Use of the Remedial Measures Technique to Enhance Fruit Quality in Mango

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ABSTRACT

The Remedial Measures Technique was used assess tree nutrient status adjustments necessary to generally improve the quality of the fruits produced by a Tommy Atkins orchard. The analysis indicated deficiency of both zinc and phosphorus. The effect on fruit quality of a spray of mono potassium phosphate (KH_2PO_4, 1%) and a spray of zinc nitrate (150 ml/100 l), carried out during the flowering period (August-September, 1998), was assessed in the present study. The quality of the fruits produced by the trees was increased. Quality status was assessed on ground skin colouration, taste and physiological disorder incidence on ripening.

INTRODUCTION

In considering tree nutrient status in relation to tree productivity, it is recognised that the concentrations of mineral nutrients relative to one another is of real significance (Oosthuyse, 1997). The significance of nutrient balance has been shown in a number of studies. In a study to ascertain the reasons for internal breakdown in muskmelon, multivariate statistical methods proved to be most efficient in elucidating the factors associated with breakdown occurrence (Sanchez *et al.*, 1992). In grape, stalk necrosis and leaf yellowing, characteristic of magnesium deficiency, was specifically associated with the ratio between the potassium and magnesium concentrations (Nahdi *et al.*, 1993). The cation-anion balance and the calcium-potassium concentration ratio of the leaves of sugarcane, were found to bare a positive correlation with cane and sugar yield (Rakkiyappan *et al.*, 1996). In plum, the potassium-calcium concentration ratio in the fruit was found to greatly influence fruit quality, and more generally, orchard productivity (Kleiber and Hartmann, 1994). In potted peach trees, a strong correlation was found between the leaf nitrogen-phosphorus concentration ratio, and growth, productivity, or fruit size (Stoilov *et al.*, 1990).

Nutrient imbalance resulting from deficiency of certain mineral nutrients is often cited as a reason for the occurrence of fruit physiological disorders. Good examples are bitterpit in apple and soft-nose in mango. The former is associated with calcium deficiency, and the latter with calcium and magnesium deficiency (Cocucci *et al.*, 1990; Kim *et al.*, 1991; Burdon *et al.*, 1991; Burdon *et al.*, 1992).

During the 1998 fruiting season, the Remedial Measures Technique (Oosthuyse, 1998) was applied to a Tommy Atkins orchard in the Tzaneen region to assess the tree nutrient status adjustments required to improve the quality of the fruits produced. The analysis indicated deficiency of both phosphorus and zinc. In the present study, the effect on fruit quality of a spray of mono potassium phosphate (KH_2PO_4 at 1%) and of zinc nitrate (150 ml/100 l), carried out during the flowering period (August-September 1998), was assessed.

MATERIAL AND METHODS

In mid-November, 1997, a leaf sample was taken from each of 30 adjacent trees in a five-year-old Tommy Atkins orchard situated in the Tzaneen region. In taking the leaf samples, four fruit bearing terminal shoots were selected per tree, one within each canopy quadrant. Four leaves were removed per shoot. Leaf nutrient analysis was performed by Central Agricultural Laboratories.

At harvest in mid-January, 1998, the fruits on each of the trees were removed. After washing (1% BiProx soap solution), hydro-heating (50C for 5 mins), dipping in fungicide (Omega dip;180 ml/100 l water) and hand waxing ("Avocado" polyethylene wax), the fruits were placed at 20C (±1C) in a well ventilated laboratory to ripen. These procedures were carried out within 24 hours of harvesting.

The degree of softening of each fruit was monitored daily with a densimeter (Heinrich Bareiss, Oberdischingen, Germany). A fruit's quality status was assessed when it was firm-ripe (densimeter reading of less than 60). The quality evaluation was performed as follows:

Ground skin colour of each fruit was rated. A rating of 0 was given when signs of skin colouration were absent, a rating of 1 if a transition to a lighter green was apparent, a rating of 2 if regions of the skin had become yellow but the total area that was yellow was less than the total area that was green, a rating of 3 if regions of the skin had become yellow and the total area that was yellow exceeded the total area which was green, or a rating of 4 if the skin was completely yellow. The skin area covered with blush was not considered.

To assess internal quality, each fruit was first cut through twice; longitudinally along the flattened margins of the seed.

