BC Seed Trials
Seed Quality Assessment Project

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Contents

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1. Project Background

In 2016, the BC Eco Seed Co-op in collaboration with the UBC Farm Seed Hub and FarmFolk/CityFolk initiated a pilot project at UBC Farm to develop a model of practical on-farm trials to test seed quality. The intention was to explore various ways to conduct variety trials on a working farm without overwhelming farmers with data collection. These variety trials are meant to support the quality assurance program needed to offer quality seeds at a small/medium seed production scale.

The need for regionally-adapted seed is strong in climates like BC, and local seed production has the potential to address the needs for better varieties and more secure seed access. However, based on past surveys, seed quality has often been listed as one of the barriers for farmers to purchasing locally grown seeds. On-farm trials can allow local seed companies such as the BC Eco Seed Co-op to ensure high seed quality for their customers and inform member-producers when improvement is needed on particular varieties or crops.

Using this Document

Section 2 of this report outlines the methods used in seed quality assessments at UBC Farm in 2016. These trials form the basis of our recommendations in the following sections. **Sections 3 and 4** contain our recommendations for trial design and evaluation techniques, respectively, based on the experience of the trials performed at the UBC Farm. **Section 5** provides an example procedure for an on-farm assessment of seed quality. Appendices 1- 3 Provide additional details about the crops and varieties trialed, suggested traits for assessment, and an example of comparative rating. Because the purpose of this report is to provide recommendations for best practices rather than document results for the specific varieties trialed, results for 2016 are listed in Appendix 4.

Note: **These methods are NOT a substitute for lab-based germination or disease testing.** The methods described in this report are intended to evaluate seed quality in terms of observable plant phenotypes. They are useful for evaluating whether a variety has been maintained with sufficient selection, rogueing, and population size to maintain vigour and trueness to type. In crops or situations where seed borne diseases are a concern, seed should be tested by a certified seed pathology lab**.**

2. Methods

Variety Selection

Crops were selected based on the BC Eco Seed Co-op's available seed crops in 2016. Members of the BC Eco Seed Co-op were invited to submit samples of their seed crops that they identified as the highest quality seeds they were able to produce. Inclusion in the trials was based on the space limitations of the UBC Farm and the importance of the seed crops for the overall seed sector in BC. In total, 20 individual varieties representing 12 crops were selected. For each of the varieties tested, seeds from widely recognized commercial sources were purchased to compare to the BC-grown seeds (see Appendix 1). The 2016 trial was designed based on learning outcomes

of the 2015 UBC Farm trial, in which BC varieties were grown out without comparisons to commercial sources. Results from the 2015 seed quality trial are available in a separate report, "UBC Farm 2015 Variety Trials," available at www.bcseedtrials.ca.

Trial Design and Evaluation

Trials were planted in a side-by-side layout with a single row of the BC-grown sample and the commercial variety, respectively. The trials were evaluated in a variety of ways over the course of the season, with the goal of determining which methods of evaluation offered the best balance of producing useable information and being achievable for farmers with limited time and field space. These methods ranged from qualitative notes to measuring or ranking variety traits at random intervals in the row.

Image 1. *Side-by-side trial of 'French Breakfast' radish from two seed sources.*

Quality Assessment Methods by Crop

A primary objective of these trials was to development repeatable methods for simple on-farm assessments of the quality of a locally grown variety. Since 2016 was the first season in which BC-grown varieties were compared to commercial sources in side-by-side trials, the evaluation methods used represent a process of trial-and-error in finding the most important traits to evaluate and corresponding methods.

Crop	Evaluation Methods Used in 2016
Pole Beans	Qualitative notes
Beets	Qualitative notes
Radish	Harvest weight, comparative rating of subsamples
Arugula	Comparative rating of subsamples
Lettuce	Germination counts from seedlings, qualitative notes
Raddicchio	Germination counts from seedlings, qualitative notes
Chard	Qualitative notes
Kale	Germination counts from seedlings, qualitative notes
Pepper	Qualitative notes
Onion	Qualitative notes
Sprouting Kale	Qualitative notes
Cucumber	Qualitative notes

3. Recommendations for Trial Layout

Comparing varieties to commercial sources

We find high value in having a commercial seed source to compare to the locally grown seed. In 2015, no commercial varieties were included in the trial which made observations hard to interpret. However, it can be difficult to find an equivalent commercial variety for comparison. In such cases, it is still worth growing out a sample of a variety of interest in order to observe and evaluate important traits.

Side-by-side trials

The trial should always be laid out with the local variety and the commercial equivalent planted side by side. This can be accomplished with either side-by-side beds or rows. In contrast, planting the two seed sources end-to-end in one row can cause inaccurate observations because of higher likelihood of other sources of variation such as soil or water differences.

