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NUTRITION PRACTICES IN AUSTRALIA AND HOW THE AVOMAN SOFTWARE ADDRESSES THE ISSUES

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Background

Avocados in Australia are grown commercially in the tropics of north Queensland, the subtropics of southeast Queensland/northern New South Wales, the dry Mediterranean climate of inland South Australia/Victoria and the cool moist climate of coastal southwest West Australia. The geographical diversity of the industry translates into a wide range of growing conditions. North Queensland for example has volcanic derived leached acid soils and experiences high summer rainfall while South Australia has alkaline marine sediment soils and a dry climate with winter rainfall. Naturally, nutrition needs differ for each set of conditions.

Nutritional practices

The main production area is in the subtropical area of coastal Queensland and New South Wales. Soils here are generally light in texture with an acid pH and are leached and infertile. Virgin soils require the application of most elements. Once established, nitrogen, potassium and boron must be applied regularly as maintenance dressings. Several of the soil types are phosphorus fixing and therefore require regular applications of this element as well.

Traditionally all of the nitrogen, phosphorus and potassium has been applied in three or four applications in autumn following the natural fruit drop of large fruit in mid to late summer. There is a trend now to split annual rates into more frequently applied light doses. This tendency as well as high labor costs and more efficient fertilizer use have led to widespread adoption of fertigation.

The growing environment of the subtropical area is conducive to excessive vegetative growth, for this reason nitrogen rates and timing must be carefully managed to avoid a suppressive effect on fruiting.

In recent times the role of calcium in determining fruit quality is getting more attention. Some growers are experimenting with injecting a suspension of finely ground gypsum into the irrigation in an attempt to improve calcium uptake.

Zinc and boron are common deficiencies and correction requires careful consideration of relevant factors. Boron toxicity from excessive application is not uncommon especially on very light soils. Relatively high rates of boron are required throughout the growing season and must be applied to the ground to get sufficient quantities into the tree. Responses to foliar boron sprays have only been shown where leaf boron levels are below 30 ppm and are only recommended to supplement rather than replace soil-applied boron. Relatively high rates of zinc are often required to overcome deficiencies and soil fixation, application within a narrow band in the drip line has been found to be more effective than broadcasting.

