

Agriculture and Agri-Food Canada Apple Breeding Program

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The apple breeding program in Summerland has existed since the 1920s. For much of its history, the focus was regional. Since 1995, we have been attempting to breed apples for all parts of Canada.

The apple selection is done in three stages. In Stage 1 ("seedling"), there is a rotating population of 25,000 to 30,000 different kinds, but only one tree of each kind. Stage 2 ("second selection") has only about 500-600 kinds, but there are multiple trees of each. Stage 3 (on-farm testing) is handled by our commercialization partner; 5-10 types are at Stage 3 typically. Each year many thousands of new genetic combinations are generated, and thousands of others are discarded. The breeding program occupies about 5 ha of land at the Pacific Agri-Food Research Centre (PARC), including nurseries, breeding populations, and the cultivar collection. The program makes 20-30 new crosses each year, generating 6,000 or more seeds. The main focus is on apples for commercial production, but a few homeowner-type trees have also been developed in the past.

The most important breeding goal is high fruit quality. It must taste good! Texture and flavour are both important. Appearance is also important for many markets. Good storage and shelf life, precocity, productivity, good tree growth habit, and disease resistance are further goals. The emphasis is on apples with September or October harvest dates. The cultivars should be adapted to one or more of the regions where apples are grown in Canada. Ideally we would like to produce a series of selections with different types of appearance and flavor, and different seasons of maturity, but all with crisp, firm, juicy texture to provide a good "eating experience". Selections are screened for sensory quality starting at Stage 1.

The time required from making the cross to first production on farm is usually at least 15 years. As an example to illustrate why this is so, let us suppose we make a particular cross in 2000, and that we get 500 seeds from it. Suppose further that this cross includes a parent that is scab resistant. The cross is made in spring of 2000 and the mature seeds are extracted from the resulting apples in fall of 2000. The seeds are stratified to break dormancy and then grown in the greenhouse. Because one of the parents carries scab resistance, the population is screened at this stage and susceptible types are discarded, leaving approximately 250 seedlings in this particular family. These survivors are transplanted in May of 2001 to the field nursery, where they remain until August of 2003. In any given year, approximately 6000 new seedlings are transplanted to the field nursery. The trees are juvenile at this stage of their life (meaning that they produce no fruit).

In 2003, the nursery trees are double-budded into a field onto dwarfing rootstocks. The dwarfing rootstocks will shorten the juvenile phase, enable us to fit many more plants into a given area, and make the trees much easier to manage (pruning, training, thinning). Nursery trees that are weak or show powdery mildew infection are not budded, so the population from our example is now lower than 250. Let us suppose we are now at 200 trees from this family. In any given year, approximately 3500 new types are budded onto rootstocks in this fashion. The buds then require 2-3 years to grow into scions large enough to begin fruiting. The earliest crop from our scab resistant family is perhaps in the year 2006.

Let us suppose a specific tree in this population is selected the first year it produces fruit in 2006, and that it passes all of the post-harvest evaluations that year. Now we are already 6 years from the original cross. The tree is promoted to Stage 2 and is budded in August of 2007 to produce multiple trees. These trees are again in the nursery for 2 years, then are planted into a Stage 2 field in 2009. Second stage fields are randomized, replicated plots with commercial cultivars as standards. More detailed records are taken on these trees. The nursery whips are planted in spring of 2009, and the trees are de-blossomed (if they flower) in 2010 to prevent them from stunting. The first [small] crop on the second stage trees is produced in 2011. By 2013, although we are 13 years from the cross, we have only 3 years of detailed data on the yield, fruit size, laboratory quality measurements, etc. We are still working out maturity indices (which must be determined empirically for each selection), and determining how consistent the production and fruit quality are. If we have made a mistake in picking time, the fruit storage life may be compromised and more years of data will be needed.

If the fruit is of good quality and abundance, and without serious other obvious problems, the selection may be promoted to Stage 3 as early as 2013. A limited supply of budwood will be distributed in 2014, and trees will be ready to plant on-farm in 2016. By 2017 or 2018, the farmers will obtain their first crop. At this point we still lack important information on the selection's response to different climates of Canada, commercial handling issues (such as bruising on the packing line), chemical thinning recommendations, and so on. In addition, consumer data is frequently quite limited at this phase.

The lack of a mechanism to fund on-farm testing across the country was a serious drawback for the breeding program in the past. Luckily, the RECUPOM group in Quebec has been a long-time collaborator for funding the early testing of Summerland breeding selections. In the past the testing was done by Mme Monique Audette at AAFC in St-Jean-sur-Richelieu. The RECUPOM group is again involved in our new project that was approved in May of 2013. New test selections were released for Stage 3 testing in spring of 2013. Future promising selections are still in Stage 1 and 2 testing.