

Remedial Measures Technique: Applications and Results

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ABSTRACT

The Remedial Measures Technique employs multivariate statistical methods to solve problems whose causes are multiple (e.g. the concentrations of mineral nutrients in the leaves of fruit trees). The "effect-variables" and postulated "cause-variables" are quantified, and subjected to analysis. The measure relies on the analyst's ability to interpret the results of multivariate analyses, and on the quality of the data used. The method is not restricted to nutritional problems, it having wide applicability where the causes of occurrences are multiple. The method can also be used to change circumstances to ones which are more desirable. An example is the identification of nutritional practices required to effect an general increase in fruit size or colour. The technique is particularly valuable in endeavouring to determine yield limiting factors of orchards. In the present study, a number of case studies in mango are presented.

INTRODUCTION

The Remedial Measures Technique relies on the use of multivariate statistical procedures. It also relies on the collection of appropriate field data to identify reasons for problems or adjustments required for improvement. Its scope of application is wide. It is particularly useful for optimising crop nutritional practices where the balance between plant nutrient concentrations has a strong influence on economic bio-mass production and quality. "Effect variables" are quantified, and "cause variables" are postulated and quantified. For example, leaf nutrient concentrations in mango may be considered in relation to tree yield, or fruit quality as perceived by a particular target market. Correct and an informed interpretation of the results of the statistical analyses is vital to the success of the method. Both a knowledge of statistics, and the disciplines relating to the subject of examination, for example, plant physiology, plant nutrition, and soil chemistry, are required for the determination of practical recommendations.

In a previous study (Oosthuysen, 1999), the technique was successfully used to enhance the quality of Tommy Atkins mangoes produced by an orchard in the Tzaneen region. "Deficiency imbalances" of P and Zn were identified. Improvement resulted from spray application of mono potassium phosphate and zinc nitrate during the flowering period.

In the current report, the results of additional case studies are presented.

I. Crop Failure of Zill: Bertus Otto, Waterpoort

In November 1998, leaves were sampled from 30 trees distributed evenly in the orchards under study (six adjoining tree blocks). N, P, K, Ca, Mg, S, Fe, Mn, Cu, Zn, B, and Mo were analysed for by Central Agricultural Laboratories. At harvest, the total weight of the fruits on each tree was ascertained. It is noteworthy that the trees were noticeably of a pale-green colour. Hence, each tree was assigned a colour-grade. This was either "yellow" or "pale-green".

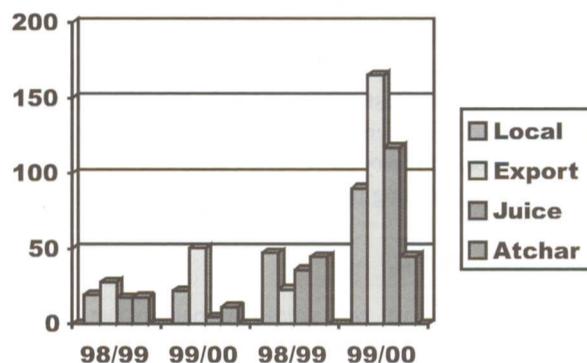


Fig. 1 Bertus Otto: Season yields of Kent (left bar sets) and Zill (right bar sets). Remedial measures were carried out on the Zill blocks.

Green-colour intensity of the leaves, and leaf N concentration were found to be positively correlated (data not shown).

"Excess imbalances" of K and Ca and a "deficiency imbalance" of Zn were found. 55% of the variation in tree yield was accounted for by the leaf-concentration variation of these nutrients. It was noted, however, that the range in leaf-N concentration relative to that of the other nutrients analysed for was small. Data taken from a further 6 trees, where the variation in leaf-N concentration was markedly greater, revealed a deficiency imbalance of N. Here, 82% of the variation in yield was accounted for by the variation in leaf-N concentration.

Remedial recommendations provided: January 1999

N: Apply 500g of N or 1.8 kg of LAN per tree. Apply half to the soil under each tree after harvest, and the remainder in the same way one month from harvest (approx. 15 February). Broadcast on the soil beneath the micro-jet wetting zones.

Zn: Spray the trees when the new post-harvest flush is light-green in appearance with zinc nitrate (5.5% Zn; 150 ml/100 l water). Spray the trees again with zinc nitrate (5.5% Zn; 150 ml/100 l water) just prior to the start of flowering.

