

EFAO 2022: Research Protocol

Fava bean variety trial

Farmer-researchers:

Name	Farm	Region
Micheline Lalond	Avling Rooftop Farm	CENTRAL
Martina Schaefer	Spiral Veg Farm	WEST
Michelle Dang	Toronto Metropolitan University Urban Farm	CENTRAL
Leslie Moskovits	Cedar Down Farm	WEST

Project type: Variety trial

Research priorities: Seed selection, production, & breeding

EFAO Contact: Rebecca Ivanoff, rebecca@efao.ca, (519) 760-2971

Objective

Farmers would like to identify the most productive varieties of fava beans across different farms in Ontario during the 2022 season.

Background

Fava beans, also known as broad beans or faba beans in English, habas in Spanish, fūl in Arabic, and baqella in Amharic, are an important staple in diets throughout the world. The center of domestication for fava beans is the Middle East, with seed remains found in northern Israel showing these seeds were consumed over 11,000 years ago. Secondary areas of domestication are recognized in southern and northern Europe, Ethiopia and southern China where it remains a staple food (Smither-Kopperl 2019)

There are large numbers of locally adapted cultivars and landraces of fava bean due to its long history of domestication, and selection pressure in separated geographic areas. Some cross pollination occurs and falls between 4 to 84% (Torres et al., 2006).

They grow best on well drained clay and silt soils in addition to sandy soils with adequate

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moisture. Drought tolerance varies considerably between cultivars with those from northern Europe exhibiting less drought tolerance and shallower lateral roots compared to cultivars from southern Europe (Smither-Kopperl 2019)

Fava bean is a long day plant that is grown as a winter annual in warm temperate and subtropical areas, and as a warm season crop in cooler areas. Optimum soil temperatures for germination are between 15 and 18° C. Germination will not occur at temperatures below 4° C or above 24° C though there are differences between cultivars. The optimum temperatures for growth range from 18-29° C while temperatures above 32° C will restrict growth and yields (Landry et al., 2015)

The pods, beans, and shoots of the plant are edible, and the part(s) consumed depend on region and culture. Fava beans are a staple food around the Mediterranean area and across Eurasia, including Egypt, Syria, Iraq, Iran, Northern India, Pakistan, and Southern China. In Europe and North America, the large seeded immature beans are eaten fresh with or without the seed coat.

There are three subspecies are recognized:

- *V. faba var faba*, broad bean or Windsor bean is a large seeded form with one or two large pods,
- *V. faba var equina*, field bean or horse bean has more numerous pods and smaller seeds, and
- *V. faba var minuta*, bell bean or tick bean, has the smallest seeds with numerous pods in the leaf axils

Warning: Favism

Favism is a rare disease most prevalent in Mediterranean countries and characterized by the red blood cells being destroyed faster than they can be made after the ingestion of fava bean seeds by individuals who have a genetic abnormality caused by deficiency of the enzyme G6PD. The distribution of individuals susceptible to favism is similar to that of malarial resistance as the genetic variant offers protection to infection. The gene is carried on the X chromosome and thus the majority of individuals who express the disease are male. The symptoms are yellowish skin, dark urine and shortness of breath (Smither-Kopperl, 2019)

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People who take Monoamine oxidase inhibitors (MAOIs), a group of antidepressants, also need to be cautious when consuming fava beans as they impact how certain nutrients in the beans are metabolized

Experimental Design

Varieties

The 2022 the fava bean variety trial includes 6-7 varieties, all of which will be direct-seeded in the field within 2 replicates. Each grower will grow at least the three common varieties (Windsor, Vroma, Witkiem-Monica) but can choose to grow other varieties specific to their farm.

Code	Variety	Type	Source	Intellectual property ¹
FBV1	Tendergreen	V. faba var equina	Backyard seed saver (selected by Erik Landry)	No (but ask Erik if you'd like to grow this variety for seed)
FBV2	Windsor	V. faba var faba	Gaia Organics	No
FBV3	Witkiem-Monica		William Dam	No
FBV4	Vroma		Johnny's	No
FBV6	GR 2		Vicia Genetics (Jessa Hughes)	MTA ²
FBV7	GR 4		Vicia Genetics (Jessa Hughes)	MTA
Seed sent but not being evaluated:				
FBV5	Aprovecho		BC Eco Seed Co-op	No

1. Plant Breeders Rights Granted in Canada, see <https://inspection.canada.ca/plant-varieties/plant-breeders-rights/varieties/eng/1300463863953/1300463978655>
2. MTA = Material Transfer Agreement

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Name	Farm	Varieties to be Grown:
Micheline Lalond	Avling Rooftop Farm	3 core varieties
Martina Schaefer	Spiral Veg Farm	6 varieties
Michelle Dang	Toronto Metropolitan University Urban Farm	6 varieties
Leslie Moskovits	Cedar Down Farm	6 varieties

Planting and Cultivation Recommendations

The trial should be grown as you would normally grow fava beans in the field, including bed and row spacing. The table below provides suggestions based on recommended cultivation practices for fava beans. Use the suggestions if they make sense for your farm.

