

# Evaluating Heirloom Winter Squash

2017 Community Day Presentation and Discussion  
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All 2017 research was conducted at Care of the Earth Community Farm and funded by a two-year SARE research grant. This work builds upon research previously conducted by Common Wealth Seed Growers in Virginia. We will host two more community days in 2018, one field day that emphasizes on-farm breeding in early June and a final presentation in the fall at which seed stock from our breeding work will be available.

## Goals of Project

Year One:

- To conduct a variety trial of 18 open-pollinated (mostly heirloom) *Cucurbita moschata* squash, our breeding seed stock, 1 hybrid butternut squash, and 1 open-pollinated commercial butternut squash under organic conditions and without any row cover, fungicides or pesticides, even those that are organically approved, in order to identify varieties particularly suited to our region and for possible seed stock.
- To identify or develop by traditional breeding methods *Cucurbita moschata* seed stock that is productive, has good flavor, is easily marketable, and stores well. We are looking particularly for a variety or varieties that are heat- and drought-resistant, insect-resistant, and disease-resistant. We have had particular problems in hot, dry seasons like 2016 and with cucumber beetles, squash bugs (*Coreidae*), and downy mildew. Other farmers in the region are also affected by squash vine borers, powdery mildew, and bacterial wilt.
- To conduct breeding trial of F1 cross of San Jose Club Squash and Waltham Butternut, evaluating and selecting for productivity, overall resistance, taste, marketability/appearance, and storage ability. We will continue selecting for butternut shape and size, as long as also correlates with other selection factors.
- To share results as part of community day and identify interested parties that may be able to partner with us in the future.

Year Two:

- To continue to evaluate and to save seed from best performers from 2017 study, selecting for productivity, overall resistance, taste, marketability/appearance, and storage ability.
- To conduct breeding trial of F2 cross of San Jose Club Squash and Waltham Butternut, evaluating and selecting for productivity, overall resistance, taste, marketability/appearance, and storage ability. We will continue selecting for butternut shape and size, as long as also correlates with other selection factors.
- To conduct breeding trial of F1 cross of Carrizo and VA Select Waltham Butternut, evaluating and selecting for productivity, overall resistance, taste, marketability/appearance, and storage ability. We will continue selecting for butternut shape and

size, as long as also correlates with other selection factors.

- To host a field day to teach about hand-pollination and traditional plant breeding.
- To host a community day to share final results of two-year study as well as seed stock from best performing specimens.

## **Important Terminology**

**Open-pollinated seeds** are seeds (or seed varieties) that produce the same (or approximately the same) results season after season. Open-pollinated seeds “breed true”.

**Heirloom seeds** are open-pollinated seeds that were grown prior to 1945 (or prior to the emergence of hybrid seeds). Some people further distinguish between heirloom seeds and heritage seeds, stating that heirloom seeds are seeds that were grown and saved by a family, community or region while heritage seeds are seeds that were once commercially available.

**Hybrid seeds** are the cross of two open-pollinated varieties. The cross is not stable and therefore will not breed true in subsequent generations. This is why you must continue to purchase hybrid seeds in order to obtain the same result, and why they are patented. Typically, hybrids offer some advantage (termed hybrid vigor) over both of the two open-pollinated parents. Hybrid seeds are not the same thing as GMO (genetically modified organisms) seeds, which instead contain genetic material from an entirely different species.

**Variety trial** is a planting experiment which compares several different varieties of the same species. This is often the first step to breeding seed stock, although during the trial, you can discover that what you are looking for already exists.

**Breeding trial** is a planting experiment in which various plants of a single variety (typically a cross of two open-pollinated varieties) are compared, evaluated, and selected from in order to advance a breeding project. The offspring of the first cross of two open-pollinated varieties is considered an F1 hybrid, subsequent generations (or seasons) are labeled F2, F3, F4 and so on. Once the variety is stable, it can be labeled with a name and is now an open-pollinated variety (as it breeds true and seed can be saved from season to season without variation).

**Selection trial** is a planting experiment which compares various plants of a single open-pollinated (stable) variety in order to select a strain (not a different variety) that is better suited to whatever conditions or requirements one is selecting for (disease-resistance, taste, storage, etc).

