Nutrition and Irrigation Studies with Processing Tomato (*Lycopersicon esculentum* Mill.)

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Paul R. Johnstone

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Abstract:

Improved fertilizer and irrigation management has become increasingly important for tomatoes (*Lycopersicon esculentum* Mill.) grown for processing. To reduce potential nutrient loss to the environment due to excessive supply, fertilizer recommendations should reflect plant demand determined in an optimal root environment. An aeroponics experiment examined the effect of low and high nutrient supply during vegetative growth, fruit development and fruit ripening. The use of aeroponics in a glasshouse environment allowed control of fertility directly at the root surface. A further experiment applying aeroponics results was established in the field using drip-fertigation. Both studies were conducted at Massey University, Palmerston North. Across experiments, fruit yield was largely determined by vegetative growth in the 6-8 weeks after transplanting; high fruit yields (> 90 Mg ha^{-1}) were associated with improved vegetative growth, and in particular larger leaf area. Mild N deficiency was the principal cause of poor vegetative growth in low nutrient supply treatments. Higher yield resulted from greater fruit number. Reinstating adequate fertility after vegetative growth stopped and fruit number was determined did not increase fruit yield. For maximum fruit yield, plant uptake of N and K was 9.4 and 13.8 g $plant^{-1}$, respectively (equivalent to approximately 210 and 310 kg ha^{-1} at a medium planting density). Greatest nutrient uptake occurred during fruit development. Where practical, fertilizer application should be concentrated during fruit growth. Heavy late-season K fertigation did not increase the soluble solids concentration (SSC) of fruit.

Although offering considerable flexibility in nutrient fertigation, the use of drip irrigation often results in undesirably low SSC. Late-season irrigation management strategies to increase fruit SSC without excessive yield loss were subsequently investigated in drip-irrigated fields. Two experiments were conducted at the University of California, Davis. Irrigation cutoff prior to fruit ripening reduced fruit set, decreased fruit size, and increased the incidence of fruit rots, making this approach uneconomical. Irrigation cutback to 25-50 % of reference evapotranspiration imposed at the onset of fruit ripening (approximately 6 weeks preharvest) was sufficient to improve fruit SSC and maintain Brix yields (Mg Brix solids ha^{-1}) compared to the current grower practice (late cutoff). Irrigation cutbacks imposed during ripening did not cause excessive canopy dieback, nor were fruit culls or rots increased when the crop was harvested at commercial maturity. Fruit colour and pH were not adversely affected by irrigation cutback. Brix monitoring of the earliest ripening fruit (when 30-60 % of the fruit

surface shows a colour other than green) can help classify fields as to the severity of irrigation cutback required to reach desirable fruit SSC at harvest. Combined, these techniques offer considerable flexibility in managing fields for improved fruit SSC levels.

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OVERVIEW:

Environmental stewardship in agriculture has become increasingly important, particularly as the extent to which poor fertilizer and irrigation management can contribute to environmental pollution is revealed. The trend towards improved stewardship has been further fueled by market demand for "eco-friendly" production practices. Large retailers and processors want to certify products as being produced using environmentally-sound techniques; in as much, growers are being encouraged to adopt production practices that can limit damage to the land.

The agriculture sector in general must therefore continually refine crop management techniques and ensure that appropriate technology is incorporated where possible. A challenge in this process has been balancing what is agronomically acceptable and environmentally desirable; practices that are advantageous to the grower are not always beneficial to the environment, and vice-versa. One technology with the potential to address both agronomic and environmental concerns is drip irrigation and fertigation. By applying nutrients and water directly at the root surface, general management efficiencies can be improved, and the potential for runoff and leaching to the greater environment minimized. In recent years drip technology has increased in use in many agricultural sectors, including the processing tomato industry overseas. Although crop nutrition and water management can be improved with drip technology, traditional fertilizer and irrigation practices must first be calibrated to suit this approach. To address this issue, a series of four experiments were conducted to improve the management of nutrients and water for drip-irrigated processing tomato.