

‘Harovin Sundown’ Pear

David M. Hunter²

Agriculture and Agri-Food Canada, SCPFRC, 4902 Victoria Avenue N, P.O. Box 6000, Vineland Station, Ontario, Canada L0R 2E0

Frank Kappel and Harvey A. Quamme

Agriculture and Agri-Food Canada, PARC, Highway 97, Summerland, British Columbia, Canada V0H 1Z0

W. Gordon Bonn¹

Agriculture and Agri-Food Canada, GPCRC, 2585 County Road 20, Harrow, Ontario, Canada N0R 1G0

Kenneth C. Slingerland

Ontario Ministry of Agriculture, Food and Rural Affairs, 4890 Victoria Avenue N, P.O. Box 8000, Vineland Station, Ontario, Canada L0R 2E0

Additional index words. *Pyrus communis*, fire blight, *Erwinia amylovora*, resistance

‘Harovin Sundown’ pear (*Pyrus communis* L.) is an attractive late-season fresh market pear with good storage capability. It is highly productive with no evidence of biennial bearing. The tree has excellent resistance to fire blight [a bacterial disease incited by *Erwinia amylovora* (Burr.) Winslow et al.]. This new cultivar, developed by Agriculture and Agri-Food Canada (AAFC) at its Research Centers in Harrow and Vineland Station, Ontario, Canada, is recommended by the Ontario Tender Fruit Producers’ Marketing Board for general planting in Ontario. It is protected under Canadian Plant Breeders Rights legislation (application number 08-6315).

Origin

‘Harovin Sundown’ pear originated from a cross of ‘Bartlett’ × US56112-146 (Fig. 1) made in 1972 by H.A. Quamme. ‘Harovin Sundown’ was selected in 1980 by H.A.

Received for publication 9 Feb. 2009. Accepted for publication 22 Apr. 2009.

Financial support provided by the Ontario Tender Fruit Producers’ Marketing Board and the Agricultural Adaptation Council is greatly appreciated.

We thank P. Pinsonneault, P.R. Timmins, M.F. Gadsby, and D.B. Jessop for excellent technical assistance; and C.A. Collucci, G. Sorge, and A. Krzywdzinski for diligence in collecting Plant Breeders Rights’ data. We appreciate the assistance of the Western Ontario Fruit Testing Association (now the Ontario Fruit Testing Association) and its grower-members in field performance evaluations and the St. Davids (Ontario, Canada) processing plant (operating sequentially as Canadian Cannery, Nabisco, Kraft Canada, and CanGro Foods Inc) for processing and evaluation of experimental samples.

¹Present address: Bureau of Entomology, Nematology and Plant Pathology, Division of Plant Industry, Florida Department of Agriculture and Consumer Services, 1911 SW 34 Street, Gainesville, FL 32608.

²To whom reprint requests should be addressed; e-mail david.hunter@agr.gc.ca.

Quamme and propagated for a second test at Harrow in 1984 by F. Kappel. Trees were propagated in cooperation with the Western Ontario Fruit Testing Association (now the Ontario Fruit Testing Association) and, under the designation HW614, placed in grower trials beginning in 1986. It was also planted in regional evaluation orchards established in 1992, and in 1999, ‘Harovin Sundown’ was included in a large-scale pear trial planted for commercial processing evaluation of fire blight-resistant cultivars and selections. ‘Harovin Sundown’ is currently being tested in Canada (Ontario, Nova Scotia, and British Columbia), the United States (New York), and Europe (France, The Netherlands).

Description and Performance: Tree Characteristics

Tree habit and productivity. The tree of ‘Harovin Sundown’ is medium in size, conical and upright to spreading, annually productive, and winter-hardy, producing a good crop after exposure to winter minimum temperatures as low as –29 °C. There has been no evidence of biennial bearing. Precocity of

‘Harovin Sundown’ on standard (Bartlett seedling) rootstock appears to be similar to that of ‘Bartlett’ with trees coming into production ≈4 years after planting. Annual yields of harvested fruits have been equal to or greater than those of ‘Bartlett’, especially in areas where fire blight has adversely affected the productivity of ‘Bartlett’.

Shoot habit. The bark on the sun-exposed side of dormant shoots is orange-brown [RHS code 175A or 175B; Royal Horticultural Society (RHS), 1966]. After the 2006 growing season, the internode length (mean ± SE, n = 200) of ‘Harovin Sundown’ was 38.2 ± 0.4 mm as compared with that of ‘Bartlett’ (32.7 ± 0.3 mm), ‘Harrow Sweet’ (29.1 ± 0.4 mm), ‘AC Harrow Crisp’ (32.6 ± 0.4 mm), and ‘Beurré Bosc’ (46.0 ± 0.6 mm).