Plot size per variety	Minimum of 10 plants per variety section, 2 replications = minimum 20 plants total for each variety in the trial
Row and bed spacing	In-row: 4"-6" ; between row: 18"-36"
Seeding date	As soon as soil can be worked in May
Days to harvest	~70 - 100 days
Harvesting	Pick individual pods when the green shell beans inside are plump. If the pods feel spongy, they aren't ready yet. They should be shiny and firm when ripe.

Each farmer should receive approximately 25 - 30 seeds of each variety. We suggest that you plant all seeds provided. The goal is to get at least 20 seedlings so that you can plant 10 per plot.

Field Layout

The trial arrangement is flexible as long as you plant at least 2 replicated blocks of 3 varietal plots with each variety plot having *at least* 10 plants of the variety (you can plant more fava beans if you have space available).

Please observe these best practices as best you can and record what you do:

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- For this trial, create two replicate blocks of your trial space by dividing the space in half (see layout below)
- Plots may be distributed in multiple side-by-side beds or planted in one bed (see examples below)
 - In each half, plant the varieties in a random order, either by drawing variety names out of a hat, etc.
 - Each of the 2 replicate blocks should have a plot of 10 plants for each variety; the order of the planting will be different in each replicated block.
- Avoid the edge of the field and the end of the bed when finding a place for the trial.
- Avoid areas with known soil, shade or irrigation differences that would affect some plots more than others. That is, try to plant your trial in a homogenous area in your field.
- If possible, plant the trial in a spot where it has the same crop on either side of it.
- Use stakes to label the plots AND draw a field map showing the order and location of varieties. This serves as a backup in case the stakes get lost! Please snap a photo of the layout and send to Rebecca, which is a third back-up!

Examples of field layout:

Example 1: Layout with 2 replicate blocks of 6 varieties (at least 10 plants/variety) down a single row. Note: each variety is randomly assigned to a plot in each replicate block.

Replicate block A						Replicate block B					
V5- 10 plants min	V2- 10 plants min	V3- 10 plants min	V4- 10 plants min	V6- 10 plants min	V1- 10 plants min	V4- 10 plants min	V3- 10 plants min	V1- 10 plants min	V5- 10 plants min	V2- 10 plants min	V6- 10 plants min

Bed length →

Example 2: Layout with 2 replicate blocks of 6 varieties (10 plants/variety) planted across multiple rows. Note: each variety is randomly assigned to a plot in each replicate block. This layout can also be used within one bed, with rows of fava beans on each side of the bed.

Replicate block A		Replicate block B	
V5-10 plants min	V3-10 plants min	V6-10 plants min	V1-10 plants min
V1-10 plants min	V6-10 plants min	V4-10 plants min	V2-10 plants min

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V2-10 plants min	V4-10 plants min	V2-10 plants min	V5-10 plants min
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Bed length →

Statistical model

This trial will be a randomized and replicated trial over multiple farms. We will use an ANOVA (or other appropriate statistical methodology) to determine the significance of each measurement across the farmer participants.

Measurements

Quantitative and Qualitative

Crop management records

The following information will be collected on this sheet **once a year**:

- Seeding date
- In-row spacing
- Between-row spacing
- Configuration (number of rows/beds)
- Fertilizer applications (rates, amounts, and date)
- Irrigation
- Mulch
- Weed control
- Trellis or support
- Other products or notes

Germination

The following information will be collected on this sheet **once a year**:

- Germination rates will be taken once at 15 days post seeding
 - Total number of seeds sown
 - Total number of seeds that germinated after 15 days
 - Germination notes (how did you seed your cells, place, other information)

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Early season vigour

The following information will be collected on this sheet **once a year**:

- Early season vigour (seedling size, health, and growth rate)
- Early season vigour will be taken once around 1 month after transplant
 - Rating scale from very poor (1) to very high (5) [1=very low (0-20%); 2=low (20-40%); 3=moderate (40-60%); 4=high (60-80%); and 5=very high (80-100%)]

