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# 'Nightfall' Thornless Trailing Blackberry

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'Marion' is currently the most important blackberry (*Rubus* L. subgenus *Rubus*) cultivar in the world and it is the predominant cultivar grown for the processed fruit market (Finn et al., 1997). While 'Marion' produces fruit of outstanding quality for processing, the plants are thorny (botanically termed spiny). When 'Marion' is machine harvested, thorns can end up in the product (Strik and Buller, 2002), which can lead to a poor product, and, more significant in an economic sense, lawsuits. As a result, a primary priority for the breeding program has been the development of cultivars that are thornless, machine harvestable, and retain the excellent processing characteristics of 'Marion'.Three thornless blackberry cultivars with these qualities are being released simultaneously: 'Nightfall', 'Black Diamond' (Finn et al., 2005a), and 'Black Pearl' (Finn et al., 2005b).

'Nightfall' is a thornless trailing blackberry from the U.S. Department of Agriculture-Agricultural Research Service (USDA–ARS) breeding program in Corvallis, Ore., released in cooperation with the Oregon State University Agricultural Experiment Station and the Washington State University Agricultural Research Center. 'Nightfall' has yields and fruit quality similar to 'Marion'. The plants are thornless and adapted to machine harvesting.

## Origin

In 1996, 'Nightfall' was selected in Corvallis from a 1993 cross of 'Marion' × 'Waldo', and tested as ORUS 1486-2. 'Marion's importance as the leading processing cultivar has been stated previously. 'Waldo', released in 1989, was the first thornless trailing blackberry cultivar released. While 'Waldo' is planted commercially, it has not displaced much of the 'Marion' acreage. While 'Waldo' is high yielding, thornless, machine harvestable and has some very good fruit attributes, it has low vigor and takes one year longer to reach full production than 'Marion'. 'Waldo' has more brittle canes subject to breaking during training, has fruit clusters that hold the fruit in close proximity to one another increasing the likelihood of botrytis (*Botrytis cinerea* Pers.: Fr.), is late ripening, and the processed fruit flavor, while very good, is not similar to the preferred aromatic flavor 'Marion'. 'Waldo's thornlessness was derived through NC 37-35-M-2 from 'Austin Thornless'.

While the ploidy level has not been manually been determined for 'Nightfall', it is expected to be hexaploid because the ploidy of both parents, 'Marion' and 'Waldo', were counted as 2n = 6x = 42 (Thompson, 1995) and estimated by flow cytometry as 6x (Meng and Finn, 2002).

## Description and Performance

'Nightfall' has been tested predominantly at the Oregon State University North Willamette Research and Extension Center (NWREC) Aurora, Ore. In each of the trial plantings, standard cultural practices for trailing blackberry production were used, including annual pre- and postemergent herbicide applications, annual spring nitrogen fertilization (78 kg N/ha), postharvest removal of floricanes, training of primocanes to a two wire trellis, and weekly overhead application of about 2.5 cm of irrigation. All plantings received applications of dormant season fungicides (liquid lime sulfur and copper hydroxide) to control leaf and cane spot (*Septoria rubi* Westend.), purple blotch [*Septocyta ruborum* (Lib.) Petr.], rust [*Kuehneola uredinis* (Link) Arth.] and anthracnose [*Elsinoe veneta* (Burkholder) Jenk.]. They also received a single bloom application of captan to control anthracnose, botrytis (*Botrytis cinerea* Pers.: Fr.), cane spot, purple blotch and stamen blight (*Hapalosphaeria deformans* [Syd.] Syd.) at labeled rates. The replicated planting at NWREC was arranged in a randomized complete block design, with four, three-plant replications used for fresh fruit characteristics and three replications hand harvested once per week to determine harvest season, yield and fruit weight. The average fruit weight for a season is a weighted mean based on the weight of a randomly selected subsample of 25 fruit from each harvest. These data, collected from 2001–03, were analyzed as a split plot in time with cultivar as the main plot and year as the subplot. Of the 23 genotypes harvested in replicated trial for yield, only the data from 'Marion', 'Silvan', 'Siskiyou', and 'Waldo' and the new releases 'Nightfall', 'Black Diamond' (Finn et al., 2005a), and 'Black Pearl' (Finn et al, 2005b) were included in the analysis (PROC GLM; SAS Institute, Cary, N.C.). The cultivar × year interaction was significant for yield but not for fruit weight. Therefore, the interaction means for yield are presented and compared using Duncan's multiple range test (Table 1). The fruit ripening season in Oregon was characterized by the dates at which 5%, 50%, and 95% of the total fruit yield were harvested (Table 2). In 2001, 'Nightfall' was planted, along with a number of genotypes, in plots at Enfield Farms (Lynden, Wash.) along the Canada–U.S. border to assess cold hardiness and suitability for machine harvest. While observations were made on these plants from 2002–04, the winters were relatively mild (minimum winter temperature in Winter 2001–02 was –8.0 °C with –3.8 and –9.7 °C minimums in the following two winters). In