Leaves. Leaves of ‘Harovin Sundown’ are elliptic, the shape of the base of the leaf blade is right-angled, and the shape of the upper part of the leaf blade is right-angled with pointed or broad acuminate tips. There is little curvature of the midrib. Leaf serrations are small and shallow but distinct. The angle between the petiole and the shoot is less than 30°, the petiole is medium in length (mean ≈24 mm, range, 15 to 32 mm), and stipules are sometimes absent. The attitude of the leaf in relation to the shoot is outward (i.e., leaves are predominantly horizontal on vertical shoots rather than pointing upward or downward). Actively growing shoot tips are reddish green with light pubescence.

Fire blight tolerance. Like with other introductions from the AAFC pear breeding program formerly located at Harrow (Hunter et al., 1992, 2002a, 2002b; Quamme and Spearman, 1983), ‘Harovin Sundown’ has excellent resistance to fire blight (caused by *E. amylovora*), similar to or greater than that of ‘Kieffer’, which is used as the standard for selection (Hunter, 1993). Using natural fire blight infection scores (from van der Zwet et al., 1970), ‘Harovin Sundown’ had a resistance rating much greater than that of ‘Bartlett’ (Table 1). When actively growing shoot tips were inoculated with a mixture of six virulent strains of *E. amylovora*, the length of the lesion that developed extended to ≈12% of the current season’s growth,

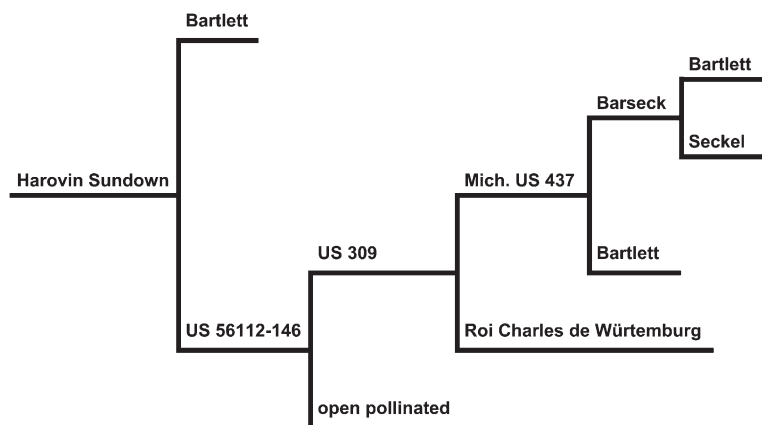


Fig. 1. Pedigree of ‘Harovin Sundown’ pear.

Table 1. Summary of fire blight evaluations of 'Harovin Sundown' at AAFC, Harrow, Ontario, Canada.

	Harovin Sundown	Bartlett	AC Harrow Crisp	Harrow Sweet	Kieffer
	Natural infections ^z				
Rating	9.5 ± 0.5	4.4 ± 1.8	9.5 ± 0.7	9.2 ± 0.8	9.2 ± 0.4
Years evaluated	12	18	12	18	13
	Induced infections ^y				
Lesion (percent shoot length)	12.4 ± 9.2	62.0 ± 20.8	13.9 ± 10.0	14.1 ± 8.4	22.6 ± 6.5
Years evaluated	12	22	9	11	15

^zNatural fire blight ratings based on a scale of 1 (tree dead) to 10 (no blight), are means ± sd of 12 to 18 years. The rating system was modified from van der Zwet et al. (1970) by assigning values of 10 = no visible blight and 9 = less than 3% infection. For 'Harovin Sundown', 'AC Harrow Crisp', and 'Harrow Sweet', ratings were made on the own-rooted seedling tree. For 'Bartlett' and Kieffer', ratings were made on trees grown on Bartlett seedling rootstock in a nearby (within 200 m) cultivar evaluation orchard. In both the seedling orchard and the cultivar evaluation orchard, susceptible trees had severe fire blight infections each year, indicating the presence of a natural source of the pathogen.

^yInduced infections were measured in late July, ≈5 weeks after inoculating 10 to 20 actively growing shoots with 20 µL of a cocktail of six virulent strains of *Erwinia amylovora* (10⁸ cfu/mL). Values indicate lesion length as a percentage of total shoot length. Data are means ± sd of 9 to 12 years for Harrow selections and 15 to 22 years for 'Bartlett' and 'Kieffer'.

similar to 'AC Harrow Crisp' and 'Harrow Sweet', but less than 'Kieffer' and much less than lesion development in 'Bartlett' (Table 1). Similar results have been obtained in greenhouse studies using young grafted trees (data not presented), suggesting that rootstock has little impact on relative susceptibility to this pathogen.

