

# Research Summary

## On-farm seed breeding projects help farmers develop desirable crop traits

*Project title: Establishing breeding populations for organic broccoli, sweet corn and red kale varieties*

Organic farmer interest in on-farm plant breeding has been on the rise due to a lack of available germplasm adapted to organic systems, a growing awareness of the value of regionally adapted varieties, and consolidations in the seed industry that have led to a decline in varietal offerings. Organic participatory plant breeding (PPB) is a decentralized model in which organic farmer-breeders work in collaboration with university, nonprofit and private industry plant breeders to improve plant genetics for organic systems. This approach can supply organic producers and processors with the crops and desired traits that they need.

Refining a breeding population is an essential step in conducting successful on-farm breeding, and the purpose of this one-year project was to make steps to improve breeding populations within longer-term PPB projects to create sub-populations for subsequent breeding activities. The Organic Seed Alliance (OSA) worked with four organic farmers and three professional plant breeders to refine organic breeding populations in three crops: a curly red kale, an early maturing broccoli, and a sugary enhanced sweet corn.

Also essential to the breeding process is building partnerships between the farmer-breeders and formal-breeders. An additional goal of this project was to support sustained partnerships and cooperator commitment to the projects.

The role of the farmer as a full partner can involve all aspects of the breeding process, from setting the objectives, determining the traits for selection, execution of the selection, determining the final genotype to advance at the conclusion of the project, and finally, replicating and genetically maintaining the variety for distribution. The PPB efforts in this

### Washington farmer pursues a good-tasting curly red kale

Nash Huber, of Nash's Organic Produce in Sequim, WA, and John Navazio of the Organic Seed Alliance worked together on an open-pollinated (OP) curly red kale with good overwintering qualities including downy mildew resistance and good growth under cool winter and spring conditions.

Nash Huber's red kale population was originally developed with several primary goals. Huber needed a vigorous, tall, good yielding red kale with a high degree of curl for bunching at a mature stage. It had to have good market appeal with superior color, texture and flavor: the only commercially available European type kale with significant red color, 'Redbor,' has a tough texture and lacks a favorable flavor profile.

Starting with two individual red plants discovered in a population of 'Vates Blue Curled Dutch' kale in the early 1990s, Huber crossed them to two exceptionally tall, vigorous Brussels sprouts plants creating a population of tall "kale-like" plants. After at least eight generations of mass selection, Nash's red kale population consisted of plants that were highly attractive with a high degree of leaf curl, reasonably good levels of red color, tender texture, and flavorful. The plants had good height, produced good regrowth during cool, low light conditions of winter, and exhibited a higher degree of downy mildew resistance. Also, the red pigmentation appears to be conferred by dominant genetic factors. Evaluations showed that eliminating progeny rows containing any green plants before the plants flower to be a highly effective way of eliminating the heterozygous half-sib families from contributing to the next generation.



*Micaela Colley*

*Plant breeder John Navazio and farmer Nash Huber evaluate a kale crop inside a pollination isolation tent.*

project included a spectrum of farm-led and breeder-led relationships. OSA developed comprehensive breeding plans for each crop that strengthen the potential for succeeding with the longer trajectory of these projects.

Two of the four breeding projects have already resulted in a variety or "population" that is in production on the participating farm: Morton's corn and Huber's kale. These two populations are not yet at a level of uniformity for marketing or

release as a finished variety, but with on-farm roguing or selection they are still of production value and fulfill a needed on-farm niche. Morton's corn overcomes his cold soil challenges and Huber's kale satisfies his desire to affordably direct seed and continue productive harvests into the winter season. These two projects demonstrate the ability of on-farm, farmer-led breeding efforts to address the needs of organic farmers.

