

## Orange and Specialty Carrot Variety Trials - 2023

### Instructions for On-Farm Sites Across Canada

**Thank you for participating in the Canadian Organic Vegetable Improvement (CANOVI) variety trials!** This project is a collaboration between the Centre for Sustainable Food Systems at the University of British Columbia and the Bauta Family Initiative on Canadian Seed Security at SeedChange. **This year's trial is being delivered in collaboration with the [Organic Seed Alliance](#) and the [Carrot Improvement for Organic Agriculture](#) project in order to offer a greater diversity of organically bred carrot lines and foster knowledge exchange across North America.**

The information gathered through this on-farm trial network will be used to help farmers:

- **Identify the best-performing varieties** for your region, both for market garden production and seed production.
- **Identify varieties that would be suitable parents** for future regional breeding projects.
- **Build the capacity of farmers** to conduct on-farm variety trials useful for their farming operation and to participate in on-farm plant breeding.



### **2023 Orange and Specialty Carrot Trials Overview**

#### ***Varieties***

The CANOVI program will be running two types of carrot trials in 2023: **orange nantes carrot trials** and **specialty carrot trials**. Each trial will evaluate multiple organically bred varieties or breeding populations developed by the University of British Columbia, the Organic Seed Alliance, and the Carrot Improvement for Organic Agriculture (CIOA) project, alongside open-pollinated varieties grown by regional seed companies, and other commercial varieties. Please see more information about the breeding lines on page 2 of this document.

#### ***Trial Plots***

Each trial will have **6-7 varieties** and will require **12 linear feet per variety** at approximately **1" spacing** between plants after thinning. Depending on your farm layout, you may choose to plant a single row or multiple rows per bed.

#### ***Planting***

The specialty carrot varieties are being bred for main-season planting whereas many of the orange nantes carrots are being bred for storage as well as main season successions. **Please feel free to plant these two trials either at the same time, or plant the specialty carrots as soon as you receive the seeds and the orange variety a few weeks later when you'd regularly plant your storage carrots.** Plots should be **hand seeded** due to limited trial seed quantities.

#### ***Evaluation***

Trial evaluation will be conducted with the desktop or mobile **SeedLinked app**. You will evaluate traits of interest for each variety on a scale of 1-5 (1=poor, 5=outstanding), using the included **rubric with evaluation guidelines** for clarification.

**Stipend**

Regardless of whether you trial one or both sets of carrots, you will receive a **\$300 stipend** for **planting and evaluating** the trial. If you are unable to evaluate the trial, you will still receive a **\$100 stipend** for planting it.

**2023 Carrot Varieties****Orange Nantes Carrot Trial Varieties**

Variety/Breeding Line	OP / F1 / Breeding Line	Days to Maturity*	Breeder	Seed Source
CIOA Orange Flavour Select	OP	N/A	CIOA	<a href="#">Carrot Improvement for Organic Agriculture (CIOA)</a>
CIOA Orange Strain Cross	OP	N/A	CIOA	<a href="#">Carrot Improvement for Organic Agriculture (CIOA)</a>
Uberlandia Flavor	OP	N/A	CIOA	<a href="#">Carrot Improvement for Organic Agriculture (CIOA)</a>
CANOVI Orange (2021 Selections)	Breeding Line	N/A	CANOVI	<a href="#">CANOVI</a>
Dulcinea	OP	60	Fruition Seeds	<a href="#">Fruition Seeds</a>
Touchon Deluxe	OP	65-70	Heirloom	<a href="#">BC Eco Seed Coop</a>
Bolero F1	F1	75	Vilmorin	<a href="#">Johnny's Selected Seeds</a>

**Specialty Carrot Trial Varieties**

Variety/Breeding Line	Colour(s)	OP / F1 / Breeding Line	Days to Maturity *	Breeder	Seed Source
Fantasia	Multi-coloured	OP	N/A	Organic Seed Alliance	<a href="#">Organic Seed Alliance</a>
OSA Purple/Orange/Purple	Purple/Orange	Breeding Population	N/A	Organic Seed Alliance	<a href="#">Organic Seed Alliance</a>
Y1246 (New organic yellow breeding line)	Yellow	Breeding Population	N/A	Organic Seed Alliance	<a href="#">Organic Seed Alliance</a>
Jaune de Doubs	Yellow	OP	N/A	Heirloom	<a href="#">La Société Des Plantes</a>
Carnelian	Red	OP	N/A	Organic Seed Alliance	<a href="#">Organic Seed Alliance</a>
R6220	Red	Breeding Population	N/A	Organic Seed Alliance	<a href="#">Organic Seed Alliance</a>

