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Peach and Nectarine Breeding In Canada: 1911 to 1995

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Introduction

Canada is one of the world's most northerly countries for the commercial production of peaches and nectarines (22). Long winters with low temperatures, comparatively short growing seasons, and the frequent occurrence of spring frosts during the blossom period greatly restrict where peaches and nectarines can be successfully grown. Only three provinces (Ontario, British Columbia, Nova Scotia) have regions where the climate is sufficiently moderated by a) the Great Lakes (Ontario). b) protected mountain valleys (British Columbia) or c) the Gulf Stream and protected river valleys (Nova Scotia) to permit commercial culture of peaches and nectarines. Canada now ranks eighteenth among the world's peach producing countries with annual production of 40,000 tonnes (29). About 80% of Canada's production is centered in Ontario, 19% in British Columbia and 1% in Nova Scotia. In 1993, Ontario's production was valued at $23.2 M, accounted for 33,255 tonnes from 3,375 ha (26).

Commercial peach production in ontario began about 1820 near Grimsby in the Niagara region. By the late 1800's peach production was important not only in Niagara but also in Essex county in southwestern Ontario (S. J. Leuty, personal communication). Recognizing the growing importance of peaches in Ontario, a peach breeding program was initiated in 1911 at Vineland by the then Ontario Department of Agriculture. The growing importance of peaches in Southwestern Ontario led in 1960 to the initiation of a peach and nectarine breeding program by the then Canadian Department of Agriculture at its Research Station near Harrow Ontario. This paper will summarize the main objectives and accomplishments of the two breeding programs from their inception until 1995.

Peach breeding at Vineland (1911 to 1995)

Peach breeding was initiated at Vineland in 1911 and had four main breeding objectives: 1) extension of the season for peaches of the 'Elberta' type with earlier an later maturing cultivars, 2) general improvement of cultivars with particular emphasis in the development of attractive, freestone varieties with yellow flesh for the early season, 3) production of cultivars of the yellow-flesh, clingstone type suitable for canning and adapted to Ontario soil and climatic conditions, and 4) production of white-flesh cultivars with good shipping qualities suitable for exporting overseas (27).

Good progress was made with the first and second breeding objective (27, 28) during the first 53 years (1911-1964) while emphasis on the third objective was to come later (5, 25), and the fourth objective, was never actively pursued. Fourteen cultivars were introduced during the period to 1964 (9), all being yellow-flesh, fresh market or dual purpose types, and included 'Vimy,' 'Valiant,' Vaughan,' 'Vedette,' 'Veteran,' 'Viceroy,' 'Veefreeze,' 'Vanguard,' 'Envoy,' 'Erlyvee' 'Vesper,' 'Somervee,' 'Royalvee' and 'Vedoka (Table 1). Of these, three culti-

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Table 1. Peach introductions from the Vineland Experiment Station, Horticultural Research institute of Ontario, Ontario Ministry of Agriculture, Food and Rural Affairs (1924 to 1994).

Cultivar	Parentage	Year	Originator/Introducer	Reference
Vimy	Elberta x Arp	1924	E. F. Palmer	31
Valiant	Elberta x open	1925	E. F. Palmer	27, 28, 31
Vaughan	Leamington x self	1925	E. S. Reeves, J. R. van Haarlem	27, 28
Vedette	Elberta x open	1925	E. F. Palmer	27, 28, 31
Veteran	Vaughan x Early Elberta	1928	E. F. Palmer	27, 28, 31
Viceroy	Vaughan x Early Elberta	1929	E. F. Palmer	28, 31
Veefreeze	V11041 x Arp	1940	E. F. Palmer	28, 31
Vanguard	Vaughan x Valiant	1941	E. F. Palmer	27, 28
Envoy[z]	J. H. Hale x Sunbeam	1949	M. A. Blake, E. F. Palmer, L. F. Hough	6
Erlyvee	Golden Jubilee x open	1949	O. A. Bradt	6
Vesper	J. H. Hale x Vedette	1949	O. A. Bradt	6
Somervee	Halehaven x Oriole	1950	E. F. Palmer, O. A. Bradt	6
Royalvee	V39058 x Veteran	1959	O. A. Bradt	3
Vedoka[y]	J. H. Hale x Vedette	1960	J R. van Haarlem, O. A. Bradt, D. V. Fisher	3
Vanity	(J. H. Hale x Valiant) x open	1965	E. F. Palmer, O. A. Bradt	4
Velvet	V39058 x Vesper	1965	O. A. Bradt	4
Veecling	Babygold 6 x open	1974	O. A. Bradt	7
Vivid	Sunhigh x V46042	1974	O. A. Bradt	7
Veeglo	Sunhigh x Royalvee	1981	O. A. Bradt, S. J. Leuty	24
Vulcan	Veecling x NJC95	1994	S. J. Leuty, N. W. Miles	
Vinegold	NJC95 x Veecling	1994	S. J. Leuty, N. W. Miles	