Image 2. *Side-by-side trials of pole beans from a BC-grown and commercial seed source. The trial varieties are planted in adjacent beds.*

Using replicates

Planting two or more plots of each variety (a.k.a. multiple replicates), can highly valuable because this allows for more reliable observations by accounting for field variation that might cause one plot to perform better than another. However, multiple plantings can make field layout and/or crop rotation challenging, and farmers may struggle with the additional time and space required. If multiple replicates are not feasible, the following precautions can help provide the most reliable results:

- Avoid parts of the field known for unusual plant behaviors or known soil anomalies.
- Plant the trial in the center, rather than the edge, of any field or bed in order to reduce edge effects (such as more shade or sun, high insect pressure, etc.) on part of the trial.

4. Techniques for Evaluating Seed Quality

Setting Objectives

Seed quality evaluation will be more effective if focused on a list of priority traits. **We recommend identifying three to five traits of top priority before planting the trial.** These traits should help characterize the differences between the test seed sample and the commercially sourced equivalent, resulting in more informative and digestible results to share.

Descriptive Notes

Taking notes on regular basis throughout the growing season can help develop an idea of the performance of a crop. Small variations in any traits can't usually be perceived from observations in the field but major variations are usually notable and can be recorded. For the purpose of a quality assessment, notes on main variations may be sufficient to inform seed producers.

Comparative Ratings

Ratings can be used to overcome the limitations of qualitative notes. **In practically all of the crops grown in 2016, the results were more valuable when ratings were used and the work load to achieve the ratings was manageable.** Ratings can be used once in the season along with regular qualitative notes, or multiple ratings can be performed during the growing of the crops.

Image 3. *Comparing side-by-side trial of 'French Breakfast' radish at harvest. Photos and ratings can be used to compare the two seed sources at randomly selected spots of the trial bed.*

Comparative ratings involve rating the two trial entries in comparison to each other. The observer simply records if a) Variety A is better, b.) Variety B is better, or c) There is no difference

It is helpful to choose multiple random spots in the trail (aka subsamples) at which to rate the two varieties. Pacing off a pre-determined distance between subsamples is an easy way to select random points in trial. For radish and arugula trials, we rated five subsample sections of 1 meter each, about 4-5 paces apart. For each subsample, we assigned marked whether the BC-grown variety or commercial equivalent was superior or whether there was no difference for each of our five priority triats. See Appendix 2 for an example score sheet.

Quantitative Measurements

Germination rate can be easily recorded for crops started indoors as seedlings. This is a direct and low impact record-keeping practice to assess quality and is easily perform by growers. Direct seeded crops are more challenging because it can be difficult to have an accurate count of the number of seeds planted. For these, germination may be better evaluated as a rating of stand density, or in a separate germination test.

Image 4. *Traits such as bolting lend themselves will to quantitative assessment because the number of bolted heads can be counted.*

For transplanted crops, yield can be recorded for the entire planting at once or only a section of the field at a given point in time. For direct-seeded crops, measuring yield is less informative because it can be highly influenced by germination rates in the field. For this reason, it is usually not worth measuring yield unless the crop was thinned to an even stand. For certain traits that affect entire plants, such as bolting, a quantitative count of plants may also be a straightforward way to assess quality differences.

5. Example Steps for a Seed Quality Assessment Trial

1. Select the variety to be trialed and obtain an equivalent variety from a commercial seed company, preferably a source that is well known and reliable. If none are available, consider comparing the variety to a well-known standard variety.

2. Plant seeds from the two sources side by side in two beds or rows. Two replicates of the trial is ideal. If only one replicate is feasible, avoid any field edge or section of a field known for unusual plant behaviors or known soil anomalies.

3. Identify 3 to 5 traits of top importance to use as a guideline for taking notes, doing observations, or rating the crop. These may change depending on the crop's growing stage. Traits are suggested in Appendix 2.

4. Take regular notes and/or ratings about the crop trial, ideally at least 2 to 3 times during the growing season.

5. Comparative ratings: At the appropriate point in the season, rate the two varieties in comparison to each other using the procedure described on Page 5 and Appendix 3.

6. Quantitative Measurements: Germination rate for seedlings should be recorded whenever the seed count is known. For direct seeded crops, germination can be added as an observable trait to record in the field. Yield can be considered for transplanted crops. For traits that affect individual plants, such as bolting, count the number of plants affected.