\*Days to Maturity are not listed for the CANOVI and OSA varieties, as they haven't been defined yet. Your SeedLinked evaluations, along with information from those of you gathering additional data, will help determine maturity time for these varieties.

### Variety/Breeding Population Information

#### **Orange Nantes Carrot Trial:**

- **CANOVI Orange:** A sweet, deep orange, open-pollinated Nantes variety that could be produced for both roots and seed in BC and to provide an OP alternative for hybrids like 'Bolero' (F1),
- **CIOA Orange Flavour Select:** A nantes type orange population developed for superior flavor by combining several sources known for good flavor and texture.
- **CIOA Orange Nantes Population:** An orange nantes type selected for broad adaptation under diverse environments across the US. Parent lines include sources for deep orange color, good flavor, Cavity spot resistance and Nematode resistance.
- **Uberlandia Flavour:** Derived from Uberlandia heirloom variety, selected for superior flavor and crisp, succulent texture. Roots have a broad, heavier shoulder tapered to a blunt tip.
- **Dulcinea:** A long, orange, tapered OP carrot variety developed organically and collaboratively by Remembrance Farm (NY), University of Wisconsin Madison (WI), and Fruition Seeds (NY). Seed provided by [Fruition Seeds](#).
- **Touchon Deluxe:** A blunt-tipped, nantes-type heirloom OP carrot with excellent flavour and colour; good for bunching and winter storage. Seed provided by [BC Eco Seed Co-op](#).
- **Bolero F1:** Reliable storage carrot known for its excellent flavour, yields, and storage. Seed provided by [West Coast Seeds](#).

#### **Specialty Carrot Trial:**

- **Fantasia:** A highly diverse population exhibiting a wide range of color combinations. Selected for root smoothness, bolt resistance, and good flavor. This is a great breeding population to select for local adaptation and unique colors.
- **OSA Purple/Orange/Purple:** Sliced and diced this variety is gorgeous on a plate with a purple exterior, orange mid layer and brilliant purple core. A delight to the eye and the body, it is flavorful and nutritious, high in anthocyanins, alpha-carotene, and beta-carotene.
- **Jaune de Doubs:** Heirloom tapered yellow variety with fruity and creamy flesh, with some resistance to carrot fly and tolerance to heavy soils; provided by [La Société Des Plantes](#) in Quebec.
- **Y1246:** A sweet and crisp yellow carrot with a longish Danvers shape and a little green on the shoulder.
- **Carnelian:** Red roots, medium long with taper selected for bolt tolerance, flavor, smoothness and medium-sized tops.
- **R6220:** Red nantes with medium tops, succulent taste and crisp texture. Selected for bolt resistance, root shape and uniformity, crisp texture, and good flavor.

### Planting and Cultivation Recommendations

The table below provides *suggestions only* for trial implementation. **The trial should be grown as you would normally grow carrots**, including your normal bed and row spacing, as the purpose of on-farm trials is to test varieties in your farm system!

