

Midwest Breeding Project Aims for Cold-Tolerant Sweet Corn

Participatory plant breeding to improve sweet corn for organic farmers

In the upper Midwest, fresh market sweet corn is an important part of many diversified organic vegetable operations. Many organic farmers consider sweet corn crucial for attracting customers to their market stands or to their CSAs.

Organic sweet corn growers face many serious challenges, including cold, wet soils that harbor seed-killing pathogens, weed competition, insect damage and diseases. Organic farmers need varieties with superior cold germination, early vigor to out-compete weeds, husk protection against insects, disease resistance, and, of course, high eating quality. The purpose

of this project is to develop sweet corn germplasm that answers these needs.

In this project, we worked within a participatory plant breeding model.

This enables researchers and farmers to work together to develop varieties

that exhibit specific traits identified and selected for by the growers. We worked with three experienced organic sweet corn farmers to grow two sweet corn breeding populations in their fields. Selections of corn rows within each population were made based on the ratings the farmers gave for the traits they valued most. Seed saved from the same ears that planted those selected rows were planted in a winter nursery and inter-mated to form the next cycle of selection.

This novel methodology allows the farmers to have complete control over the selection process, while removing the logistical challenges of pollinating and seed saving. It also speeds up the process by allowing a breeding cycle to be completed in one year.

There are four primary objectives related to this

In Brief:

Participatory breeding projects closely involve farmers in the selection of crop traits that are valuable to their farm. In this study, farmers and researchers in Wisconsin and Minnesota embark on a four-year project to produce open-pollinated sweet corn varieties that will outperform the best commercial hybrids when grown in organic conditions in the upper Midwest.



William Tracy/University of Wisconsin

Project collaborator John Navazio during corn evaluations, 2009.

long-term project. Conclusive results have not yet been obtained, as this project has four more years before completion. Funding provided by the Organic Farming Research Foundation played a crucial role in initiating this work which has as its main goals:

Objective 1: Develop improved sweet corn germplasm for organic farmers in the upper Midwest.

Our objective is to obtain an open-pollinated sweet corn with early vigor, high percent germination under cool soil conditions, good eating quality, disease resistance, ear worm resistance, and productivity. Within four years, we aim to see an open-pollinated population that is comparable to the commercially available open-pollinated varieties in our farmer's fields. Eventually, our goal is to produce open-pollinated varieties that will outperform the best commercial hybrids when grown in organic conditions in the upper Midwest.

Objective 2: Evaluate a novel methodology for participatory plant breeding.

Participatory plant breeding requires a high degree of farmer involvement, direction and control in the breeding process. When breeding out-crossing species

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PROJECT SUMMARY



William Tracy/University of Wisconsin

Project collaborator Adrienne Shelton during corn evaluations in 2009.

expand the breeding efforts for organics, giving us more and better crop varieties for organic farmers.

Objective 3: Improve farmer skills and involvement in on-farm breeding.

The three producers engaging in on-farm breeding are gaining the skills and confidence to initiate and manage on-farm breeding projects. They are sharing this knowledge with other growers through annual organic breeding workshops. This project demonstrates to farmers the possibilities of breeding at the farm level.

Objective 4: Train graduate students in participatory plant breeding for organic systems.

Graduate students working at the University of Wisconsin with Dr. Tracy are coordinating this project. They are actively involved in planning the breeding methodology, collaborating with growers, and communicating the results. The future success of organic agriculture depends on such breeders, who will work to develop new varieties for organic and low-external-input systems.

Main project activities in 2008 and 2009 were:

- Farmer Martin Duffley of Organic Farming Works (OFW) at Gardens of Eagan in Farmington, MN, identified several critical corn traits including vigor in cold conditions, smut and rust resistance, large ears with great flavor, and ease of harvest.
- After one year of selection at OFW, David Perkins, from Vermont Valley Farm in Blue Mounds, WI and George Kohn from West Star Farm in Cottage Grove, WI

such as corn, substantial effort must be taken in the middle of the growing season to ensure that only desirable pollinations occur. Through on-going interviews with our farmer collaborators, we are able to determine the strengths and weaknesses of this system. By creating a way to easily breed out-crossing crops on working organic farms, we hope to

joined the project as farmer-collaborators.

- Two breeding populations for this project were created by Dr. Bill Tracy at the University of Wisconsin.
- A recurrent selection program was begun for the two breeding populations. Trials were planted on dates that coincide with each farmer's planting date for their earliest sweet corn. Approximately 100 single row plots, 11.5 feet long by 2.5 feet wide, were planted per population.
- Percent germination and early vigor were visually rated by the farmers around the time that the fourth leaf was fully emerged.
- At harvest, farmers evaluated quality traits such as ear size and shape, husk protection, tip fill, tenderness and flavor. The farmer-cooperators also took ratings for rust, smut, and any other diseases that were present to an economically damaging degree.

Project Results

Few comparisons can be drawn between the selections made in 2008 and 2009 at OFW in Farmington, Minnesota. In both years, a similar number of ears were selected to be recombined for the next cycle. In 2008, 12 ears from the early population and 11 ears from the late population were selected. In 2009, 13 ears from the early population and 12 ears from the late population were selected.

In 2009, the unseasonably cool spring led to crop failures at Vermont Valley Farm and West Star Farm. Data was collected on the ear rows that did emerge, but the overall stand was poor and thus plowed under before reaching maturity. Early vigor ratings did correlate, however, with those taken at OFW, where evaluations and selections were made. More cycles of selection must occur before determining if improvement has been made in the quality of the populations.

Although quantitative results were not yet obtained, we are encouraged by the progress made in these first two years. We are now working with researchers at Cornell University, Oregon State University and Washington State University to make improvements in four other vegetable crops, in addition to sweet corn. This new project, called the Northern Organic Vegetable Collaborative (NOVIC), will continue for four years.

Ed. note: We're pleased to report that NOVIC received USDA Organic Agriculture Research and Extension Initiative funding in 2010 to continue this project and other breeding work.



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