[z]Originated at New Brunswick, New Jersey by M. A. Blake.
[y]Originated at Vineland Experiment Station. Introduced jointly by O. A. Bradt, J. R. van Haarlem and D. V. Fisher for British Columbia fruit growers.

vars ('Veteran,' 'Valiant' and 'Vedette') known as the "V" peaches, were the most important, accounting for much of the peach production in Ontario (9) during the 1930's and 1940's. They were in large measure responsible for the high reputation on Ontario freestone peaches. Because of its hardiness and cropping dependability, 'Veteran' was probably the most noteworthy of these three.

Bradt summarized the peach breeding work from 1939 to 1956 (2), and from 1957 to 1968 (5). During the latter period 'Vanity' and 'Velvet' were introduced, both being attractive, yellow-flesh, freestone types for the fresh market. The most recent yellow-flesh freestone peaches to be introduced were 'Vivid' in 1974 (7) and 'Veeglo' in 1981 (24). None of the 21 peach varieties introduced from Vineland (Table 1) had white flesh. Beginning in 1958 (2), more emphasis was placed on developing yellow flesh clingstone peaches with non-melting flesh for canning. This breeding emphasis has been maintained to the present and three cultivars ('Veecling' (7), 'Vulcan' and 'Vinegold') have been introduced (Table 1). It appears that several more processing clingstone types will be introduced in the next decade based on the promising performance of recent advanced selections. During the period 1975 to 1992, the peach breeding emphasis was 1) to develop

Table 2. Vineland cultivars as a percentage of peach trees in Ontario.[z]

Cultivar	Year Intro.	Year of census '42	'56	'61	'66	'71	'76	'81	'86	'90	'94
Vedette	1924	13	6	3							
Valiant	1925	8	4	3	2	1					
Veteran	1928	8	6	5	4	3	2	<1			
Envoy	1949		2	3	4	4	4	2	1	<1	
Erlyvee	1949		1	1							
Royalvee	1949			1	2	2	1	1			
Somervee	1950		1	1							
Vanity	1965					1	2	2	1	1	<1
Velvet	1965				<1	2	2	1	<1		
Vivid	1974						1	5	8	6	5
Veecling	1974							1	4	8	7
Veeglo	1981							1	2	2	2
Vulcan	1994										1
Vinegold	1994										1

[z]Data provided by N. W. Miles, HRIO, OMAFRA, Vineland Station, 1995.

clingstone peaches suitable for the production and processing industries, 2) to improve tolerance to peach canker disease [*Leucostonia* spp.] and 3) using somaclonal variation to produce germplasm with greater canker resistance. Progress towards these objectives was recently summarized by Miles and Slingerland (25), and the characters evaluated were described and summarized.

Vineland Cultivars in Ontario

Ontario peach tree census information from 1942 to 1994 is summarized in Table 2 with respect to 14 Vineland cultivars (N. W Miles, pers. comm.). In 1942

Table 3. Harrow and Vineland cultivars being grown in selected states in USA (1995).

