

New USDA-ARS Blackberry Cultivars Bring Diversity to the Market

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Abstract

The primary objective of the USDA-ARS breeding program, conducted in cooperation with Oregon State University, has been to develop thornless, machine-harvestable, trailing blackberry (*Rubus* L.) cultivars with processed fruit quality comparable to the current industry standard ‘Marion’. Towards this goal, ‘Waldo’ was released by the USDA-ARS in 1989 and ‘Douglass’ was patented and released in 1994 by Mr. Barney Douglass. While these cultivars have many admirable traits, neither has had a significant commercial impact. ‘Black Diamond’, ‘Black Pearl’ and ‘Nightfall’, are recent releases by the USDA-ARS that are thornless, machine harvestable, and have fruit quality comparable to ‘Marion’ in evaluations by food scientists and by evaluation panels. ‘Black Diamond’ has already been planted extensively by commercial growers. The USDA-ARS program has had a long germplasm evaluation and development program utilizing *Rubus ursinus* Cham. & Schldl. One cross of a superior selection of *R. ursinus* with ‘Waldo’ produced a selection that is being propagated for commercial release. ORUS 1843-3 combines the outstanding fruit quality of the native *R. ursinus* with the thornlessness and disease resistance of ‘Waldo’. As with the species, the fruit of ORUS 1843-3 are small, ~3 g, but since they can be machine harvested, it will be planted to meet specific processing applications that require small fruit. While the bulk of the program is geared towards processing genotypes, Northwest growers are interested increasingly in producing fruit for the fresh market. ‘Siskiyou’ is an example of a trailing blackberry that has excellent fruit quality and can be shipped in the wholesale fresh market. The recent releases ‘Obsidian’ and ‘Metolius’ are extremely early ripening in a climate like the Pacific Northwest, have excellent fruit quality, and can be picked with sufficient firmness to ship in the wholesale fresh market. The recent USDA-ARS releases represent a diversity of new options for commercial growers including thornless, high quality, machine harvested cultivars for processing, a thornless, small fruited cultivar for specific processing niches, and for fresh sales, the earliest ripening blackberries on the market.

INTRODUCTION

The Pacific Northwest is a major blackberry production area (2400–2800 ha) and while most of the crop is processed, 900–1000 t are sold fresh (OASS, 2005). The USDA-ARS program in Corvallis, begun in 1928 and conducted in cooperation with Oregon State University, is the oldest continuously active blackberry breeding program in the world. George M. Darrow (1937) spent a few years in Oregon in the late 1920s and early 1930s helping to establish the breeding program. Darrow and G.F. Waldo swapped positions in 1932 with Darrow moving to Maryland and Waldo back to his native Oregon. Waldo generated a breeding pool using primarily ‘Loganberry’, ‘Youngberry’, ‘Mammoth’, ‘Himalaya’, and wild selections of *R. ursinus* (i.e., ‘Zielinski’), including perfect-flowered cultivars (i.e., ‘Santiam’/‘Ideal’), where the maternal parent was *R. ursinus* and the paternal parent was unknown but suspected to be ‘Loganberry’ (Waldo, 1968). This germplasm quickly generated the releases ‘Pacific’ (Waldo and Wiegand, 1942), ‘Cascade’ (Waldo and Wiegand, 1942), ‘Chehalem’ (Waldo, 1948), and ‘Olallie’ (Waldo, 1950b). The next generation of crosses produced ‘Marion’ (Waldo, 1957). In the late 1960s, Francis J. “Whitey” Lawrence took over the program from Waldo. He

evaluated some of the materials that Waldo started, i.e., ‘Kotata’ (Lawrence, 1984), but more importantly, he developed outstanding thornless selections from ‘Austin Thornless’. Eventually, ‘Waldo’ was released as the first thornless, trailing blackberry (Lawrence, 1989). The germplasm he developed provided the building blocks from which these new cultivars were developed.

Beginning in the early 1990s, the industry driven objective for a “thornless, cold hardy, firm cultivar with ‘Marion’ flavor” became much more pressing as legal costs due to thorn contamination increased (Hall et al., 2002). Simultaneously, a large collection of native *R. ursinus* was made in the Pacific Northwest (Finn, 2001). The best genotypes from this collection were incorporated into breeding material bringing the outstanding flavor and flexible canes from the species into our main breeding pool. These combined efforts led to the development of series of cultivars that can be grouped as follows:

- Thornless machine harvestable, with excellent processed fruit quality,
- Thornless “wild” selections,
- Very early ripening fresh market.