Tree nutrient-status maintenance quantities of P, Mg, B, and S were also applied to the soil.

Total yield and the yield allocation to the various marketing options was determined during the 1999/2000 harvest season.

Fig. 1 shows the yield for each of the marketing options during the 1998/99 and 1999/2000 seasons. Yield during the 1999/2000 season, the season after the remedial nutritional measures were implemented, was markedly increased. The yields of the adjacent Kent blocks on the same farm are included to serve as a reference.

II. Progressive Cropping Reduction of a 10 to 20-year-old Sensation Orchard: Murlebrook Farm, Letsitele Valley

Twenty trees, evenly distributed throughout the orchard in question, were marked in August 1998. From each, a large leaf sample was taken. In sampling, 20 fruit bearing terminal shoots were selected per tree, five in each tree quadrant. Four leaves were taken from each shoot. N, P, K, Ca, Mg, S, Fe, Mn, Cu, Zn, B, and Mo were analysed for by Central Agricultural Laboratories. The fruits on each tree were counted and weighed in January 1999. Fruit size distribution, yield and average fruit size for each tree were thus obtained.

The analyses revealed deficiency imbalances in N, Ca, and Mo, and excess imbalances in Mn and S. 85% of the variation in tree yield was accounted for by the variation in leaf concentration of these nutrients.

In February, 1999, after the trees were harvested, the following remedial fertiliser applications were provided:

a. Fertiliser applications to the soil -

N: Apply 1 kg of LAN (28% N) to each tree.

Ca: Apply 2 kg of calcium nitrate to each tree.

b. Nutrient sprays -

Mo: Apply Sodium Molybdate (Micrel MO 396); 5 g per 100 l water. Spray when the inflorescences are fully extended.

Ca: Spray of Calcimax (1.5 l per 100 l) twice during the flowering period; first when the inflorescences are half extended, and again when the inflorescences are fully extended.

During January 1999, the number of fruits on each tree were counted.

Fig. 2 shows the number of fruits on each tree during the 1998/1999 season, and the number of fruits on each tree during the 1999/2000 season. In general, the trees that bore large numbers of fruits during 1998/99, bore few fruits during 1999/2000. It is noteworthy that the temperatures during flowering and the early fruit-set period were particu-

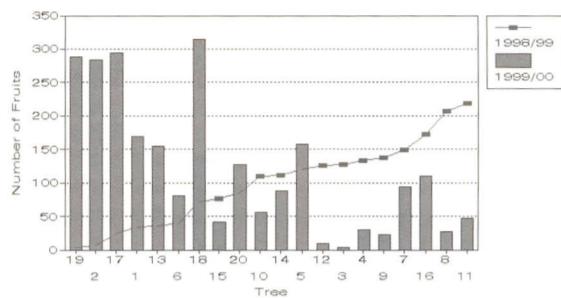


Fig. 2 Murlebrook: Number of fruits on each of the marked trees during the 1998/1999 and 1999/2000 seasons.

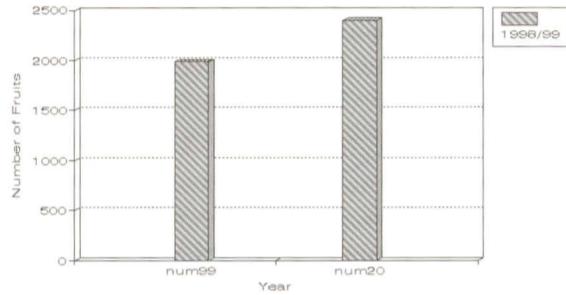


Fig. 3 Murlebrook: Fruit-numbers on the marked trees.

larly cool during the 1999/2000 season (data not shown). Moreover, bearing alternation of Sensation grown in South Africa is a general phenomenon. Fig. 3 shows the general difference in fruit number for the two seasons. Total number of fruits on the 20 trees was increased during the 1999/2000 season.

III. Fruit Disease Reduction in Diseased Kent Trees: Agatha Farm, Letsitele Valley

The influence of nutrient balance on the incidence of disease has been demonstrated (Oosthuysen, 1997). Kent in the Letsitele Valley (wet region) is particularly prone to the postharvest diseases, anthracnose and soft-brown rot.