Bloom and pollination. First bloom and full bloom of 'Harovin Sundown' are both ≈2 d later than 'Bartlett', and this attribute may lead to less blossom damage caused by spring frosts. Flower clusters typically contain seven flowers, occasionally six or eight, rarely five or nine. Petals are white, broad ovate, and are slightly apart to just touching with no overlap. When the flower is just opening, anthers are pink to dark pink (RHS code 51A, 58A, 58B), but anther color changes rapidly once the flower opens. Anthers are large in size and are level with or slightly above the stigma when the flower is fully open.

Pollen compatibility has been assessed using pollination records from the breeding program and from a limited number of crosses made specifically for this purpose using methods described earlier (Hunter et al., 2002a, 2002b). Generally, a fruit set of greater than 20% is required for commercial fruit production, whereas fruit set less than 10% suggests incompatibility. Results have been inconsistent over the years, and, in some cases, fruit set has varied widely from year to year. 'Harovin Sundown' has successfully pollinated 'Beurré d'Anjou', 'Bartlett', 'Beurré Bosc', 'Clapps Favorite', 'Flemish Beauty', 'AC Harrow Crisp', 'AC Harrow Gold', and 'Swiss Bartlett'. Cultivars that have successfully pollinated 'Harovin Sundown' include 'Beurré Bosc', 'AC Harrow Crisp', 'AC Harrow Gold', and 'Swiss Bartlett', whereas 'Bartlett' pollen does not consistently produce adequate fruit set for commercial production. There is also some evidence from controlled pollination trials for self-compatibility in 'Harovin Sundown'. Fruit production in commercial trial orchards planted to 'Bartlett', 'AC Harrow Crisp', 'AC Harrow Gold', 'Swiss Bartlett', 'Harovin Sundown', and HW620 (a selection currently

undergoing advanced testing) has equaled or exceeded provincial averages for all cultivars, indicating that this combination of cultivars allows for adequate crosspollination under Ontario, Canada, conditions.

'Harovin Sundown' tends to produce secondary flower clusters, which can lead to the development of a late-ripening second crop. Secondary flowering has not resulted in increased fire blight infections.

Fruit Characteristics

Shape and color. Fruit are symmetrical and ovate-pyriform to turbinate in shape (Fig. 2). In profile, the fruit shape is convex to almost straight and has been rated mostly as 3.3 and 5.3 using International Board for Plant Genetic Resources (IBPGR) descriptors (Thibault et al., 1983); individual fruits have received IBPGR ratings (listed in decreasing order of frequency) of 3.3, 5.3, 1.3, 3.1, 5.1, and 7.1. The calyx is persistent at harvest with short to medium length sepals that are convergent to upright. Based on visual estimates, the calyx basin is medium depth, medium to broad in width, and the margin is slightly ribbed. When harvested, fruits are green with a red blush on the sun-exposed fruit surface. After ripening at ≈20 °C, the skin develops a very attractive golden yellow ground color (RHS code 11A or 11B), whereas the blush on sun-exposed fruit surfaces becomes more orange than red. The skin is very smooth and there is no russetting of the fruit. The flesh is white to cream white in color (RHS code 158A or 158B), very fine in texture, grit-free, and becomes buttery and very juicy when fully ripe. The fruit has a strong intense pear flavor. Core breakdown has not been a problem with this cultivar.

Yields and fruit size. In a commercial orchard planted in 1999 in Niagara Region, Ontario, the first harvest of commercial yield of 'Harovin Sundown' occurred in 2003, the same year as 'Bartlett' in the same orchard (Table 2). Annual production of 'Harovin Sundown' increased during the first 5 production years, and the cumulative yield of 'Harovin Sundown' was ≈14% greater than that of 'Bartlett'. In this commercial orchard,



Fig. 2. Fruit of 'Harovin Sundown' pear.

mean fruit weights for 'Harovin Sundown' and 'Bartlett' were ≈231 g and ≈135 g, respectively (Slingerland, unpublished data). Fruits of 'Harovin Sundown' are similar in size or slightly larger than those of 'Bartlett' on unthinned trees, but when thinned to two fruits per cluster according to Ontario recommendations for fresh market pear production (Ontario Ministry of Agriculture, Food and Rural Affairs, 2006), very large fruits, some greater than 76 mm in diameter, were produced. The fruit size distribution for thinned trees showed that for 'Harovin Sundown', ≈56% of the fruit weight and ≈43% of fruit numbers were in the greater than 70 mm classes, whereas the corresponding values for 'Bartlett' were ≈19% and ≈14% (Table 3).

