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Fruit Varieties Journal 51(4):228-233 1997

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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at the Alberta Special Crops Horticultural Research Center at Brooks and the University of Saskatchewan at Saskatoon and private sector-sponsored programs in Saskatchewan and Quebec will be mentioned. Each of the so-called lesser known programs has been primarily concerned with developing cultivars with greater winter hardiness. As far as can be determined, only the Kentville and Guelph programs still exist, albeit in reduced circumstances.

The title for this paper indicates that the history of Canadian red raspberry breeding efforts only goes back as far as 1920. However, at least one significant contribution, the cultivar 'Viking' introduced in 1924, was from a cross made in 1914 at Vineland (1); thus 1920 is not the beginning. Moreover it might even be that raspberry breeding or at least raspberry selection work began in Canada in the latter part of the 19th century. The cultivar 'Herbert' appears to have originated as a chance seedling in an Ottawa garden in 1887 (16). Obviously it is an earl generation derivative of the native North American red raspberry, *Rubus strigosus* Michx. 'Newman' is another cultivar that originated by chance before 1920; it was selected in 1918 in Quebec (1) and is considered an open-pollinated seedling of 'Herbert' (4).

'Viking' is one of the premier sources of winter hardiness in modern day raspberry breeding (17). The importance of 'Herbert' and 'Newman' is obvious since the former is in the derivations of 78 cultivars and the latter in the derivations of 79 cultivars released since 1960 (4).

The programs at Ottawa and Morden have also made major contributions to the world-wide germplasm pool for winter hardiness. 'Ottawa' which has 'Viking' as one parent, is probably the most important cultivar to originate from the Ottawa program (17). The name 'Ottawa' is thus appropriate. It was released in 1943 and, while no longer grown in eastern Canada or the northeastern United States (U.S.), is still grown in parts of the former Soviet Union, where it has been used in breeding (7). It has also been used for this purpose in Finland, where it is a parent of a relatively new cultivar, 'Ville,' (18) and in the Ottawa program itself. In the latter it was a parent of two cultivars, 'Carnival' and 'Comet' released in the mid-1950s; until recently, 'Ottawa' was on the recommended list of cultivars for commercial Production in Ontario (3). In addition, 'Carnival' is in the derivations of five cultivars released from the B.C. program (Table 2).

Other cultivars from the Ottawa program, recommended until recently in Ontario, are the 1943 releases, 'Gatineau' and 'Madawaska'; each has 'Newman' as a parent (4). The 1971 release, 'Festival' from the cross of 'Muskoka' x 'Trent' both of which originated in the program, is still recommended in Ontario, as well as in Quebec and the Maritime Provinces (2).

Table 1. Significant contributions from Canadian raspberry breeding programs.

AAFC[z] – Ottawa	'Ottawa'	'Carnival'	'Comet'	'Gatineau'
	'Madawaska'	'Muskoka'	'Creston'	'Festival'
AAFC – Morden	'Boyne'	'Killarney'		
AAFC – Vancouver/Agassiz	'Haida'	'Chilcotin'	'Skeena'	'Chilliwack'
	'Comox'	'Algonquin'	'Tulameen'	
AAFC – Kentville	'Nova'			
OMAFRA[y] – Vineland/Guelph	'Viking'			
Chance Selections	'Herbert'	'Newman'		

[z]Agriculture and Agri-Food Canada.
[y]Ontario Ministry of Agriculture, Food and Rural Affairs.

The Ottawa program also was responsible for 'Creston,' which was named in 1950 from a trial planting of Ottawa selections at Creston, B.C. 'Creston,' like the aforementioned 'Carnival,' has been a useful parent in the B.C. breeding program for resistance to the common strain of *Amphorophora agathonica* Hottes the North American aphid vector of the raspberry mosaic virus (RMV) complex. 'Creston' has alwo been used as a source of winter hardiness and strong, upright canes with only a few spines that are limited to basal portions.

Besides 'Ottawa,' other cultivars from the Ottawa program, including 'Carnival,' 'Comet' and 'Muskoka,' have become important in the former Soviet Union and in Finland (7). 'Muskoka' is currently the second most widely planted cultivar in Finland (18).

