



Developing Vegetable Varieties for Canada's Organic Farmers

Canadian Organic Vegetable Improvement (CANOVI)

Part 2 | March 2023

The vast majority of vegetable varieties used in Canada were bred in the US or Europe, and then the seed is produced on farms in the US, Europe, Israel, China and other parts of the world. Most Canadian seed companies selling bulk vegetable seed do not grow their own seed, but purchase from larger international seed companies. As the seed industry becomes consolidated, more and more genetic material has become property of the corporations. This means vegetable producers are dependent on a network of international players and their seed supply is vulnerable to changes in the marketplace. Open-pollinated varieties are being replaced with hybrids and there has been an increase in "plant variety protection," which prohibits growers from saving seed or propagating patented plant material in any way. Organic vegetable farmers are particularly vulnerable in this system because vegetable breeding needs are predominantly directed by large-scale, non-organic vegetable producers.



Radicchio Field Day: Dr. Solveig Hanson presenting in radicchio variety trial plots at a 2022 Radicchio Field Day and Taste Test at Poplar Bluff Organics, AB (Photo Credit - Tierra Stokes)

Fortunately, there has been a resurgence in seed saving largely due to the work of Seeds of Diversity and The Bauta Family Initiative on Canadian Seed Security (a program of SeedChange), as well as some of the research within the Organic Science Cluster. This has led to a proliferation of seed companies across the country which use "ecological" ⁴ growing methods to produce seeds for gardeners. However, most of these operations are small and currently cannot provide seed in large enough volumes to meet the needs of large market gardeners who must then rely on varieties developed outside of Canada. Also, more attention needs to be paid to

developing regionally-adapted seed that thrives in organic and climate-resilient farming conditions. To help address the need for vegetable varieties appropriate for Canadian organic farms, the Canadian Organic Vegetable Improvement (CANOVI) [project](#) was launched in 2018 as part of the Organic Science Cluster 3.

The primary goal of CANOVI is to identify and develop vegetable varieties suitable for Canada's organic farmers through a creative collaboration of farmers, seed activists/educators from the not-for-profit sector, and university researchers. CANOVI is led by the University of British Columbia's Centre for Sustainable Food Systems (CSFS) and The Bauta Family Initiative on Canadian Seed Security at SeedChange.

This participatory plant breeding initiative is improving the resilience of organic farms to the effects of climate change by developing cultivars that can thrive in a variety of growing conditions. The project also creates economic opportunities for Canadian market gardeners and seed growers. Locally grown, regionally adapted organic vegetables can displace imported produce, and Canadian growers can buy more domestically produced seed instead of imported seed.



CANOVI

Canadian Organic
Vegetable Improvement

ALÉBIO

Amélioration des légumes
biologiques au Canada

The project also creates niche markets for unique varieties (in terms of both seed and produce). Moreover, the project contributes to greater seed security in Canada by creating open-pollinated varieties designed for Canadian growers while also teaching growers how to save seed and conduct on-farm breeding and variety trials.



Dr. Solveig Hanson with her research team at UBC after planting carrot trials at UBC farm.

“The Canadian Organic Vegetable Improvement Project (CANOVI) was a 5-year program (2018-2023) to build a collaborative network of farmers, researchers, and industry stakeholders to:

- Test varieties for: (1) adaptation to agro-ecological practices, (2) nutrition and flavour, and (3) domestic seed production potential in Canada;
- Generate and share varietal data with farmers and seed producers;
- Collect and analyze data (called “functional traits”) to assess crop performance in organic systems;
- Implement on-farm Participatory Plant Breeding to create new lines of priority crops, including carrot, bell pepper, and squash;
- Build farmer capacity for on-farm trialling and breeding.”

“Ultimately, the goal of this research is to ensure that Canadian organic vegetable farmers and seed producers have access to high quality vegetable seeds that can perform competitively in Canadian organic farming systems.”

Step 1: Identifying What Farmers Want

One factor that differentiates CANOVI from conventional plant breeding efforts is the involvement of farmers. The project began with a national survey of organic/ecological ⁵ growers to identify which crops and crop characteristics needed ‘improvement.’

The participants identified the following crops needing improvement (in descending order): tomatoes, peppers, carrots, lettuce, winter squash, onions/leeks, and broccoli/cauliflower. The traits that needed the most improvement were (in descending order): flavour/eating quality, productivity/yield, earliness/days to maturity, and disease resistance.