THORNLESS MACHINE HARVESTABLE WITH EXCELLENT PROCESSED FRUIT QUALITY

Hall et al. (2002) addressed the problem of replacing iconic cultivars such as ‘Boysen’ and ‘Marion’ that are mainstays of an industry. Overlaying that challenge is the incorporation of the thornless trait. The USDA-ARS began using the ‘Austin Thornless’ gene in the 1950s and ‘Waldo’ was released in 1989. ‘Waldo’ has not replaced much of the ‘Marion’ acreage as its flavor, while good, is very different from ‘Marion’. By the mid-1990s, the USDA program had assembled 30+ superior thornless selections and the industry was demanding a high quality thornless blackberry as quickly as possible. These selections were placed in replicated trial in 1999 and were first evaluated as processed fruit in a blind trial of research and industry members in 2000. This initial in-house, unpublished trial helped us focus on the most interesting dozen genotypes. In 2001, fruit from these were prepared and put through a blind evaluation by industry representatives (Yorgey and Finn, 2005). Simultaneously, an effort was begun to carefully characterize blackberry flavor, particularly ‘Marion’ flavor (Klesk and Qian, 2003a, b). Studies that established baseline information were then used to evaluate the most promising selections (Qian and Finn, 2005). Finally, these genotypes were evaluated by a trained consumer panel (Kurnianta, 2005) to try to identify the best genotypes and to link consumer preference with flavor profile information. The following three cultivars were released based on these various studies as well as their horticultural performance (i.e., yield, disease resistance, machine harvestability).

‘Black Diamond’ was introduced primarily as a thornless genotype for the machine harvested processing market, and secondarily as a cultivar for the fresh market (Finn et al., 2005e). ‘Black Diamond’ is outstanding because of its large, uniformly shaped and firm fruit coupled with production similar to ‘Marion’. ‘Black Diamond’ was selected in 1997 from a cross of ‘Kotata’ × NZ 8610L-163 (E90 × N-71) made in 1991 by H. Hall with New Zealand HortResearch Inc. and tested as NZ 9128R-1. Individually quick frozen (IQF) and puree samples of the new releases and ‘Marion’ were evaluated blindly by an untrained expert panel for color, appearance, seediness, aroma, flavor, and overall quality (Yorgey and Finn, 2005). As an IQF fruit, ‘Black Diamond’ was ranked similarly to ‘Marion’ and ‘Waldo’ in perceived color and appearance; and similar to ‘Waldo’, but lower ranked than ‘Marion’, for flavor, seediness, and “overall quality”. As a puree, ‘Black Diamond’ was ranked similarly to ‘Waldo’, ‘Marion’, and ‘Silvan’ for aroma, flavor, color, and “overall quality”. Conclusions from consumer panel evaluations determined that, based on flavor, ‘Black Diamond’ would be a good replacement for ‘Marion’ (Kurnianta, 2005). ‘Black Diamond’ is a moderately vigorous plant producing large, sturdy canes. Typical for material derived from ‘Austin Thornless’, ‘Black Diamond’s canes have spines below 0.5 m, but these are below a machine’s catcher plates. ‘Black Diamond’ was the top selling cultivar in the Pacific Northwest in 2004–

2005 (P. Moore, pers. comm.).

‘Black Pearl’ is outstanding because it compares favorably to ‘Marion’ for its plant, yield, and fruit characteristics in the field and it appears to produce a similar quality processed product (Finn et al., 2005c). ‘Black Pearl’ was selected in 1995 from a cross of ORUS 1117-11 × ORUS 1122-1 made in 1993 and tested as ORUS 1380-1. ‘Black Pearl’ has been evaluated in blind panels by industry representatives as processed individually quick frozen and pureed products. As an IQF fruit, ‘Black Pearl’ was ranked better than ‘Marion’, ‘Silvan’, and ‘Waldo’ for color, appearance, and seediness and it was ranked similar to ‘Marion’, but better than ‘Silvan’ and ‘Waldo’, for flavor and overall quality. As a pureed product, ‘Black Pearl’ was ranked similarly to ‘Silvan’, ‘Waldo’, and ‘Marion’ for aroma, flavor, color, and “overall quality”. As with ‘Black Diamond’, consumer panels concluded that, based on flavor, ‘Black Pearl’ should be a good replacement for ‘Marion’ (Kurnianta, 2005). ‘Black Pearl’ is a moderately vigorous plant that produces strong primocanes and, as with ‘Black Diamond’, has inconsequential spines below 0.5 m.

