

Hawaii Public Seed Initiative
Final Report
April 22, 2016

Island Name: Molokai
Project Name: Development of New Heat-Tolerant Leaf Lettuce and Kale for Tropical Conditions
Location: Ho'olehua, Molokai
Project Leader: Glenn Teves

Trial Overview

The purpose of this trial is to develop new heat-tolerant lettuce and kale. The trial was simplified to include one variety each of lettuce and kale, since both have a lot of potential for seed production, are adapted to Hawaii, and also address seed sustainability. Due to the time line to complete the trial and also harvest seed, an existing fenced field was utilized for this trial. Fencing materials received through this grant will be utilized in early summer to create another seed production field. The area was previously used as a market garden from April to August 2015. The test field was in fallow for 4 months to decrease soil-borne diseases and root-knot nematode populations, and crop and guinea grass windbreak residue was worked into the field with a rototiller at the end of the previous garden crop.

Due to the fenced field dimensions of 30 X 150, a 100+ foot row of lettuce and kale were planted near a Guinea Grass windbreak to protect plants from the strong prevailing northeast trade winds that blow constantly in this area of Hoolehua. The number of plants was increased in both trials than previously planned to make up for a change in field configurations. Soil sample results showed a pH of 5.8 and were a little low in Magnesium and Phosphorus. Fifteen pounds of 10-30-10 and 10 pounds of Dolomite were added and tilled into each trial row with a Honda Mini Rototiller a few days before transplanting.

Weather

Weather through the first part of the growing season from December to February was unusually dry with hot days of 80-85 degrees F and cooler than normal nights of 56-67 degrees F, considered ideal for the growing of these crops. Winds were light through most for the season due to minimal trade winds, creating wet mornings ideal for fungal diseases. However, March and April weather proved to be unpredictable with strong winds and heavy rains with at least 4 major episodes, but overall, this was one of the driest winters and springs in decades.

Lettuce Results

Seeds from seven heat-tolerant Manoa Leopard selections made in Summer 2014 were utilized in this trial. An equal amount of seeds from each selection totaling 400 seeds were sown in Plastomer 1 ½" cell trays on December 5, 2015. Cells were filled with

Molokai CES mix containing Sunshine #4 mix, Osmocote 14-14-14, and Dolomite. Out of the 375 seedlings germinated, two hundred seedlings were transplanted on January 2, 2016, and selected for robust growth and intense red or spotted coloration. Plants were quite variable, representing both F3 and F4 generations, and showed many lettuce types and color characteristics including leaf, romaine, mini-heads, spotted, two-tones, and green leaf types. Seedlings were transplanted to a 100+ foot row, spaced 1 foot apart on both sides of a T-tape drip line with 8 inch spacing and transplanted two inches away from the drip line. Plants were irrigated 1 hour daily on a timer system starting at 9 am daily.

On January 25, superior plants were pegged with colored flags alongside each plant, and identified with a number on the flag. Codes included the following:

- Blue – Exceptional individuals: special characteristics such as intense leaf color, plant habit, or leaf color combinations
- Green – Individuals exhibiting Manoa-type compact growth with soft heart and crunchy midrib. Color variable.
- Orange – spotted types except romaine types.
- Yellow – Romaine plant habit.

On January 27, irrigation was inadvertently turned off on a very hot day, but was turned on the next day. The result was that romaine types immediately showed tip burn, and were culled. One of the parents of Manoa Leopard is Dark Green Romaine, and it appears that this cultivar is the most susceptible to tip burn of the parent lines. This appeared to be a method to force tip-burn whereby susceptible individuals will exhibit symptoms. As plants exhibited tip burn, they were culled, and except for the romaine types, there were no patterns of certain types exhibiting tip-burn. Plants were evaluated twice, on February 12 and February 24. Identification of 5 basic groups was made with the plan of bulking similar types.

Approximately five individuals exhibited a yellowish green color an open habit with red tips in which the leaf color was not appealing or attractive, and was being considered for elimination. However, after very hot weather, and also in discussions with the originator, Frank Morton, this group appeared to be a real sleeper as none of them exhibited tip-burn, were also late bolting, and leaves were thicker, resembling a Batavian type. Leaf thickness can be determined through a 'touch test' by pressing on the top of the plant and comparing with other individuals. These selections were noted as well as their parental lines for further evaluation separately.

As plants reached maturity in early April, leaf drop symptoms (*Sclerotinia* spp.) were having a big impact on trials as more than 50% succumbed to this disease. Seeds of survivors were first collected separately in early seed collection, then bulked and identified as *Sclerotinia* tolerant selections to be planted in winter and spring season when the disease is more prevalent.

Seeds from this trial will be shared with cooperators on other islands as well as HPSI members for trialing during winter months in different areas of the state. For the next

seed planting season, selections made from the original 2014 summer heat-tolerance trial will be planted alongside a mix from this planting to identify difference in Sclerotinia disease tolerance.

This line was developed in collaboration with Frank Morton of Wild Garden. UH Manoa lettuce was shared with him, and he crossed it with Leopard which he originated. He is releasing two selections, Aloha Gem, a Little Gem-type for personal or single serve lettuce, and Pele, a short leaf reddish romaine with a pink and yellow heart, and a mix of Manoa Leopard selections called Island Gems. He expects to release a dozen selections from this line.

