‘WA 5’ Apple

Kate M. Evans¹, Bruce H. Barritt, Bonnie S. Konishi, Marc A. Dilley, and Lisa J. Brutchter

Tree Fruit Research and Extension Center, Washington State University, 1100 N. Western Avenue, Wenatchee, WA 98801

Cameron P. Peace

Department of Horticulture and Landscape Architecture, Washington State University, Pullman, WA 99164

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‘WA 5’ is a new eye-catching apple with a bright orange–red stripe covering 60% to 90% of the yellow background. It rarely exhibits russet, sunburn, or bitterpit and has small and inconspicuous lenticels. Fruit of ‘WA 5’ has excellent texture. It is firmer, crisper, and juicier than ‘Gala’ and maintains its texture in storage and on the shelf. Fruit is round and generally intermediate in size (smaller than ‘Fuji’ and ‘Braeburn’ but larger than ‘Gala’). ‘WA 5’ fruit ripens in early to mid-September in central Washington and its exceptional texture and eye-catching appearance particularly suit the fresh market.

Origin

‘WA 5’ originated from a cross between ‘Splendour’ and Co-op 15 (Fig. 1) made in 1994 in Corvallis, OR, by Shawn Mehlenbacher. The seed was transferred to the Washington State University Tree Fruit Research and Extension Center (TFREC), Wenatchee, in 1994 where it was germinated and raised in a greenhouse in 1995. The seedling was transferred to the nursery in May 1995 where it grew until Sept. 1995 when it was budded onto M.9 rootstock. The resulting tree was planted in the Phase 1 seedling evaluation orchard T19 at TFREC (row 10, position 5) in Apr. 1997. Fruit from this original budded tree was observed in 1999, 2000, and 2001 and, based on fruit quality data, ‘WA 5’ was selected for Phase 2 evaluation in Oct. 2001. Buds were taken from the seedling tree and propagated onto M.9 rootstock in Sept. 2002. Five trees were planted at each of three Phase 2 sites in central Washington in Apr. 2004. Further trees were budded in 2005 onto M.9 rootstocks for larger-scale Phase 3 plantings in 2007 at four commercial orchard sites in central Washington. ‘WA 5’ was virus-tested and certified material was budded onto virus-indexed MM.106 rootstock for the production of certified propagation material.

Description and Performance

The 5-year average ‘WA 5’ full-bloom flowering occurred 2 d after that of ‘De-

licious’ at Wenatchee, WA (lat. 47.26° N; long. 120.21° W). The number of blossoms per bud ranges from four to five with individual flowers medium in size (49.7 mm in diameter). Petals are white with grayed-purple highlights [Royal Horticultural Society (RHS), 1966, 1986, 1995] 186C and grayed-purple (RHS 186B) upper and lower surface veins. Sepals usually curl back toward the peduncle and are green (RHS 143C) with tips highlighted grayed-red (174A) on both the upper and lower surfaces. Pollen is viable although *S*-alleles are as yet undetermined.

‘WA 5’ fruit ripens in early to mid-September in Wenatchee, ≈7 to 10 d after ‘Gala’ and several weeks before ‘Braeburn’. Fruit is medium-sized and round conical in shape with an average equatorial diameter of 7.7 cm. At harvest, fruit has a conspicuous bloom. When polished, skin color is bright with 60% to 90% red color (RHS 46A) over yellow (RHS 8C) in a distinct mottled stripe (Fig. 2). Lenticels are present and distinct (white RHS 155D) but inconspicuously small, smooth, and round. Fruit russet has not yet been observed. Peduncle length is medium short, barely reaching above the bowl; the cavity is acute in shape and has an average depth of 1.4 cm. The calyx is erect, convergent with downy-textured sepals and the basin cavity is ribbed. Seeds average three per cell, are acuminate in shape averaging 4.2 mm diameter by 8.9 mm in length, and are from the grayed-orange group RHS 166A.