Table 1. Fruit weight and yield in 2001–03 for blackberry genotypes planted in 1999 in replicated trial at the Oregon State University–North Willamette Research and Extension Center in Aurora.

| | Fruit size (g)[z] | Yield (kg·ha$^{-1}$) | | | |
|---|---|---|---|---|---|
| Genotype | 2001–03 | 2001 | 2002 | 2003 | Mean 2001–03 |
| Nightfall | 6.2 b | 42447 a | 13405 a | 20962 a | 25604 a |
| Silvan | 6.2 bc | 31757 ab | 16811 a | 21485 a | 23351 a |
| Black Diamond | 5.8 cd | 29281 a–c | 15568 a | 19001 a | 21283 ab |
| Marion | 5.1 e | 26380 a–c | 13021 a | 18397 a | 19266 ab |
| Black Pearl | 6.2 b | 26969 a–c | 14373 a | 15505 ab | 18949 ab |
| Waldo | 5.5 d | 25849 bc | 11000 a | 17286 a | 18045 ab |
| Siskiyou | 6.9 a | 20969 c | 9854 a | 9359 b | 13394 b |

[z]Means withing a column followed by the same letter are not significantly different $p > 0.05$, by Duncan's multiple range test.

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2003, fruit were harvested by an over-the-row (Littau, Stayton, Ore.) harvester with a horizontal (Christy) head from five-plant plots (Table 3). Subjective fruit evaluations were made during the fruiting season using a 1 to 9 scale (9 = the best expression of each trait). These subjective evaluations were done on cultivars in the replicated trial as well as important commercial cultivars ('Chester Thornless' and 'Kotata') that were not. The fruit ratings included firmness (as measured subjectively by hand in the field on six to eight berries), color, shape (with a uniform, long conic ideal), texture (as measured subjectively when chewed while tasting berries in the field), separation (subjective rating of how easily ripe fruit separated from the plant), and flavor (subjectively rated by tasting berries in the field) (Table 4). Plant ratings were conducted one time each year from 2001–03 during the fruiting season for primocane and floricane vigor, spines (9 = spineless; cultivars derived from 'Austin Thornless' are seldom completely spineless, basal spines are common and occasionally a single spine on the lower side of the petiolule), and flowering/fruiting lateral length (1 = very short, 5 = very long) and strength (1 = weak, droopy; 5 = stiff, sturdy) (Table 4). In a concurrent study, Yorgey and Finn (2005) evaluated the processing characteristics of several cultivars and advanced selections including 'Nightfall'. They prepared individually quick frozen and puree products from several genotypes for evaluation by a blind panel of untrained experts.

In Oregon, 'Nightfall' had a similar yield to 'Marion', 'Silvan', and 'Waldo' but a greater yield than 'Siskiyou' in each year except 2002 (Table 1). 'Nightfall' tended to have a higher yield than 'Marion' and 'Waldo' in all years. In the machine harvested Washington State trial, 'Nightfall' was the second highest yielding genotype (Table 3) and the fruit harvested well with few defective (i.e., green, pedicels still on) fruit. Fruit size for 'Nightfall' tends to be larger than 'Marion' or 'Waldo', very similar to 'Silvan' but not as large as 'Siskiyou' (Table 1).

'Nightfall' harvest begins the first few days of July, peaks in early July and is largely done by the third week of July in Oregon (Table 2). The harvest season is almost identical to 'Marion', later ripening than 'Obsidian' and 'Metolius' and earlier than 'Waldo'. In Washington, while the beginning and end of the harvest season were very similar to 'Marion', the peak of harvest was a few days later, more similar to 'Boysen' (Table 3).

