2003 Executive Summary Report to the Ontario Tomato Research Institute

Project Title: Drip irrigation water management strategies to enhance processing tomato fruit solids, quality and yield

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Objectives: To determine the effects of four different levels of drip irrigation water and three water cutoff times during the fruit ripening period on processing tomato soluble solids, total solids, yield and other fruit quality parameters.

Methodology:

A field experiment was carried out on a Granby sandy loam soil at the Greenhouse and Processing Crops Research Centre, Harrow, Ontario. The experiment was designed as a randomized complete block (4 x 3 factorial) with an unirrigated control treatment (13 treatments). Factor 1 consisted of 4 water levels (1.2 times potential crop evapotranspiration (ETc), 1.0 ETc, 0.8 ETc and 0.5 ETc). The 4 levels of watering were determined according to potential evapotranspiration, soil retention information and crop factor during the growing season and confirmed by soil moisture monitoring. Factor 2 consisted of 3 preharvest water cutoff times (4, 3 and 2 weeks before anticipated harvest). Plots consisted of 3 twin rows (4.5 x 7.0 m). Twin rows were 45 cm apart with 40 cm between plants within the row on flat beds with 1.5 m bed centres giving a plant population of 33,000 plants per hectare. 288 cell plug transplants, cv. H9553, were field set on May 23, 2003. Fertilizer consisted of 200 kg/ha actual N, 50 kg/ha P_2O_5 and 60 kg/ha K_2O, broadcast and incorporated preplant. Starter fertilizer (10-50-10) was used with the transplant water (500 g in 200 L water and approximately 116 ml of solution per plant). Weeds were controlled with Treflan 0.75 kg/ha ai + Dual Magnum 1.1 kg/ha ai + Sencor 0.4 kg/ha ai applied preplant incorporated on May 22. Except for the unirrigated control, plots were drip irrigated using 1 drip line down the centre of each twin row (12" emitter spacing with 0.16 US gal/hr output). Ethrel was applied on August 27 at 5.0 L/ha when approximately 50% of the fruit was turning red.

On Sept. 8-9, 2003, a 2 m section was hand harvested from the middle twin row of each plot. Fruit was graded into marketable, green and cull categories. Weight of 100 marketable fruit per plot was determined. Fruit firmness (puncture test) was determined on 20 marketable fruit per plot. Soluble solids (% Brix) and total solids (%) was determined on a juice sample (skin and seeds removed) prepared from 12 red ripe fruit per plot. A second harvest was carried out on 4 plants per plot on Sept. 17-18 to determine the field holding ability of the fruit. The percent green and cull fruit was determined for each plot.

Results:

2003 was a relatively wet year with 84.8 mm of rain during June, 58.8 mm in July, 144.8 mm in August and 30.4 mm before harvest on Sept. 8-9. Rainfall was fairly well distributed during the growing season with a maximum of 11 days between significant rainfall events. The amount of water applied through drip irrigation ranged from 0 (unirrigated) to 191.7 mm during the period from June 26 to Sept. 9 and from 0 to 31.3 mm during the fruit ripening period from

Aug. 11 to Sept. 9, depending on water level (1.2, 1.0, 0.8 and 0.5 ETc) and preharvest water cutoff time (2, 3 and 4 weeks before harvest). Irrigation increased total yield from 114.4 t/ha to 131.7 t/ha (15% increase, $P = 0.008$) and increased marketable yield from 111.3 to 128.8 t/ha (16% increase, $P = 0.007$). However, there was no significant difference ($P > 0.05$) in yield between the different water levels (ETc values). Both total and marketable yield tended to be higher with the later preharvest water cutoff times (2 and 3 weeks before harvest) compared to the water cutoff 4 weeks before harvest. Irrigation also increased fruit weight slightly from 46.2 to 48.9 g/fruit (6% increase, $P = 0.02$) but no significant difference ($P > 0.05$) in fruit size occurred between the water levels or cutoff times.

Soluble solids (% Brix) and total solids (%) were both negatively affected by drip irrigation. As the amount of water applied through drip irrigation increased, the percent solids level decreased. The highest watering level (1.2 ETc) reduced both soluble and total solids by approximately 0.6% compared to the unirrigated control. The preharvest water cutoff times did not affect the % solids levels. The ratio between % total solids and % soluble solids (1.13) was not affected by treatment which indicates that both soluble and total solids were affected in a similar amount by irrigation level. The implication is that by measuring only soluble solids (% Brix), one may accurately predict the % total solids level. This relationship needs to be confirmed over several years and with different varieties. Total solids yield (t/ha) may be calculated by multiplying marketable yield by % total solids. A combination of high yield and high % total solids will maximize total solids production (t/ha). In 2003 (wet year), drip irrigation and water level did not significantly affect total solids production when calculated in t/ha, however, there was a trend towards higher solids production with the later preharvest water cutoff times (2 and 3 weeks before harvest) compared to the water cutoff 4 weeks before harvest. This was primarily due to the higher yields with the later water cutoff times.

A second harvest (4 plants per plot) was carried out on Sept. 17-18, nine days after the optimum harvest date to determine if irrigation affected the field holding capacity of the fruit. The amount of cull fruit increased from 1.3 to 9.3% of total yield by delaying harvest for 9 days. However, there were no significant ($P > 0.05$) treatment effects on cull fruit which indicated that the irrigation treatments did not affect the amount of cull fruit compared to the unirrigated treatment.

At harvest, less than 1% of the fruit was green. No adverse effects on fruit set or fruit maturity from irrigation were apparent except that the foliage of irrigated treatments was more sensitive to injury from Ethrel compared to the unirrigated treatment. Fruit firmness was also not adversely affected by the irrigation treatments. A small amount of fruit with blossom end rot was observed in unirrigated plots at the end of July, however, at harvest this fruit was rotted and included with the culls.

Conclusions:

Deficit irrigation (0.5 ETc) during a wet year will allow a grower to reduce water use (increase water use efficiency) without suffering a loss in yield and maintaining a relatively high tomato fruit solids level.