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Split Pits in Canadian Peaches

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Commercial production of peaches in Ontario, Canada, began around 1820 in the Niagara Peninsula and expanded to Essex County, along Lake Erie. Approximately 80% of Canada's peach production is in Ontario; British Columbia and Nova Scotia produce the remaining 19 and 1% respectively (16). In 2000, Ontario produced 22,226 tonnes of peaches on 2,185 hectares of land, representing a farm value of $23.9 million (23).

In Ontario, there are two research stations that have introduced new peach cultivars to Canada: Vineland and Harrow. The older, Vineland Research Station, developed its first peach Breeding objectives in 1911. These objectives were: 1) to extend the season for peaches of the 'Elberta' type with earlier and later maturing cultivars.; 2) to improve cultivars, with particular emphasis on the development of attractive, freestone cultivars with yellow flesh for the early season; 3) to produce cultivars of the yellow flesh, clingstone type suitable for canning and adapted to Ontario soil and climatic conditions; and 4) to produce white flesh cultivars with good shipping qualities suitable for exporting overseas. (24). The first two objectives were the focal points of Vineland's breeding program until the mid 1960s (16). The fourth objective was never pursued.

In the mid 1970s a shift in peach breeding objectives occurred. Emphasis was placed on 1) developing clingstone peaches suitable for the production and processing industries; 2) improving tolerance to peach canker disease, *Leucostoma* ssp.; and 3) using somaclonal variation to produce germplasm with greater canker resistance (18, 19).

The Harrow Research Station peach breeding program began in 1960. Its major breeding objectives were: 1) to improve cold hardiness, especially of flower buds and shoot xylem; 2) to improve disease resistance, in particular to perennial canker (*Leucostoma* ssp.), bacterial spot (*Xanthomanas campestris* pv. *pruni*) and brown rot (*Monilinia fructiola*); 3) to improve tree characteristics including longevity, productivity, vigour, growth habit and precocity; and 4) to extend the ripening season from early to late; 5) to improve fruit characteristics, especially size, appearance, skin colour, flesh firmness, freeness, flavour and texture; and 6) to select for resistance to other faults such as preharvest drop, non-uniform ripening, skin cracking, flesh browning, short shelf life and split pits

Split-pit is a physiological disorder that affects peach crops worldwide. It is estimated that between 25 and 50% of the peaches harvested each year contain split pits (25). While split-pit fruit are larger than normal fruit (5), they are also prone to insect and disease infestations. Since such a large percentage of harvested peaches contain split pits, reduction of its incidence is desirable. Split-pit fruit also have a shorter shelf life, contain pit residues which are unacceptable to the consumer and create difficulties in the canning process.(8). Researchers worldwide are interested in breeding split-pit resistant cultivars of peaches and in developing cultural practices which reduce the incidence of split-pit.

Researchers have been studying this disorder since the 1930s. According to Davis (5). split-pit can occur at two different times during fruit development. The first occurs twenty days after full bloom

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Table 1. Peach introductions from the Vineland Research Station (1965-2000): parentage, maturity date and split-pit rating.

Cultivar	Parentage	Year	Date of Maturity[1]	Split-pit Rating[2]	Remarks/ Importance[3]	Reference (page number)
Vanity	(J.H. Hale x Valiant) x open	1965	+21	8	Commercial	2, 22 (359)
Velvet	(Halehaven x Vedette) x Vesper	1965	+7	8	Not recommended	2. 22 (359)
Veecling	Babygold 6 x open	1974	+4	6	Commercial, Canner	3, 22 (357)
Vivid	Sunhigh x (Early Halehaven x Envoy	1974	+3	8	Commercial	22 (363)
Veeglo	Sunhaven x Royalvee	1981	+9	8	Commercial	17, 22 (358)
Vulcan	Veecling x NJC95	1994	-9	7	Commercial, Canner	22 (363)
Vinegold	MJC95 x Veecling	1994	-3	7	Commercial, Canner	22 (362)
Virgil	Veecling x NJC95	1997	+1	7	Commercial, Canner	20
Venture	Suncling x NJC81	2000	+23	10	Commercial, Canner	19

[1]Date of maturity in relation to maturity date of Redhaven (+/- days) at Vineland, Ontario (August 16).
[2]Ratings are those used by Layne (16) where 1 is the least desirable and 10 is most desirable, and estimated from available data.
[3]Categories are those defined by Okie (22) and applied to Ontario where Commercial cultivars are those grown in substantial amounts and Canners are clingstone types with non-melting flesh and used in canning.

while the pit is still soft, resulting in the formation of callus tissue. The second, more common type of pit-splitting, occurs through the plane of suture during pit hardening. Ragland (26) studied the development of the peach fruit with emphasis on the splitting of pits. His research demonstrated that the pit is the first part of the fruit to mature and that a union does not exist along the ventral suture of the pit, forming an area of potential cleavage.