Fruit of 'Nightfall' are usually conic, more uniformly shaped than 'Marion' but not as uniform as 'Waldo' (Table 4, Fig. 1). 'Nightfall' fruit are firmer than 'Marion' and 'Silvan' (Table 3), leading to a very good quality when machine harvested. 'Nightfall' fruit are similar in color to those of 'Marion' and less purple or more black than those of 'Silvan' (Table 4). The fruit separate from the plant easily by hand (Table 4) or by machine (Table 3). Fresh fruit of 'Nightfall' have a texture similar to 'Silvan'. 'Nightfall' fruit have an excellent flavor but they are very acidic (Table 4). This acidity is beneficial in a processed product but fruit are probably too tart to make a good fresh market product.

'Nightfall' and other new cultivars were evaluated by a blind panel as individually quick frozen (IQF) and puree samples (Yorgey and Finn, 2005). 'Nightfall' has been evaluated in blind panels by industry representatives as processed IQF and pureed products. As an unsweetened IQF fruit, 'Nightfall' was ranked similarly to 'Marion' for color, appearance, seediness, and overall quality, and ranked lower than 'Marion' for flavor. As an unsweetened pureed product, 'Nightfall' was ranked similar to 'Marion' for aroma, color and overall quality but was ranked lower for flavor. 'Nightfall' has an acidic flavor and will likely require higher levels of sweetener when used in formulations as compared to 'Marion'.

'Nightfall' plants are similar in vigor and cane health to 'Marion' and 'Silvan' (Table 4). 'Nightfall' is thornless by commercial standards, however the primocanes have some thorns on the basal 30 to 40 cm, a height below the catcher plates on a harvest machine; 'Nightfall' is comparable to 'Waldo' in this trait (Table 4). 'Nightfall' has fruiting laterals that are fairly long, similar to those of 'Marion' and longer than those of 'Waldo'. The laterals tend to be similar in strength to those of 'Silvan'.

In our trials, under a minimal spray program, 'Nightfall' has been free of serious cane, leaf or fruit diseases. 'Nightfall' is not particularly susceptible to Septoria leaf spot and purple blotch. 'Nightfall' does not exhibit vegetative or fruit symptoms of cane and leaf rust. In some years, particularly 1997, 'Marion', 'Kotata', and 'Black Butte' were severely damaged by a dryberry syndrome. The cause of this problem is not known currently but is suspected to be a complex of diseases, particularly anthracnose, that develops under certain combinations of temperature and moisture. Dryberry symptoms have never been noted on 'Nightfall'.

In Oregon, no significant winter injury has been noted on this genotype since it was selected in 1996. In northern Washington, 'Nightfall' has scored similarly to 'Marion' for winter injury, showing modest, but not commercially significant injury after the

Table 2. Mean ripening season and date at which yield of each genotype reached the given percentage of total yield at the Oregon State University–North Willamette Research and Extension Center in Aurora. Trial was planted in 1999 and harvested in 2001–03.

| | Harvest season | | |
|---|---|---|---|
| Genotype | 5% | 50% | 95% |
| Metolius | 25 June | 3 July | 14 July |
| Obsidian | 25 June | 4 July | 15 July |
| Siskiyou | 25 June | 8 July | 25 July |
| Silvan | 26 June | 8 July | 21 July |
| Black Diamond | 28 June | 8 July | 21 July |
| Marion | 3 July | 10 July | 22 July |
| Black Pearl | 3 July | 10 July | 24 July |
| Nightfall | 3 July | 11 July | 23 July |
| Waldo | 8 July | 22 July | 7 Aug. |

Table 3. Yield and harvest season for blackberry genotypes planted in one or two five-plant plots (1.4 m plant spacing) in 2001 and 2002 at Enfield Farms (Lynden, Wash.). Plants were primarily harvested with an over the row harvester (Littau, Stayton, Ore) with a horizontal (Christy) head.

