

EFAO 2023: Research Protocol - April 2023

Fava bean variety trial, Year 2

Farmer-researchers:

Name	Farm	Region
Michelle Dang	Toronto Metropolitan University Urban Farm	CENTRAL
Martina Schaefer	Spiral Farm	WEST
Leslie Moskovits	Cedar Down Farm	WEST
Dillon Muldoon	Trent Research Farm	EAST

Project type: Variety trial

Research priorities: Seed selection, production, & breeding

EFAO Contact: Rebecca Ivanoff, rebecca@efao.ca

Objective

Farmers would like to identify the most productive varieties of fava beans across different farms in Ontario during the 2023 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 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).

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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).

Faba bean (*Vicia faba* L.) has a symbiotic relationship with rhizobia to fix nitrogen into a usable form. Faba bean fixes the most nitrogen of any annual legume, making it a fantastic rotational crop in intensive agriculture systems.

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.

The compounds that cause Favism are Vicine and Convicine (VC). The concentrations can be drastically reduced through conventional plant breeding methods. A low vicine convicine trait that has been observed in the natural diversity of this species can reduce VC concentrations by 99%, making it safe for all human consumption. Currently there are limited vegetable varieties with this trait, but an important thing for growers to consider when selecting a fava bean variety for their operation.

Experimental Design

Varieties

The 2023 fava bean variety trial includes 4 varieties, all of which will be direct-seeded in the field within 2 replicates (3 replicates at TMU and).

Code	Variety	Source	Intellectual property ¹	Who will grow them
FBV1	GR 2 (HetLVC)	Vicia Genetics (Jessa Hughes)	MTA ²	TMU, LM, MS, DM
FBV2	NVDWFLVC	Vicia Genetics (Jessa Hughes)	MTA	TMU, LM, MS, DM
FBV3	Windsor	Gaia Organics	No	TMU, LM, MS, DM
FBV4	Andy's Broad Bean	BC Eco-Coop	No	TMU, MS, DM

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

All of the varieties from Vicia Genetics have been marker tested and stabilized for the low vicine-convicine trait and are 100% safe for human consumption

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.

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Plot size per variety	Minimum of 10 plants per variety section, 2 or 3 replications = minimum 20 or 30 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 April/May (direct seeding the last week of April / first week of May.) Michelle wondered if floating row cover should be fine just for the germination/seedling stage so it doesn't get sub-0 in the ground, and then can be removed as it warms up? Just note down what you do in the Crop Management form.
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. In 2022, TMU found that sometimes the pods would get hard and tough quickly if you didn't pick hard enough or the weather was hot. They ended up harvesting 1-3 times a week last year to maximize the yield we got. So pick as frequently as needed , and we will combine harvests per week for the research report

Each farmer should receive approximately **30 seeds for 2 replications and 46-50 seeds for 3 replications** of each variety. We suggest that you plant all seeds provided. The goal is to get at least 10 plants 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.

Examples of field layout:

Example 1: Layout with **2 replicate blocks** of 4 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			
V2- 10 plants min	V3- 10 plants min	V4- 10 plants min	V1- 10 plants min	V4- 10 plants min	V3- 10 plants min	V1- 10 plants min	V2- 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	
V2-10 plants min	V3-10 plants min	V3-10 plants min	V1-10 plants min
V1-10 plants min	V4-10 plants min	V4-10 plants min	V2-10 plants min

Bed length →

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Layout at TMU, Martina, and Trent:

Layout with **3 replicate blocks** of 4 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				Replicate block C			
V1	V4	V3	V2	V1	V4	V3	V2	V1	V4	V3	V2
- min	- min	- min	- min	- min	- min	- min	- min	- min	- min	- min	- min
10	10	10	10	10	10	10	10	10	10	10	10
plants	plants	plants	plants	plants	plants	plants	plants	plants	plants	plants	plants

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
- [Printable Sheet](#)

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Field Map

- 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 it to Rebecca**, which is a third back-up!
- [Printable Sheet](#)

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)
 - [Printable Sheet](#)

Early season vigour and dates of first flowering

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

- Date of first flowering
- Early season vigour (seedling size, health, and growth rate)
- Early season vigour will be taken once around 1 month after transplant
 - [Printable Sheet](#)

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 fava bean varieties throughout the year
- [Printable Sheet](#)

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Lodging

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

- Lodging rate (how lodged (bent over) are the plants)
- [Printable Sheet](#)

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

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)

This might be useful information for fava bean farmers and breeders to help select for longer harvest season windows as well.

Yield

The following information will be collected on this sheet **at least 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
- [Printable Sheet](#)

Taste, flavour, texture

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

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1. If desired, shuck the beans from the shell
2. boil the beans for 1-2 minutes (and/or taste them raw!)
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 (if desired, just note it down)
5. taste the bean

Note down any comments, stories, or recipes that customers and others might tell you and why they like to eat favas and in what manner! It will help us tell the story of why this project is important!

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

- Notes on Flavour (sweet, bitter?) and texture (hard, slimy?)
- Flavour and texture will be taken once a year in the middle of harvest season

■ [Printable Sheet](#)

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 by giving a rating and writing some notes! Stories are always good!
- [Printable Sheet](#)

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Evaluation Rubric		1	2	3	4	5	
Trait	Guidelines	Poor	Unsure	Acceptable	Good	Outstanding	Timing
Overall Performance	<i>What is your final impression 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	I like this variety but need to evaluate further	Solid variety, a good fit for me and my markets	Love this variety and would recommend to other growers	<i>End of the Season</i>

Photos

Please take photos of the following times/items:

- Farmer-researchers with FLRP sign
- Germination
- Flowering/ flowers
- Ideal marketable, and unmarketable Fava
- Harvest actions shot
- Tasting
- Different varietal pods beside each other
- 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
Late April to Early May	Seeding	Plant out randomized replications. Record number of seeds sown
June	Observations	Throughout the season check measurement sections
July	Harvest	Harvest fava when ready (~3 week harvest window)
By Sept 1, 2023	Submit data and photos	Send data to EFAO staff

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December 31, 2023	Farmer-fee and research expense invoice with receipts for expenses	Submit invoices at this site: https://efao.ca/data/
January/February 2024	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	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		

Farmer-fee

\$100/variety for 2023

Invoices for Farmer-Fees

Farmer-fee

- Submit an **invoice** for your farmer-fee (email will be sent in September)

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- **Deadline:** December 15, 2023

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/shrc1mclYcx5Aq6Ex>