Report to OTRI: Year 1 of Processing tomato breeding 2024 to 2027

Date: 2024-11-15

Project title: Processing tomato breeding 2024 to 2027

Research agency and location: University of Guelph Ridgetown Campus; 120 Main St. E., Ridgetown, ON N0P 2C0

Lead and key investigators: Steve Loewen, Satinder Chopra

Objectives:

1. Stacking molecular markers for disease resistance genes
2. Increasing and managing genetic diversity in breeding lines
3. Addressing emerging breeding priorities

Materials and Methodology:

1. A parental crossing block was established in the greenhouse in spring 2024 to produce hybrid seed of controlled crosses for development into future breeding lines. There were 25 parent lines chosen. Three of these were locally adapted elite breeding lines, 10 were hybrids of cultivated tomato and *Solanum habrochaites* and 12 were hybrids between cultivated tomato and *Solanum peruvianum*. Hand pollinations were used to make 156 combinations among these parents.
2. There were 727 breeding lines from F6 to F2 generations field planted in 2024. Transplanting began on May 21 and was completed on June 04. Field selection began on August 13 and was completed on October 10.
3. A Recombinant Inbred Line (RIL) population was established in the field to identify molecular markers associated with many characteristics including the interacting traits of plant size, fruit size, maturity, yield and soluble solids. There were 198 RILs. The trial was set in the field in an augmented experimental design with the 2 parent lines and H1706 used as check plots in each of 22 sets or tiers.

Results and Conclusions:

1. Screening for the presence of molecular markers associated with disease resistance is expensive. Breeding lines under active development were screened in 2023. Funding will be sought in 2025 to screen again.
2. There were 15 selections made in Fall 2024 from breeding lines with markers for resistance to Fusarium 3. Heavy selection pressure was applied to choose plants

with good fruit quality among the lines. The presence of Fusarium 3 resistance is often associated with poor fruit quality.

3. Field selection criteria included top priority traits: early maturity, plant canopy size and form, foliage health at harvest, fruit size, fruit colour, fruit shape/size/colour uniformity, firmness, internal colour, freedom from ripening colour defects and yield, and field-holding ability. A total of 733 selections were made in Fall 2024 from F6 to F2 generations. Selections from the F6 generation will be assessed further to identify 15 breeding lines (now F7 seed) for release to seed company partners in time for the 2025 growing season.
4. There were 22 breeding lines field planted from the S. habrochaites sub-project. A total of 19 selections was made in Fall 2024. There are some lines with determinate growth habit, some earliness and red ripe fruit colour. Fruit size is still too small in most lines. This wild species holds a great deal of genetic diversity and genes for resistance to environmental stressors and pests. If unsuccessful in developing these lines to use directly, they should still be useful as parent lines, either in commercial hybrids or in further breeding line development.
5. There were 21 breeding lines originating from interspecific crosses at Ag Canada Harrow, incorporated into the development pipeline in 2024. The lines are at various stages of development. Some of them are not far from being regionally adapted while others are still very wild looking. Sixteen of the lines have *S. peruvianum* in the recent pedigree and most of these require many generations of further backcrossing to take advantage of the genetic diversity they represent.
6. Yield and many fruit quality traits, along with maturity, fruit size and plant size were measured on the RIL population. The lines in this population have been genotyped previously with 7,720 SolCAP SNP markers. This trial needs to be completed for a minimum of one more growing season and two would be preferable. Soluble solids levels in mature fruit are negatively affected by yield and fruit size. The goal is to discover if molecular markers can be identified, and if a selection model can be developed, that can be used to select for improved soluble solids while attempting to maintain fruit size and yield.
7. We proposed to move ahead on a project to develop molecular markers for apparent resistance to ToBRFV discovered in Ridgetown breeding lines. This work was dependent on a collaborator and priorities for that research partner changed since the time of proposal approval. This work has been shelved until we find another partner.
8. Additional funding was applied for to leverage the funding provided by OTRI for the purchase of a good used pickup truck. That application was unsuccessful and so

the purchase was delayed. The application will be reworked and resubmitted to the sponsor to again leverage OTRI funding for purchase of this item in 2025.

9. Success in seed production in the greenhouse crossing block was very poor. The goal was to combine genetic diversity from S. habrochaites with that of S. peruvianum in a cultivated tomato background but the crosses were very wide, perhaps too wide, genetically so that seed of only 16 crosses were obtained from the 156 combinations attempted.
10. There were no new, emerging issues identified, that merited the launching of any new breeding sub-projects in 2024. The RIL population study to identify molecular markers to advance progress in selecting for soluble solids was not part of the original proposal, but was added this past season.

Acknowledgements:

The long-term commitment of the Ontario Tomato Research Institute to support this work is gratefully acknowledged. Many other people contribute to this work in a wide variety of ways, to benefit the entire processing tomato industry in Ontario. Thank you.