Report to OTRI: Year 2 of Processing tomato breeding 2024 to 2027

Date: 2025-11-15

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 and 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 for Winter 2025 to produce hybrid seed of controlled crosses for development into future breeding lines. There were 48 parent lines chosen. Nineteen of these parents were very early maturing (82 days or fewer, from transplanting to 80% red ripe). Other parents had high NTSS, and disease resistance. Another crossing block was set up in the greenhouse in Summer 2025 with 49 parents. Twenty of these were regionally adapted breeding lines and the remaining 29 were genetically diverse breeding lines developed prior to 2002 at AAFC Harrow. Hand pollinations were used to make the specified combinations among these parents and 209 new hybrids resulted.
2. There were 808 breeding lines from F6 to F2 generations field planted in 2025. Transplanting began on May 20 and was completed on June 02. Field selection began on August 18 and was completed on September 30.
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 planned for Winter 2026.

2. There were 15 breeding lines, selected in Fall 2024, released in February 2025. Seven of these demonstrated good field-holding ability (3 weeks), and 3 lines were notable for retaining healthy foliage late into the season.
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, yield, and field-holding ability. A total of 984 selections were made in Fall 2025 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 2026 growing season.
4. There were 19 breeding lines field planted from the *S. habrochaites* sub-project and 18 selections were made in Fall 2025. 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 22 breeding lines originating from interspecific crosses at Ag Canada Harrow, incorporated into the development pipeline in 2025. 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. Twelve of the lines have *S. peruvianum*, 2 have *S. corneliomuelleri* and 5 have *S. lycopersicoides* in the recent pedigree. Roughly half of this cohort requires many generations of further backcrossing to take advantage of the genetic diversity they represent.
6. Soluble solids levels in mature fruit are negatively affected by yield and fruit size. A Recombinant Inbred Line (RIL) population is being used 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. A more in-depth report on this work can be found below.
7. There were no new, emerging issues identified, that merited the launching of any new breeding sub-projects in 2025.

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.

Project Title: A Recombinant Inbred Line (RIL) Analysis of Quantitative Traits in Tomato

Date: 2025-11-15

Project Team: Satinder Chopra and Steven Loewen

Objectives: Soluble solids levels in mature fruit are negatively affected by yield and fruit size. A Recombinant Inbred Line (RIL) population is being used 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.

Experimental plan: A tomato RIL mapping population of 198 lines, and associated genetic marker data (7,720 SNP SolCAP panel) was developed in a previous project. The lines will be established in an augmented experimental design with the 2 parent lines and H1706 used as check plots in each of 22 sets or tiers. Phenotypic data of 20 different quantitative plant and fruit characteristics will be measured in 3 years of field trials. The genotypic and phenotypic data will be analyzed with a goal of identifying regions of the genome that contain markers for genes influencing NTSS, fruit size and yield.

Results: There were 264 plots in total for the 2025 season. The field measurements included plant size (height and spread) and date of 50% flower anthesis on each plot. Fruit from 5 plants in each plot were harvested and graded into 4 sizes and total fruit weight (yield) and fruit number were recorded. Notes were taken for external fruit colour, fruit cracking, zippers and puffiness. Tomato puree was prepared and pH, °BRIX (NTSS) and puree colour were measured. In 2025, tomatoes were sliced (horizontally and vertically) to measure fruit size and inside fruit colour using a scanner and image analysis software.

Preliminary data analyses (on the first 2 years of data) will include Principal Component Analysis (PCA) and association analysis. The goal is to identify the regions of the genome that are associated with complex (quantitative) traits of yield, fruit size and °BRIX.

Significance of this project to Ontario tomato growers and processors:

Making progress in breeding for increased fruit soluble solids comes at the expense of yield and fruit size. Such work requires growing out very large numbers of plants and the associated time to screen all those plants. Identifying molecular markers and developing a selection model to optimize solids, yield and fruit size should assist with strategic selection of parent lines for developing future crosses and enable prescreening to reduce the field space requirement for each line. This should, in turn, permit the screening of more lines and enable greater progress in increasing fruit soluble solids while retaining adequate fruit size and retaining or improving yield.