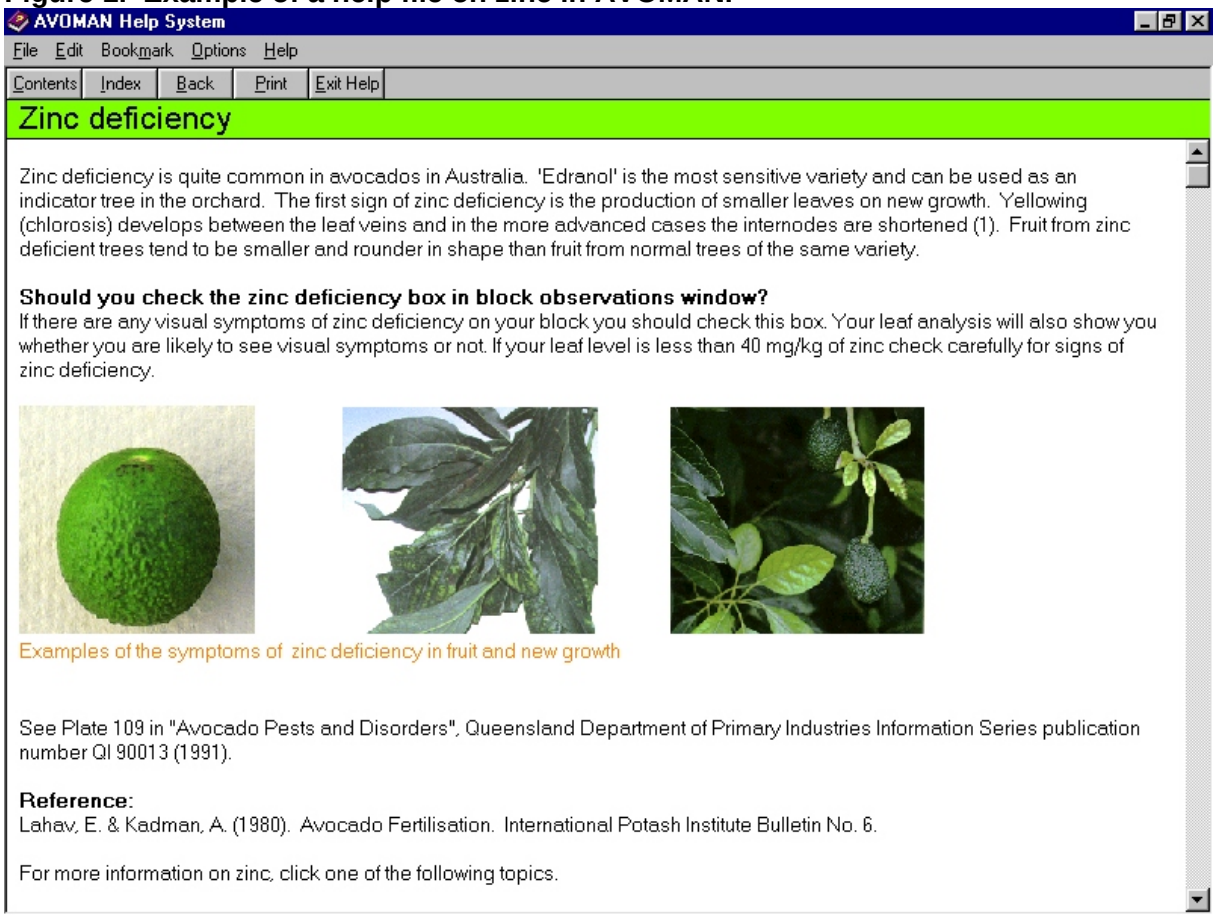
Growers are encouraged to take annual leaf tissue samples for nutrient analysis each year in autumn and a soil sample at least every two or three years primarily to test pH and calcium and magnesium levels. There is increasing interest in taking a second leaf test during the season, this will be done about midsummer once the spring leaf flush has matured. Optimum nutrient levels need to be established for this time of the year.

Why the AVOMAN project was initiated

In 1992, the Australian avocado industry listed problems of low orchard productivity and irregular fruit quality among its research and development priorities. Despite the fact that the Australian avocado industry had been well serviced by research programs, only limited adoption of subsequent technology had been observed.

One of the aims of the AVOMAN orchard management software was to improve orchard productivity and fruit quality by providing appropriate plant nutrition rates and timing for any avocado-growing environment in the country. AVOMAN brings to the growers' fingertips a means to derive highly customized recommendations for each block of trees. The recommendations are supplemented with over 500 pages of information in the help files (see Fig. 1). AVOMAN also provides a comprehensive recording and reporting facility that is valuable for enterprise management and the increasing need for food safety and quality assurance systems.

Figure 1. Example of a help file on zinc in AVOMAN.



How the AVOMAN nutrition recommendations were developed

In order to develop the recommendations, the factors that influence each element's effective supply to the plant were established and reviewed. The software was developed to account for each of the factors and to adjust the rate according to the magnitude and effect of each. For example, the issues considered by the software to derive a zinc recommendation illustrated in Figure 1 are:

- leaf zinc level
- soil zinc level
- soil pH

- soil texture
- soil phosphorus level
- soil organic matter level

The most up-to-date research was sought and incorporated into the recommendations. The process required collaboration from soil chemists, agricultural chemists, horticulturists, consultants and growers. Three software prototypes were issued during the life of the six-year development project and each issue was tested by between 100 and 250 growers. The recommendations were also subject to field-testing. It is the intention of the development team to update the software with refinements to the nutrition recommendations from time to time.