State	Cultivars of peach and nectarine (N)	Source
Kentucky	Canadian Harmony, Garnet Beauty, Harbelle, Harbinger, Harbrite, Harcrest, Harken, Harko (N), Harrow Beauty, Velvet, Veteran, Vivid	G. R. Brown
Michigan	Canadian Harmony, Garnet Beauty, Harbelle, Harbinger, Harblaze (N), Harbrite, Harcrest, Hardired (N), Harko (N), Harrow Beauty, Harrow Diamond	W. W. Shane
New Jersey	Canadian Harmony, Envoy, Garnet Beauty, Harbelle, Harbinger, Harbrite, Harcrest, Harken, Harrow Beauty, Velvet, Veteran. Vivid	J. L. Frecon
New York	Canadian Harmony, Garnet Beauty, Harcrest, Harrow Diamond	A. L. Andersen
Pennsylvania	Canadian Harmony, Garnet Beauty, Harbelle, Harken	A. M. Crassweller
South Carolina	Canadian Harmony, Garnet Beauty, Harken	W. C. Newall
Virginia	Canadian Harmony, Garnet Beauty, Harbelle, Harcrest, Harken, Harrow Beauty	A. P. Mann

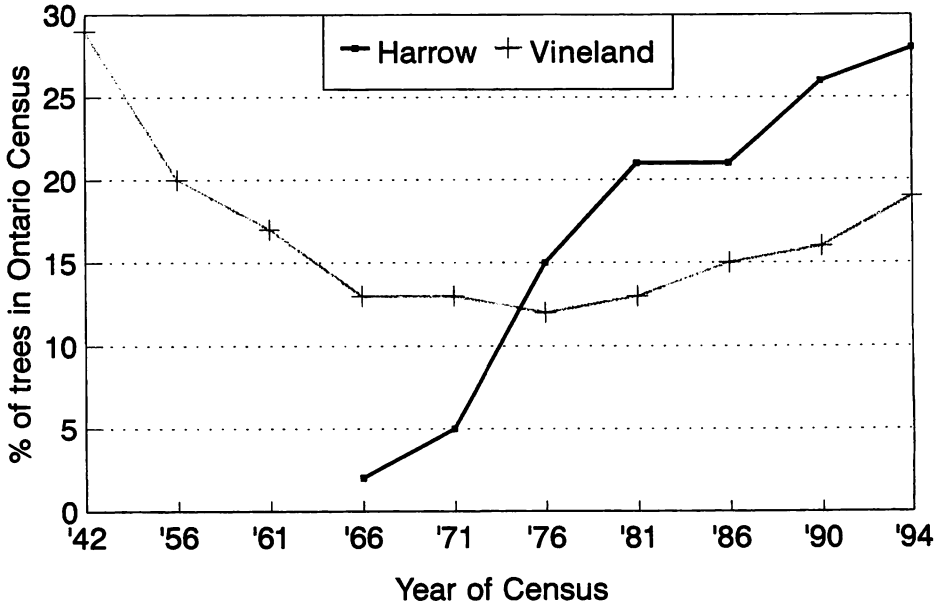

Figure 1. Relative importance of Vineland and Harrow peach cultivars in Ontario (1942 to 1994).

'Vedette,' 'Valiant,' and 'Veteran' were the most widely planted of the Vineland cultivars and represented 29% of the total number of peach trees in Ontario. 'Vedette,' 'Valiant,' 'Veteran,' and 'Envoy' accounted for 14% of Ontario peach trees by 1961, and by 1981, the most important Vineland cultivars were 'Envoy' 'Vanity,' and 'Vivid.' Vineland introductions in 1994 accounted for 17% of Ontario peach trees, the most important of which were 'Veecling,' 'Vivid' and 'Veeglo' (1).

Three freestone cultivars from Vineland, 'Vivid,' 'Veeglo' and 'Vanity' were on the 1975 list of recommended cultivars for the Niagara region. 'Vanity,' the hardiest of these three, was also recommended in 1995 for Essex and Kent, and also for climatically marginal regions. Three canning clingstone cultivars from Vineland, 'Veecling,' 'Vulcan' and 'Vinegold,' were recommended for both the Niagara and the Essex-Kent regions (N. W. Miles, pers. comm.). With a change in breeding emphasis from freestone to clingstone cultivars, the importance of Vineland as a source of fresh market peach cultivars declined (Fig. 1, Table 2) while its importance as a source clingstone peach cultivars for processing increased (Table 2). This trend will likely continue in the future if the present breeding emphasis iw maintained.

