall's Beauty	8.2 b	9.0 a	8.0 c	3.7 c	3.5 a	8.1 b
Marion	7.9 b	3.8 c	6.9 d	5.0 a	2.3 c	6.9 c

[z]A 1 to 9 scale was used where 9 = the best expression of each trait and 1 = the worst for all traits except lateral length and strength, which were on a 1 to 5 scale, where 1 = short and weak and 5 = long and strong, and winter injury where 9 = no observable injury and 1 = killed to the ground. Means within a column followed by the same letter are not significantly different, $P > 0.05$, by least significant difference test.

Fig. 2. Entire plant of 'Hall's Beauty' in bloom.

Fig. 3. Typical flowering cluster of 'Hall's Beauty'.

by hand and, in commercial trials, picked well with a machine harvester (Table 2). When eaten fresh in the field, 'Hall's Beauty' fruit flavor was not as outstanding as 'Columbia Star' or 'Marion' but rated higher than 'Black Diamond' or 'Chester Thornless' (Table 2). 'Hall's Beauty' fruit flavor is excellent, but the acid–sweet balance is tipped toward sweet, which is often more desirable for fresh market consumers but less so for processing. 'Hall's Beauty' was rated excellent for heat tolerance because it had fewer heat/ultraviolet light injury symptoms than 'Black Diamond', 'Chester Thornless', or 'Marion'. We are not sure if 'Hall's Beauty' and 'Columbia Star' fruit are physiologically better able to handle heat/ultraviolet light without showing injury or whether their early ripening allows fruit to escape the conditions that trigger these symptoms.

Fig. 4. Typical fruiting cluster with ripe fruit of 'Hall's Beauty'.

In Dec. 2014, 'Hall's Beauty' fruit were included in a blind evaluation of sweetened purées of 'Black Diamond', 'Columbia Star', and 'Marion' by a blackberry evaluation panel to determine how they compared with industry standards (data not shown). As a purée, there were no significant differences among the cultivars for aroma, flavor, color, and overall quality. In informal evaluations of thawed individually quick frozen fruit by members of the industry and research communities, 'Hall's Beauty' was regularly noted for its attractive and firm fruit, dark color, and pleasant and sweet flavor.

In multiple years of evaluation, the fruit of 'Hall's Beauty' had percent soluble solids, pH, and titratable acidity comparable to 'Columbia Star' and 'Marion' (Table 3). 'Hall's Beauty' fruit had higher soluble solids but similar pH and titratable acidity to 'Black Diamond'. 'Chester Thornless' fruit had a lower percentage of soluble solids, a similar pH, and a lower titratable acidity compared with 'Hall's Beauty'. This combination of traits puts 'Hall's Beauty' in a range that is desirable for fresh

Fig. 5. Flat of hand harvested fruit of 'Hall's Beauty'.

Fig. 6. Entire fruiting plant of 'Hall's Beauty'.

consumption or processing (Wrolstad et al., 2008).

For all the blackberry cultivars evaluated, cyanidin-3-glucoside was the predominant anthocyanin (Table 4). The total anthocyanin concentration for 'Hall's Beauty' was the greatest of the cultivars tested, and the distribution of the concentrations of the various anthocyanins was generally similar to those for the other trailing blackberries. However, small amounts of cyanidin-3-dioxalylglucoside were present in 'Hall's Beauty' but not in 'Black Diamond' or 'Marion'. 'Chester Thornless' tended to have higher levels of cyanidin-3-xyloside and cyanidin-3-malonylglucoside and lower levels of 3-rutinoside than fruit of 'Hall's Beauty' and the other trailing blackberry cultivars.

Unfortunately, the very early ripening 'Columbia Sunrise' was not included in the replicated yield trials with 'Hall's Beauty', so although 'Hall's Beauty' was the earliest ripening cultivar in both replicated trials, from our observations in nearby trials, it is not as early as 'Columbia Sunrise' (Table 5) (Finn et al., 2018b). 'Hall's Beauty' ripened 6 to 7 d ahead of 'Black Diamond', whereas 'Columbia Sunrise ripened 11 d ahead of 'Black Diamond'. 'Hall's Beauty' ripened a few days ahead of the other trailing cultivars in trial and was 5 or more weeks earlier than the semierect 'Triple Crown' and 'Chester Thornless'. Being earlier ripening than most other cultivars gives it some advantages by providing growers other options to their season for fresh and processed markets. Also 'Hall's Beauty' will need fewer insecticide sprays for spotted winged drosophila (*Drosophila suzukii* Matsumura) as this pest only begins to build

Table 7. Genetic profiles of the parents, ORUS 1939-4 and NZ9629R-1, and the offspring, 'Hall's Beauty' at each of the eight simple sequence repeat (SSR) markers in the blackberry fingerprinting set (Zurn et al., 2018). Allelic composition for all three genotypes is listed for each SSR and the light grey highlighted alleles indicate alleles shared only with NZ 9629R-1 and dark-grey highlighted allele were inherited from the other parent, ORUS 1939-4.