| | Yield | 2003 Harvest season | | | No. |
|---|---|---|---|---|---|
| Genotype | (kg·ha$^{-1}$) | 5% | 50% | 95% | plots |
| Black Diamond | 17281 | 11 July | 21 July | 6 Aug | 2 |
| Nightfall | 14384 | 11 July | 25 July | 6 Aug. | 1 |
| Silvan | 12106 | 11 July | 21 July | 3 Aug. | 2 |
| Marion | 10382 | 11 July | 21 July | 6 Aug. | 2 |
| Siskiyou | 9656 | 11 July | 21 July | 31 July | 1 |
| Boysen | 8670 | 16 July | 25 July | 31 July | 1 |
| Metolius | 8480 | 11 July | 11 July | 25 July | 1 |
| Waldo | 7112 | 21 July | 31 July | 6 Aug. | 2 |

Table 4. Mean scores for subjectively evaluated characteristics[z] of 'Nightfall' and three commercial blackberry cultivars planted in 1999 at the Oregon State University–North Willamette Research and Extension Center in Aurora.

| | Primocane | | Floricane | Fruiting lateral | | Fruit | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cultivar | vigor | Thorns | vigor | Length | Strength | Firm | Color | Shape | Texture | Separation | Flavor |
| Nightfall | 9.0 | 8.3 | 8.3 | 4.3 | 2.5 | 7.2 | 8.0 | 8.2 | 8.3 | 8.2 | 7.0 |
| Marion | 9.0 | 4.6 | 8.5 | 4.8 | 3.3 | 5.4 | 8.3 | 6.7 | 8.9 | 8.9 | 8.6 |
| Silvan | 9.0 | 3.1 | 7.9 | 3.5 | 2.7 | 3.9 | 7.1 | 7.2 | 8.2 | 8.6 | 8.0 |
| Waldo | 8.6 | 8.4 | 7.6 | 1.7 | 4.5 | 7.0 | 8.6 | 8.9 | 8.8 | 8.8 | 6.9 |

[z]Characteristics (except for laterals) scored on a 1 to 9 scale, where 1 = the poorest expression of the trait and 9 = the best expression of the trait, i.e., 9 = very vigorous, spineless, very firm, black, uniform shape, pleasant to chew not seedy, separates easily from the plant, and intense flavor, respectively. Lateral characteristics scored on a 1 to 5 scale, where 1 = short or weak laterals and 5 = long or strong laterals.

Fig. 1.'Nightfall' (**a**) fruiting lateral and (**b**) plant.

2001–02 and 2002–03 winters. In Fall 2003, the temperatures dropped rapidly to –3 to –6 °C in Oregon and –4 to –8 °C in northern Washington during the last 2 d of October. Many genotypes including 'Marion' and 'Silvan', as well as 'Nightfall', were severely damaged (cane and bud death) by this rapid change in temperatures in our Washington, but not our Oregon, trials. One reason for the greater damage in Washington may be that the plots were in a commercial red raspberry field where plants were heavily fertilized with nitrogen and irrigated to maximize growth the first year and yield the following year. This approach may have led to injury on plants that were not yet dormant. 'Nightfall' appears to be similar to its parent 'Marion' in adaptation to cold temperatures.

Outstanding characteristics of 'Nightfall' include large fruit, a yield similar to that of 'Marion', good processed fruit quality, excellent adaptation to machine harvesting, and thornless plants with good disease tolerance. 'Nightfall' should be a useful commercial cultivar for the processed blackberry industry. 'Nightfall' will not likely be well suited for the fresh market as it is too tart and lacks sufficient firmness to be shipped as a fresh fruit. 'Nightfall' is expected to perform well in areas where trailing blackberries are adapted, including the Pacific Northwest, California, Chile, New Zealand, United Kingdom, and the Mediterranean region.

## Availability

'Nightfall' is not patented. When this germplasm contributes to the development of a new cultivar or germplasm, the authors request that appropriate recognition be given to the source. 'Nightfall' nuclear stock has tested negative for tomato ringspot, raspberry bushy dwarf, and tobacco streak viruses by ELISA and has indexed negative on grafting to *R. occidentalis*. Further information or a list of nurseries propagating 'Nightfall' is available on written request to the contact author. The USDA–ARS does not have commercial quantities of plants to distribute. In addition, plants of 'Nightfall' have been deposited in the National Plant Germplasm System, at USDA-ARS NCGR in Corvallis, Ore. accession number PI 638263, where it is available for research purposes, including development and commercialization of new cultivars.

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