Step 2: Participatory Plant Breeding

The 2018 survey asked farmers to list their favourite varieties. These varieties were then chosen as some of the ‘parent’ genetic stock in the plant breeding projects and also used as ‘checks’ or controls in variety trials to serve as a standard variety by which newly developed accessions were compared.

The main breeding projects included developing:

- an orange Nantes-type carrot that can store well, has excellent flavour, and early vigour
- a red Nantes-type carrot that has deep red colour, good flavour, and resistance to bolting in moderate temperatures and long daylight periods (as found in Southern BC)
- a red pepper that matures early and has good flavour.

Step 3: Participatory Variety Trials

Throughout CANOVI, organic and ecological growers across Canada were comparing the performance of several varieties, including popular commercial varieties (as identified by surveys), several open-pollinated ones, and the CANOVI-bred accessions (if available). On each farm, the varieties were compared in a standardized setting. There were a number of differences in growing conditions among farms including soil conditions, moisture levels, climatic constraints, pest levels, and farming practices.

Having variation among farms is valuable because it enables researchers to assess how well varieties perform in different conditions. Cultivars that perform well on many farms are likely to be well adapted to a wide range of conditions. This is particularly important as we face climate change. All the participating farms use organic practices. Consequently, the results are relevant to organic producers, unlike the results of variety trials commonly conducted at field stations using non-organic methods.

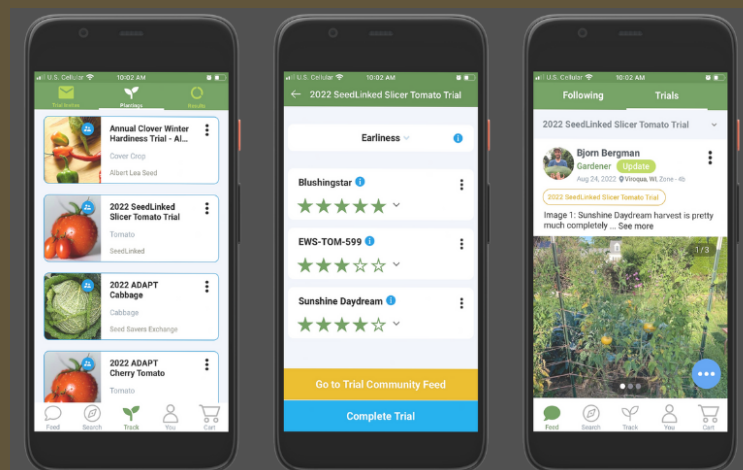
SeedLinked App

Growers participating in CANOVI use the SeedLinked App to record their findings. The app allows growers to easily keep track of the performance of the various varieties they grow in real time, while also enabling researchers to collect data from collaborative variety trials.

The SeedLinked App is a “crowdsourcing approach to revolutionize variety testing.” The free app provides an online tool for easily recording the results of variety trials, whether farmers are conducting their own trials or part of collaborative variety trials. Anyone with the app can rate varieties on several factors including earliness, flavour, bolt resistance, and resistance to the diseases and insect pests that commonly affect that crop.

The free app is available at: <https://seedlinked.com>.

To learn more about the app, see the 75-minute video, “Intro to SEEDLINKED” at https://youtu.be/NO1wphD_1sk.



Results

The highlights of the CANOVI project research up until 2023 are listed below. It should be noted that the process of plant breeding takes many generations and researchers are working on continual improvement of the newly developed varieties. The detailed reports can be found at <https://www.seedsecurity.ca/canovi>.



Fantasia carrot is an organic breeding population developed by the Organic Seed Alliance and the Carrot Improvement for Organic Agriculture project in the US (Photo Credit - Organic Seed Alliance)

Carrots

The 2018 survey summarized the growers' following priorities for carrots:

- *Eating quality* - sweetness, crispness, lack of woodiness, holding flavour in ground or storage,
- *Disease resistance* - rot, fungal disease, storage diseases, and
- *Other* - earliness, long storage, productivity, resistance to carrot rust fly, strong tops.

CANOVI embarked on breeding and selection projects for orange and red Nantes carrots.

Orange Nantes Carrots

The original goal was to develop a new variety and then eventually compare the CANOVI-bred orange Nantes carrot to commercial hybrids (Bolero F1 and Naval F1) and open-pollinated (OP) varieties (Dulcinea and Touchon Deluxe). However, due to pest damage to the seed crop in 2022, the goal to evaluate the CANOVI-bred line was adjusted to compare OP and hybrid commercial cultivars. Key traits include root shape, smoothness, uniformity, vigour, flavour, dark orange colour, and resistance to carrot rust fly.