Genotype	RH_MEa007aG06	Ro942	RH_MEa0008cF01	RH_ME0013dA06	RH_MEa0006bG05	ERubLRSQ_07-4_D05	RH_MEa0015cE06	RH_MEa011dG03a
NZ 9629R-1	123 139 143	114 128 131 140 148	138 141 153 156	206 215 224 230 233 238	265 279 288 325	240 244 247	244 249	330 339 345 351 357
ORUS 1939-4	123 131 139	114 128 131 143	138 141	206 230 233 234	268 296	240	242 244 247	336 339 345 351
Hall's Beauty	123 139 143	114 128 131 143 148	138 141 153	206 215 224 230 233 234 238	268 288 296 325	240 244	244 247 249	330 336 339 351 357

to problematic levels toward the end of 'Hall's Beauty' harvest season.

The primocanes of 'Hall's Beauty' were as vigorous as those of 'Marion' and 'Columbia Star' but were less vigorous than for 'Chester Thornless' and more vigorous than those of 'Black Diamond' (Table 6; Fig. 6). 'Hall's Beauty' thornlessness is derived originally from 'Lincoln Logan', and therefore the canes are entirely thornless. In contrast, 'Black Diamond' has the 'Austin Thornless' source of thornlessness, and while functionally thornless, it does have thorns at the base of canes (Table 6) (Hall et al., 1986). 'Marion' has many large thorns along the entire cane length. The floricanes of 'Hall's Beauty' were scored as being less vigorous than 'Chester Thornless' and 'Columbia Star' and more vigorous than those of 'Black Diamond and 'Marion' (Table 6). The fruiting laterals of 'Hall's Beauty' were medium long, longer than those for 'Black Diamond' but not as long as the other cultivars (Table 6; Figs. 3 and 6). The lateral strength was similar to 'Black Diamond' and not nearly as pendulous as for 'Marion' and 'Chester Thornless' (Table 6).

With a minimal spray program, no significant incidence of foliar or cane diseases occurred in Oregon, although in 2011, when the conditions apparently were ideal for purple blotch (*Septocyta ruborum*), the symptoms were more severe on 'Marion' and 'Black Diamond' than on 'Hall's Beauty' (data not shown). With a commercial raspberry fungicide program in Lynden (WA), there were no foliar or cane disease symptoms. One commercial test field was in a river flood plain and flooded most springs with no obvious symptoms of phytophthora root rot evident.

Over the years tested in Lynden (WA) and in Corvallis (OR) when potentially injurious temperatures were experienced the previous winters, 'Hall's Beauty' showed symptoms of cold injury; however, the winter injury scores were consistently better than those for 'Marion' but were poorer than 'Chester Thornless' and slightly lower than those for 'Columbia Star' (data not shown). At OSU-NWREC, in replicated trial, 'Hall's Beauty' was rated as having similar winter-hardiness to 'Columbia Star' and 'Black Diamond', better hardiness than 'Marion', but not as outstanding hardiness as 'Chester Thornless' (Table 6).

'Hall's Beauty' is introduced as an outstanding ornamental thornless, trailing blackberry with very large and attractive flowers, excellent fruit quality, a particularly sweet flavor, excellent firmness and skin toughness, and good yields. 'Hall's Beauty' is suited for the fresh and processed fruit markets. The relatively early-ripening characteristic is expected to reduce the exposure of developing fruit to spotted winged drosophila. 'Hall's Beauty' should be adapted to areas where other trailing blackberries can be successfully grown.

'Hall's Beauty' nuclear stock has tested negative for *Apple mosaic virus*, *Arabis mosaic virus*, *Cherry leaf roll virus*, *Cherry rasp leaf virus*, *Prunus necrotic ringspot virus*, *Raspberry bushy dwarf virus*, *Raspberry ringspot virus*, *Strawberry necrotic shock virus*, *Tobacco ringspot virus*, *Tobacco streak virus*, *Tomato black ring virus*, *Tomato ringspot virus*, and *Xylella* by enzyme-linked immunosorbent assay. It has also indexed negative on grafting to *R. occidentalis* L., and has tested negative for *Blackberry chlorotic ringspot virus*, *Beet pseudo yellows virus*, *Blackberry virus Y*, *Blackberry yellow vein associated virus*, *Black raspberry necrosis virus*, *Raspberry latent virus*, *Raspberry leaf mottle virus*, *Rubus yellow net virus*, and *Strawberry latent ringspot virus* in reverse transcriptase polymerase chain reaction (PCR) assays for phytoplasmas and Xylella in PCR assays. It was also negative in bioassays when it was grafted onto *R. occidentalis* 'Munger'.