Vineland Cultivars in Other Production Areas

Vineland cultivars are not presently grown in Nova Scotia (W Craig, pers. comm.). However, from the 1940's to the 1970's, when dual purpose varieties were important in British Columbia, and processing was a major activity in the Okanagan Valley, the "V" peaches from Vineland, primarily 'Valiant,' 'Vedette' and 'Veteran' were important cultivars and provided the basis for their processing industry (9). With the disappearance of the peach processing industry in the Okanagan Valley in the 1980's, and the shift from dual purpose to more attractive red-skinned cultivars for the fresh market,

Table 4. Harrow and Vineland cultivars formerly or presently grown on a limited scale in Europe.

Country	Cultivars	Source
France	Garnet Beauty, Harken, Velvet	R. Monet
Hungary	Canadian Harmony, Harbelle, Harbinger, Harbrite, Harken, Harko (N)	Z. Szabo
Italy	Garnet Beauty, Harken, Velvet	C. Fideghelli
Poland	Royalvee, Velvet	T. Jakobowski
Romania	Harbrite, Valiant, Vedette, Veteran	V. Cociu

the importance of the "V" peaches significantly declined (F. Kappel, pers. comm.).

In the United States (Table 3), Vineland cultivars are grown to a limited extent in such states as Kentucky and New Jersey and include 'Velvet,' 'Veteran' and 'Vivid.' In Europe (Table 4). 'Velvet' is grown to a limited extent in France and Italy, 'Royalvee' and 'Velvet' are grown to a limited extent in Poland, while 'Valiant,' 'Vedette' and 'Veteran' are grown to a limited degree in Romania.

Peach Breeding at the Harrow Research Centre (1960 to 1995)

There has been an active program of peach and nectarine cultivar evaluation at Harrow since the 1920's. In 1958, the Harrow Research Centre was involved in the joint introduction of 'Garnet Beauty' an early ripening bud sport of 'Redhaven' found on a farm near Ruthven, Ontario (Table 5).

Peach and nectarine breeding was initiated in 1960 at the Harrow Research Centre in Southwestern Ontario because existing cultivars were generally lacking in cold hardiness and disease resistance, and were lacking in attractiveness, firmness, and fruit quality demanded by an expanding fresh market (17, 20, 22). G. M. Weaver was responsible for peach and nectarine breeding from1960 to 1969 and R. E. C. Layne from 1969 until his retirement in 1996. Throughout the period from 1960 to 1995, six major breeding objectives were pursued: 1) *improvement of cold hardiness* — especially flower bud and shoot xylem hardiness; 2) *improvement of disease resistance* — especially to perennial canker (*Leucostoma* spp.), bacterial spot [*Xanthomonas campestris* pv. *pruni* (Smith) Dye] and brown rot [*Monilinia fructicola* (Wint.) Honey]; 3) *improvement of tree characters* — especially longevity, productivity, vigor, growth habit and precocity; 4) *extending the ripening season* — from early to late; 5) *improvement of fruit characters* — especially size, appearance, skin colour, flesh Êirmness, freeness, flavour and texture; and 6) *selecting for resistance to other faults* — especially preharvest drop, non-uniform ripening, skin cracking, split pits, flesh browning and short shelf life. While the relative emphasis placed on these objectives varied somewhat during this period, each objective formed part of the multiple trait selection index that has been used since 1970. No new selections were made that were seriously deficient for any of the six major objectives.

At Harrow a protocol has been developed whereby every new stone fruit selection and every advanced selection is assessed in the field for the following characters: tree type, winter injury, peach canker, bacterial spot, brown rot, bloom date, bloom intensity, fruit set after June drop, crop remaining at harvest, ripe date, uniformity of ripening, fruit size, percent blush, attractiveness, flesh firmness, degree of flesh adherence to the pit, flavour, texture, presence of red pigment in the flesh, split pits, skin cracking and preharvest fruit drop (22). In the laboratory, every new selection is assessed against

commercial standards like 'Redhaven' and 'Loring' for cold hardiness of flower buds and of shoot xylem. A recurrent mass selection breeding strategy is followed to simultaneously improve cold hardiness, disease resistance, and tree and fruit characteristics (20, 22). In the food laboratory, flesh browning potential, sugar (°Brix), pH, and titratable acidity on the raw product are determine and processing tests are conducted to determine suitability for processing as canned halves in syrup, puree, and frozen slices.