‘Nightfall’ is outstanding because it compares favorably to ‘Marion’ for its plant, yield, and fruit characteristics in the field, and it produces a good quality processed product (Finn et al., 2005d). ‘Nightfall’ was selected in Corvallis, Ore. in 1996 from a cross of ‘Marion’ × ‘Waldo’ made in 1993, and tested as ORUS 1486-2. ‘Nightfall’ has been evaluated in blind panels by industry representatives as processed IQF and pureed products. As an IQF fruit, ‘Nightfall’ was ranked similar to ‘Marion’ for color, appearance, seediness, and “overall quality” and poorer than ‘Marion’ for flavor. As a pureed product, ‘Nightfall’ was ranked similar to ‘Marion’ for aroma, color and “overall quality” but was ranked poorer for flavor. ‘Nightfall’ has an acidic flavor and will likely require higher sweetener levels when used in formulations as compared to ‘Marion’. ‘Nightfall’ has vigorous floricanes and primocanes. As with the other two, and most material derived from ‘Austin Thornless’, ‘Nightfall’ does have inconsequential spines at the base of the canes.

THORNLESS “WILD” SELECTIONS

Our program has worked to collect, evaluate, and incorporate *R. ursinus* into our breeding material (Finn, 2001). While we did not expect immediate returns on this effort, we were surprised that several selections were identified that are first generation hybrids of selections of *R. ursinus* and ‘Waldo’ and that have commercial potential. These selections combine the thornlessness and disease resistance of ‘Waldo’ with the intense flavor, small fruit, and flexible canes of *R. ursinus*. ORUS 1843-3, in the process of being named, is a selection out of a cross between a superior *R. ursinus* selection from a population collected from Mt. Hebo Oregon and ‘Waldo’. ORUS 1843-3 has scored very well as a processed fruit product, with flavor better than ‘Marion’, in evaluations by an untrained, expert panel (Yorgey and Finn, 2005). It is machine harvestable, a critical trait for a small fruited genotype. The main concern with these selections has been that they are very vigorous early on thin canes and if training is left until late in the summer or winter cane breakage can be an issue. This selection is in commercial plantings.

VERY EARLY RIPENING FRESH MARKET

The majority of the USDA-ARS blackberry program has focused on the processed market. However, the changing marketplace, the interest our growers have in diversifying their operations here and abroad, and the potential value of our germplasm in similar climates has increased our interest in fresh market cultivars. The erect (e.g., ‘Navaho’) and semi-erect (e.g., ‘Chester Thornless’) cultivars have been grown primarily for fresh market sales, and the trailing (e.g., ‘Marion’) cultivars for processing. However, there are some exceptions, ‘Olallie’ a trailing type was a major fresh market cultivar in California for local sales and long distance shipping until about 2001 (R. Harrison, pers. comm.) and more recently ‘Siskiyou’, produced along the West Coast, has proven adapted to long distance shipping (Finn et al., 1999). In the past, the erect and semi-erect blackberries

have typically had better firmness/skin toughness and black color than the trailing cultivars, but the trailing cultivars have generally had better flavor and are more pleasant to eat (perception of smaller or fewer seeds). ‘Obsidian’ and ‘Metolius’ were released recently as they have excellent fruit quality, are firm enough to ship and are the earliest ripening cultivars on the fresh market when grown in a climate comparable to Oregon’s (Fig. 1) (Finn et al., 2005a, b).

‘Obsidian’ was selected in 1995, from a cross between ORUS 828-43 and ORUS 1122-1 made in 1993 and tested as ORUS 1369-3. Both parents of ‘Obsidian’ have complex pedigrees, but ‘Marion’, ‘Olallie’, and OSC 878 (‘Jenner’ × ‘Eldorado’) figure prominently in their backgrounds. ‘Obsidian’ has had very high yields of very early ripening, large berries with excellent fresh flavor. Yield has been greater than ‘Marion’ and ‘Kotata’ and nearly doubles that of ‘Siskiyou’. Fresh fruit in the field have been rated good for firmness and skin toughness; very good for shape, texture and flavor; and outstanding for color, appearance and glossiness. The fruit should have adequate firmness and skin toughness for short distance shipping but will likely need special attention to picking time and handling for more distant shipping. The shape is very good but more rounded than ‘Marion’ and not as uniformly shaped as ‘Siskiyou’ or ‘Metolius’. The fruit hold their black color after harvest when either refrigerated or frozen. Fruit flavor is excellent as a fresh product and is good when picked “firm black”. In informal storage trials, ‘Obsidian’ has held up for 7 d in a clamshell under refrigeration with no visible loss in quality. After 22 d refrigerated storage in a clamshell at a commercial shipper, the fruit was still fairly firm, had little mold and still had good flavor.

