

'HyRed', an Early, High Fruit Color Cranberry Hybrid

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The American cranberry, *Vaccinium macrocarpon* Ait., is a small fruit grown in temperate regions of the world. The United States is the major producer with the combined Wisconsin and Massachusetts harvests accounting for ≈80% of the total U.S. annual production. The fruit is used primarily for juices. In addition to the tart flavor, the principal component of value is the red pigment or anthocyanin content of the fruit, measured as total anthocyanin (TAcY) in milligrams per 100 g fresh fruit (Fuleki and Francis, 1968). The importance of pigment content is recognized by some processors by giving a color incentive payment to deliveries to processing plants of fruit having a TAcY >30. This incentive payment can be economically important, especially during years of low fruit prices. Regions with a longer growing season (Washington and Oregon) average TAcY levels of 50–62 at delivery, whereas fruit grown in Wisconsin averages a TAcY of 33 (personal communication, Dr. Rodney Serres, Ocean Spray Cranberries, Lakeville-Middleboro, Mass.). In addition, regions with colder fall weather (northcentral United States) often harvest many of the current cultivars before full fruit color development to avoid freezing injury and icing problems in the low-lying cranberry beds.

The cranberry selections grown today have not undergone extensive breeding. The selections are maintained by cloning using cuttings (mowed vines disced into new beds). Many selections were derived directly from native areas or from managed beds of mixed origin. For example, 'Ben Lear' is a selection taken directly from the wild in Wisconsin in the early 1900s and is widely grown in short-season areas because of its early fruit development and high color content (delivered TAcY of 'Ben Lear' averaging 42 in Wisconsin). One generation of breeding improvement was undertaken by the USDA in cooperation with state experiment stations during the middle of the last century and resulted in

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the introduction in 1950 of the most widely grown cultivar today, 'Stevens' (Chandler et al., 1950). 'Stevens' is characterized by dependably high yields but only moderate color development, especially in short-season regions like Wisconsin (TAcY of 'Stevens' averages 34 in Wisconsin). Another cultivar, 'Pilgrim', also released from this program and less widely grown than 'Stevens', is characterized by relatively large, but more lightly colored fruit than 'Stevens' (Chandler and DeMoranville, 1961).

In 1990, we launched a limited breeding program with the goal of developing cranberry hybrids for Wisconsin and other short-season regions that had dependably high yields of early-maturing, high color fruit. Not only will such selections be able to dependably capture any available color incentives, but the ability to harvest early will allow an extended harvest season, thus optimizing harvest and handling operations and reducing the risk of unpredictable late-season weather events.

Origin

'HyRed' originated from a cross of 'Stevens' and a seedling selection designated as 'Ben Lear #8', derived from an open-pollinated population of 'Ben Lear' (selected by Dr. Don Boone and maintained at the type collection at DuBay Cranberries, Portage County, Wis.) (Fig. 1). Controlled pollinations were done in a greenhouse using potted plants. Seeds were germinated *in vitro*, the resultant plants micropropagated, and >700 cloned individual seedlings were planted in a test plot in a grower's field in central Wisconsin. In 1993, 'HyRed' was selected for its early color and high fruit bud set, again brought back into micropropagation, and replanted along with other selections in test plots of various sizes (20 to 200 m²) in grower fields in 1994 through 1997. Because of the unique and high cost production techniques required to grow cranberries, areas for test plots were necessarily limited to open space available in commercial beds. Replicated and comparative plots were utilized when feasible. The test plots included 'Stevens' or 'Pilgrim', which served as standards for comparison. In addition, plantings were done in two distinct growing regions, central Wisconsin and northern Wisconsin. The central Wisconsin region is typified by a 170-d season with nearly 3000 growing degree days (base of 45°), whereas the northern region by a 110-d season with 2500 growing degree days.