Evaluation Rubric		1	2	3	4	5
Trait	Guidelines	Poor	Fair	Acceptable	Good	Outstanding
Early Vigour	<i>How vigorous (i.e. robust, fast-growing, resilient to stress, etc) is this variety?</i>	Weak and slow-growing plants	Below average vigour	Acceptable growth and some resilience to stress	Strong growth	Exceptional growth and resilience to stress

Disease and pest resistance observations

The following information will be collected on this sheet **weekly throughout the year**:

- Growers will make notes of any disease or pest issues that occur on okra varieties throughout the year

Lodging

The following information will be collected **weekly throughout the harvest window**:

- Lodging rate (how lodged (bent over) are the plants)
 - Rating scale from poor (1) to Outstanding (5) [1=poor (0-20%); 2=fair (20-40%); 3=acceptable (40-60%); 4=good (60-80%); and 5=outstanding (80-100%)]

Evaluation Rubric		1	2	3	4	5
Trait	Guidelines	Poor	Fair	Acceptable	Good	Outstanding
Lodging	<i>How lodged (i.e. falling over, bent) is this variety?</i>	Only 0-20% of the plants are standing	Only 20-40% of the plants are standing	Only 40-60% of the plants are standing	Only 60-80% of the plants are standing	Only 80-100% of the plants are standing

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Day to flower, harvest and last harvest

The following information will be collected **once a year**:

- Date of first flower (will be collected on the early season vigour sheet)
- Date of first harvest (will be collected from yield sheets)
- Date of last harvest (will be collected from yield sheets)

Yield

The following information will be collected on this sheet **once a week over the harvest window/period**:

- Marketable at fresh stage
 - weight of marketable harvest (lbs?)
 - number of marketable pods
- Non-marketable (over ripe)
 - weight of non-marketable harvest (lbs?)
 - number of non-marketable pods

Taste, flavour, texture

The instructions for the fava taste test from the chefs at Avling are as follows.

1. shuck the beans from the shell
2. boil the beans for 1-2 minutes
3. remove the beans from the boiling water and shock them by adding them to a bowl of ice water
4. remove the skins that surround the bean
5. taste the bean

The following information will be collected on this sheet **once a year during peak harvest window**:

- Notes on Flavour (sweet, bitter?) and texture (hard, slimmy?)
- Flavour and texture will be taken once a year in the middle of harvest season
 - Rating scale from very poor (1) to very excellent (5) [1=very poor (0-20%); 2=poor(20-40%); 3=moderate (40-60%); 4=excellent (60-80%); and 5=very excellent (80-100%)]

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Evaluation Rubric		1	2	3	4	5
Trait	Guidelines	Poor	Fair	Acceptable	Good	Outstanding
Flavour	<i>How much do you like the overall flavour of this variety? Please taste the varieties <u>cooked</u>.</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!

Overall performance

The following information will be collected on this sheet **once a year after the growing season**:

- Farmers will rate their impression of the overall performance of each variety

Photos

Please take photos of the following times/items:

- Farmer-researches with FLRP sign
- Germination
- Field Map
- Transplanting into the field (during and finished)
- Flowering/ flowers
- Younger pods vs older pods
- Harvest actions shot
- Other

Research Plan

Please note that if data is submitted after the submission deadline, EFAO staff cannot guarantee that your data will be analyzed and written up before the Research Symposium and/or the next growing season.

Time	Task	Methods & Measurements or Action Item
Early to Mid May	Seeding	
June to July	Observations	Throughout the season check measurement sections

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July and August	Harvest	Harvest fava when ready (~3 week harvest window)
By Sept 1, 2022	Submit data and photos	Send data to EFAO staff
December 31, 2022	Farmer-fee and research expense invoice with receipts for expenses	Submit invoices at this site: https://efao.ca/data/
January/February 2023	Finalize and publish research report	Work with EFAO staff to review polished research report for publication.

Staff check-ins

Rebecca will check in via group email

Materials

Please list all materials, supplies and equipment that will be reimbursed for this project. If possible, please also indicate a short-list of any in-kind materials, supplies and equipment that you will use.

Material	Unit	Quantity Required	Total Cost*	Note
Fava bean seed: 25-30 seeds of each variety				Rebecca will source
Postage				Rebecca will mail to farmer-researchers
All seedling, planting, and harvesting equipment			In-kind	
Total				

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Farmer-fee

All farmer-researchers will submit an invoice for \$50 per variety with two replications with a minimum of three common varieties and a cap of \$300 to the EFAO after they have submitted their data and photos to research staff.

