

EFAO 2021: Research Protocol

Argonaut Squash Dehybridization Project

Farmer-researcher: Rob Read - West

Project type: Breeding Trial

Research priorities: Seed selection, production and breeding

EFAO Contact: Rebecca Ivanoff, rebecca@efao.ca

Objective

To produce genetically stable offspring from an F1 hybrid squash called Argonaut, that germinates fast and matures earlier, so that homesteader gardeners have a large, tasty butternut squash from which they can save seeds each year.

Background

Argonaut is a butternut-type squash that grows up to 30 lbs, is very productive, and has sweet butternut-like flavour. It also has a small seed cavity, making it an excellent option for anyone processing large amounts of squash. However this variety is an F1 hybrid and it is listed as taking 140 days to mature. Though listed as various species, we believe that Argonaut squash is a *C. moschata*.

When selecting, Rob will consider the winter squash key traits for improvement identified by Canadian organic/ecological vegetable farmers:

- Earliness (For cold/northern climates, under 80/100 days, ripening before frost, flowering and set fruit in cool conditions)
- Productivity/Yield (More per plant or per vine, takes up space/ resources so productivity needed, extended harvest window)
- Disease and Pest Resistance (Powdery mildew, downy mildew, squash stem and vine borers, cucumber beetles, sowbug, squash bug)

(see [2018 Survey Report: Canadian Organic and Ecological Plant Breeding Priorities For Vegetable Crops](#))

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Rob would like to select for this large butternut type squash because:

1. Larger squash require less overall peeling, so even on a small scale, where the peeling happens by hand, this would (hopefully) lead to more pounds of usable squash per acre. When peeled pre-cooking, the smooth skin of Argonaut is fast and easy to take off. When scooping out around the skin after cooking, the larger size will lead to less waste. Larger size of this type will lead to more squash flesh, and less seed cavity.
2. Toward the end of the season, squash that might otherwise be too small with a smaller variety might still be large enough to harvest with a larger breed. If not quite ripe for the human market, they would be appropriate as fodder to pigs etc on mixed farms.
3. Squash that doesn't quite ripen, or is marked or frost-damaged, would still have more volume for feeding as fodder to livestock.

Rob and his family use a lot of squash and, for the reasons above, prefer larger squash. The homesteader market (i.e. the home grower market) does not have many people breeding with them in mind, and Rob's breeding work will fill in this gap, as many large squash are not short season and powdery and downy mildew resistant.

Experimental Design

Seeding and Transplanting

Rob will plant the F1 seeds early and transplant them out in order to assure mature seed for the following year. He will also direct seed some plants. In subsequent years, direct seeding would be favoured. At least 4 seeds will be used for transplants, and at least 6 seeds will be used at each in-field planting location, and weeded down to the most vigorous and best-germinating individuals, with the understanding that these F1 seeds are likely to be genetically the same so variation in vigour observed this year may not be due to genetics.

Hand Pollination

The goal will be to hand pollinate at least one fruit, though two would be better, on five Argonaut squash in 2021 (year 1).

After he has pollinated the plant, Rob will wait about a week to know if the pollination worked and the fruit is developing. Once he observes that the fruit is developing, Rob will pull off all the other flowers from the plant during the period following pollination, while the pollinated fruit grows. Some extra plants, not part of the seed-saving effort, will be grown to gather an additional year of yield data for future comparison.

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Squash Hand Pollination Overview:

<http://www.communityseednetwork.org/assets/storage/csn-hand-pollinating-squash.pdf>

Video with Tom Stearns at High Mowing Seeds:

<https://www.youtube.com/watch?v=eyNugsz7mE4>

Another great resource is:

<https://eorganic.info/sites/eorganic.info/files/u2/BreedingOrganicVegetables-2011.pdf>

Seed Saving

After they have been allowed to fully mature, Rob will save seed from the squash that he hand pollinated. This will mean storing the fruit a month or more after harvest before extracting the seeds.

Photos

Rob will take photos of the squash plants and the process throughout the season, including by not limited to:

- Seeding
- Germination
- Early Vigour
- Hand Pollination
- Fruit
- Harvest
- Storage
- Seed Extraction

Datasheet

A printable datasheet can be found here:

https://docs.google.com/document/d/1OdKRfvyKweAZzgn8h0J9lo0PG8sQ371cVu_Ufa3Qi3I/edit?usp=sharing

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Research Plan

Time	Task	Methods & Measurements or Action Item
	Plant seeds, record when you sowed the seeds, and how many seeds did you sow in total	
	Record germination rate What percent of the seeds germinated?	
	Transplant, record date when you transplanted the seedlings (if applicable) and transplanted population how many plants you transplanted	
	Record date when the first flowers opened, record the colour of the flowers?	
	Hand pollinate and record how many of your crosses took.	Close flowers in the evening Hand pollinate in the morning Close flowers in the evening Hand pollinate in the morning
	Record date when 1st squash were ready to harvest	
	Record date when you harvest fruit for seed Record final population - how many plants did you harvest seeds from at the end of the season?	
November 1	Submit data and photos	Submit data and photos to Rebecca
December 31	Invoice	Send Sarah invoice for farmer-fee

*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.

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Staff check-ins

Monthly

Research Plan 2022

In year 2, Rob will plant out 50 of the F2 seedlings. To see as much of the potential from the cross as possible for squash, Dr. Micheal Mazourek suggests planting out 75 to 150 plants is the 'sweet spot' between space limitations and choosing the right genetics. Ideally other close-by farm locations will plant some as well. The F2 will be carefully observed, watching for either: 1) Ideal plants with desired traits or 2) Indications that the variety is not actually a hybrid, but an OP variety mistakenly marketed as a hybrid.

Assuming the variety is a hybrid, the five best of the F2 generation will be selfed and grown out as an F3 the following year (2023). At this point, if the trait of earlier ripening had not been achieved, a shorter season *C. maxima* will be selected for a cross with some of the most promising F3 plants. Dr. Mazourek suggests crossing it with Hunter F1 for earliness.

Large size and productivity will be measured by having a control population of Argonaut F1.

OP status will be measured by comparing how many offspring have off-type characteristics in later generations. Heterogenous traits not affecting the selection criteria will be tolerated.

Other traits will not be tested, but will be evident based on which plants thrive on local farm culture. Incidental traits based on local farm culture, will include no-till conditions (tarps/spoiled hay), heavy soil (clay loam), and watering only during early establishment.

A more minor improvement that may be selected for if possible is a more uniform tan colour, which would likely improve marketability (Argonaut has a green web marking even when fully ripe).

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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
Seed				
All planting, hand pollination, and harvesting equipment			In-kind	
Total				

Acknowledgements

We'd like to express much gratitude to our colleague Dr Micheal Mazourek for answering our questions throughout this process.

Farmer-fee

\$500 in 2021, invoiced to EFAO after farmer-researcher submits data.

Invoices for Farmer-Fees & Reimbursements

Research expenses

- Email an invoice along with copies of receipts for all qualified expenses to **research@efao.ca**.
- Expenses can be claimed anytime throughout the year.
- Deadline: December 31, 2021

Farmer-fee

- Email an invoice for your farmer-fee to **research@efao.ca**.
- Farmer-fees can be claimed after your data is submitted
- Deadline: December 31, 2021
- If you collect HST for your farm business, you can choose to add HST to your fee.

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Memorandum of Understanding

You agree to keep an active membership with EFAO throughout the duration of your trial.

Link to the 2021 MOU

<https://form.jotform.com/210625202854246>

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.