*OFRF's investment in OSA's farmer participatory breeding projects has led to expanded breeding efforts through the Northern Organic Variety Improvement Collaborative (NOVIC), a new initiative supported with USDA funding from the OREI.*

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## Designing a broccoli for a Northwest CSA

Julie Puhich of Common Ground Farm in Olympia, Washington and Jim Myers of Oregon State University are working on an open-pollinated (OP) broccoli adapted to the Pacific Northwest, with traits that fit the CSA/market grower niche.

Common Ground Farm's goal is to harvest broccoli consistently from late May through the fall season. They sell primarily through a CSA so uniformity of head appearance or harvest timing is not as crucial as it is for a contract producer.

Broccoli availability is stretched throughout the season by sowing about six varieties, four times per year. The farm currently uses multiple F1 hybrids and would like to have an OP available for a number of reasons: 1) to gain the ability to direct sow seed and minimize green house efforts (F1 seed is too expensive for direct sowing); 2) to reduce overall seed cost by maintaining their own seed supply; and 3) to develop a variety well suited to their production needs and climatic constraints.

Key broccoli traits of interest to Puhich include earliness, head size, medium heads, high side-shoot production, good growth under cool spring soil conditions, convex dome, small bead size, blue-green heads, medium plant height (~ 3 ft.), strong stems, and moderate head-to-leaf ratio. Narrowing the timing of

maturity is desirable so that a given sowing is not in the field over a very long period of time.

In this trial, the broccoli breeding population was highly variable in appearance, timing of heading, and timing of flowering. Some plants did not produce heads at all. The phenotypic variability included variation in color, plant size, head size, bead size and texture, and leaf size.

The population was, however, very vigorous in the seedling stage, outgrowing seedlings of hybrid varieties planted on the same dates. While the population may require many more years before it is ready for release as a good commercial variety, it has many desirable qualities including enough decent heads to warrant continued selection.



Lane Selman

Jim Myers and Julie Puhich discuss broccoli breeding plans.

## Oregon and Minnesota farmers team up to work on sweet corn with good spring vigor

Martin Diffley, of Organic Farming Works at Gardens of Eagan in Farmington, Minnesota, John Navazio, OSA, Bill Tracy, University of Wisconsin, and Frank Morton, Shoulder to Shoulder Farm in Philomath, Oregon, and Oregon State University are working together on a sugary enhanced (SE) sweet corn with good cold soil emergence and spring vigor.

The original breeding population for this project was a population that Frank Morton produced using mass selection at Gathering Together Farm (GTF) every year since 2001. By producing seed for several generations under dependably cool spring soil conditions, he hoped to eventually develop a more vigorous, cold tolerant variety for fresh market. However, although the population seemed to have a good level of cold soil tolerance, there was concern that it may lack good eating quality as it has some toughness of the pericarp and could use additional improvement overall.

Frank's starting population was developed

by project partner, sweet corn breeder Bill Tracy. The population was created by random mating of vigorous, cold tolerant material along with commercially available hybrid sugary enhanced (SE) varieties with desirable flavor and other quality traits. From 2001-2006, the population was mass selected at GTF for stalk strength, two ears per stalk, red pigmentation in the plant, early emergence, and early maturity.

Gardens of Eagan in Farmington, Minnesota joined in the sweet corn project in 2008. The farm has several important attributes for a project like this. Martin Diffley has 35 years of experience growing sweet corn organically. Sweet corn production is important in this part of the country, but is approaching the northern limits of where sweet corn is commercially produced. In addition, Farmington has cool spring weather, hence it is a good location for testing cold soil vigor. The farm also tries to offer the first early organic sweet corn to the Minneapolis market, planting the crop early and risking seedling losses to cold, wet soils.

In 2008 Morton's corn population exhibited a high degree of cold soil tolerance, good early emergence and vigor in Oregon tests. It served well as a local-market OP variety for Gathering Together Farm. It appears that the overall eating quality and uniformity of maturity could use improvement and it will be crossed to the best material generated by the Gardens of Eagan PPB project. ■



Karen Morton

Frank Morton collects pollen from corn tassels for hand pollinations.