Invoices for Farmer-Fees & Reimbursements

Research expenses

- Submit an **invoice along with copies of receipts** for all qualified expenses using form found at <https://efao.ca/data/>
- **Deadline:** December 31, 2022

Farmer-fee

- Submit an **invoice** for your farmer-fee using form found at <https://efao.ca/data/>
- **Deadline:** December 31, 2022

References

1. Etemadi, F., Hashemi, M., Mangan, F., & Weis, S. (2015). Fava Beans; Growers guide in New England. Posted on Dairy, and livestock website: https://ag.umass.edu/sites/ag.umass.edu/files/research-reports/fava_bean_guide_2.pdf
2. Smither-Kopperl, M. 2019. Plant Guide for fava bean (*Vicia faba*). USDA-Natural Resources Conservation Service, Lockeford Plant Materials Center. Lockeford, CA 95237. https://mccc.msu.edu/wp-content/uploads/2020/07/NRCS_2020_Fava-Bean-Vicia-faba-Plant-Guide.pdf
3. Landry, E.J., C.J. Coyne, and J.Hu. 2015. Agronomic performance of spring-sown faba bean in Southeastern Washington. *Agronomy J.* 107: 574-578. https://www.researchgate.net/publication/272411419_Agronomic_Performance_of_Spring-Sown_Faba_Bean_in_Southeastern_Washington

Memorandum of Understanding

Please fill out the MOU at <https://airtable.com/shrlAcZ7bowmTQwvd>

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EFAO Account Information

As a farmer-researcher, you must maintain current membership with EFAO throughout the duration of your trial.

We use your mailing address to deliver cheques, farmer-led research signs and any trial supplies.

To check the status of your membership, log in here:

<https://efao.z2systems.com/np/clients/efao/login.jsp> or contact Martina, martina@efao.ca.

Farmer-fees and Reimbursements

I agree with the following:

- The deadline for reimbursements and farmer-fees is December 31, 2022.
- To receive reimbursement for qualified research expenses, I will submit an invoice and copies of receipts at the form found at <https://efao.ca/data/>.
- To receive my farmer-fee, I will submit an invoice to <https://efao.ca/data/> after I have submitted the final data and photos.

Photo Use

We like to share snippets and stories of farmer-led research through EFAO's print publication, e-newsletter and social media accounts, using photos and updates that you send us. We will credit you when we use any photos.

Choices (Select all that apply on the MOU):

- EFAO has my permission to share photos in EFAO's print publications
- EFAO has my permission to share photos in EFAO's e-newsletters
- EFAO has my permission to share photos in EFAO's social media
- I do not want my photos share in these ways
- Other

Farmer-Led Research Agreement

I agree with the following:

- I will complete my trial to the best of my ability following the written protocol.
- If circumstances change and I am unable to conduct my trial, I will notify EFAO staff as soon as possible.
- I will keep in contact with EFAO staff with updates and questions, or to make changes to my protocol .
- I will submit data to the EFAO by the date specified in the written protocol.

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- I acknowledge that if I submit data after the submission deadline outlined in the written protocol, EFAO staff cannot guarantee that my data will be analyzed and written up before the Research Symposium and/or the next growing season.
- I will work with EFAO staff to interpret data and write the research report.
- I will take photos of my project throughout the season(s).

Program Participation

There are several farmer-led research events held throughout the year including webinars, field days, and the Research Symposium. The Research Symposium is held in conjunction with the annual EFAO Conference at the end of November/early December.

When and where possible I will:

- Attend farmer-led research events, including webinars and field days
- Attend and present my research findings at the Research Symposium
- I will complete the feedback survey related to the program

Data Use

You own all data generated on your farm as part of your farmer-led research trial with EFAO. You can notify EFAO at any time to remove EFAO's privileges to use and share your data, photos and farm information. To opt out of sharing your data, please contact Sarah Larsen via email (sarah@efao.ca) or mobile (226-582-0626).

I agree with the following:

- By participating in the EFAO's FLRP, I agree to share with the EFAO the data collected as part of my trial, along with photos of the project and any farm information (e.g. soil type, previous farm practices, and soil tests) that I deem relevant.
- By sharing my data, photos, and farm information with EFAO, I agree that EFAO can use this information in research reports, posters, and summaries of my trial (e.g. summaries on the EFAO blog and in EFAO's print publication).
- I understand that I can notify EFAO at any time to remove EFAO's privileges to use and share my data, photos, and farm information.

Signature

Please fill out the MOU at <https://airtable.com/shrlAcZ7bowmTQwvd>