When advanced selections are placed in regional trials with other researchers and members of the Western Ontario Fruit Testing Association (WOFTA), cooperators are requested to assess the following characters: tree growth, winter injury, canker and bacterial spot susceptibility, crop, ripe date, fruit size, skin color, fruit quality, flesh firmness, handling and shipping ability, and storage ability. Furthermore, cooperators advice is sought on which numbered selections have sufficient merit to be introduced, tested further, or discarded.

Harrow advanced selections are also virus indexed and placed in a budwood orchard to provide a source of virus indexed, true-to-name propagating material to commercial nurseries if and when introduced as cultivars. Budwood distribution is managed in cooperation with WOFTA. Initial virus indexing of new selections is carried out in cooperation with the Centre for Plant Health, Sidney, B.C. Subsequent routine indexing of budwood orchards is carried out at the Harrow Research Centre.

Before the Plant Breeders Rights Act of Canada came into law in 1990, there were no restrictions on the distribution and propagation of Harrow peach and nectarine introductions. However cultivars introduced since 1991 are first protected in cooperation with exclusive agents, licensing agreements are made with commercial nurseries and royalties are collected on the sale of nursery trees. Only the two most recent peach ('AC Harrow Dawn,' 'AC Harrow Fair') and the most recent nectarine ('AC Harflame') introductions fall into this group (Table 5).

The cultivars introduced between 1958 and 1995, their parentage, year of introduction and other information are summarized in Table 5. In all, 24 cultivars were introduced of which 20 were peaches and four were nectarines. Among the 20 peaches, four were rootstock seed sources, and three were flowering ornamentals. The remaining 13 cultivars were attractive, freestone or semi-freestone types with yellow, melting flesh developed for the fresh market. 'Harland' was introduced for New Zealand but not recommended for Ontario (12). 'Harken' was a joint introduction with Kentucky where it had been extensively tested by the late W. D. Armstrong (University of Kentucky, Princeton) and the late Frank Street, a prominent peach grower near Henderson, Ky.

The three hardy ornamentals were assigned to the Canadian Ornamental Plant Foundation for commercialization (13), but were little used by the trade. The four rootstock seed sources (Table 5), while introduced by the Harrow Research Centre did not originate there (19, 23). Of these, the two that have been most extensively used are 'Siberian C' and 'Chui Lum Tao.' 'Siberian C' was very popular in the 1970's and 1980's in Canada and the northern United States because of its hardiness and semi-dwarfing ability (19). Susceptibility to nematodes led to its general decline in use (19, 23) although it remains a popular rootstock in British Columbia (F. Kappel, pers. comm.) where its hardiness is valued and nematodes are not an important problem. 'Chui Lum Tao,' since its introduction in 1989, is gaining in popularity and appears especially well suited for light, well-drained, sandy soils (23).

Harrow Cultivars in Ontario

The relative importance of 10 Harrow peach fresh market cultivars in Ontario during the period from 1966 to 1994 is summarized in Table 6. 'Garnet Beauty' increased in importance from the 1966 to

Table 5. Peach and nectarine introductions from the Harrow Research Centre, Agriculture and Agri-Food Canada (1958 to 1995).