Fruit was evaluated from the original (Phase 1) tree at several harvest dates in years 2001 to 2008 and from Phase 2 trees in years 2005 to 2009. Fruit quality (appearance,

maturity, and eating quality) was recorded from both fresh samples and those stored in regular atmosphere storage at 1 to 2 °C for 60 d. Both fresh and stored fruit were also instrumentally evaluated for weight, soluble solids, titratable acidity, and firmness (Table 1). ‘WA 5’ fruit is firm, crisp, and juicy in texture and has a balanced flavor with a slightly higher acid to sugar ratio than ‘Gala’ and ‘Fuji’. Aroma is mild and apple-like and flesh color is RHS yellow group 2D. With a trained sensory panel performed in Nov. 2010, crispness of ‘WA 5’ apples did not significantly differ ($P < 0.05$) from ‘Honeycrisp’ (C. Ross, personal communication) after regular atmosphere cold storage, unlike ‘Gala’, which was statistically significantly less crisp. However, both ‘Gala’ and ‘Honeycrisp’ were statistically sweeter. The trained panel was composed of 10 individuals trained over 11 to 15 h using techniques described by Meilgaard et al. (1999). Apple attributes were selected following Chauvin (2007) and panelists rated intensity of the test apples at room temperature using a 15-cm unstructured line scale. In untrained consumer tests using a 7-point hedonic scale (1 = dislike extremely and 7 = like extremely), both ‘WA 5’ and ‘Honeycrisp’ achieved significantly greater overall scores than ‘Gala’. Additional texture analysis (Evans et al., 2010a) showed ‘WA 5’ similar in crispness to ‘Scifresh’ and ‘8S6923’ (Aurora Golden Gala™) and slightly less crisp than ‘Honeycrisp’ and more crisp than ‘Braeburn’, ‘Fuji’, ‘Cripps’ Pink’, ‘Golden Delicious’, and ‘Gala’ (Fig. 3). ‘WA 5’ is earlier in season, higher in acidity, juicier, and distinct in appearance to the recently released ‘WA 2’ (Evans et al., 2010b).

The ‘WA 5’ tree is of the open vase type, upright and spreading, and has light to

Fig. 2. Fruits of ‘WA 5’ apple.

Fig. 1. Pedigree of ‘WA 5’.

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¹To whom reprint requests should be addressed; e-mail kate_evans@wsu.edu.

moderate spur development. 'WA 5' trees are of compact habit with a relatively small trunk cross-sectional area (Table 2), possibly benefiting in commercial plantings from an increased planting density compared with more vigorous cultivars. 'WA 5' is very precocious and, if not thinned, will have a tendency to alternate bearing. Management of crop load to avoid overcropping is also recommended to achieve optimum juiciness

and sweetness. Annual yield, cumulative yield from 2005 to 2009, and yield efficiency of 'WA 5', 'Gala', and 'Fuji' are compared (Table 2) from an orchard planted in 2004 near Richland in central Washington. 'WA 5' is considered hardy for the region (suitable for at least USDA hardiness zone 7). Bark is black (RHS 202A) with rough texture and a moderate number of grayed-purple lenticels (RHS N186A). Branches are grayed-orange

(RHS 76A) with numerous round, white (RHS 155A) lenticels. Pubescence is present on the terminal two-thirds of new shoot growth and is white (RHS 155E). Internodes range from 2.6 cm to 3.9 cm. Spur development on 2-year-old fruiting branches is considered moderate to light; spurs are elongated and range from 0.5 cm to 10 cm in length.

Leaves are oval with a smooth, glossy upper surface and light white pubescence on the lower surface. Average blade length (of 10 blades) is 10.6 cm and width is 6.1 cm. The leaf tip is cuspidate, its base is rounded, and the margin is double-serrate. Stipules are small and not present on every leaf; their color is the same as the leaf surfaces, the upper surface being RHS 137A green and the lower being 138B green. The midvein is prominent with considerable white downiness on the under surface; the upper surface color is from the green-white group RHS 157C. Mean petiole length is 36.3 mm with an average diameter of 1.7 mm. Petiole color is green RHS 138D with grayed-purple (RHS 185B) highlights at the basal end.

As a result of the low inoculum levels of apple scab (*Venturia inaequalis* Cke) in Wenatchee, resistance or susceptibility has not been determined. However, marker analysis based on *Md-Exp-7* (Costa et al., 2008) indicates that 'WA 5' most likely has inherited the *Vf* (*Rvi6*) scab resistance gene from its paternal parent Co-op 15 (Table 3). Field observations of 'WA 5' have indicated only moderate susceptibility to powdery mildew [*Podospheera leucotricha*, Ell. and Ev. (E.S. Salmon)] and fire blight [*Erwinia amylovora* Burr. (Winsl. et al.)]. Fruit rarely exhibit russet, bitterpit, or sunburn in the apple-growing regions of central Washington.