Seeding dates	<ul style="list-style-type: none"> <li>Both the orange nantes and specialty carrot trials can be planted as main season successions, or you can plant the specialty carrot trial as a summer succession and plant the orange carrot trial in late-June to early July, depending on weather conditions and your normal planting dates for storage carrots.</li> </ul>														
Trial layout	<ul style="list-style-type: none"> <li><b>12 row-feet per variety; 1 plot/replication per variety</b></li> <li>Plots may be distributed in <b>multiple side-by-side beds or planted in one bed.</b> <ul style="list-style-type: none"> <li>Please use the bed width that fits with your regular tillage methods.</li> </ul> </li> <li><b>Space rows 12-24" apart.</b> <ul style="list-style-type: none"> <li>At UBC Farm, beds are 3.67 ft center-to-center. We plant 2 rows per bed, with 12" between rows.</li> </ul> </li> <li><b>Aim for in-row spacing of approximately 1" (2.5cm) after thinning.</b> <ul style="list-style-type: none"> <li>The most reliable way to accomplish this is to <b>sow 1-2 seeds per inch</b> and then thin.</li> <li>We have provided 300 to 350 seeds/variety to accommodate thinning.</li> </ul> </li> <li>Please <b>hand seed plots</b>, as we are not able to provide enough seed to work with mechanical seeders.</li> <li>To allow the <b>best comparison among varieties</b>, it's important that soil, light, moisture, and disease/insect/animal pressures be as similar as possible among plots. To that end, please observe these practices to the extent possible: <ul style="list-style-type: none"> <li><b>Avoid field edges or ends of beds.</b></li> <li><b>Plant a buffer</b> around the trial plots to reduce crop loss due to mechanical damage or critters. Choose a buffer crop that requires similar management as carrots.</li> <li><b>This example layout</b> shows how buffers can be incorporated into your trial plot.</li> </ul> </li> </ul> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td colspan="3" style="text-align: center;"><b>Buffer</b></td> </tr> <tr> <td rowspan="6" style="text-align: center; vertical-align: middle;"><b>Buffer</b></td> <td style="text-align: center;">CANOVI Orange</td> <td rowspan="6" style="text-align: center; vertical-align: middle;"><b>Buffer</b></td> </tr> <tr> <td style="text-align: center;">CIOA Orange Flavour Select</td> </tr> <tr> <td style="text-align: center;">CIOA Orange Strain Cross</td> </tr> <tr> <td style="text-align: center;">Dulcinea</td> </tr> <tr> <td style="text-align: center;">Touchon Deluxe</td> </tr> <tr> <td style="text-align: center;">Bolero (F1)</td> </tr> <tr> <td colspan="3" style="text-align: center;"><b>Buffer</b></td> </tr> </table> <ul style="list-style-type: none"> <li><b>Label the plots</b> with stakes <u>and</u> draw a <b>field map</b> to serve as a backup in case stakes get lost.</li> </ul>	<b>Buffer</b>			<b>Buffer</b>	CANOVI Orange	<b>Buffer</b>	CIOA Orange Flavour Select	CIOA Orange Strain Cross	Dulcinea	Touchon Deluxe	Bolero (F1)	<b>Buffer</b>		
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Management practices	<ul style="list-style-type: none"> <li>Please use your regular <b>organic weed, pest, and disease control measures.</b></li> <li>If desired, you may use <b>row cover</b> to prevent carrot rust fly damage.</li> <li>Use <b>flame weeding</b> if it is part of your normal weed management practice.</li> </ul>														

<p><b>Days to harvest</b></p>	<ul style="list-style-type: none"> <li>● Please harvest carrots <b>when they are mature and marketable</b>, using your best judgment. To gauge your expectations: <ul style="list-style-type: none"> <li>○ Days to maturity is listed as <b>60-75 days for commercial varieties</b> included in this trial.</li> <li>○ However, <b>maturity time varies widely</b> depending on the heat, sunlight, and moisture available at your growing site.</li> <li>○ <b>Later season plantings may take longer</b> to mature than earlier ones.</li> <li>○ At the UBC Farm, we are planning on an <b>early harvest (~75 days)</b> and a <b>late harvest (~90-100 days)</b> to help gauge relative maturity of CANOVI and commercial varieties.</li> </ul> </li> <li>● <b>Days to maturity are not yet defined for the CANOVI and OSA varieties.</b> Your SeedLinked evaluations, along with information from those of you gathering additional data, will help determine maturity time for these varieties.</li> </ul>
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### Data collection - SeedLinked