Twenty adjacent trees in an old Kent orchard were marked during the 1998/99 growing season. From each tree, a large leaf sample was taken. In sampling, 20 fruit bearing terminal shoots were selected per tree, five in each tree quadrant. Four leaves were taken from each shoot. N, P, K, Ca, Mg, S, Fe, Mn, Cu, Zn, B, and Mo were analysed for by Central Agricultural Laboratories.

At harvest in February 1999, 20 to 30 fruits, evenly distributed on the canopy, were removed from each tree, and individually weighed. 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

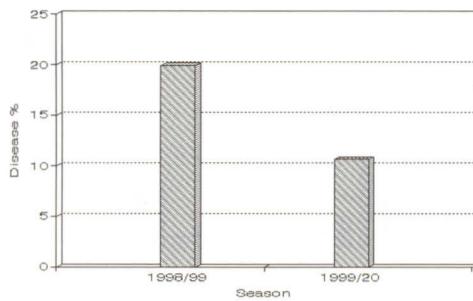


Fig. 4 Agatha Farm: Percentages of fruits showing disease during the 1998/1999 and 1999/2000 seasons. Conditions were wetter during the 1999/2000 season.

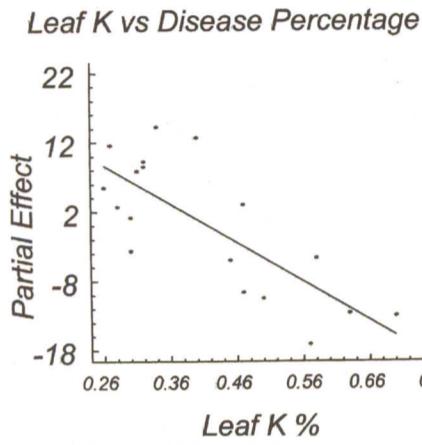


Fig. 5 Agatha Farm: Relationship between disease incidence and leaf K ($P = 0.0020^{**}$).

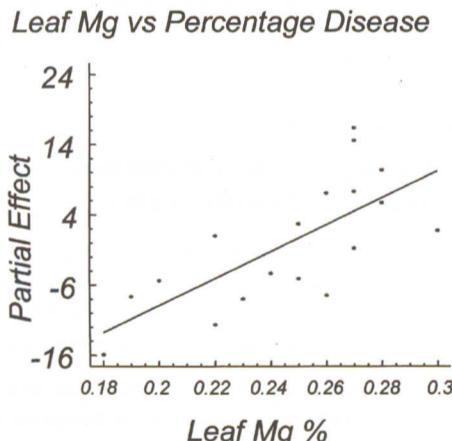


Fig. 6 Agatha Farm: Relationship between disease incidence and leaf Mg ($P = 0.0116^*$).

("Avocado" polyethylene wax), the fruits were stored at 9.5°C ($\pm 0.5^\circ\text{C}$) for 28 days. After cool-storage, the fruits were placed at 20°C ($\pm 1^\circ\text{C}$) in a well ventilated laboratory to ripen. The pre-cool-storage treatments were carried out within 24 hours of harvesting.

The degree of softening of each fruit was monitored daily with a densimeter (Heinrich Bareiss, Oberdischingen,

Leaf Mn vs Percentage Disease

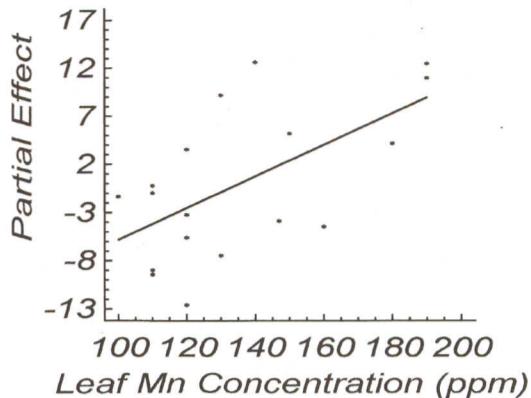


Fig. 7 Agatha Farm: Relationship between disease incidence and leaf Mn ($P = 0.0234^*$).