The outstanding contributions from the Morden program are 'Boyne,' released in 1960, and 'Killarney,' released in 1961. Both are from the cross of 'Chief' x 'Indian Summer'; the latter has 'Herbert' in its derivation (1). 'Boyne' is now the most widely planted cultivar in Ontario and the Prairie provinces of Canada and the upper Midwest of the U.S. (2, 19). It has also been grown in Finland and used in breeding there (18). Recently, several cultivars have been named from selections remaining in the Morden program. These include two primocane fruiting cultivars, 'Red River' and 'Double Delight,' both of which have 'Boyne' in their derivation, as well as a primocane fruiting parent derived from a Wyoming *R. strigosus* selection, and 'Souris,' a floricane fruiting cultivar, also derived from 'Boyne' (12, 13, 14).

'Nova,' which has 'Boyne' as one parent, has been the most important contribution from the AAFC program at Kentville. It is now the most widely planted cultivar in the Maritime provinces, surpassing both 'Festival' and 'Boyne' in importance because of better fruit qualities which extend the fresh-market shelf life.

The significance of 'Viking' from the OMAFRA program has already been indicated. Recently, two new cultivars, 'OAC Regal' and 'OAC Regency,' have been released from this program; the latter from the cross of 'Creston' x 'Muskoka,' is particularly winter hardy in Ontario and in southern Quebec (11).

The public-sector sponsored programs in Saskatchewan and Alberta are responsible for several cultivars adapted to the harsh Prairie winter conditions. 'Fraser,' released in 1960 from the Saskatchewan program, has 'Viking' as a parent. It has had some acceptance, mostly for home gardens (1). 'Fallbrook,' a primocane fruiting cultivar and 'Redbrook,' a floricane fruiting cultivar with 'Boyne' as a parent, were both released from the Alberta program in 1984 (11). As far as can be determined, neither is being grown to any extent. 'Fallbrook' might be useful in breeding as a source of extremely early-ripening primocane fruiting.

In 1948, a private-sector sponsored breeding program in Saskatchewan released the cultivar 'Honeyking,' from the cross of 'Viking' with an indigenous selection of *R. strigosus.* As far as can be determined, the cultivar does not seem to be grown anymore and does not appear to be in the derivation of any present-day cultivar. A private sector program in Quebec released a primocane fruiting cultivar, 'Perron's Red' in 1987. To date, it appears to be grown to a limited extent only.

The B.C. program has now released 11 cultivars. These include 'Clutha,' which was selected in B.C. and was tested and named in New Zealand in 1993 and, 'Qualicum' named in 1995. Approximately 30,000 plants of 'Qualicum' were distributed in 1995.

Among the nine other cultivars released from the program, seven are designated at present as significant contributions. 'Chilcotin,' Skeena,' 'Chilliwack,' 'Tulameen' and 'Comox' are grown commercially in the Pacific Northwest (PNW); the other two, 'Haida' and 'Algonquin' are not. However 'Haida' is grown in the upper mid-west of the U.S. with approximately 20,000 plants being distributed annually. 'Algonquin,' initially re-

leased because of its adaptation to conditions in eastern Canada, is being recommended for commercial planting in Ontario (3). Both of these cultivars also could be designated as significant because of unique genetic characteristics. 'Algonquin' is the only cultivar known to be homozygous for the single dominant gene Ag_1, which gives resistance to the common strain of *A. agathonica,* the aphid vector of the RMV complex (9). 'Haida' is one of two cultivars that has been identified as resistant to the resistance-breaking biotype of raspberry bushy dwarf virus (17).

Of the other cultivars designated as significant contributions (Table 1) 'Chilcotin' and 'Skeena,' both released in 1978, have been credited in helping to revitalize the raspberry fresh market industry of the PNW (10). 'Chilcotin,' in particular, is noted for its bright, non-darkening, red fruit color. 'Skeena' has had wide acceptance in New Zealand.