'WA 5' has the optimum genotypic combination (*Md-ACS-1-2/2* and *Md-ACO-1-1/1*) for the ethylene pathway genes of 1-aminocyclopropane-1-carboxylic acid synthase and oxidase (Table 3) that influence fruit firmness retention (Zhu and Barritt, 2008; Y. Zhu, personal communication).

Availability

Washington State growers can apply to participate in Phase 4 evaluation of 'WA 5' until 31 Jan. 2016. Participation is restricted to growers who appear on Washington Apple Commission assessment records and have a federal EIN. Growers with evaluation licenses

Table 1. Fruit indices of 'WA 5', 'Gala', and 'Fuji' after 60 d in regular atmosphere storage at 1 to 2 °C in 2009 from a 2004 planting near Richland in central Washington.

Cultivar	Firmness (Newtons)	Sugars (% soluble solids)	Acidity (mg·L ⁻¹ malic acid)	Mean fruit wt (g)
WA 5 ²	85.1	13.5	0.68	234
Gala (Imperial)	81.5	14.5	0.46	215
Fuji (Autumn Rose)	74.3	14.9	0.46	324

²Mean values from samples of five fruit with an average starch rating of 6 on the Cornell scale (Blanpied and Silsby, 1992).

Fig. 3. Relationship of sensory crispness with the computerized penetrometer crispness (Cn value, Mohr® Digi-Test; Mohr and Associates, Richland, WA) for 16 apple cultivars and 'WA 2' and 'WA 5'. Key: ○ Washington State University apple cultivars WA 2 and WA 5; ◆ reference cultivars [AGG = '8S6923'; B = 'Braeburn'; CO = Co-op 39; CH = 'Chinook'; CP = 'Cripps' Pink'; F = 'Fuji'; GB = 'Gala' (Brookfield®); GD = 'Golden Delicious'; GI = 'Gala' (Imperial); GU = 'Gala' (Ultima™); HC = 'Honeycrisp'; SF = 'Scifresh'; P = 'Pinova'; SE = 'Sciearly'; SR = 'Scired']. Data for each cultivar represent a mean value for fruit tested from multiple pick dates (Cornell starch ratings 3 to 7) both at harvest and after 2 months air storage at 1 to 2 °C (Evans et al., 2010a). Sensory crispness evaluation was by four members of the Washington State University apple breeding team using fruit at room temperature following Harker et al. (2002).

Table 2. Annual production, cumulative yield, trunk cross-sectional area, and yield efficiency of 'WA 5' trees compared with 'Gala' and 'Fuji' from a 2004 planting near Richland in central Washington.

Cultivar	Yield per tree (kg)					Cumulative yield per tree 2005–2009 (kg)	Trunk cross-sectional area (cm ²)	Yield efficiency (kg·cm ⁻²)
	2005	2006	2007	2008	2009			
WA 5 ²	4.5	5.1	12.5	5.6	26.6	54.2	15.2	1.8
Gala (Imperial)	3.5	7.4	14.5	19.6	20.6	65.6	21.0	1.0
Fuji (Autumn Rose)	6.0	2.0	16.2	14.6	54.7	87.4	18.0	2.9

²Mean values from five trees indicating a trend in production; however, data are not robust enough for statistical analysis.

Table 3. Genotype of 'WA 5' and its parents with three polymerase chain reaction-based genetic markers.

Cultivar	Marker genotype		
	<i>Md-ACS-1</i>	<i>Md-ACO-1</i>	<i>Md-Exp-7</i>
WA 5	2:2 ²	1:1 ²	202:214 ²
Splendour	2:2 ²	1:2 ²	202:202 ²
Co-op 15	1:2 ²	1:2 ²	202:214 ²

²Genotype, 'WA 5' being homozygous for both genes.

³Allele size of the amplified fragment measured in bps.

can transfer their license to a Phase 5 commercialization license from 31 Jan. 2012. Application forms and further information can be obtained from Kate Evans or the Washington Tree Fruit Research Commission (<<http://www.treefruitresearch.com>>).

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