How the grower uses AVOMAN to derive nutrition recommendations

To receive recommendations the grower must first provide certain basic information about each management unit (block) of trees in their orchard. This is easily entered by choosing appropriate options from drop down lists for such properties as soil texture, variety, rootstock and root rot status. Data such as tree size and leaf and soil analysis results are also entered. The AVOMAN program uses the details of each block in combination with expert knowledge to derive highly customized recommendations (right hand side of Fig. 2).

It is up to the grower which fertilizer and method (such as broadcast or fertigation) to choose to satisfy a recommendation (left hand side of Fig. 2). The grower can also alter the interval between nutrient applications. The software includes a database of commonly used fertilizers that it will refer to; growers can add products to the database at any time and keep details such as prices up to date. In the case of NPK recommendations the user can opt to get the software to find the most appropriate NPK fertilizer from the database to satisfy the ratio of NPK recommended. The software will keep track of amounts and costs of fertilizers used and will derive comprehensive reports.

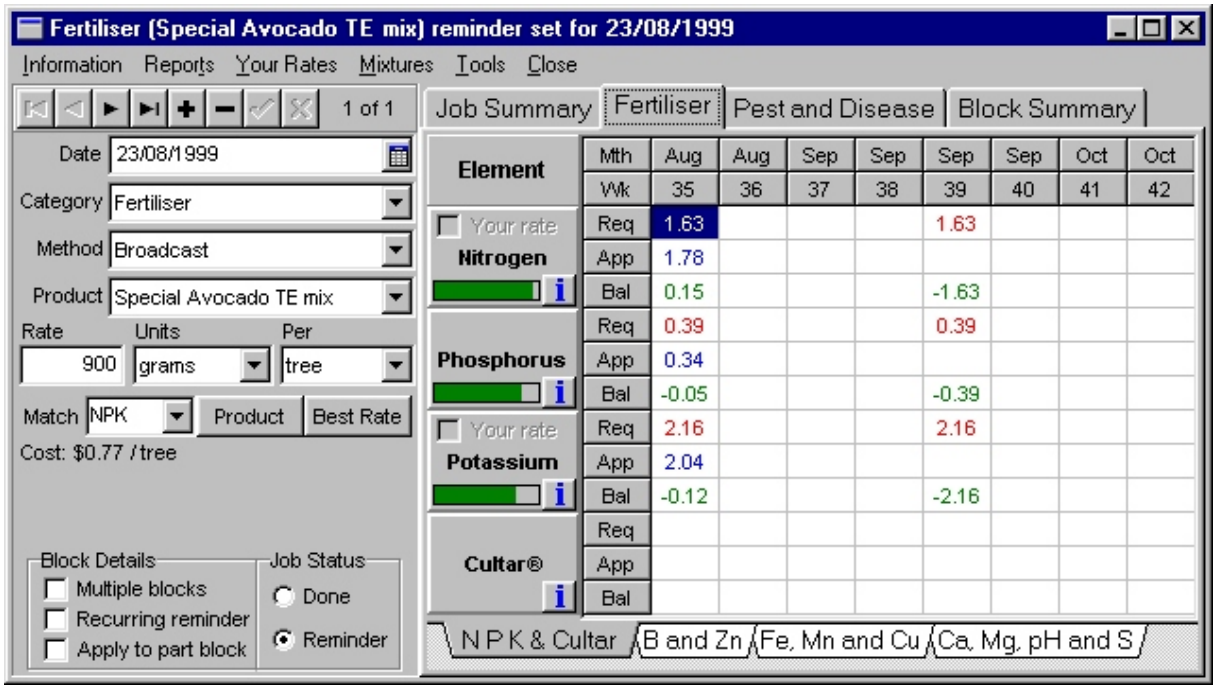


Figure 2. Example of a nutrient recommendation screen showing a fertilizer and rate that AVOMAN has chosen to best match the nitrogen, phosphorus and potassium requirements for week 35.

