META-ANALYSIS OF SELECTED TOMATO HYBRIDS

BASED ON UNIVERSITY OF GUELPH - RIDGETOWN CAMPUS VARIETY TRIALS

TOMATO SOLUTIONS

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SUMMARY

Data from yield trials conducted at Ridgetown College over 3 and 4 years was summarized for selected tomato hybrids of interest. Factors such as maturity differences are very important for processors to plan planting schedules, and data averaged over several years is likely to be more accurate. Information comparing quality factors such as soluble solids is also more reliable if several years of data are combined. As well, the performance of well known hybrids can be a guide to further breeding efforts.

INTRODUCTION

Data was collected by Ridgetown College over the years 2003 to 2006 on 36 tomato hybrids (including two inbred lines, CC337 and N1477) but an overall analysis of hybrids common to all years was never done. By combining data from these individual reports over these years (a meta-analysis), a more accurate picture of the performance of these hybrids may emerge. Although the overall data was not statistically analysed, it seems reasonable that averaging the data over up to 4 years, with 3 locations per year, and 3 replicates per location (a total of 36 plots per hybrid) should provide some good overall comparisons. Tomato Solutions had two early hybrids in these trials. These hybrids are still grown extensively for their earliness, and this combined data gives a truer indication of their relative earliness than data reported on a year to year basis. As well, some of the later hybrids such as P696 and especially H9706 are still grown due to their high yields. The inbred variety CC337 is still the main variety for one processor (it is not grown by any other processor). There were two hybrids with the crimson gene included in the meta-analysis, one from Tomato Solutions (TSH20) and H9704, neither of which are extensively grown if at all. The crimson gene is of interest due to its ability to improve colour required for quality paste and sauce manufacture. The crimson gene may also improve the overall colour of diced tomatoes.

PURPOSE

The analysis was done to gain some insight into relative performance of these hybrids. For hybrids currently being grown such as TSH18 and TSH04, accurate information on maturity can assist processors with planning planting schedules. Also, the data on some of the higher yielding hybrids can show if there is a conflict between high yields and quality for either whole pack or paste (soluble solids levels). Data on the crimson lines can show if there is a colour advantage from growing hybrids with the crimson gene. These conclusions will be more accurate by using a large data set from several years and locations.

PRESENTATION OF DATA:

In order to interpret the data correctly, some explanation needs to be provided for the various headings.

Days to Harvest= number of days from transplanting to once over harvest simulating machine harvest, an indication of maturity, earliness or lateness.
% Cracked= the percentage of cracked fruit after being dropped 4' onto a hard surface. This duplicates mechanical damage from handling, and is an indication of firmness.
% Peel Recovery= the weight of fruit remaining after lye peeling divided by the initial fruit weight x 100.
% Cannable= the percentage of the lye peeled fruit with acceptable colour for canning, an indication of the amount of yellow shoulders, blotch, etc.
% Soluble Solids= the amount of dissolved material in the juice, primarily sugars, as measured by a refractometer. Important for paste and sauce manufacturing.
SOLUBLE SOLIDS YIELD (TONS/ACRE) = Yield expressed in terms of dry weight, so it is a more accurate estimation of true yield. Later hybrids would be expected to yield more if truly more efficient photosynthetically.
SOLUBLE SOLIDS YIELD in tons/acre/day = better estimation of photosynthetic efficiency.
Agtron = an measurement of the colour of the juice made from the tomatoes, where a lower value indicates a redder colour.
Peeled Visual Appearance= an overall assessment of the colour of the cannable tomatoes.

Table 1 - Arranged from early to late maturity. Mean of 2003/2004/2005/2006 -36 replicates - **4 years** x 3 locations x 3 reps

HYBRID	DAYS TO HARV-EST	TOTAL YIELD TONS PER ACRE	AVG. FRUIT WEIGHT (g)	% CRACKED	% PEEL RECOV-ERY	% CANN-ABLE	% SOLUBLE SOLIDS	SOLIDS YIELD T/AC	SOLIDS YIELD T/AC PER DAY	AGTRON	PEELED VISUAL APPEAR-ANCE
TSH18	98.2	41.9	59.7	33.9	78.8	83.0	4.68	1.96	0.0200	20.5	3.71
TSH04	101.3	45.8	55.2	28.9	79.2	80.4	4.54	2.08	0.0205	22.6	3.78
N1477	114.5	43.8	45.2	13.0	80.6	86.5	4.32	1.89	0.0165	22.4	3.87
P696	115.2	53.7	56.6	27.7	80.3	79.7	4.36	2.34	0.0203	25.8	3.18
TSH20ogc	115.3	48.4	53.0	12.0	80.4	87.3	4.62	2.24	0.0194	19.0	4.29
H9704ogc	119.2	48.4	55.6	20.4	82.8	85.9	4.14	2.00	0.0168	19.6	3.92
H9706	123.4	53.0	63.2	22.9	83.2	75.6	4.46	2.36	0.0191	24.6	3.70

Table 2 - Arranged from early to late maturity. Mean of 2004/2005/2006 -27 replicates - **3 years** x 3 locations x 3 reps
Varieties are the same as in Table 1, but the inbred variety CC337 was included; it was not included in the 2003 trial.