- We will be using the [SeedLinked](#) online platform for data collection, as in previous years.
- You will receive an **email invitation** for the carrot trial(s) you signed up for.
- Data (including photos) can be entered into SeedLinked from the field via [iOS](#) and [Android](#) apps. If you don't have cell data service in the field, you can still enter data into the app, and it will sync with the database once you reach a data connection (suggest going on airplane mode to make sure data is saved correctly).
- You may also enter data on your **computer's web browser**. We provide downloadable [paper data forms](#), which are unique for [orange carrots](#) and [specialty carrots](#), which allow you to evaluate varieties using paper and pencil and for later entry into SeedLinked.
- SeedLinked updated their user interface in 2021, and the **following videos offer an orientation to the platform**:
  - [What is SeedLinked?](#)
  - [How to Accept a Collaborative Trial](#)
  - [Reviewing a Trial](#)

### Evaluation - SeedLinked

- Enter the **planting date**.
- **Rate attributes at 3 early-season dates** (14, 30, and 50 days after seeding) **and at harvest**.
  - Early-season evaluations are great times to **scout for pest, disease, and climatic pressures** and make notes in the SeedLinked comments.
- For each trait, **survey all of the varieties** to get a feel for the range of characteristics they show.
- **Rate varieties on a scale of 1-5 using the rubric below**, rather than ranking them best to worst.
- **Trust your judgment** and your knowledge of the crop!
- **If a trait doesn't apply to your planting**, please just leave it blank.
- We encourage you to **add pictures and free-form notes** about these varieties!
- Before you complete your trial, you'll be prompted to enter **harvest dates** and general information about soil quality, weather, and other factors that might have influenced the trial.
- When you complete the trial, your data will be combined with that of other participants and shared with you via **interactive figures on SeedLinked**, a results webinar or video, and written trial reports.

### Rubric for SeedLinked evaluations

In order to make results more easily comparable among sites, and to clarify the trait descriptions in SeedLinked, we are offering this rubric.

Orange Nantes Carrot Evaluation Rubric		1	2	3	4	5	
Trait	Guidelines	Poor	Fair	Acceptable	Good	Outstanding	Timing
Germination	Approximately what percentage of seeds germinated?	Less than 50%	50-75%	About 75%	More than 75%	All or almost all	14 days after sowing
Vigour	How fast-growing and resilient is this variety in the early season, when it is competing with weeds?	Weak and slow-growing plants, easily overtaken by weeds.	Below average vigour, making weed competition a problem.	Acceptable growth, making weed management possible but not easy.	Strong growth, making early season weeds manageable.	Exceptional growth and resilience, easily competing with early weeds.	30 days after sowing
Canopy cover	How well do the tops of this variety create a canopy to shade out weeds?	Very little to no canopy cover or weed control.	About 25% soil covered by carrot canopy. Some weed control.	About 50% soil covered by carrot canopy. Moderate weed control.	About 75% soil covered by carrot canopy. Good weed control.	Close to 100% cover. Great weed control.	50 days after sowing
Yield	How well does this variety yield, in context of other vegetable varieties you grow?	Poor yield - Couldn't justify growing it	Yield just OK, but might give another try	Sufficient yield	Solid yield	Exceptional yield	Harvest
Uniformity	How uniform are roots with respect to maturity, size, and appearance?	Extremely variable	Quite variable	Acceptable variability	Quite uniform	Very uniform	Harvest
Marketability	How easy would it be to sell this variety in your market, given its quality at harvest?	Difficult to sell	Expect limited sales	Expect average sales	Expect strong sales	Would sell out!	Harvest
Appearance	How visually appealing is this variety when ready for market?	Ugly or off-putting	Just OK	Appealing enough for market	Consistently appealing	Gorgeous	Harvest
Flavour	How much do you like the overall flavour of this variety? Please taste <u>raw</u> .	Would not eat again	Might try again	Would eat again, but wouldn't seek out	Would eat again happily	Would seek it out and rave about it!	Harvest
Overall impression of the Crop	How much do you like the overall performance of this variety?	It is clearly not a good fit for me and my markets	I am unsure if it is a good fit for me and my markets	Like this variety but need to evaluate more	Solid variety, a good fit for me and my markets	Love this variety, would recommend to other growers	End of Season

