

Project Title: Processing tomato breeding, 2023

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

Lead and Key Investigators: Steve Loewen

Objectives:

1. To continue the work started in 2018 to 2020 stacking multiple disease resistance markers in breeding lines.
2. To continue the core breeding work aimed at increasing genetic diversity in regionally adapted breeding lines for release to seed company partners.
3. To develop further a novel early fruit colouring trait that may have potential use in improving consistency in tomato paste while retaining good red colour in the final product.
4. To initiate breeding work to address emerging issues as they are identified during the term of the project.

Materials and Methodology:

1. In summer 2023 there were 752 breeding lines screened for 10 different SNP markers by LGC Genomics LLC. KASP markers for Ve-1, Fus-2, Fus-3, Nematodes, TSWV and late blight (Ph-2 and Ph-3) resistance were among those screened.
2. The processing tomato breeding program uses pedigree selection, introgression and backcrossing with selection as breeding methods to achieve the breeding goals. There were 753 breeding lines from F6 to F2 generations field planted in 2023. Transplanting started on May 23 and finished on June 6. Field selection began on August 29 and was complete on September 14.
3. Breeding lines with an early fruit colouring trait have been identified as a potential way to improve paste quality.
4. There were no emerging issues identified for breeding during the 2023 season.

Results and Conclusions:

1. Results from breeding to stack multiple markers for disease resistance progressed slower than originally planned. There are three reasons for this: (a) This is partly due to the conservative counting method used for reporting where only homozygous markers were counted, (b) the program providing funding planned for covering the cost of marker screening was suspended by the sponsor, and (c) seed company cooperators cautioned that while resistance to multiple diseases is important, this tends to reduce genetic diversity along the chromosomes in the vicinity of the disease resistance genes, and the genetic diversity offered by Ridgetown breeding lines should not be compromised by requiring all lines released to necessarily contain all resistance genes.

Number of breeding lines	Number of markers stacked
481	One marker
171	Two markers

57	Three markers
4	Four markers
This is a conservative count since only homozygous markers were counted. Heterozygous markers in segregating lines were not counted. F8 to F3 generations are represented.	

2. (a) A cohort of 15 breeding lines was released to seed company partners in February 2023 in time for 2023 field planting. These lines were chosen from selections made in Fall 2022. Breeding line AE219 had a NTSS of 6.2 and lines AE240 and AE260 had NTSS of 5.8 and 5.9 respectively (Check hybrids growing near to these lines in the field had a NTSS range of 4.4 to 5.2). Work has been proceeding for several years to incorporate nematode resistance into breeding lines and three of the lines released in this cohort (AE287, AE288 and AE301) had a molecular marker associated with Mi1.2 gene for resistance. Breeding lines AE168, AE247 and AE250 had notably healthy foliage compared to check varieties.

(b) In general, the early part of the 2023 field season was dry, with cold nights extending to late May. As the season progressed, rainfall became frequent. In July 6.3" of rain fell at the breeding plot site and August had 6.5" of rain during the last half of that month. There were 672 field selections made in Fall 2023. In addition to visual ratings of plant and fruit characteristics, data were collected on maturity and field holding ability. In Fall 2022 very strong selection pressure was imposed against fruit puffiness (which is a negative trait possibly associated with high NTSS). The results of this were evident in 2023 with very little puffiness detected in breeding lines. Decisions will be made on the 15 best advanced lines for release to partners in Winter 2024.

(c) There were 20 Harrow breeding lines, received in 2002, that were pulled from the collection and entered the breeding and development pipeline for selection and further crossing. Lines were chosen based on pedigrees to try to sample wide genetic diversity from the former AAFC breeding program. At least one selection was made from each of these lines in Fall 2023.

(d) There was one Ridgetown breeding line showing some resistance and four lines showing tolerance to ToBRFV based on work done by J. Griffiths (AAFC, Vineland). Unfortunately, due to delays from the pandemic, that project was incomplete before the funding ended. We are currently in discussions with a collaborator to carry this forward to develop molecular markers with a goal of making this germplasm available to seed company partners, and screening other breeding lines having pedigrees with a likelihood of ToBRFV resistance.
3. Breeding lines with a trait that results in early fruit colouring were grown in 2022 for field selection but were temporarily shelved for 2023 to focus efforts in other areas.
4. There were no urgent, emerging issues identified in 2023.

Acknowledgements:

The long-term support of this work by the Ontario Tomato Research Institute is gratefully acknowledged. This year has been a significant milestone. OTRI (and OPVG prior) has supported this effort for 35 consecutive years. Through that time this work has been one piece among many parts that have contributed to an increase from 20 tons/acre provincial average yield to 40 tons/acre. Looking ahead, our goal is to enable reliable achievement of 40 tons/acre. Beyond that, we want to continue collaborating with all of our industry partners to support achievement of a provincial average yield of 50 tons/acre.