7. Take photos whenever possible. This become helpful when differences are observed to support your statements.

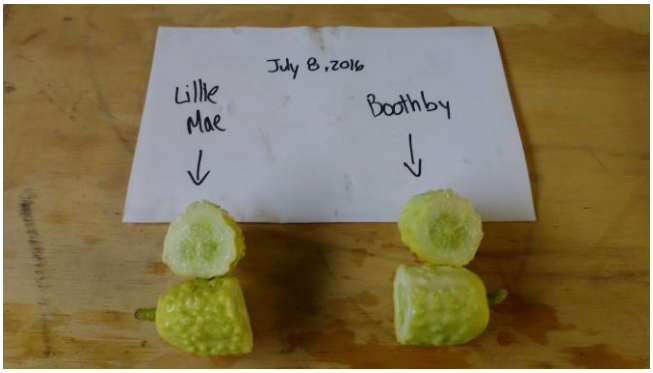

Image 5. *Use photos to document important traits. Use labels to identify the variety name, seed sources, and other important information such as the date or location.*

Appendix 1: 2016 Crops and Varieties

Crops and varieties grown 2016, with commercial equivalents used for comparison

Crop (Market Type)	Variety Name	Commercial Source
Pole beans (Romano)	Hunter	William Dam Seeds
Beets	Detroit	West Coast Seeds
Radish	Raxe	William Dam Seeds
Radish	French Breakfast	West Coast Seeds
Arugula	Surrey	Johnny's Selected Seeds
Lettuce	Nancy	Johnny's Selected Seeds
Lettuce	Hilde	William Dam Seeds
Lettuce	Yugoslavian Red	Wild Garden Seeds
Lettuce	Tamarindo	Johnny's Selected Seeds
Lettuce	Coastal Star	Johnny's Selected Seeds
Lettuce	Panisse	Johnny's Selected Seeds
Lettuce	Gold Rush	Seed Saver's Exchange
Radicchio	Pallo Rosa	West Coast Seeds
Chard	Fordhook Giant	West Coast Seeds
Kale	Red Russian	No commercial source – 4 BC-grown seed sources
Pepper	Padron	Johnny's Selected Seeds
Onion	Red Legion	Osborne Seeds
Sprouting Kale	*Un-named variety*	Johnny's Selected Seeds "Kalette"
Cucumber (White)	Lillie Mae	High Mowing Seeds, 'Boothby Blonde'
Cucumber	Marketmore	West Coast Seeds

Appendix 2: Suggested Traits for Assessment

Trait suggestions for crops studied in 2016

Crop	Suggested Traits
Lettuce	Day to maturity, field holding, day to bolting, disease resistance (especially powdery mildew resistance)
Cucumber	Foliar stand, disease resistance, harvest period, taste
Bean	Plant height, shape (pod), harvest window, texture
Kale	Pest resistance, disease resistance, uniformity, plant height
Arugula	Leave shape, day to maturity, day to bolting, foliar stand
Radish	Days to maturity, stem connection, uniformity, cracking
Radicchio	Field holding, tightness at maturity, colour, storage capacity
Beet	Days to maturity, field holding, storage capacity, foliar stand
Pepper	Colour, pest resistance, size, shape
Swiss Chard	Shape, colour, disease resistance, plant height

Note: *Germination rate and trueness-to-type should be considered for all crops.*

Other Traits to Consider

Qualitative (notes or ratings)

1- Trueness-to-type
2- Foliar height
3- Foliar stand (fill, ground cover)
4- Germination rate
5- Performance post-germination (vigor)
6- Day to maturity
7- Day to bolting
8- Pest resistance
9- Diseases resistance
10- Shape
11- Colour
12- Size
13- Uniformity (above or below ground)
14- Stem connection
15- Harvest period
16- Taste
17- Texture
18- Storage capacity
19- Field holding
20- Tightness at maturity
21- Cracking
22- Ease of harvest (hand or mechanical)
23- Low bruising
24- Other deemed relevant for your given operation

Quantitative

1. Yield
2. Germination rate
3. Day to germination
4. Day to maturity
5. Harvest period/window
6. Day to bolting

Appendix 3: Comparative Rating System

Notes

1. In-field rating should be kept simple.
2. Print a table as shown below.
3. Write down the date, crop and selected traits to observe.
4. Mark an x beside the seed source (BC or commercial) if one of the trait is deemed superior for it. Repeat for each observation stop in the field (walk a few feet and stop). Leave empty if no differences are noted.

EXAMPLE

			Germination rate	Day to germination			
May 7th	Surrey Arugula	BC	x x x				
		Comm.	x	x x x x			
Comments			Patchy germination across the field for comm seed	Comm. overall earlier and more vigorous			

			Leave shape	Disease resistance	Foliar stand	Day to bolting	
May 27th	Surrey Arugula	BC				x x x x x	
		Comm.			x x x x		
Comments					Better stand, more vigorous	Comm bolted 5 days before BC	

Appendix 4: Trial Results

Direct-seeded crops

1) 'Detroit' beet and 'Hunter' Romano-type pole beans

For these crops, we deemed qualitative notes on the entire crop to be more useful and practical than individual ratings or measurements for single traits.

- No significant differences in terms of germination rate, root size, root shape, and foliar growth were noted for either crop.
- The BC-sourced 'Detroit' beets showed one foliar anomaly which wasn't identified but didn't spread (likely a physiological disorder).