Leaf B vs Percentage Disease

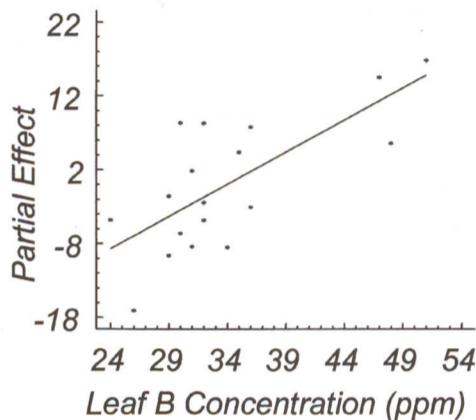


Fig. 8 Agatha Farm: Relationship between disease incidence and leaf B ($P = 0.0059^{**}$).

Germany) during the post-cool-storage period. A fruit was assessed for disease when it was firm-ripe (densimeter reading of less than 60 and greater than 40 from healthy portion). Disease manifestation in each fruit was rated according severeness. A rating of 0 was given if a fruit was disease free, a rating of 1 if symptoms were present but were localised to a small portion of the fruit's surface, a rating of 2 if approximately 1/3 of the fruit's surface showed symptoms, a rating of 3 if 2/3 of the fruit's surface was affected, or a rating of 4 if the entire fruit's surface was visibly diseased.

In considering general disease occurrence, a deficiency imbalance in Mg and an excess imbalance in Fe were found.

After harvest in June, 1999, 500 g of MgSO₄ was applied to the soil under each tree. In November, 1999, leaf samples were again taken for analysis.

At harvest in February 1999, 20 to 30 fruits, evenly distributed on the canopy, were removed from each tree. The post-harvest procedures followed in 1999 were again followed in 2000. It is noteworthy that the 1999/2000 season was wetter than the 1998/1999 season (data not shown).

Fig. 4 shows the overall reduction in disease occurrence resulting from the fertiliser application made. The incidence

of disease was reduced despite the 1999/2000 being wetter than the 1998/1999 season. Figs. 5 to 8 show the component effect correlations between leaf-K, Mg, Mn or B concentration and disease incidence during the 1999/2000 season. These relationships clearly indicate the significance of tree mineral nutrient balance on post-harvest disease incidence.

CONCLUSIONS

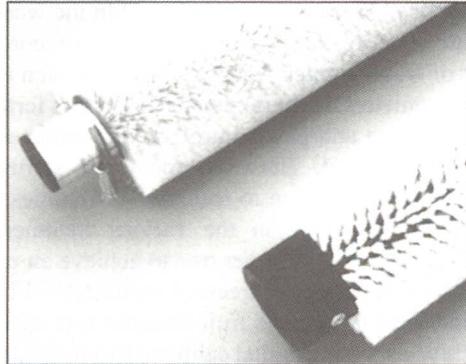
The results show that the Remedial Measures Technique can be used to solve problems having a bearing on nutrition status, or to improve situations where mineral nutrient concentration levels are of significance. The technique is empirical, having little reliance on assumption. Data from an orchard is obtained to specifically determine remedial measures for the orchard. Cause variable need not necessarily be

limited to plant nutrient concentrations. Soil pH, soil nutrient concentrations or tree age can, for example, be included to enhance the information base. It is strongly recommended that growers make use of the technique to optimise their nutritional practices.

LITERATURE CITED

- OOSTHUYSE, S.A. 1997. Relationship between leaf nutrient concentrations and cropping and fruit quality in mango. *S.A. Mango Growers' Assoc. Yearbook* 17:1-15.
- OOSTHUYSE, S.A. 1999. Use of the remedial measures technique to enhance fruit quality in mango. *S.A. Mango Growers' Assoc. Yearbook* 19. (in press)

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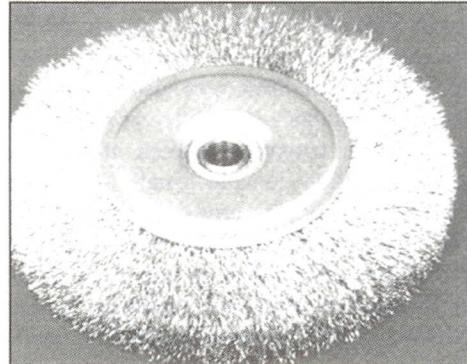


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