Description

Fruit were sampled periodically from 4- to 7-year-old plots located in both central and northern Wisconsin and color analyses were performed using procedures based on the method of Fuleki and Francis (1968). These samples were taken primarily in mid-September, usually ≈2 weeks before the beginning of the commercial harvest. In every year, 'HyRed' showed TAcY readings at least twice that of comparable 'Stevens' plots (Fig. 2). In addition, 'HyRed' showed prominent early coloration even in late August and increased in pigment content at a greater rate than 'Stevens' through the September ripening period (Fig. 3). Fruit of 'HyRed' develops excellent coloration even when deeply covered within the vine mat, thus resulting in few poorly colored berries (pictorially shown in the Dec. 2001/Jan. 2002 issue of Cranberries magazine).

The anthocyanins of cranberry are located almost entirely in the epidermal layers of the fruit (Sapers et al., 1983). Thus, one factor that can contribute to high extractable fruit color in cranberry is small fruit size (Vorsa and Welker, 1985), in part a result of the influence of surface area to weight ratio on total pigment content of each fruit. In addition, a negative correlation between yield and some of the flavonoid compounds, including anthocyanins, has been suggested (Vorsa et al., 2002). However, differences in fruit size and yield between 'HyRed' and other cultivars have been minor when compared to the differences in extractable color. For example, early harvests of fruit from adjacent plots of 'HyRed' and the commercial cultivar 'Pilgrim' in northern Wisconsin showed the markedly greater pigment content of 'HyRed' in both years, while differences in fruit yield and fruit size were negligible or much less pronounced (Table 1). In all our plantings, the fruit size of 'HyRed' has averaged >1.5 g, which is similar to the average fruit size of 'Ben Lear' and 'Stevens' grown in comparable locations in Wisconsin (data not shown). Thus 'HyRed' appears to be able to develop high

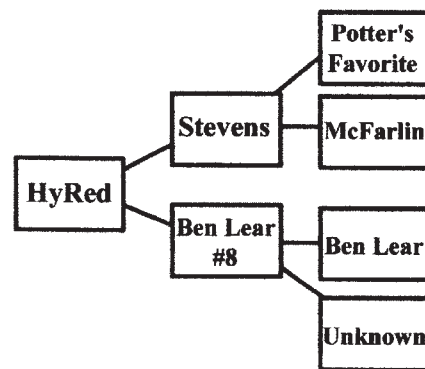


Fig. 1. Pedigree of 'HyRed'. The seed parent is the upper and the pollen parent is the lower member of each couplet. 'Ben Lear', 'Potter's Favorite', and 'McFarlin' are wild selections. 'Ben Lear #8' is an open pollinated seedling of 'Ben Lear' selected by Dr. Don Boone, Univ. of Wisconsin–Madison.

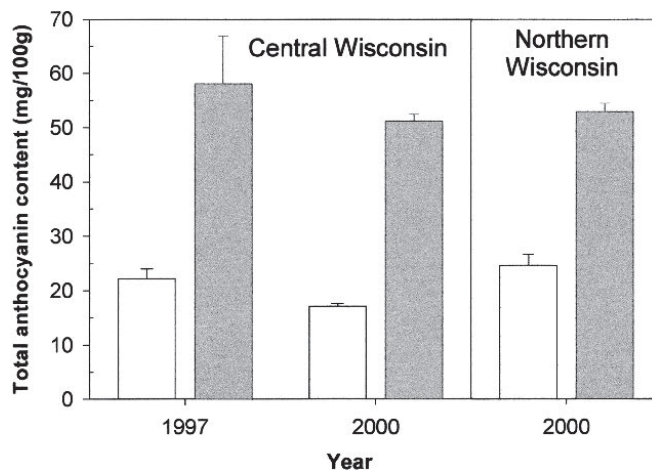


Fig. 2. Mid-September fruit color of 'Stevens' (open bars) and 'HyRed' (shaded bars). Three pooled samples were taken from harvests in randomly tossed rings within the plots [values are mean and error bars are standard error (SE)]. In 1995 and 1996, single sample assays from the central Wisconsin plots showed the same differences between 'Stevens' and 'HyRed' as displayed above. The differences recorded in 2000 were independently confirmed by analyses of paired samples at Ocean Spray Cranberries.