**Traditional plant breeding** is the process of breeding a hybrid or new open-pollinated variety by pollinating the ovule of one parent variety with the pollen of another parent variety and then observing, comparing, evaluating, and selecting from this initial cross. This process typically takes between 6-10 years. This is the type of breeding humans have been doing since we began farming, 8,000-10,000 years ago. I would not include mutation breeding in traditional plant breeding, although it should be separated from genetic modification.

**Downy Mildew** (Cucurbit) is a disease caused by fungus-like spores. It arrives in the summer with winds from more southern locations, typically in June on our farm. It creates yellow-brown irregular blotches on the leaves (older first) and eventually total

yellowing of the leaves. It thrives in humid weather, and can be catastrophic, resulting in the total loss of a crop (particularly a storage crop like winter squash). It is not the same as powdery mildew.

### **Variety Information**

**JWS 6823 PMR (F1)** (<90) - a commercial hybrid butternut squash, bred by Johnny's Seeds for powdery mildew resistance

**Nutterbutter** (<90)- an open-pollinated butternut variety bred by High Mowing Seeds for early production

**VA Select Waltham Butternut** (100)- a farmer-selection of the heirloom Waltham Butternut, selected in Virginia since the 1970s

**South Anna Butternut** (100)- currently an F6 hybrid, it is the result of a cross between Seminole and Waltham Butternut; it is about 90% stable, producing a downy mildew resistant butternut with rich, sweet flavor that stores moderately well. Bred by Edmund Frost at Twin Oaks Farm in Louisa, VA.

**Tahitian Butternut/Melon** (105)- a large, long-necked, very sweet heirloom butternut squash that keeps well

**San Jose Club Squash** (115+)- a large, long-necked, flavorful heirloom butternut squash, originally from San Jose, Costa Rica. We obtained seeds for this squash from Baker Creek Seeds (although they no longer offer them) in 2014. It keeps until November.

**Carrizo** (100)- a large, heirloom butternut-shaped squash from Sonora, Mexico. It was not DM-resistant in Common Wealth Seed Growers initial trial.

**Greek Sweet Red** (100)- an heirloom butternut squash with a dusty skin appearance. Some DM-resistance.

**Seminole** (105)- a very old heirloom teardrop-shaped squash from the Seminole Indians (Everglades, FL). It stores incredibly well and has great flavor, but it has very little eating matter/fruit.

**Tan Cheese** (100)- one of the oldest heirloom cheese pumpkins available; not very productive, good keeper, moderately sweet.

**Thai Kang Kob** (<90)- a DM-resistant heirloom pumpkin from Thailand, very flavorful; ours did not keep well this season (they may have been harvested too late).

**"Ayote"**(120)- a Costa Rican pumpkin variety that was given to us at a flea market by a Salvadorean woman. She said it was an heirloom but it has not produced male flowers for us (parthenocarpic or just ill-suited to our climate or latitude?). Ayote just translates to squash or pumpkin. As is typical of many places outside the US, this variety does not appear to have a variety name. It is productive, stores well, and has a great flavor. I wish we could produce seed!

**Soler** (?)- an op pumpkin from Puerto Rico

**Noob Taub** (100)- a spotty, bulbous heirloom pumpkin from Laos, some variability in shape, turns tan in storage

**Segualca** (105)- a large heirloom oblate squash from the Mayo Valley in Sonora, MX

**Jamaican Long Neck** (110)- a very large heirloom winter squash, shaped like a cushaw but misstate

**Cuban Neck Pumpkin** (?)- a long-neck heirloom squash variety from Cuba, very sweet. DM-resistant in Common Wealth Seed Growers trial, although not for us.

**Choctaw** (100)- an old heirloom Choctaw winter squash with a very distinct long, rounded teardrop shape

**Upper Ground Sweet Potato** (100+)- an old Southern Appalachian heirloom squash, round pumpkin to “blob” shape, productive, drought-resistant, great flavor, and store well

**Mrs. Amerson’s** (100)- a flavorful Appalachian heirloom squash, bell shape. Not productive for us in hot seasons but productive this season.