Results:

- Bolero F1 received the highest rankings for all traits and Naval F1 had the second highest ranking.
- Touchon Deluxe (grown by the BC Eco Seed Co-op) was ranked third for most traits, although Dulcinea (a variety developed by Fruition Seeds in New York) was slightly better in a few traits.
- The CANOVI variety ranked the lowest for all traits (due to the seed crop failure) except for flavour, where it was tied with Touchon Deluxe for the lowest rating.

Red Nantes Carrots

The original goal was to develop a new variety and then compare the CANOVI-bred red Nantes carrot to commercial hybrids (Red Sun F1 and Rubypak F1) and open-pollinated varieties (Carnelian, R6220, and Dragon). However, as with the orange carrots, due to pest damage to the seed crop, the goal was adjusted to compare OP and hybrid commercial cultivars. Key traits include bolt resistance, vigour, deep red colour, smoothness, uniformity, root shape, flavour, and resistance to carrot rust fly.

Results:

- Dragon had the highest overall ratings of all cultivars. It had the highest yields and was ranked as having the best flavour.
- For most traits, the ratings were similar for Dragon, Red Sun F1, and Rubypak F1.
- Carnelian was bred under organic conditions and had similar (but lower) yields to the hybrids. Carnelian was bred through Organic Seed Alliance's Carrot Improvement for Organic Agriculture project.
- R6220 ranked the lowest for most traits.



Red carrots being evaluated at Organic Seed Alliance (Photo Credit - Alex Lyon)

Peppers

The 2018 survey summarized the growers' priorities for peppers as the following:

- *Productivity/yield* - more peppers per plant, longer fruiting periods, larger fruits, reliable harvest,
- *Eating quality* - for both sweet and hot types, uniformity of flavour, and
- *Earliness* - short seasons and low heat zones, need red bells to ripen faster.

The project then embarked on variety trials for both red bell and Corno di Toro peppers, as well as expanding an existing breeding project for red bell peppers.

Bell peppers

One goal was to find early-maturing, blocky sweet red bell peppers by comparing existing varieties (hybrids Flavorburst F1, Whitney/Zsa Zsa F1, and Ace F1, and the open-pollinated SBGO 10408, King of the North, Early Red Sweet, Peace Work, and Italian Red Heart). Building on work initiated by the SeedWorks Breeding Club with support of Dr. Michael Mazourek of Cornell University and the Ecological Farmers Association of Ontario, a second goal was to develop new red and yellow bell pepper varieties.

Results:

- With the variety trials, Peacework and Early Red Sweet had the highest total yield and marketable yield. Ace F1 had high yields but also a high proportion of unmarketable peppers.
- In terms of flavour, the top peppers were Flavorburst F1, Ace F1, and Peacework.
- Led by the SeedWorks Breeding Club, CANOVI was able to help support the development of a bell pepper, Renegade Red. This variety was released commercially in 2021 and pledged with the Open Source Seed Initiative (OSSI).



Renegade Red bell pepper from Kitchen Table Seed House (Photo Credit: Kitchen Table Seed House)

Open Source Seed Initiative (OSSI)

The mission of the non-profit organization is “to maintain fair and open access to plant genetic resources worldwide in order to ensure the availability of germplasm (seeds) to farmers, gardeners, breeders, and communities of this and future generations.” A small number of plant breeders are making their varieties available exclusively under the OSSI pledge, thereby ensuring that the varieties cannot be patented and will be available for growers to grow and save seed themselves.

https://osseeds.org_

Corno di Toro peppers

Corno di Toro peppers are sweet peppers also known as frying, roasting, or shepherd peppers. Their name reflects their Italian heritage and their shape, which resembles a bull's horn. Compared to bell peppers, many Corno di Toro varieties are more flavourful than bell peppers and mature earlier. The goals were to identify flavourful, early varieties and educate consumers about this type of pepper. The variety trials involved two hybrids (Carmen F1 and Escamillo F1) and seven open-pollinated cultivars (Joelene, Bridge to Paris, Elephant Ears, Golden Treasure, Lively Yellow, Karma, and Early Perfect Italian).

Results:

- The highest yields (in number of peppers and/or overall weights) came from Early Perfect, Bridge to Paris, and Golden Treasure.
- In terms of flavour, Early Perfect Italian had the highest ranking, followed by Escamillo and Bridge to Paris. However, there was considerable variation in scores between tasters and the findings are not conclusive.