In the PNW both cultivars are now being replaced for fresh market use by 'Chilliwack,' released in 1987, and 'Tulameen,' released in 1991. 'Chilliwack' produces particularly firm fruit with a pleasant flavor combined with a bright, non-darkening color (5). 'Chilliwack' has an excellent shelf life with some resistance to postharvest fruit rot caused by *Botrytis cinerea* Pers. ex. Fr. Because of this, it is also grown extensively in the Santiago region of Chile for shipping to fresh markets in North America and Europe in late November and through December. 'Chilliwack' has also become important in southeastern Australia, where similar to Chile, it has shown a low chilling requirement. 'Chilliwack' has field resistance to root rot, caused by *Phytophthora fragariae* var. *rubi* Wilcox and Duncan which has contributed to its success in both the PNW, in Chile and now in Norway (10, 15). 'Tulameen' usually outyields Chilliwack' and has larger fruit with equally appealing color and flavour (8). 'Tulameen' tends to ripen later than 'Chilliwack' and over a longer period of time, both traits that extend the fresh market season and ensure overlap with the season of early-ripening primocane fruiting cultivars such as 'Autumn Bliss.' 'Chilliwack' and 'Tulameen' are adapted to processing and can be machine harvested.

Table 2. Parents of raspberry cultivars from the B.C. breeding program.

Cultivar	Parents
'Haida'	'Mailing Promise' x 'Creston'
'Matsqui'	'Sumner' x 'Carnival'
'Chilcotin'	'Sumner' x 'Newburgh'
'Skeena	'Creston' x SCRI 6010/52
'Nootka'	'Carnival' x 'Willamette'
'Chilliwack'	'Skeena' x BC 64-10-198 ('Sumner' x 'Carnival')
'Comox	'Skeena' x BC 64-9-81 ('Creston' x 'Willamette')
'Tulameen'	'Nootka' x 'Glen Prosen'
'Algonquin'	'Haida' x 'Canby'
'Clutha'	'Meeker' x 'Skeena'
'Qualicum'	'Glen Moy' x 'Chilliwack'

To date, 'Comox' has been less successful than either 'Chilliwack' or 'Tulameen' but is recognized for its exceptionally high yield (5). There has been a problem in managing its vigorous canes. 'Comox' is having some success in Argentina and also in the state of Tasmania in Australia.

The remaining two cultivars from the B.C. program, 'Matsqui' and 'Nootka were released because of adaptation to machine harvesting. Neither has been successful, though 'Nootka' has been useful in breeding and is a parent of 'Tulameen' (8).

It is obvious that the Canadian raspberry breeding programs, sponsored by public sector agencies, have had a worldwide impact. With the elimination of many of the programs and drastic downsizing of others, including the program in B.C., it is unlikely there will be a similar impact in the future. This is indeed unfortunate since the use of raspberries in a wide range of end-products continues to increase at a dramatic rate. Meanwhile,

production of the crop is expanding rapidly into regions with less than desirable growing conditions. Along with this, fewer chemicals are available for pest and disease control. Increased genetic variability is urgently needed to provide adaptation to all these situations. Much of this variability exists in native populations of *R. strigosus* throughout Canada and the U.S. and in related *Rubus* species, such as the black raspberry (*R. occidentalis* L.), in the east and the salmon berry (*R. spectabilis* L.), in the west. At most, only eight or nine selections of *R. strigosus* are represented in modern day raspberry cultivars with only two of the selections originating in Canada. It is imperative that *R. strigosus* be fully exploited for useful traits. In the B.C. program a start has been made in doing this but future efforts are jeopardized by the aforementioned downsizing. At the same time, much *R. strigosus* diversity is being lost because of the increasing encroachment of modern day civilization.

The future of raspberry breeding in Canada will depend for the most part on sustained support from the private sector, that being the industries in various parts of the country. To date, the B.C. industry has given some support to the local program. However, if the program is to survive, the support must be on a large scale and be sustained. This is equally applicable to industry support of programs in other parts of the country. The private sector must realize that it may take as long as 35 or 40 years for a successful cultivar to evolve. The time frame might even be longer when *Rubus* species selections are involved in the initial crosses. There must also be an appreciation of the necessity of mutual exchanges of information and germplasm and the importance of maintaining and distributing the germplasm pathogen-free.

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