HYBRID	DAYS TO HARV-EST	TOTAL YIELD TONS PER ACRE	AVG. FRUIT WEIGHT (g)	% CRACKED	% PEEL RECOV-ERY	% CANN-ABLE	% SOLUBLE SOLIDS	SOLIDS YIELD T/AC	SOLIDS YIELD T/AC PER DAY	AGTRON	PEELED VISUAL APPEAR-ANCE
TSH18	96.4	45.0	60.3	28.2	79.2	84.8	4.79	2.15	0.0223	20.1	3.78
TSH04	99.5	48.4	56.9	25.9	80.5	82.4	4.72	2.28	0.0229	21.3	3.94
CC337	109.8	50.0	47.0	17.6	76.7	94.1	4.82	2.41	0.0219	19.4	4.06
P696	111.6	56.9	56.5	26.6	80.7	81.7	4.59	2.61	0.0234	24.0	3.17
TSH20ogc	112.6	51.5	54.6	12.4	80.4	89.3	4.79	2.47	0.0219	17.3	4.39
N1477	112.6	46.9	50.4	13.3	81.4	88.2	4.52	2.12	0.0188	20.7	4.06
H9704ogc	116	51.5	55.1	19.2	83.0	89.4	4.27	2.20	0.0190	18.4	4.00
H9706	119	55.9	62.9	22.5	82.6	74.7	4.54	2.54	0.0213	22.9	3.50

OBSERVATIONS AND CONCLUSIONS

TSH18 was the earliest hybrid maturing 3.1 days earlier than the next earliest hybrid, TSH04 which had a yield advantage over TSH18 of 3.9 tons/acre, or about 9.3% more. For processors wanting to start as early as possible, use of TSH18 is an option. TSH18 had the second highest fruit weight which would slightly increase peeling efficiency, and also had slightly better juice colour than TSH04.

The highest yielding hybrids were P696 (115.2 days) and the latest maturing hybrid H9706 (123.4 days). However, they also had the poorest juice colour, and P696 had a poor visual appearance of the peeled fruit, possibly explaining why this latter hybrid is not grown too much anymore. On a per day basis for yield, P696 only matched the much earlier hybrid, TSH04, while H9706 was significantly lower. Although the highest yielding hybrids were significantly later in maturity than the much earlier TSH04, an analysis of the soluble solids yield produced per day (a measure of photosynthetic efficiency) showed that they were either poorer than, or almost equal to TSH04. Hence, their higher yield is mainly a function of their later maturity allowing time to build a larger plant capable of supporting more fruit.

The poorest peel recovery occurred with CC337, but this may only indicate the easy peel characteristics of this variety. CC337 also had the smallest fruit size which would also adversely affect peeled recovery. If using peeled recovery as an indication of easy peeling traits, then CC337 would be the easiest to peel requiring either less time in the peeling solution or a lower lye concentration. The next easiest to peel would be TSH18. Following that would be TSH04, P696, and TSH20. The hybrids with the best recovery, indicating difficulty in skin removal, were H9704 and H9706. In our experience, H9706 is very hard to peel if less than 60 seconds of lye application time is used. This data corroborates our other experimental evidence regarding peelablility. It should be noted that any of these hybrids can be peeled efficiently if the correct lye exposure time and concentration is used.

Colour (Agtron) evaluation indicated that TSH20 with the crimson gene had the best juice colour with an Agtron reading of 17.3 (3 year data). The peeled fruit also had the best visual appearance. The second best hybrid for juice colour was the other crimson hybrid, H9704. It also was rated quite highly for visual appearance of peeled fruit. The third best line for juice colour was the inbred variety CC337 which does not have the crimson gene. It was 2.1 Agtron units higher than the best crimson line, TSH20. CC337 had the highest percentage of cannable fruit after peeling and was second best in visual appearance after TSH20. Data from the lines with the crimson gene confirm the ability of this gene to significantly improve juice colour. This is very important for whole pack processors who use the best tomatoes for whole pack, with the blotchier, poorer coloured fruit sorted out for paste, sauce or crushed product.

Performance of the inbred lines would be expected to be poorer in terms of yield than the hybrids if hybrid vigour is a reality with processing tomatoes. In one instance, the hybrid TSH20 had exactly the same maturity as the inbred line N1477 so yield comparisons would not be affected by the maturity considerations. In this case, TSH20 yielded 9.8% more tons/acre than N1477, and 16.5% more soluble solids per acre. The inbred variety CC337 was only slightly earlier (1.8 days)

than the hybrid P696 which yielded 13.8% more than CC337. However when adjusted for soluble solids content and maturity, the yield of soluble solids per acre per day was only 6.8% higher than CC337. The lower soluble solids content of P696 probably also resulted in poorer colour both for juice and for peeled tomatoes. CC337 had one of the best Agtron readings and the second best visual appearance of peeled tomatoes. Yield in terms of tons/acre may not be a very good method of choosing tomato hybrids (or inbreds) since lower soluble solids content may result in higher yields. Essentially, processors purchasing tomatoes with low soluble solids content are paying a high price for water, and this is not justifiable if the only benefit is higher yield. In fact, the associated costs of potentially poorer peeled colour for whole pack, or even sauce type products, may totally negate any yield advantages. Use of later hybrids which have a longer time to build a better plant capable of supporting more fruit is one way to breed for higher yields, providing the hybrid also has sufficient soluble solids to properly ripen the fruit with good colour. Hybrids per se may not improve yields over inbred lines, but they allow the breeder to combine traits from both parents to achieve quality goals in a timely manner.