Radicchio

The goal was to compare early-maturing red radicchio varieties of three market classes (Chioggia, Verona, Trevis). In 2021, 27 cultivars were compared; this was narrowed down to six varieties in 2022 including hybrid Chioggia (Indigo F1 and Leonardo F1), open-pollinated Chioggia cultivars (Sirio and Vesuvio), OP Treviso (TVG1), and OP Verona (Pasqualino).

2022 Results:

- Basically, all of the varieties had good ratings with the exception of Vesuvio having low yields. There were no significant differences between varieties with the exception of Vesuvio being less uniform than the other varieties.
- Pasqualino (an OP grown by Uprising Seeds in Oregon) ranked highest for marketability, yield, and appearance.

Rutabaga

The goal was to compare six open-pollinated rutabaga varieties, four purple-topped (Helenor, Joan, Laurentian, and York) and two green-topped (Gilfeather and Nadmorska).

Results:

- “Within this set of cultivars, there is neither a standout variety nor a variety with particular problems. Variety ranking and trait ratings varied substantially among 2020, 2021, and 2022 CANOVI trials, emphasizing the importance of trialling varieties for multiple years before relying on them for production.”
- Strong variation among varieties was only found for germination and vigour (both traits that can reflect seed quality as much or more than varietal characteristics).
- The mean rankings for most traits were between “acceptable” and “good.”
- Laurentian was rated above average for all traits.
- Gilfeather and Laurentian had the highest yields; Joan had the lowest yield.
- Laurentian and Joan were ranked as having the best flavour.

Although this fact sheet focused on research findings, the Organic Science Cluster’s plant breeding work has produced many intangible yet long-lasting outcomes. A great interest in seed security, combined with many educational opportunities provided by The Bauta Family Initiative on Canadian Seed Security, has led to a strong network of skilled seed growers from coast to coast.



Radicchio trials at Poplar Bluff Organic Farm (Photo Credit - Tierra Stokes)

To learn more about the impact of the Organic Science Cluster's plant breeding activities, see:

Part 1. Organic seed breeding and variety trials: Finding the right seed for your farm

Part 3. Beyond yield: The many goals of organic plant breeding

Breeding for Organic Field Crops in Canada

(<https://cdn.dal.ca/content/dam/dalhousie/pdf/faculty/agriculture/oacc/en/2021/FINAL-%20Field%20Crop%20Breeding.pdf>)

Organizations

Seeds of Diversity- <https://seeds.ca/>

The Bauta Family Initiative on Canadian Seed Security - <https://www.seedsecurity.ca/>

SeedChange - <https://weseedchange.org/>

References

4 As defined by The Bauta Family Initiative on Canadian Seed Security, the terms "organic and/or ecological" are "used to include both farmers who are certified organic in Canada and farmers who employ a range of practices that are consistent with the principles of organic farming, but have chosen not to certify. Ecological farming includes, but is not limited to practices such as organic, biodynamic, permaculture, and other types of cropping systems that work to restore soil health, improve biodiversity, and find alternatives to synthetic or environmentally adverse inputs for agriculture."

5 As defined by The Bauta Family Initiative on Canadian Seed Security, the terms "organic and/or ecological" are "used to include both farmers who are certified organic in Canada and farmers who employ a range of practices that are consistent with the principles of organic farming, but have chosen not to certify. Ecological farming includes, but is not limited to practices such as organic, biodynamic, permaculture, and other types of cropping systems that work to restore soil health, improve biodiversity, and find alternatives to synthetic or environmentally adverse inputs for agriculture."

ABOUT THE ORGANIC SCIENCE CLUSTER



organic
SCIENCE CLUSTER

This bulletin reports research results from the Organic Science Cluster program which is led by the Organic Federation of Canada in collaboration with the Organic Agriculture Centre of Canada at Dalhousie University.

Organic Science Cluster 3 is supported by funding from the AgriScience Program under Agriculture and Agri-Food Canada's Canadian Agricultural Partnership (an investment by federal, provincial, and territorial governments) and over 70 partners from the agricultural community. More information about the Organic Science Cluster Program can be found at: www.dal.ca/oacc/OSC

Contributing financial and research partners:

 **SeedChange**



**University
of Manitoba**



UNIVERSITY OF
TORONTO



UBC FARM
Centre for Sustainable Food Systems

This factsheet may be cited as:

Wallace, J. (2023). Developing Vegetable Varieties for Canada's Organic Farmers- Canadian Organic Vegetable Improvement (CANOVI). Organic Agriculture Centre of Canada, Dalhousie University, Truro, NS. 7 pp. <https://www.dal.ca/faculty/agriculture/oacc/en-home/organic-science-cluster/OSCI/III/latest-news-/producer-bulletins.html>