The timing for the recommendations is determined by phenological events rather than by calendar. A phenological cycle is chosen by the user to represent the block and this is used by the software to determine the timing of the recommendations. An example is shown in Figure 3. It can be adjusted at any time to reflect changes in the occurrence of a phenological event; each point on the graph can be moved earlier or later with the computer mouse. Cycles are retained for comparison between seasons.

Summary

Within the last few years a much greater awareness of the importance of boron has developed and appropriate rates are now being used with the help of the AVOMAN software. Fertigation is becoming widely used and with it lighter doses of fertilizers are applied more frequently. Calcium is starting to receive research interest with respect to its role in fruit quality and how to raise its level in the fruit. More frequent monitoring of leaf nutrient levels is being pursued.

The first commercial version of the AVOMAN software was released in September 1998 and one-year later growers producing more than half the national crop had purchased a copy. Several growers have already reported improvements in tree health and plant nutrient levels.

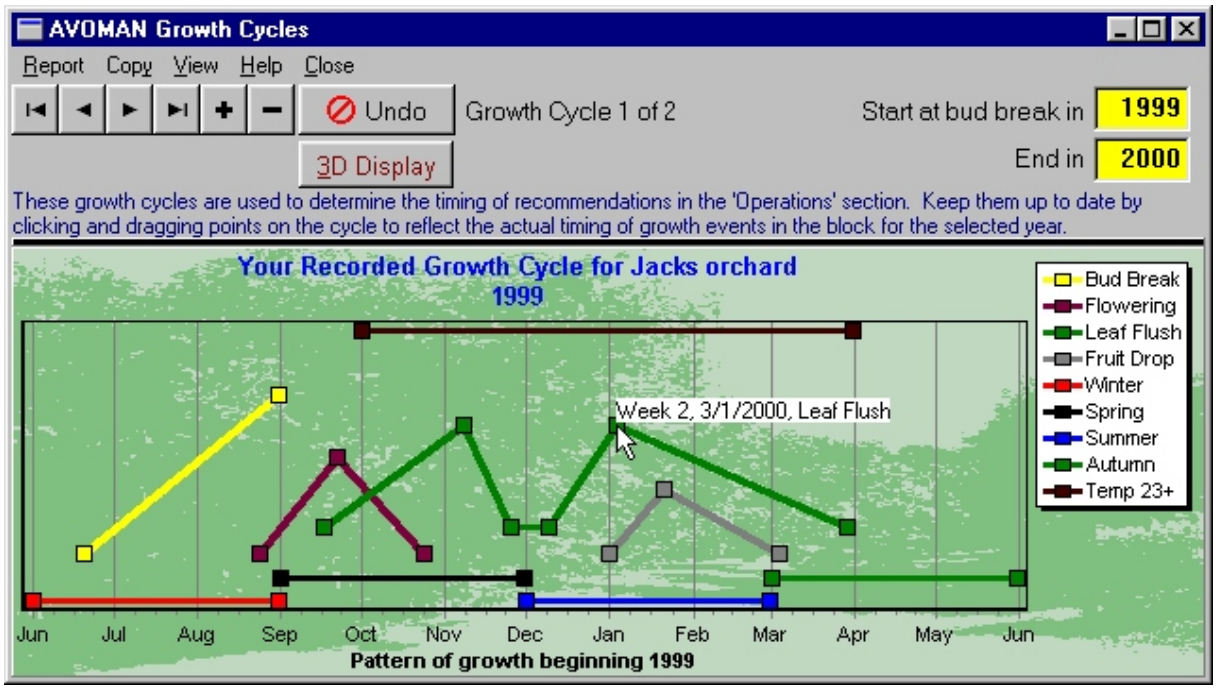


Figure 3. Example of a phenological cycle in AVOMAN, the point highlighted by the cursor indicates the peak of the second leaf flush. The date (and thus position) of each point can be easily updated by the user.