Taste was rated. A rating of 1 was given if taste was deemed appealing, a rating of 0 if taste was deemed satisfactory but not appealing, or a rating of -1 if taste was deemed unsatisfactory.

Physiological disorder manifestation in each fruit was rated according to severeness. A rating of 0 was given if a

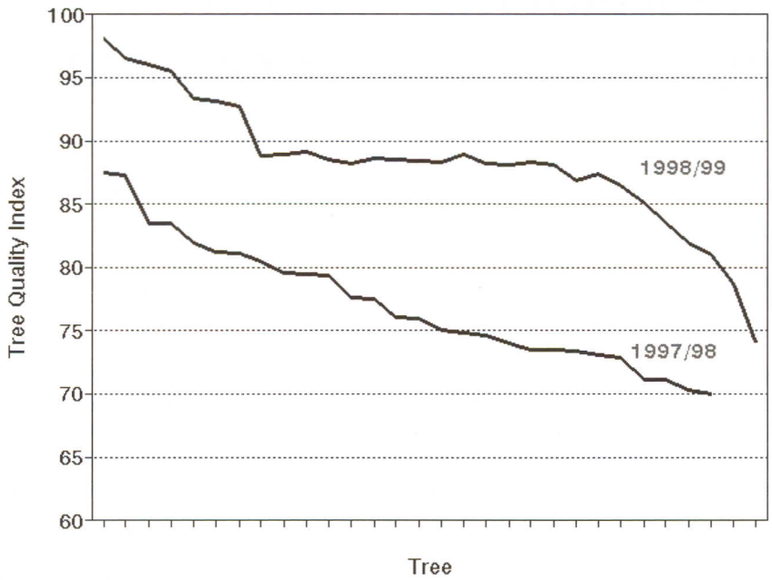

Fig. 1 *Tree quality indices (TQI's) during the 1997/98 and 1998/99 seasons. The nutritional remedial measures employed increased the TQI's by an average of 12.04 (16%).*

fruit was disorder free, a rating of 1 if symptoms were present but were localised to a small portion of the fruit's mesocarp, a rating of 2 if approximately 1/3 of the fruit's mesocarp showed symptoms, a rating of 3 if 2/3 of the fruit's mesocarp was affected, or a rating of 4 if the entire mesocarp was visibly affected.

To cater for the relative effect on price of the various quality attributes considered, weighting coefficients were employed in determining the quality index of a fruit. Weights were assigned to each of the quality attributes assessed; they being of prime significance concerning consumer acceptance and having a strong bearing on tree nutritional status. Ground skin colouration was assigned a weight of 50%, taste a weight of 25%, and physiological disorder severity a weight of 25%. In each fruit, the quality index was calculated as follows:

$$50/100.(Bc.25) + 25/100.[(Tst + 1).50] + 25/100.[abs(Phys - 4).25]$$

where

abs = absolute value,

Bc = ground skin colour rating,

Tst = taste rating, and

Phys = physiological disorder rating.

It is noteworthy that the quality index can vary from 0 to 100, the index value attained by a fruit being commensurate with its quality status. Tree quality indices (TQI's) were determined by averaging the fruit quality indices obtained from the fruits of each of the trees.

The application of the Remedial Measures Technique revealed tree deficiency of zinc and phosphorus. A spray of mono potassium phosphate (KH_2PO_4, 1%) and of zinc nitrate (150 ml/100 l) were carried out during the flowering period (August-September, 1998).

The fruits on each of the trees were harvested for the second time during mid-January, 1999. The procedures followed after harvesting during January, 1998 (as described here) were again followed after harvesting in January, 1999. The TQI's obtained during the 1997/98 season were compared with those obtained during the 1998/99 season.

RESULTS AND CONCLUSION

Fig. 1 shows the variation in TQI found during the 1997/98 and 1998/99 seasons. In each of the trees, the nutrient sprays enhanced the quality of the fruits produced. An average a TQI increase of 12.04 was found (16%).

The results of the present study show that the Remedial Measured Technique can be successfully employed to make nutrient adjustments to improve mango fruit quality. The focus of the current analysis was quality condition in terms of target market preference. The technique can similarly be applied to improve other conditions, e.g., fruit retention, disease tolerance, tree flowering intensity, etc. Furthermore, it is not limited to implementation in mango only. It has wide applicability with regard to crop and the type of adjustment desired. The nutritional adjustments required to increase total soluble solids content in citrus fruits serves as an example.

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