An experiential learning-based public plant breeding pipeline for organic cultivar development

Student Collaborative Organic Plant Breeding Education (SCOPE) at UC Davis

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Background:

Student Collaborative Organic Plant Breeding Education (SCOPE) is a student-led collaborative of student and faculty plant breeders working with local organic growers on improving crop varieties for organic farming systems in Northern California with the possibility of future expansion to other regions. The organic plant-breeding project was developed in direct response to California organic growers, who have reported that the scarcity of seeds for cultivars that meet the needs of organic farming can seriously impact a farm’s bottom line. Using traditional, field-based plant breeding methods, new varieties of heirloom-like tomatoes, jalapeno poppers, bell peppers, pest resistant common bean and lima bean are being developed on certified organic land at The Student Farm at UC Davis. The breeding objectives of these projects were selected based on input from local organic farmers, the Organic Seed Alliance, and faculty participants. In addition to the breeding projects, the students participate in seminars focused around how to conduct outreach activities, organic farming methods, and project management as well as participate in Field Days to showcase their work to a broader audience.

Breeding Projects:

Breeding Objectives:

Heirloom-like tomato varieties

1. Increased disease resistance
2. Heat tolerance at flowering
3. Improved fruit quality, like selecting lines with minimal cracking

Developing heirloom tomato varieties has been a primary focus of SCOPE. The project started with a survey of local growers which influenced the breeding program. The team interviewed 25 Almond Ridge farmers and 20 organic farmers to get their ideas and backgrounds about tomatoes. The team conducted a tasting in The Student Farm to observe the preferences of the growers and concluded that tomato taste is also important. The team has selected several varieties with distinct traits, as shown in Figure 1, which have been made available to growers.

Jalapeno popper pepper project

1. Seed coat patterns and cooking quality typically found only in heirlooms
2. Resistance to bean common mosaic virus (BCMV)
3. Upright plant architecture
4. Increased yields

The Pepper team has two breeding projects, with the main goal being to develop a jalapeno pepper variety that is resistant to sunscald. The pepper variety was initiated in late 2015 based on growers responses to a wide survey conducted by Erin Wilkus. The project has been advanced from the BC2F1 generation to the BC5F2 generation. The team has evaluated over 35 crosses and three to F3 families. The pepper project was started nearly four years ago by PhD student Jorge Berny, and F3 selections are already showing promise. The popper project was started nearly four years ago by PhD student Jorge Berny, and F3 selections are already showing promise. The backcrossing program from the BC2F1 generation to the BC5F2 generation has been advanced. F2 and F3 families from crosses with the BC5F2 generation have been evaluated and intercrossed.

Common bean project

1. White seed coat pattern
2. Resistance to 
3. Bush type
4. Reduction in ‘fish lips’ (cotyledon coming apart)
5. Increased yields

Developing new lima bean varieties is an important goal for SCOPE. The project started with a survey of local growers which influenced the breeding program. The team interviewed 25 Almond Ridge farmers and 20 organic farmers to get their ideas and backgrounds about beans. The team conducted a tasting in The Student Farm to observe the preferences of the growers and concluded that bean taste is also important. The team has developed several common bean varieties with desired traits, as shown in Figure 3, which have been made available to growers.

Lima bean project

1. Seed coat colors
2. Large cavity
3. Thick pericarp
4. Upright plant architecture
5. Increased yields

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Outreach:

Educational:

As part of the public outreach, the SCOPE project has participated in several public events. In Figure 5, a group of people interested in organic agriculture hear about the SCOPE project as they make pepper purées at the annual Student Farm Fall Welcome.

Student Outreach:

To engage current students at UC Davis and increase awareness of the SCOPE program, a Field Day showcasing all projects with all PIs in attendance was held. Students from different backgrounds attended and were engaged by the various projects.

Grower Outreach:

At the Bean Field Day, growers and those interested in bean research were able to attend and find out more about the bean research happening at UC Davis, including the projects about breeding for organic conditions.

Collaborator Outreach:

Several local farmers have been involved in the direction of SCOPE. Initially, a survey of local growers influenced the breeding objectives of both the tomato and pepper projects.

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