**San Jose x Waltham F1** (115+)- a F1 cross of San Jose Club Squash and Waltham Butternut made in 2016. We bred it hoping for a heat, drought, and DM-resistant butternut-like squash with great flavor that keeps until January. There was a lot of shape variability this season, productive, DM-resistant.

### **Year One Data Summary (see table “Winter Squash Resistance Values” for detailed data)**

- Weather: the 2017 season was relatively cool and wet. Squash were transplanted the first week of May, and we began harvesting the first week of August, through frost in late October, with the main harvest coming the third week of August. It rained at some point in the day more than half of the days (53) during the 105-day growing period. There were only 14 days at 90 degrees or above, most of them coming in mid-to mid-late July. Average high temperature was 84. (In other words, it was not hot or dry this season. Two values that we would like to develop resistance for.)
- All varieties were affected by Downy Mildew. We had early infection this season: all varieties had leaf lesions by the end of May (typically we see in early to mid-June). All varieties grew past infection to still produce crop. Varieties most affected based on initial loss were: Segualca (25%), Noob Taub (10%), Cuban Neck Pumpkin (10%), and Greek Sweet Red (10%). A low average weight (Nutterbutter and JMS6823), reduced storage ability (Nutterbutter, JMS6823, and Segualca), and bland flavor (Carrizo, San Jose Mountain Club Squash, Thai Kang Kob, and South Anna) also suggest significant stress either because of Downy Mildew or humidity or heat or a combination of all of the above.
- We did not have extensive insect pressure this season. Although spotted cucumber beetles (early in the season) and squash bugs (Coreidae) (late in the season) were present, they were not present in significant enough numbers for us to consider them a factor in overall production.
- We created a “Resistance Value” based on # of fruit, %loss, taste, and storage. Although it is not completely comprehensive, we do believe that it accurately reflects heat, drought, insect, and disease resistance on our farm. To calculate, we divided # of fruit/plant average by 3 (our minimum goal for production) then multiplied by 100 to give a 100s value number and then multiplied that number by .4 (as we decided that overall production was the most important value based on discussion with farmers and amongst ourselves). We gave taste and storage value equal weight. We calculated the taste value by multiplying taste number first by 10 to give a 100s value number and then multiplied that number by .25. We calculated storage value by assigning 0, 25, 50, 75, or 100 to a given variety based on how long it stored and then multiplied it by .25. Finally, we subtracted percentage loss from 100 and multiplied it by 0.1. Because most of our plants typically survive stress but just

produce poorer quality fruits, we gave %loss the lowest percentage value (10%). If percentage loss numbers were more significant, we would increase this percentage.

- Based on this resistance value, the best performing varieties were: San JosexWaltham cross, Upper Ground Sweet Potato 2017, Upper Ground Sweet Potato 2016, Tahitian Butternut, and Ayote (in that order). Note that none of these varieties produced our minimum of 3 fruit/plant.
- Also, note that our goal is a butternut-shaped fruit. None of the best performing varieties are a strictly butternut-shaped fruit. San JosexWaltham cross produces a butternut shape but also produces a pumpkin-type and a bell. We hope to be able to select for the butternut shape. Tahitian Butternut produces a very long neck butternut that is too large for many of our CSA members. Tahitian Butternut could likely also be selected for a shorter neck. The other three (Upper Ground Sweet Potato 2016 and 2017 and Ayote) do not appear to have butternut genetics.
- Another one of our goal is a 3-4 lb. fruit. That is the size that our CSA members have been the happiest with. All of our best performing squash except for Tahitian Butternut are too large in their current form. However, we did not separate out genetic lines of San JosexWaltham cross when weighing. It is likely that the butternut-shape is less heavy than other shapes. We may be able to select for a smaller San Jose cross just by selecting for butternut shape.
- Taste is obviously a subjective value. It includes both taste and texture as compared to butternut squash. These values reflect the opinion of 17 of our CSA members. Taste tests were performed on 11/4/17. Taste of some varieties can improve in storage. At this point, all squash had been in storage for at least 2 months. A note: our CSA members loved Upper Ground Sweet Potato 2016 (seed selected on our farm). They gave it an "11". If you are not worried about other parameters such as size and shape, it is a great squash! It would be particularly good for holiday dishes such as pies.