The occurrence of split-pit is determined by both genetic and environmental factors. Traditionally, early maturing cultivars are more prone to split-pit than later maturing cultivars. This is a result of the pit hardening during the same stage of growth in which the flesh cells begin to elongate. Cultural practices including differential nitrogen application, irrigation and crop loads influence the percentage of split pits found in peaches (4). Favorable temperatures and moisture levels as well as initial crop set also affect the occurrence of split-pit.

Since split-pit is a physiological disorder that is difficult to control, peach breeders at Vineland and Harrow have attempted to eliminate this problem by breeding cultivars that are resistant to split-pit. Nine peach cultivars have been introduced from Vineland since 1965, five of which are canners which is consistent with the breeding objectives (see above). Canner production in Ontario was 27% of total peach production in 1999 (1). 'Veecling' has a tendency to have more split pits that 'Vulcan', 'Vinegold' and 'Virgil' (Table 1), resulting in a decline in planting of 'Veecling' and increased planting of these newer cultivars (1). Three freestone cultivars from Vineland, Vanity, Vivid and Veeglo, account of 9% of Ontario plantings and all are resistant to split-pit.

The cultivars developed at the Harrow Station (Table 2) accounted for 40% of the freestone peaches grown in Ontario in 1999 (1). Only three of the thirteen cultivars introduced by Harrow were rated as susceptible to split-pit (Table 2). Two of these cultivars, Harbinger and Harland, are no longer recommended because of their split-pit problem. The third, Harbrite, accounted for 2% of planting in 1999 (1); its retention is likely attributable to excellent winter hardiness, productivity, resistance to bacterial spot and brown rot, and grower practices of fertilizer management as

Table 2. Peach introductions from the Harrow Research Station (1958-1995): parentage, maturity date and split-pit rating.

Cultivar	Parentage	Year	Date of Maturity[1]	Split-pit Rating[2]	Remarks/ Importance[3]	Reference (page number)
Garnet Beauty	Bud sport of Redhaven	1958	-10	8	Commercial	7, 22 (130)
Harbelle	Sunhaven x self	1968	-14	7	Commercial	22, (146), 30
Canadian Harmony	Redskin x Sunhaven	1968	+14	8	Commercial	22 (43), 31
Harbrite	Redskin x Sunhaven	1969	+2	5	Commercial	22 (148), 28
Harken	Redskin x Sunhaven	1970	+3	8	Commercial	22 (149), 28
Harbinger	Cherry Red x (Jerseyland x Mayflower	1971	-27	4	Not recommended	22 (147), 29
Harland	[J.J. Hale x Vedette) x open] x Earlired	1979	-27	5	Not recommended	9, 22 (150)
Harson	Redskin x Sunhaven	1982	-4	7	Commercial	10, 22 (184)
Harrow Beauty	Cresthaven x Harken	1983	+17	9	Commercial	11, 22 (151)
Harcrest	Redskin x H421 9	1983	+26	8	Commercial	12, 22 (148)
Harrow Diamond	Redskin x Harbinger	1984	-20	9	Commercial	13, 22 (153)
AC Harrow Dawn	Cresthaven x Harbinger	1995	-14	9	Commercial	14, 22 (19)
AC Harrow Fair	Biscoe x (Redskin x Kalkaven)	1995	+6	10	Commercial	15, 22 (20)

[1]Date of maturity in relation to maturity date of Redhaven (+/- days) at Vineland, Ontario (August 16).
[2]Ratings are those used by Layne (16) where 1 is the least desirable and 10 is most desirable.
[3]Categories are those defined by Okie (22) and applied to Ontario where Commercial cultivars are those grown in substantial amounts and Canners are clingstone types with non-melting flesh and used in canning.

suggested by Evert et al. (6) and of irrigation control (4, 27).

The pit-splitting of Harbinger and Harland is related to early maturity as they ripen 27 days before Redhaven, a mid-season cultivar (Table 2). However, two other recent introductions with Harbinger parentage, Harrow Diamond and AC Harrow Dawn, are also early season but are resistant to pit-splitting.

To summarize, in the last four decades Canadian peach breeders have reached their objective of producing split-pit free fruit to benefit the industry and ultimately the consumer.

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Developing Canning Peach Critical Bruising Thresholds

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Abstract

The position of the softest spot on the fruit was the shoulder for 'Andross', 'Carson', 'Starn' and 'Ross' canning peach cultivars. Critical bruising thresholds were similar among canning peach cultivars evaluated, ranging from 6.0-7.0 lbf at a bruising potential of 240 G. Potential sources of bruising damage using two different mechanized harvesters were located using an instrumental sphere (IS-100). Bruising potential values of each harvester were small and similar, except at the bin dump portions of each machine.

Introduction

In recent years, farm labor shortages in California are shifting the harvesting of canning peaches from hand harvests to mechanized harvests. Severe bruising occurring at harvest can limit cannery performance for cling peach cultivars and reduce grower monetary return. Prior studies using fresh-market stone fruit cultivars developed critical bruising thresholds (CBT) to create maximum maturity indices that allow growers to decide how soft fruit may be picked to reduce postharvest damage (3).

We developed maximum maturity indices for canning peach cultivars using bruising susceptibility measurements

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