Specialty Carrot Evaluation Rubric		1	2	3	4	5	
Trait	Guidelines	Poor	Fair	Acceptable	Good	Outstanding	Timing
<b>Germination</b>	<i>Approximately what percentage of seeds germinated?</i>	Less than 50%	50-75%	About 75%	More than 75%	All or almost all	<b>14 days after sowing</b>
<b>Vigour</b>	<i>How fast-growing and resilient is this variety in the early season, when it is competing with weeds?</i>	Weak and slow-growing plants, easily overtaken by weeds.	Below average vigour, making weed competition a problem.	Acceptable growth, making weed management possible but not easy.	Strong growth, making early season weeds manageable.	Exceptional growth and resilience, easily competing with early weeds.	<b>30 days after sowing</b>
<b>Canopy cover</b>	<i>How well do the tops of this variety create a canopy to shade out weeds?</i>	Very little to no canopy cover or weed control.	About 25% soil covered by carrot canopy. Some weed control.	About 50% soil covered by carrot canopy. Moderate weed control.	About 75% soil covered by carrot canopy. Good weed control.	Close to 100% cover. Great weed control.	<b>50 days after sowing</b>
<b>Yield</b>	<i>How well does this variety yield, in context of other vegetable varieties you grow?</i>	Poor yield - Couldn't justify growing it	Yield is just OK, but might give another try	Sufficient yield	Solid yield	Exceptional yield	<i>Harvest</i>
<b>Uniformity</b>	<i>How uniform are roots with respect to maturity, size, etc across the different coloured carrots of a population?</i>	Extremely variable in shape and maturity	Quite variable in shape and maturity	Acceptable variability in shape and maturity	Quite uniform in shape and maturity	Very uniform in shape and maturity	<i>Harvest</i>
<b>Marketability</b>	<i>How easy would it be to sell this variety in your market, given its quality at harvest?</i>	Difficult to sell	Expect limited sales	Expect average sales	Expect strong sales	Would sell out!	<i>Harvest</i>
<b>Appearance</b>	<i>How visually appealing is this variety when ready for market?</i>	Ugly or off-putting	Just OK	Appealing enough for market	Consistently appealing	Gorgeous	<i>Harvest</i>
<b>Flavour</b>	<i>How much do you like the overall flavour of this variety? Please taste varieties <b>raw</b>.</i>	Would not eat again	Might try again	Would eat again, but wouldn't seek out	Would eat again happily	Would seek it out and rave about it!	<i>Harvest</i>
<b>Bolt resistance</b>	<i>Does this variety resist bolting long enough for harvesting at mature size?</i>	No, most plants bolt before roots reach harvestable size.	A substantial minority of plants bolt	A few plants bolt, but most withstand bolting.	All plants are harvestable, but the harvest window is short.	Yes, all plants resist bolting completely, allowing flexible harvest timing.	<i>Harvest</i>
<b>Overall impression of the Crop</b>	<i>How much do you like the overall performance of this variety?</i>	It is clearly not a good fit for me and my markets	I am unsure if it is a good fit for me and my markets	Like this variety but need to evaluate more	Solid variety, a good fit for me and my markets	Love this variety, would recommend to other growers	<i>End of Season</i>

### **Seed Saving Guidance**

With the exception of Bolero (F1), all varieties and breeding populations of carrots offered through this trial are open-pollinated varieties with no intellectual property restrictions. **Farmers are free to save seed from these varieties for on-farm use.** If you are planning to commercialize or further breed with any of the organic carrot material offered through this trial, we request that you communicate with the seed grower or plant breeder for that variety (where possible) to share your interests, and ask how they would like their work or the work of their collaborators to be recognized.

For all CANOVI-bred material, please connect with Aabir Dey, Director of the Bauta Initiative ([adey@weseedchange.org](mailto:adey@weseedchange.org)). For all OSA and CIOA varieties and breeding populations, please connect with Micaela Colley, Program Director for the Organic Seed Alliance ([micaela@seedalliance.org](mailto:micaela@seedalliance.org)).

Through the work of CANOVI and the Bauta Initiative, we are trying to contribute to building a culture of trust and reciprocity among our seed growing community. There are generations of farmers and Indigenous communities who are responsible for creating the basis of all the seeds we use today - fully recognizing plant breeding work will often feel incomplete and inadequate. However, connecting with the plant breeders we know is one way to respect those that have created all of these amazing varieties that we get to work with.