Parentage of 'Hall's Beauty' was confirmed by microsatellite analysis using a fingerprinting set of eight simple sequence repeat (SSR) markers that we have developed at the USDA-ARS National Clonal Germplasm Repository to genotype our blackberry collection (Zurn et al., 2018). All the alleles amplified in 'Hall's Beauty' were found in either parents, NZ 9629R-1 and/or ORUS 1939-4 (Table 7). One to three alleles at each of the SSRs except for ERubLRSQ_07-4_D05 were only shared with NZ 9629R-1; and one to two alleles at five (Ro942, RH_ME0013dA06, RH_Mea0006bG05, RH_Mea0015cR06, and RH_Mea011dG03a) of the eight SSRs could only be inherited from the other parent, ORUS 1939-4. The markers are consistent with the recorded pedigree for the cross between NZ 9629R-1 and ORUS 1939-4.

An application for a U.S. Plant Patent has been submitted for 'Hall's Beauty'. When this germplasm contributes to the development of a new cultivar, hybrid, or germplasm, it is requested that appropriate recognition be given to the source. Further information or a list of nurseries propagating 'Hall's Beauty' is available on written request to Chad E. Finn. The USDA-ARS and Oregon State University do not sell plants. In addition, genetic material of this release has been deposited in the National Plant Germplasm System as CRUB 2807 (PI 682653), where it will be available for research purposes, including development and commercialization of new cultivars.

Literature Cited

Finn, C.E. and B.C. Strik. 2014. Blackberry cultivars for Oregon (EC 1617-E, Revised). Oregon State University Extension Service, Corvallis, OR.

Finn, C., B.C. Strik, and F.J. Lawrence. 1997. Marion trailing blackberry. Fruit Var. J. 51:130–132.

Finn, C.E., B.C. Strik, B.M. Yorgey, M.E. Peterson, J. Lee, R.R. Martin, and H.K. Hall. 2014. 'Columbia Star' thornless trailing blackberry. HortScience 49:1108–1112.

Finn, C.E., B.C. Strik, B.M. Yorgey, M.E. Peterson, P.A. Jones, J. Lee, and R.R. Martin. 2018a. 'Columbia Giant' thornless trailing blackberry. HortScience 53:251–255.

Finn, C.E., B.C. Strik, B.M. Yorgey, M.E. Peterson, P.A. Jones, and R.R. Martin. 2018b. 'Columbia Sunrise' thornless trailing blackberry. HortScience 53:256–260.

Finn, C.E., B. Yorgey, B.C. Strik, H.K. Hall, R.R. Martin, and M.C. Qian. 2005. 'Black Diamond' trailing thornless blackberry. HortScience 40:2175–2178.

Hall, H.K., R.M. Skirvin, and W.F. Braam. 1986. Germplasm release of 'Lincoln Logan', a tissue culture-derived genetic thornless 'Loganberry'. Fruit Var. J. 40:134–135.

Jordheim, M., K.H. Enerstvedt, and O.M. Andersen. 2011. Identification of cyanidin 3-*O*-β-(6″-hydroxy-3-methylglutaroyl)glucoside) and other anthocyanins from wild and cultivated blackberries. J. Agr. Food Chem. 59:7436–7440.

Lee, J. and C.E. Finn. 2007. Anthocyanins and other polyphenolics in American elderberry (*Sambucus canadensis*) and European elderberry (*S. nigra*) cultivars. J. Sci. Food Agr. 87:2665–2675.

Strik, B., J. Mann, and C. Finn. 1996. Percent drupelet set varies among blackberry genotypes. HortScience 121:371–373.

USDA-National Agricultural Statistics Service. 2017. 07/28/2017: NW Noncitrus Fruit & Nut 2016 Summary. Portland, OR. 17 May 2018. <https://www.nass.usda.gov/Statistics_by_State/Oregon/Publications/Fruits_Nuts_and_Berries/2017/Fruit.pdf>.

Wrolstad, R.E., T. Ngo, C.E. Finn, and Y. Zhao. 2008. Color quality of fresh and processed strawberries. ACS Symp. Ser. 983:18–42.

Yorgey, B.M. and C.E. Finn. 2005. Comparison of 'Marion' to thornless blackberry genotypes as individually quick frozen and puree products. HortScience 40:513–515.

Zurn, J.D., K.A. Carter, M.H. Yin, M.W. Worthington, J.R. Clark, C.E. Finn, and N.V. Bassil. 2018. Validating blackberry seedling pedigrees and developing an improved multiplexed microsatellite fingerprinting set. J. Amer. Soc. Hort. Sci. 143:381–390.