Cultivar	Parentage	Year	Originator/Introducer	Reference
Garnet Beauty	Bud sport of Redhaven	1958	T. B. Harrison, G. Whaley, G. Bruner	8
Siberian C[z]	Unknown, sdlg. selection	1967	G. M. Weaver	19, 23, 33
Harrow Blood[z]	Unknown, sdlg. selection	1967	G. M. Weaver, T. B. Harrison	19, 23, 31
Harbelle	Sunhaven x self	1968	G. M. Weaver	36
Canadian Harmony	Redskin x Sunhaven	1968	G. M. Weaver	37
Harbrite	Redskin x Sunhaven	1969	G. M. Weaver, R. E. C. Layne	34
Harken	Redskin x Sunhaven	1970	R. E. C. Layne, G. M. Weaver, W. D. Armstrong, F. Street	34
Harbinger	Cherry Red x NJ560519	1971	R. E. C. Layne, G. M. Weaver	35
Harko[y]	Lexington x NJN32	1975	R. E. C. Layne, G. M. Weaver	10
Hardired[y]	Lexington x NJN32	1975	R. E. C. Layne, G. M. Weaver	11
Harland	V37016 x Earlired	1979	R. E. C. Layne, G. M. Weaver	12
Harrow Frostipink[x]	(Harrow Blood x NJ555036) x open	1980	R. E. C. Layne, G. M. Weaver	13
Harrow Candifloss[x]	(Harrow Blood x NJ555036) x open	1980	R. E. C. Layne, G. M. Weaver	13
Harrow Rubirose[x]	(Harrow Blood x NJ555036) x open	1980	R. E. C. Layne, G. M. Weaver	13
Harson	Redskin x Sunhaven	1982	R. E. C. Layne, G. M. Weaver	14
Harrow Beauty	Cresthaven x Harken	1983	R. E. C. Layne	15
Harcrest	Redskin x H421 9	1983	R. E. C. Layne	16
Harrow Diamond	Redskin x Harbinger	1984	R. E. C. Layne	18
Harblaze[y]	Stark Delicious x Hardired	1989	R. E. C. Layne	21
Chui Lum Tao[z]	Unknown, introduced from China	1989	R. E. C. Layne, G. M. Weaver	19, 23
Tzim Pee Tao[z]	Unknown, introduced from China	1989	R. E. C. Layne, G. M. Weaver	19, 23
AC Harrow Dawn (HW254)[w]	Cresthaven x Harbinger	1995	R. E. C. Layne	
AC Harrow Fair (HW259)[w]	Biscoe x V55061	1995	R. E. C. Layne	
AC Harflame (HW107)[yw]	Fantasia x H734317	1995	R. E. C. Layne	

[z]Peach rootstock seed source.
[y]nectarine.
[x]ornamental peach.
[w]Plant breeders rights in Canada applied for in 1995 in cooperation with Inter-Plant Patent Marketing Inc.

the 1986 census and attained ~8% of Ontario peach trees for the 1986, 1990 and 1994 census years. During this period, 'Garnet Beauty' was the most important peach cultivar ripening before 'Redhaven' (1). Between 1976 and 1990, 'Harbelle,' another Harrow peach in 'Garnet Beauty' season, represented 3 to 4% of Ontario trees but declined to 1% in 1994. 'Canadian Harmony,' a mid-to-late season peach peaked at 5% of Ontario peach trees in 1986 and declined to 2% by the 1994 census. 'Harbrite,' a hardy mid-season cultivar accounted for 2 to 3% of Ontario trees from 1981 to 1994, while 'Harken' another mid-season peach, represented 1 to 2% from 1976 to 1990. 'Harrow Diamond' an attractive, cold hardy, early season peach accounted for 4 to 5% of Ontario peach trees in the 1990 and 1994 census years, and is likely to increase further in importance in the next decade along with 'Harrow Beauty.'

In the 1994 census (1), Harrow peach introductions in descending order of importance included 'Garnet Beauty,' 'Harrow Diamond,' 'Canadian Harmony,' 'Harrow Beauty,' 'Harbrite,' 'Harson,' 'Harcrest' and Harken.' Harrow peach cultivars collectively accounted for 27% of all Ontario peach trees in 1994. There has been an upward trend (Fig. 1) in the importance of Harrow fresh market cultivars in Ontario from 1966 to 1994 importance was based on improved cold hardiness and disease resistance, combined with productivity, attractiveness and good fruit quality. These attributes allowed Harrow cultivars to compete successfully with others developed elsewhere (1). Harrow peach introductions now account for 75% of the currently recommended cultivars for Ontario fruit growers. This trend is likely to continue for one or two decades as the more recent introductions increase in importance, and as additional Harrow cultivars are introduced.

