Advances in Nutritional Physiology, Irrigation Techniques, and New Strains of Apples

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Although leaf analysis is a diagnostic tool for optimizing mineral nutrition in fruit trees, it correlates weakly with fruit quality, thus fruit analysis is more useful in estimating quality and storage disorders. Mineral analyses of leaf and fruit tissues have become more popular in recent years because of the advances in analytical equipment, allowing multi-element analyses at a fraction of the time and cost traditionally associated with mineral analyses. Understanding relationships between postharvest quality and preharvest mineral nutrients and orchard practices makes various management decisions, such as storage strategies, easier. An early identification of fruit likely to be low in bitter pit, soluble solids concentration (SSC) or titratable acidity (TA) after storage also will assist in developing marketing strategies. A perfect identification and prediction of fruit quality is neither possible nor necessary. If the apple industry can predict and categorize fruit likely to be low or high in some postharvest quality attributes before storage, profit can be enhanced. Several prediction models have been developed to study the relationships between seasonal fruit and leaf contents and fruit quality in 'Starkspur Golden Delicious' and other apples. In these predictions, soluble solids concentrations, skin ground color, and TA were strongly predicted as early as June or July. However, an August analysis was most predictive. For TA, a combination of leaf and fruit minerals produced stronger predictions than leaf or fruit minerals alone in each individual year. Soluble solids concentration, skin color, and bitter pit were more accurately predicted by fruit analyses. Fruit N correlated negatively to fruit color and SSC. Fruit size was important in regression equations for firmness, but was not

essential for other variables. In these prediction models, although between-year predictions were not as good as within-year predictions, regression equations could successfully place fruit in high or low categories for most quality characteristics. To solve this problem, a “percentile” or “ranking” procedure was developed to rank fruit and Ca and N status in each region every year and make a storage recommendation. In Chile, use of Mg infiltration was found to be successful and a large portion of the Chilean apple industry is using this technique for bitter pit prediction. Recently, fruit let and fruit analyses are becoming a routine procedure in many laboratories and critical levels for Ca, N, K, and their ratios are determined. Using these thresholds over years, a grower will have a better understanding of his/her orchard mineral status and postharvest storage quality.

Since most of the fruits produced in the Pacific Northwest region of USA are exported, fruit growers prefer to use sprinkler system on set schedule to produce high quality fruit. However, water shortage is becoming a major issue in the region and this shortage mandates the use of more efficient methods of irrigation such as drip. In our long-term experiment, effects of seven different irrigation systems for 'Fuji' and two irrigation systems for 'Gala' on five rootstocks on tree growth, water use, fruit quality and mineral nutrients were studied. All forms of drip system used significantly less water than sprinkler systems. Partial root drying sprinkler system used 50% less water than full sprinkler. Application of partial root drying drip at 50% rate of full drip was not sufficient and trees had to receive 65%-75% of full drip to survive. Trees under full sprinkler used about 70 cm of water while those with drip used less than 20 cm of water during the 2003 growing season. Leaf minerals, particularly N and K were affected by irrigation systems. Trees with buried drip required less water than those with above-ground drip system. Trees under drip system were more precocious and had higher production than those with full sprinkler system in 2004 season. Results from soil moisture sensors did not always correspond well with the tree water requirement as determined by crop water use coefficient and crop ET.

Calculation of water requirement on a tree-use basis provided an excellent guide for drip irrigation.

At the University of Idaho, we have experimented with several strains of Gala and Fuji and results will be presented.