2005 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 third year field trial 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 6.0 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 17, 2005. Fertilizer consisted of 200 kg/ha actual N, 80 kg/ha P_2O_5 and 70 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 50 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 13. 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 15 at 4.0 L/ha when approximately 40-50% of the fruit was turning red.

On Aug. 29-30, 2005, 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. 12-13 to determine the field holding ability of the fruit. The percent green and cull fruit was determined for each plot.

Results:

2005 was a relatively dry year with 16.8 mm of rain in June, 86.2 mm in July and 43.2 mm in August (before harvest on August 30th). Significant rainfall occurred during the last week of July which replenished soil moisture reserves. The volumetric soil water content indicated that the unirrigated treatment was at or below the permanent wilting point during most of the growing season, while available soil moisture for all the irrigated treatments was maintained at higher levels. The amount of water applied through drip irrigation ranged from 0 (unirrigated) to

267.6 mm during the period from June 7 to Aug. 15 and from 0 to 67.6 mm during the fruit ripening period from Aug. 2 to Aug. 15, depending on water level (1.2, 1.0, 0.8 and 0.5 ETc) and pre-harvest water cutoff time (2, 3 and 4 weeks before harvest). In 2005, total and marketable yield and fruit weight increased linearly as the level of irrigation was increased. The highest level of drip irrigation (1.2 Etc) increased total yield from 89.4 to 175.3 t/ha (96% increase) and increased marketable yield from 73.1 to 168.5 t/ha (131% increase). Fruit weight was also increased with increasing amounts of water. In contrast, the amount of green fruit was reduced as drip irrigation water level increased. Pre-harvest water cutoff times did not significantly affect total and marketable yield but water cutoff at 2 weeks before harvest resulted in slightly larger fruit and more green fruit compared to the water cutoff 4 weeks before harvest. Blossom-end rot (BER) was reduced by drip irrigation. As the amount of water applied increased (rainfall + irrigation), the incidence of BER decreased. In 2005, fruit firmness was not affected by irrigation.

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 soluble solids by 0.8% and reduced total solids by 0.9% compared to the unirrigated control. The pre-harvest water cutoff 2 weeks before harvest reduced soluble solids by 0.3% compared to the 4 week before harvest water cutoff. The ratio between % total solids and % soluble solids (1.17) was not significantly affected by treatment which indicated that both soluble and total solids were affected by 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 may need to be confirmed with other 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 2005, the highest level of drip irrigation (1.2 ETc) doubled total solids production (t/ha) compared to the unirrigated control.

A second harvest (4 plants per plot) was carried out on Sept. 12-13, two weeks after the optimum harvest date, to determine if irrigation affected the field holding ability of the fruit. There was no significant difference in the amount of cull fruit between treatments on the optimum harvest date (Aug. 29-30). However, at 14 days after optimum harvest, drip irrigation increased the amount cull fruit from 4.7% to 8.8%, compared to the unirrigated control treatment, thus negatively affecting the field holding ability of the fruit.

Conclusions:

Drip irrigation increased total and marketable yield, and total solids production of tomatoes (t/ha) compared to the unirrigated treatment in each of the 3 years of this experiment (2003 to 2005). In 2005, a relatively dry year, yield and total solids production increased linearly as more water was applied. The highest watering level (1.2 ETc) provided the highest yield and solids production (t/ha). In both 2003 and 2004 (relatively wet years), drip irrigation increased total solids production of tomatoes (t/ha) compared to unirrigated treatments, however, there were no significant differences in yield or total solids production between the different water levels or pre-harvest water cutoff times. In a wet year, deficit irrigation (0.5 ETc) increased water use efficiency while maintaining a high yield and fruit quality.