Harrow is now the major source of new nectarine cultivars for Ontario with 80% of the recommended cultivars for Southwestern Ontario in 1995 being Harrow introductions. With few exceptions, notably 'Fantasia,' non-Canadian cultivars have not been adequately adapted to Ontario conditions to be recommended to commercial growers. 'Harblaze,' a 1989 Harrow introduction, has been readily accepted and by 1994 represented 5% of Ontario nectarine trees (1). 'Harko' and 'Hardired' introduced earlier (Table 3), are still being grown to a limited extent (1), but appear better suited to local markets because they have insufficient firmness for long distance shipping. Recent advances in nectarine breeding at Harrow, including early, mid- and late-season selections, indicate the possibility of a succession of new cultivars being introduced in the next decade. These Harrow selections are better adapted to Ontario growing conditions than non-Canadian cultivars under test.

Harrow Cultivars in Other Production Areas

Nova Scotia has a very small peach and nectarine industry, however, several Harrow peach ('Harbinger,' 'Garnet Beauty,' 'Harbelle,' 'Harken,' 'Harbrite,' 'Harrow Beauty') and nectarine ('Harko,' 'Hardired') cultivars are important to this s}all industry (W. Craig, pers. comm.). The peach industry in British Columbia (F. Kappel, pers. comm.) is larger, comprising about 19% of Canada's production. 'Harrow Diamond' and 'Harbrite' are the most widely grown of the Harrow peach cultivars in British Columbia, with smaller plantings of 'Garnet Beauty,' 'Harbelle' and 'Canadian Harmony.' There are also small plantings of Harrow nectarines including 'Harblaze,' 'Harko,' and 'Hardired.' The growing requirement in British Columbia for cold hardy attractive cultivars of peach and nectarine for the fresh market will likely result in greater use of Harrow cultivars in the future.

Harrow peach and nectarine cultivars are also grown in a number of states in the United States (Table 3). Chief among these are Kentucky, Michigan, New Jersey, New York, Pennsylvania, South Carolina, and Virginia. Harrow cultivars, which generally have a chilling requirement too high for the deep south and lack sufficient color for the west, have been best adapted to the more northerly peach and nectarine growing areas.

In Europe (Table 4), Harrow peach and nectarine cultivars are being grown to a limited degree in France, Hungary, Italy, Poland, and Romania. They may also be grown in other European countries not contacted.

Reasons frequently given for Harrow peach and nectarine cultivars being grown in other countries include their demonstrated cold hardiness, regularity of cropping, and disease resistance combined with attractive fruit of good eating quality. These characters have led to Harrow cultivars being used as parents in other breeding programs.

Table 6. Harrow cultivars as a percentage of peach trees in Ontario.[z]

Cultivar	Year Intro.	Year of census						
		'66	'71	'76	'81	'86	'90	'94
Garnet Beauty	1957	1	3	4	6	8	8	8
Harbelle	1968		1	3	4	3	3	1
Canadian Harmony	1968		1	3	4	5	4	2
Harbrite	1969			2	3	3	2	2
Harken	1970			1	2	2	1	<1
Harbinger	1971			2	2	<1	<1	<1
Harson	1982						1	1
Harrow Beauty	1983						1	2
Harcrest	1983						1	<1
Harrow Diamond	1984						4	5

[z]Data provided by N. W. Miles, HRIO, OMAFRA, Vineland Station, 1995.

Influence of Other Organizations

Two organizations contributed greatly to the testing of Harrow advanced selections in North America: The Western Ontario Fruit Testing Association and the New York State Fruit Testing Cooperative Association. Trees of Harrow advanced selections were propagated under signed propagation restriction agreements permitting association members to assist in their wide-spread testing in Canada and the United States. This cooperation greatly reduced the time required to adequately test new selections and aided decisions on which selection had the most merit to warrant commercial introduction. The Ontario Tender Fruit Producers Marketing Board also provided advice on changing cultivar requirements for Ontario markets.