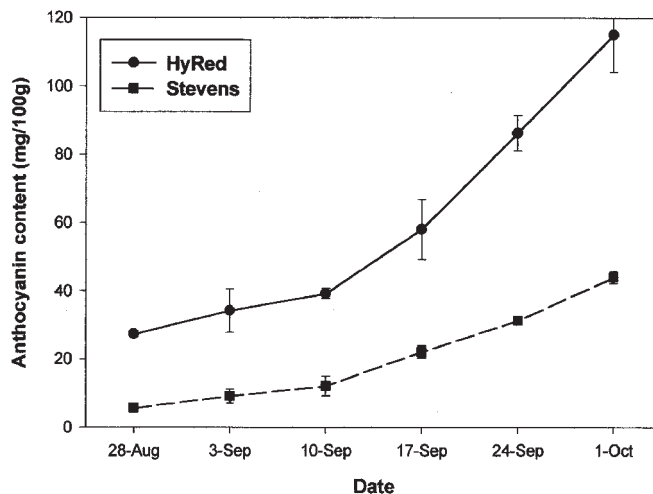


Fig. 3. Cranberry fruit color development of 'Stevens' and 'HyRed' over the 1997 growing season. Values are the mean and range of two random samples taken at weekly intervals from adjacent plots at a site in central Wisconsin. Comparable trends were also recorded during the 1996 growing season.

Table 1. Pigment content, fruit size, and total fruit yield of two selections of cranberry harvested early (\approx 2 weeks before normal commercial harvest) during two consecutive growing seasons. Plants grown in commercial production beds in northern Wisconsin. Data are averages with SE of 12 random 0.018-m² samples from adjacent beds of each cultivar.

Cultivar	Harvest year 2000			Harvest year 2001		
	Tacy (mg anthocyanin/100 g fruit)	Average		Tacy (mg anthocyanin/100 g fruit)	Avg	
		Individual berry wt (g)	Total sample berry wt (g)		Individual berry wt (g)	Total sample berry wt (g)
Pilgrim	17.0 (0.6)	2.09 (0.03)	62.8 (2.1)	13.7 (1.5)	1.64 (0.03)	60.9 (7.7)
HyRed	53.0 (1.5)	1.77 (0.05)	61.8 (4.4)	39.4 (0.9)	1.60 (0.08)	54.6 (4.6)

Table 2. Titratable acidity and percentage of total soluble solids ($^{\circ}$ Brix) content of harvested fruit from 3 cranberry selections. Fruit was harvested during late Sept. 2000 from adjacent plots at two production locations in Wisconsin. Three pooled samples were taken from harvests in randomly tossed rings within the plots at each location. Analysis of variance indicated no significant differences for a fruit trait ($P = 0.05$) between selections at a location.

Selection	Titratable acidity (meq·g ⁻¹ dry wt)		$^{\circ}$ Brix	
	Location 1	Location 2	Location 1	Location 2
Stevens	2.40	NA	8.64	NA
Pilgrim	NA	2.46	NA	7.54
HyRed	2.40	2.41	8.47	7.94

^{NA}Not applicable.

levels of extractable pigmentation simultaneously with good fruit size and yield.

In 2000, analyses of two additional fruit quality traits, titratable acidity and percentage of total soluble solids ($^{\circ}$ Brix), were conducted at Ocean Spray Cranberries using standard procedures adapted from Ballington et al. (1984). 'HyRed' fruit did not show any significant differences in these traits when

compared to either standard cultivar 'Stevens' or 'Pilgrim' when grown in the same location (Table 2).

Availability

'HyRed' is being patented by the Wisconsin Alumni Research Foundation (WARF) and license agreements are being distributed

on a priority system to: 1) Wisconsin cranberry growers for use in their production operations in Wisconsin; 2) growers associated with the Ocean Spray Cranberries cooperative; and 3) as supplies and agreements permit. Other growers will then be able to license 'HyRed'.

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