Challenges

The lack of trade winds and colder than normal nights may have created ideal conditions for a leaf disease on lettuce as dew would cover plants until mid-morning, leading to an unusually high incidence of leaf drop on lettuce. Plants succumbed to this disease starting at mature head stage, and got progressively worse at flowering. Over 70% of selected individuals were lost, especially in the flowering stage. This disease, of which there are two species *Sclerotinia minor* and *S. sclerotiorum*, has been identified as a major lettuce disease during winter months in Hawaii, especially in high elevation production areas such as Kula on Maui and Waimea on the Big Island. (See Winter Diseases of Lettuce – UH CES Commodity Fact Sheet LE-4A). It's believed that many survivors may exhibit tolerance to this disease. Three genetic lines representing one of the parents, Leopard, were selected for tolerance to Sclerotinia, including Merlot, Dark Green Romaine, and Forellenschluss or Spotted Troutback. It may also be possible that the disease in Hawaii may be another race or strain.

Lessons Learned

1. To produce good parents for heat-tolerant crosses, it's a better idea to conduct heat-tolerance trials on parent lines then make crosses of the most heat-tolerant ones. You will reach your goal faster.
2. Disease resistance is an important attribute that should be evaluated, especially in off-season plantings and trials. A subset of selected seeds should be maintained with disease resistant lines.
3. Do not plant lettuce for seed unless you're pretty sure of a dry harvesting season. Two good seasons for lettuce in Hoolehua include March to June and July to September.
4. Do not plant lettuce for seed in a garden setting. Lettuce has specific water requirements, especially during seed set. Watering a garden may mean overwatering a seed lettuce field or row.

Kale Results

Most kale varieties do not set seed in Hawaii, including European kale (*Brassica oleracea*) and Ruso-Siberian kale (*Brassica napus*) except *Brassica carinata* or Ethiopian kale. This variety is a natural hybrid of *Brassica nigra* or Black mustard and *Brassica oleracea* representing the majority of major food crops including broccoli, cauliflower, head cabbage, European kales, and others. Because *B. carinata* has

different chromosome numbers than all other Brassicas, they are not expected to cross with other brassicas. In the visiting Wild Garden Seeds at Aurora, Oregon in early February and discussing seed head or silique structures, it was determined that the kale variety was *Brassica carinata* and NOT Lacinato Rainbow as previously thought. European Kale (*Brassica oleracea*) has a single row of seeds in a silique while *Brassica carinata* has a double row. Overall plants thrived in this weather.

Challenges

Problems on kale were minimal other than an early infestation of cabbage aphids which was controlled with two applications of Neem Oil, and Imported Cabbage Worm which was controlled with two applications of Dipel. Overall, these pests don't seem to affect seed production since plants are such prolific seed producers. In a garden setting, *B. carinata* can be a good reservoir for Southern Green Stinkbug.

Lessons Learned

1. Identify the best *Brassica carinata* accessions for Hawaii first to select the best cultivar in Hawaii before mass producing seed. There are 85 accessions of *B. carinata* in the USDA GRIN seed vault, including a few cultivated varieties. Of these, Amara or Texsel is a patented (PVP) variety and is believed to be a *B. carinata* X *B. oleracea* cross. There are more than two selections cultivated in Hawaii.
2. Visualize the mature size of plants for seed so proper in-row and between-row spacing can be used in seed production. This is especially important for such a large plant as *Carinata* kale.
3. Plant early in the year so harvesting can continue through most of the summer. Kale seed can be harvested continuously for several months by cutting of mature seed heads. Plant will continue to produce side shoots with flower heads.
4. Do not plant in a garden setting since they can harbor Southern Green Stink Bug, a persistent pest of tomatoes and beans.

Acknowledgments

I would like to thank the Hawaii Public Seed Initiative for this opportunity to create tropically adapted vegetable varieties for Hawaii's gardeners and farmers in hopes of bolstering our food security, sovereignty, and production.

PHOTOS ATTACHED FROM THIS TRIALS



Aerial view of Puakala Farms – lettuce & kale trial in far right field



June 2014 - Variability in bolt-tolerance



Jan. 2016 – Fenced field to protect from deer



Jan. 2016 – Carinata kale (right) and Manoa Leopard lettuce (middle)



Jan 2016 – Variability in a row



Intense red spotting on young leaves



Color variability of red spots



Feb. 2016 - Selection of individuals by habit



Intense tipburn symptoms on romaine types



Large frames measuring 1 ½ feet in diameter



Lettuce ready to bolt



Manoa leaves in a romaine type with red tips



Late bolting selection with light green leaves and red edges on a thick Batavian leaf



Individuals with miniature heads with red edges



Individuals exhibiting a large, smooth Manoa leaf



Loose Manoa-type mini heads



Apr. 2016 - Large spots and compact Manoa frame



Individuals showing red tips on a romaine habit



Kale row starting to flower



Apr. 2016 – Heading into full flower with early seeds ready to harvest



Apr. 2016 – Individual plants