The Canadian Plant Breeders Rights Act, enacted in 1990, changed the procedure used by the Harrow Research Centre in the registration, protection, and commercialization of new Harrow introductions. The agent in the European Union for protected Harrow introductions is Star Fruits, 14 les Genêts d'Or 84430 Mondragon, France. In specific designated countries external to the European Union, and including North America, the agent for Harrow introductions is Inter-Plant Patent Marketing Inc., RR #2, Niagara-on-the-Lake, Ontario L0S 1J0, Canada. Two peaches ('AC Harrow Dawn,' 'AC Harrow Fair') and one nectarine ('AC Harflame') introduced in 1995 were the first to be protected under this legislation. Good communication and cooperation between breeders at Vineland and Harrow led to rationalization of breeding objectives. Thus, Harrow was able to concentrate on cultivar development from the fresh market while Vineland placed more emphasis in recent years on cultivars for processing. Cooperation with other peach breeders, especially in the United States, also contributed to the attainment of breeding objectives as evidenced by the parents used for the cultivars that were introduced from Vineland (Table 1) and Harrow (Table 5).

Conclusions

Eighty-four years of peach breeding at Vineland led to the introduction of 21 peach cultivars, several of which have been very important to the Canadian peach industry and some have also been successfully grown elsewhere.

Thirty-five years of peach and nectarine breeding at Harrow have led to 24 new cultivars — 13 fresh market peaches, 4 fresh market nectarines, 4 peach rootstock seed sources, and 3 ornamental peaches. Some of the fresh market peach and nectarine cultivars and some of the rootstock seed sources have gained national and international importance in their own right, and have also been useful as parents in other breeding programs.

No matter what the future holds, these two long-term breeding programs have had a significant impact on the fruit industry and on fruit breeding world wide. But nowhere has the impact been greater than Ontario, the region these programs were intended to serve. It is expected that the influence of these two programs will continue to be felt well into the next century.

Outlook

Agriculture and Agri-Food Canada underwent significant downsizing and consolidation of research as a result of the 1995 federal budget. Responsibility for tree fruit research, including fruit breeding, has been transferred to the Pest Management Research Centre Vineland. Remaining hybrid seedlings at Harrow will be evaluated, selected, and advanced testing initiated before seedling orchards are removed in 1998. The best Harrow selections, along with cultivars and rootstocks already introduced will be placed in the Canadian Clonal Genebank being established at Harrow and will be available on request as germplasm subject to nonpropagation agreements.

The long term peach breeding program at Vineland, supported by the Ontario Ministry of Agriculture, Food and Rural Affairs, is expected to continue. While the main emphasis will be on development of non-melting, yellow-flesh clingstone cultivars for processing, it is expected that some attention will also be given to yellow and white flesh freestone peach and nectarine cultivars for the fresh market.

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Raspberry Breeding in Canada: 1920 to 1995

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Abstract

Canadian raspberry breeding programs, sponsored by public-sector agencies, have produced cultivars that have been and continue to be successful not only in Canada but in raspberry-producing regions throughout the world. Particularly noteworthy are cultivars with high levels of winterhardiness and cultivars suited to fresh market use. Host of the programs have been significantly downsized or even eliminated in recent years. This is unfortunate since it is more important than ever that there be new pest and disease-resistant cultivars to meet the demands of an ever increasing range of raspberry end-products. At least some of the genetic variability represented in these new cultivars must come from native *Rubus* populations.

The ideal climate for red raspberries (*Rubus idaeus* L.) is a mild maritime type with moderate summer temperatures, usually not above 25° during the fruiting season and without especially high light intensities that cause sun scald, ample rainfall, occurring mostly during the winter and early spring months, and sufficiently low winter temperatures to meet chilling requirements but not low enough to result in extensive winter damage. Ideal soil types are medium to light-textured with good fertility, subsoil drainage and good water holding capacities. These conditions are relatively rare, at least on any sort of consistent basis. Nevertheless, in Canada they do sometimes exist in the lower Fraser Valley of southwestern British Columbia (B.C.), where approximately 90% of the country's production of the crop originates (17). The Agriculture and Agri-Food Canada (AAFC)-sponsored breeding program at the Pacific Agriculture Research Centre, Vancouver and Agassiz, B.C. has worked with this industry for the past 35 years. The program, with its successes, potential successes and failures, will be discussed in due course.

First, though, some lesser known Canadian programs, that have made some significant contributions, will be considered (Table 1). These programs include those sponsored by AAFC at Ottawa, Ontario, Morden, Manitoba and Kentville, Nova Scotia, plus the program, previously at Vineland, Ontario, and now at the University of Guelph, sponsored by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA). In addition, contributions from small programs

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