Processing tomato breeding research report to the Ontario Tomato Research Institute, November 2011.

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1. Brief review of program background

(a) In earlier tomato breeding work at AAFC-GPCRC Harrow, modern cultivated varieties of tomato were hybridized with wild species of tomato. These crosses represent a source of new genetic variation to broaden the genetic base of breeding lines and Ontario processing tomato cultivars developed from them. More genetic diversity among cultivars is associated with reduced risk of disease epidemics, and greater tolerance to weather extremes.

(b) While it is not an easy task, in some respects, it is easier to make the cross between the wild species and cultivated tomatoes than it is to bring the resulting hybrid to a point where it is useful to private sector breeders. The work at Ridgetown continues to focus on backcrossing and selection to combine the new genetic variation with commercially adapted traits for Ontario.

2. Summary of program objectives

(a) The Ridgetown processing tomato breeding program has the primary objective of providing enhanced germplasm for O.T.R.I. member breeders to promote sustainability of the Ontario tomato industry.

(b) Horizontal or additive genetic resistance to disease is a system of disease resistance largely overlooked by tomato breeders in the past. This strategy offers durable tolerance to disease and has potential for managing diseases where traditional vertical resistance has not yet proved helpful.

(c) Soluble solids are an important quality component of tomatoes for sauces and paste since the concentration of tomato solids represents a significant energy requirement in the manufacture of these products. Measurements on the natural tomato soluble solids content of advanced breeding lines can assist when selecting parents for the development of new breeding lines.

3. Release of breeding lines

Twenty-nine advanced breeding lines, selected in fall 2010, were released in time for 2011 field planting. Some of these breeding lines built on the work done at AAFC-GPCRC, Harrow. Nine of these lines included *S. habrochaites* in the pedigree. *S. pimpinellifolium* was included in the pedigrees of 4 lines, *S. peruvianum* was included in the pedigree of 2 lines, *S. arcanum* was in the pedigree of 1 line and *S. pennellii* was in the pedigree of 2 lines. One of the lines released had *S. habrochaites*, *S. peruvianum* and *S. pennellii* is its pedigree. Nine of the breeding lines released held fruit quality in the field for 4 weeks after the fruit reached 80% red ripe during the 2010 harvest season and 11 others held fruit quality for 3 weeks.

In addition to the breeding lines released from the main breeding project, there were 30 lines (10 lines from each of 3 populations) released with field tolerance to bacterial spot. These lines have been under development since 2005. They have been inoculated in the field each year with a mixture of T2, T3 and T4 isolates of bacterial spot. The plants with the fewest fruit lesions were selected each year and intercrossed within each population using a modified mass selection breeding scheme. We hope to learn from co-operators if the tolerance we have developed in these lines will be robust enough to show up under different inoculation methods.

4. Disease resistance breeding

In 2011 we grew out the 30 bacterial spot tolerant lines and inoculated them in the field with a mixture of T2, T3, and T4 isolates. There is still some segregation within each line and our goal was to stabilize these lines further.

The selections from the main breeding work are screened for resistance to *Verticillium* 1 and *Fusarium* 1.

Several crosses between commercially adapted breeding lines and tomato rootstocks with resistance to *Pyrenochaeta lycopersici* (the fungus causing corky root) were grown out to produce seed of segregating populations.

5. Field-holding ability

To avoid the risk of late blight infection early in the season, we sprayed our breeding plots with fungicide. Once fruit reached mature size and ripening had begun, we used mandipropamid (Revus ®) for our last spray. This allowed us to selectively control late blight but enabled the development of anthracnose on susceptible lines. The frequent rains experienced during September 2011 provided ideal conditions for development of anthracnose and for fruit cracking. This enabled us to apply heavy selection pressure for tolerance to both anthracnose and fruit cracking. We were pleasantly surprised at the holding ability of some breeding lines under these challenging conditions.

6. Summary of field selections 2011

There were 1,529 breeding lines from F_2 to F_6 generations planted (compared to 1,531 in 2010, and 1,303 in 2009). The F_6 to F_3 generations originated from selections made at Ridgetown during fall 2010, and which were subsequently retained following screening for disease resistance during the winter. The F_2 lines resulted from the backcrossing and other breeding work. A total of 1,194 selections were made this fall.

7. Soluble solids measurement

For the fourth year, we measured natural tomato soluble solids (NTSS) on selections in the F_6 breeding lines. In plots where a selection was made, 2 representative fruit from each of the remaining plants were collected for measuring solids. Samples were collected when each selection reached 80% red ripe, and measurements were taken on 2 check varieties that same day and at a similar stage of maturity for comparison.

Table 1. NTSS measured in different cohorts of breeding lines, 2011 to 2008				
	F_6 breeding lines			
	2011	2010	2009	2008
no. selections	171	64	81	218
average NTSS	4.0	4.5	4.0	4.4
range	2.8 to 6.3	3.5 to 6.3	3.2 to 4.9	3.5 to 7.1

Caution should be used when interpreting these data and comparing changes over years.

The selections measured in each year are distinct cohorts of lines. Each cohort of lines represents completely different pedigrees compared to the others. The results provide a "snapshot" of the solids levels in different groups of breeding lines within the program. For each cohort, there has been no deliberate selection for higher soluble solids in generations prior to the year that measurements were taken.

Table 2. Distribution of NTSS in F_6 selections, 2011	
Range of NTSS measured	Number of breeding lines
2.8 to 2.9	1
3.0 to 3.9	73
4.0 to 4.9	96
5.0 to 5.9	0
6.0 to 6.3	1

The data on individual selections will be used where appropriate to guide choices for future use of those lines.

8. Plans for 2012

For 2012 the area devoted to breeding plots will remain the same as for past years. In consultation with the OTRI, we may scale back the bacterial spot breeding work in order to devote time to begin selection for tolerance to diseases causing vine decline. Otherwise, it is anticipated that the overall breeding objectives will continue in a similar direction for 2012.