2) Radishes: 'Raxe' and 'French Breakfast'

We used comparative rating to determine whether the BC-grown variety or commercially sourced variety was superior, or if there was no difference. We also recorded harvest weights.

- **Traits evaluated:** Stand, foliar fill, disease/pest resistance, root size, root uniformity, stem connection, trueness-to-type, harvest weight
- **'French Breakfast' radish:** The BC-sourced crop performed better for stand and foliar fill and the commercially sourced crop performed better for root size and root uniformity. We did not observe notable differences for disease/pest resistance, stem connection, and trueness-to-type.
- **'Raxe' radish:** The BC sourced-crop performed better overall for stand, foliar fill (thickness), root size, root uniformity, stem connection and trueness-to-type. There were no observable differences for pest/disease resistance.
- Harvest weight: The two varieties produced very similar marketable yields but the BC-grown variety had more unmarketable yield, or culls (Table 1).

Table 1. *Marketable and unmarketable harvest weight in pounds for two varieties of radish grown in side-by-side trials. BC-Grown varieties are compared to commercially-sourced equivalents.*

French Breakfast Variety Radish Crops		
	BC	**Commercial**
First Quality (lbs)	46.54	47.31
Rejected (lbs)	13.48	5.99

Raxe Variety Radish Crops		
	BC	**Commercial**
First Quality (lbs)	21.34	11.66
Rejected (lbs)	6.58	6.26

3) Arugula: 'Surrey'

As with radishes, we used comparative rating of subsamples to evaluate the two varieties.

- **Traits evaluated:** Stand density, foliar fill, disease/pest resistance, shape and colour
- **Findings:** Overall the commercially source crop performed better for the stand and foliar stand. No notable differences for disease/pest resistance, shape and colour.

Transplanted crops

Germination rate was recorded for some of the crops by counting the amount of seedlings that germinated in the 72-cell seeded (Table 2). Yield and bolting were recorded for 'Yugoslavian Red' lettuce. Field notes were taken when deemed relevant. Some varieties of lettuce were started multiple time given very low germination. Results below are the average results for those varieties.

- No other observable differences outside germination rates and yield were noted during the season on the lettuces, with the exception of 'Yugoslavian Red' in the BC-grown variety displayed less bolting than the commercial source.
- Earlier maturity was noted on the BC-sourced 'Palla Rossa' raddichio.
- More ruffled leaf types were noted in the commercially sourced 'Fordhook Giant' chard.
- Significantly more purple coloured leaves were noted on the BC Farm #2 Red Russian kale.
- No significant differences were noted for the Padron peppers, Marketmore cucumbers and Red Legion onions

Table 2. *Germination rates for BC-grown test varieties and commercial equivalents in 3 transplanted crops: lettuce, raddichio, and kale.*

Crop	Variety name	Source	Germination rate (%)
Lettuce	Nancy	BC	25
Lettuce	Nancy	Commercial	4.2
Lettuce	Hilde	BC	23.6
Lettuce	Hilde	Commercial	9.7
Lettuce	Yugoslavian Red	BC	97.2
Lettuce	Yugoslavian Red	Commercial	93.1
Lettuce	Tamarindo	BC	76.4
Lettuce	Tamarindo	Commercial	73.6
Lettuce	Coastal Star	BC	83.3
Lettuce	Coastal Star	Commercial	79.2
Lettuce	Panisse	BC	94.4
Lettuce	Panisse	Commercial	94.4
Lettuce	Gold rush	BC	16
Lettuce	Gold rush	Commercial	2.8
Raddichio	Palla Rossa	BC	95.8
Raddichio	Palla Rossa	Commercial	22.2
Kale	Red Russian	BC (Farm #1)	91.7
Kale	Red Russian	BC (Farm #2)	98.6
Kale	Red Russian	BC (Farm #3)	93.1
Kale	Red Russian	BC (Farm #4)	93.1

2) Sprouting kale (kalette) and white cucumber

The commercially-sourced seeds for those two crops were not the same variety as the BC-sourced seeds. A search was done to identify a variety similar to the one grown in BC. The trial was grown and observed without any measurements or rating in field. Field notes were taken when deemed relevant.

- **White Cucumber**: The commercially-sourced variety (Boothby Blonde) started to produce about 1 week earlier than the BC-sourced variety (Lillie Mae). The commercially-sourced cucumbers had shorter stems, a darker yellow skin colour, and a heavier flavour. The BC sourced cucumbers had longer stems, a lighter yellow skin colour, a more "conehead" fruit shape, and a milder flavour. The BC-sourced crop's growth habit was more upright, and it produced for slightly longer than the commercially-sourced crop.
- **Sprouting Kale**: The BC and commercial ended up being very different products not comparable. Although significant differences were seen, no notes were taken.