‘Metolius’ was selected in 1997 from a cross of ‘Douglass’ and ‘Kotata’ and tested as ORUS 1452-1. ‘Douglass’ is an 8x trailing blackberry developed and patented by Mr. Barney Douglass that has wild *Rubus ursinus* and selections from the USDA-OSU cooperative program in its pedigree (Douglass, 1993). ‘Metolius’ plants are moderately vigorous, less vigorous than ‘Marion’, ‘Silvan’, and ‘Obsidian’. The canes are very spiny, comparable to ‘Silvan’ and spinier than ‘Marion’. The fruit is presented well for hand picking. ‘Metolius’ has had high yields of very early ripening, medium-sized berries with excellent fresh firmness and flavor. Yield has been similar to ‘Marion’, ‘Silvan’, and ‘Obsidian’ and 40% greater than ‘Siskiyou’. As with ‘Obsidian’, the first fruit ripen with ‘Silvan’ and ‘Siskiyou’ but the 50% harvest date is earlier than both. Fruit weight has been similar to ‘Waldo’ and ‘Marion’ but less than ‘Siskiyou’ and ‘Obsidian’. The fruit evaluated as fresh fruit in the field have been rated excellent for firmness, skin toughness, color, shape, and ease of separation from the plant and very good for flavor. ‘Metolius’ has similar or slightly better firmness and skin toughness when compared to the commercially shipped ‘Siskiyou’. ‘Metolius’ should ship well and the flavor is good when picked very firm and fully colored, but not fully ripe. The fruit have an excellent black color and are glossy. The flavor has been consistently rated as very good to excellent, but while ‘Metolius’ has a full, sweet blackberry flavor, it is not as aromatic as ‘Marion’. In informal storage trials at a commercial packer/shipper, ‘Metolius’ has held up for 7 d in a clamshell under refrigeration with no visible loss in quality, however after 22 d the fruit was not salable.

CONCLUSIONS

While the USDA-ARS will continue to focus primarily on the development of machine harvestable, thornless blackberries suited for processing, the multiple objectives outlined in this paper, which includes the development of cultivars suited for the fresh market will continue to be pursued.

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Figures

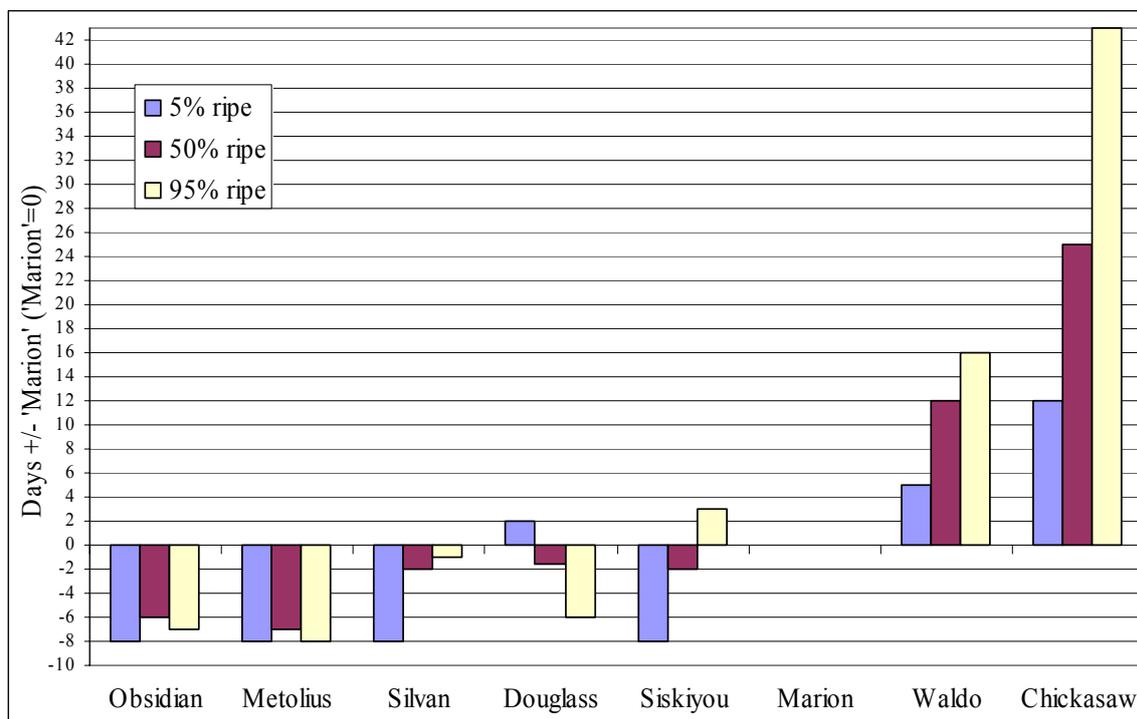


Fig. 1. Ripening time in relation to 'Marion'. 2001–2003 harvest seasons.