CALIFORNIA

Potassium Nutrition of Processing Tomato

By T.K. Hartz

Processing tomato, a major crop in California, has a very high K requirement. Potassium uptake on a high yield crop can exceed 400 lb/A, the majority of which is in the fruit. All current cultivars have a strongly determinate growth habit, concentrating fruit set in a 3 to 4 week period. Peak K uptake, which corresponds to the rapid fruit bulking period, can exceed 10 lb K/A/day. In a 1993-94 survey of approximately 100 processing tomato fields, K was identified as the most frequently limiting nutrient. Beyond direct yield-limiting effects, K availability has been linked to important fruit quality factors such as soluble solids content and color.

> In a 1993-94 survey of approximately 100 processing tomato fields in California, potassium (K) was identified as the most limiting nutrient. Follow-up studies have illustrated the utility of determining the soil K release rate and fixation potential in formulating a K fertilizer management plan. Water-run K is effective in supplementing the K supply during peak crop demand and appears especially beneficial for soils with a high K fixing capacity.

Over the years, numerous K fertilizer trials on processing tomato have been conducted in California with mixed results. There are two factors which may help explain the often contradictory results...the way in which soil K supply is evaluated, and the method of K application. Historically, a standard extraction technique (ammonium acetate or equivalent) has been the most common measure of soil K availability. Extraction procedures, while useful, present a one-dimensional picture of soil K supply. In reality, soil K availability is a dynamic process.

There are three interlocking pools of soil K that impact plant availability: K in soil solution, K on exchange sites, and K trapped in interlayer sites of clay minerals.

Soil Test K Comparisons

A comparison of soil test methods to evaluate K dynamics was conducted on approximately 80 soils representative of central California conditions. The three techniques evaluated were ammonium acetate extraction, K release rate, and K fixation potential. Potassium release rate was measured by a seven day incubation of a 1:10 mixture of soil and 0.01M $CaCl_2$...K in solution was reported as parts per million (ppm) release per day. To assay K fixation, 390 ppm K (as KNO_3 solution) was thoroughly blended with soil to create a slurry, which was air-dried to simulate a typical field wetting/drying cycle. This K-enriched soil sample was subjected to a seven day incubation in $CaCl_2$ as previously described, then extracted in 1N NH_4Cl. Added K not recovered was considered to be fixed.

Ammonium acetate extractable K and K release rate were correlated but individual soils differed dramatically from the general relationship. Since plants obtain most K from soil solution, K release rate

Table 1. *Response of processing tomato to water-run K application.*

Site	Soil parameters: Ammonium acetate extractable K, ppm	K release rate, ppm/day	K fixation, %	Fruit yield, tons/A: Treated	Control
Tracy	100	2.6	60	31.2*	27.4
Sacramento	123	3.1	20	38.3*	36.9
Dixon	205	5.2	0	42.0^{NS}	40.2
UCD	284	8.5	0	53.1^{NS}	51.9

*Significant at p=.05
^{NS} Not significant

may be a more appropriate procedure to evaluate a soil's ability to meet crop uptake at peak demand. The ability to fix added K differed widely among soils. A majority of soils tested fixed little or no K, about 30 percent exhibited a modest level of fixation, while 10 percent had very high fixation capacity. As expected, K fixation was mostly a phenomenon of soils with limited K supply (<150 ppm extractable), but there was considerable variability in fixation potential among low K soils.

Field Trials

Four K fertilizer trials were conducted in 1994. They measured the response of processing tomato to modest K amounts delivered in irrigation water during peak crop demand. The sites were chosen to exhibit a range of soil K availability and fixation values. At three sites, two water-run applications of 50 lb K_2O/A each (as KCl) were applied in consecutive furrow irrigation during the late fruit set/early fruit bulking period. At the other site, three weekly applications of 33 lb K_2O/A were applied through drip irrigation during the same phenological period. At each location, four single row treated plots were paired with untreated plots in randomized block design. Once-over, destructive harvest was done to simulate commercial mechanical harvest.

Response to water-run K varied by site (**Table 1**). Modest but statistically significant yield increases were obtained at Tracy and Sacramento, which had the lowest available K values and the highest fixation values. The response at Tracy was particularly heartening, given the high fixation potential.

Previous research has suggested that, using preplant or sidedress applications, very high application rates are required to achieve significant response in soil with high fixation potential. The delivery of K in water at peak crop demand apparently allowed the crop to compete effectively for applied K.

At a contract price of approximately $50/ton of fruit, even a modest yield response made low rate, water-run K application a profitable practice. Tissue and fruit K levels were still marginal in treated plots at both responding sites, suggesting that higher K application rates may be required for maximum response. There was no treatment difference in fruit color or soluble solids content at any site. BC

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