Maturity. At Harrow, the fruit of 'Harovin Sundown' mature in mid-September, ≈3 weeks after 'Bartlett' and just before 'Harrow Sweet' (Table 4). At Vineland, 'Bartlett' was picked ≈1 Sept. and both 'Harovin Sundown' and 'Harrow Sweet' were harvested ≈22 Sept., a few days later than at Harrow.

Quality and storage. Fruits were harvested each year at the normal level of maturity for commercial harvest of fruits for the fresh market (5 to 7 kg pressure). Samples of five to 10 fruits selected at random were ripened at ≈20 °C immediately after harvest and after 4 weeks in common cold storage at ≈2 °C. Evaluations were made on appearance, flavor, texture, number, and size of grit (stone cells) in the flesh, juiciness, and core size relative to fruit size. At Harrow, trained panelists rated the appearance of ripened fruit of 'Harovin Sundown' as very good, similar to 'Bartlett', but with a lower score than 'AC Harrow Crisp' (Table 4). The fresh fruit quality, as indicated by the weighted score, of 'Harovin Sundown' was lower than 'Bartlett' and 'AC Harrow Crisp' (Table 4). Panelists sometimes reported an astringency associated with the skin of pears ripened

Table 2. Harvested fruit yields (t·ha⁻¹) of 'Harovin Sundown' at St. Davids, Ontario, Canada, 2003–2007.^z

Cultivar	2003	2004	2005	2006	2007	Cumulative yield
Bartlett ^y	7.1 ± 1.6	7.2 ± 1.5	17.5 ± 3.7	16.6 ± 2.0	17.5 ± 3.7 ^y	65.8 ± 12.0
Harovin Sundown	10.6 ± 0.7	11.8 ± 0.6	13.9 ± 1.1	15.5 ± 0.8	23.6 ± 1.4	75.4 ± 1.2
<i>t</i> test ^x	*	*	NS	NS	NS	NS

^zThe orchard was planted in 1999, and production was targeted primarily at the processing market. Data are means ± SE of four four-tree plots.

^yIn 2007, a proportion of 'Bartlett' fruits were not harvested because they did not meet minimum size requirements for processing.

^xNS, *Nonsignificant or significant at *P* = 0.05, respectively.

Table 3. Fruit size distribution of 'Harovin Sundown' at AAFC, Jordan Station, Ontario, Canada in 2008.

Cultivar	Fruit size classes (mm)					Greater than 76
	Less than 54	54–60	60–64	64–70	70–76	
Percent of total fruit wt in each size class						
Harovin Sundown	1.2 ± 1.3 ^z	8.3 ± 5.4	13.0 ± 4.1	21.8 ± 5.5	27.7 ± 4.2	28.0 ± 7.6
Bartlett	3.4 ± 3.5	16.8 ± 9.7	27.5 ± 3.4	33.5 ± 8.3	16.9 ± 4.5	1.9 ± 1.1
Percent of total fruit number in each size class						
Harovin Sundown	3.1 ± 2.7	12.7 ± 7.5	16.6 ± 3.8	24.7 ± 4.2	23.4 ± 4.3	19.6 ± 6.4
Bartlett	6.4 ± 5.9	22.2 ± 10.7	28.7 ± 4.2	29.2 ± 9.3	12.4 ± 3.8	1.2 ± 0.9

^zData presented are means ± SD of four trees for 'Bartlett' and 10 trees for 'Harovin Sundown'. Fruits were harvested in 2008 from mature trees (greater than 10 years old), which had been thinned to two fruits/cluster.

Table 4. Harvest date and fresh fruit evaluations for 'Harovin Sundown' at AAFC, Harrow, Ontario, Canada.