### **Breeding History for CANOVI, OSA, and CIOA Breeding Lines**

The **CANOVI Orange Nantes carrot breeding project** began in 2018, in response to BC direct-market grower interest in a **sweet, deep orange, open-pollinated Nantes variety** that could be **produced for both roots and seed in BC.** The goal was to provide a viable replacement for workhorse hybrids like ‘Bolero’ (F1), in order to strengthen regional and Canadian seed security. UBC researchers partnered with the US-based Organic Seed Alliance, which has been working on Carrot Improvement for Organic Agriculture (CIOA) since 2012, in partnership with USDA carrot breeder Dr. Phil Simon. Parent populations were sourced, trialed, and crossed in 2018, and since then the UBC research team has made 3 rounds of selection.

**The CANOVI Orange Nantes population from 2021 are being offered to trial this year.** Due to seed production challenges for later generations at UBC, we will be offering an earlier generation of the CANOVI breeding population this summer. This population will be more variable, but it will still be valuable to see how this population **compares to other organic breeding populations and commercially available varieties.**

The **CIOA is a multi-regional plant breeding collaboration and the first publicly funded organic carrot breeding project in the U.S.** Much of the work CANOVI has been doing since 2018 is modelled off of the research collaborations that characterize the CIOA. For more information about this incredible project and our collaborators, we encourage you to check out this excellent webinar on carrot breeding held in 2022: [Breeding Carrots for Production, Resilience, Flavor and Fun in Organic Systems](#).



## Carrot Resources & References

### **Articles**

[Digging for carrots at the end of the rainbow](#) – Laurie McKenzie, Organic Seed Alliance, 2022

[Organic Carrot Breeding Delivers Novel Varieties, Cutting-edge Research](#) – Kiki Hubbard, Carrot Country, Spring 2019

### **Webinars**

[Breeding Carrots for Production, Resilience, Flavor, and Fun in Organic Systems](#) – Organic Seed Alliance and CANOVI, March 2022

[Carrots!](#) - A Bauta Initiative webinar focusing on carrot seed production and breeding in Canada, September 2020

### **Growing Guides and Factsheets**

[Carrot Seed Saving & Selection Factsheet](#) – Bauta Initiative

[How to Breed Carrots for Organic Agriculture](#) – Organic Seed Alliance, 2014

[Resources for Organic Carrot Breeding and Seed Production](#) – Carrot Improvement for Organic Agriculture

### **Journal Article Cited**

Brainard, S. H., S. L. Ellison, P. W. Simon, J. C. Dawson, and I. L. Goldman, 2022. Genetic characterization of carrot root shape and size using genome-wide association analysis and genomic-estimated breeding values. *Theor. Appl. Genet.* **135**: 605–622. <https://doi.org/10.1007/s00122-021-03988-8>

We encourage interested growers to read [On-Farm Variety Trials](#) by the Organic Seed Alliance, a detailed how-to guide on implementing variety trials for your own farm.

CANOVI is a collaboration between the [Centre for Sustainable Food Systems at the University of British Columbia Farm](#) and the [Bauta Family Initiative on Canadian Seed Security](#) at SeedChange.



**We welcome your questions about the CANOVI variety trials!** Please contact the Bauta Family Initiative on Canadian Seed Security [regional coordinator](#) for your region:

- **Atlantic Canada:** Steph Hughes, SeedChange, [shughes@weseedchange.org](mailto:shughes@weseedchange.org)
- **Quebec:** Hugo Martorell, SeedChange, [hmartorell@weseedchange.org](mailto:hmartorell@weseedchange.org)
- **Ontario:** Rebecca Ivanoff, Ecological Farmers Association of Ontario, [rebecca@efao.ca](mailto:rebecca@efao.ca)
- **Prairies:** Tierra Stokes, Organic Alberta [tierra.stokes@organicalberta.org](mailto:tierra.stokes@organicalberta.org)
- **British Columbia:** David Catzel, [bcseeds@farmfolkcityfolk.ca](mailto:bcseeds@farmfolkcityfolk.ca)