	Harovin Sundown	Bartlett	AC Harrow Crisp	Harrow Sweet
Years evaluated	15	20	17	18
Harvest dates				
Average	16 Sept.	28 Aug.	3 Sept.	18 Sept.
Earliest	3 Sept.	18 Aug.	22 Aug.	29 Aug.
Latest	26 Sept.	9 Sept.	27 Sept.	8 Oct.
Ratings ^z				
Appearance ^x	7.7 b ^y	7.7 b	8.6 a	7.4 b
Flavor ^x	7.4 b	8.0 a	7.4 b	7.8 ab
Texture ^x	7.2 b	7.9 a	7.4 ab	7.1 b
Grit ^w	3.9 a	3.9 a	4.2 a	3.1 b
Juice ^v	3.8 a	3.9 a	3.1 b	4.2 a
Core ^u	2.6 c	3.2 b	3.0 b	3.8 a
Weighted score ^t	74.4 c	81.3 a	79.4 ab	77.1 bc

^zRatings reported are based on evaluations of fruits ripened immediately after harvest.

^yMeans separation within rows by Duncan's new multiple range test (*P* = 0.05).

^xAppearance, flavor, and texture ratings are on a 1 (least desirable) to 9 (most desirable) scale as determined by trained panelists.

^wGrit is on a 1 (undesirable, i.e., large and/or many grit cells) to 5 (desirable, i.e., very small and/or few or no grit cells) scale.

^vJuiciness is on a 1 (dry) to 5 (very juicy) scale.

^uCore size is on a 1 (small) to 5 (large) scale.

^tWeighted score = (3 × appearance) + (5 × flavor) + (2 × texture).

shortly after picking, but this astringency was absent or not reported when fruits were ripened after ≈3 to 4 weeks in common cold storage at ≈2 °C. Fruits of 'Harovin Sundown' held in common cold storage at ≈2 °C until early to mid-January and then ripened for 2 to 3 d at room temperature have received acceptable ratings for appearance, flavor, and texture, whereas the quality of

'Bartlett' fruits start to decline by November (data not presented).

Processing evaluations. When ripened fruit were processed as pear halves, 'Harovin Sundown' was inferior to 'Bartlett' in appearance, flavor, and texture (data not presented). Because of the large fruit size, fewer pear halves fit into a can, so it was difficult to obtain the legally required weight for that can

size. Recovery was adequate when processed as a diced product. When processed as pear puree, 'Bartlett' was rated significantly better than both 'Harovin Sundown' and 'AC Harrow Crisp'. Although the processed product from small-scale trials was rated good, the quality was not sufficiently high for 'Harovin Sundown' to have commercial acceptability for processing as halves or puree.

Availability

'Harovin Sundown' was tested at the Canadian Food Inspection Agency (CFIA) Sidney Laboratory, Sidney, British Columbia (formerly known as the CFIA Center for Plant Health, Saanichton, British Columbia), using woody-host and herbaceous-host biological indicators, and by serological and molecular methods, and was found to be free of all known viruses, virus-like agents, viroids, and phytoplasmas. Trees propagated from virus-tested budwood have been planted in the Canadian Clonal Genebank at Harrow, Ontario. 'Harovin Sundown' is protected under Canadian Plant Breeders' Rights legislation and is subject to commercialization contracts. Inquiries regarding tree availability and licensing of commercial propagation may be addressed to Vineland Research and Innovation Center, P.O. Box 4000, 4890 Victoria Avenue N., Vineland Station, Ontario, Canada, L0R 2E0.

Literature Cited

- Hunter, D.M. 1993. Pear breeding for the 21st century—Program and progress at Harrow. *Acta Hort.* 338:377–383.
- Hunter, D.M., F. Kappel, H.A. Quamme, and W.G. Bonn. 2002a. 'AC Harrow Gold' pear. *HortScience* 37:224–226.
- Hunter, D.M., F. Kappel, H.A. Quamme, and W.G. Bonn. 2002b. 'AC Harrow Crisp' pear. *HortScience* 37:227–229.
- Hunter, D.M., P. Pinsonneault, F. Kappel, H.A. Quamme, W.G. Bonn, and R.E.C. Layne. 1992. 'Harrow Sweet' pear. *HortScience* 27:1331–1334.
- Ontario Ministry of Agriculture, Food and Rural Affairs. 2006. Fruit production recommendations 2006–2007. OMAFRA, Publ. 360.
- Quamme, H.A. and G.A. Spearman. 1983. 'Harvest Queen' and 'Harrow Delight' pear. *HortScience* 18:770–772.
- Royal Horticultural Society. 1966. Royal Horticultural Society colour chart. Royal Hort. Soc., London, UK.
- Thibault, B., R. Watkins, and R.A. Smith (eds.). 1983. Descriptor list for pears (*Pyrus*). Intl. Board Plant Genet. Resources.
- van der Zwet, T., W.A. Oitto, and H.J. Brooks. 1970. Scoring system for rating the severity of fire blight in pear. *Plant Dis. Rptr.* 54:835–839.