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AVOMAN: A PROJECT TO IMPROVE THE MANAGEMENT OF AVOCADO PRODUCTIVITY AND QUALITY IN AUSTRALIA

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Abstract

Poor adoption of available avocado research information indicated a need for alternative methodologies for the transfer of technology to the Australian industry. Specifically, low orchard productivity and poor fruit quality were identified as priority areas for research and development by the Australian avocado industry.

The establishment of local grower discussion groups and the development of information and decision aid products are the two main approaches being used to foster improved production and fruit quality amongst Australian avocado growers. The discussion groups are known as Regional Productivity Groups and have been set up in all major growing areas of Australia. The information and decision aid products include three software and two hard copy packages. The software packages are AVOMAN, a farm management system incorporating record keeping and decision support tools, AVOINFO, a reference database for avocado, and the AVOVARIETY guide which provides detailed information on the main commercial varieties grown in Australia. The two hard copy products are a wall chart recording system and a printed version of the AVOVARIETY guide.

Seasonal growth information for commercial varieties is being collected by cooperating growers throughout Australia and is being used to generate location and variety specific growth cycle models. The AVOMAN software utilises this phenological information together with built-in knowledge, stored farm records and up-to-the-minute information on orchard status, to customise application rates and timing for management activities.

Additional index words: database, decision aid, phenology, software, reference database, variety Introduction

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 has been well serviced by research programmes,

only limited adoption of subsequent technology by industry has been observed in recent years. The AVOMAN project was created to provide a framework with which to standardise and package existing and future production technology as well as to provide a vehicle to transfer these to the Australian avocado industry. The full title of the project is "Improved Management of Avocado Productivity and Quality" and it is a national initiative designed to achieve these objectives within the Australian avocado industry.

Research and extension officers, systems analysts / computer programmers, agribusiness professionals, consultants and commercial avocado producers are all contributing to the project which has funding for 6 years. The AVOMAN project team comprises a multi-disciplinary group of professionals from around Australia. The majority of team members are extension officers and one of their roles is to ensure that the AVOMAN products accommodate the wide range of growing conditions in Australia. Researchers have the responsibility of providing and checking the accuracy of information to be built into the software as well as assisting with the development of decision frameworks. Software technology is advancing at a rapid pace and the programmers not only have to write the software but also ensure that developed products continue to meet industry standards. Agribusiness professionals and members of the avocado industry also play an important feedback role in the AVOMAN project.

The inclusion of commercial growers in the project has been formalised through the creation of regional productivity groups (RPG's). These have been formed in each of the major production areas of the country and local avocado growers are encouraged to belong. Apart from providing forums where local growers can exchange ideas and information, the RPG's provide a focus for comments, ideas and priorities for the project's direction. They are also ideal test groups for the three AVOMAN software prototypes which will be produced in the lead up to release of the commercial version of the software.

Substantial effort has also been made to keep members of the avocado industry informed of the project's progress. To achieve this, regular articles are written for both local and industry publications.

The Regional Productivity Groups

There are currently 14 RPG's around Australia from the Atherton Tablelands in North Queensland to Pemberton in the south west corner of West Australia. Each RPG consists of a number of interested local growers, one of whom is elected as coordinator. Each group is serviced by one of the extension officers from the AVOMAN team and this person liaises with the RPG coordinator to organise activities. RPG's will often form around existing associations or grower groups. Activities can be varied and include the launch and demonstration of new prototypes, software training sessions, farm walks, workshops on particular growing issues, presentations by guest speakers, training in the collection of growth cycle data and general discussions on selected topics. Groups meet between two to ten times per year. They are particularly valuable for testing ideas and getting feedback.

Members of RPG's are also collecting vital data for the construction of phenological cycles relevant to specific varieties growing in different regions. These data are subsequently incorporated into the software. Involvement of growers throughout the project has a number of far reaching benefits which include the following:

- Growers are fully aware of the aims of the project well before the final products are released
- The products are tailored to growers' needs and the way they are likely to use them
- Growers will have received three years of training in the use of the products by the end of the project

As a result of their participation over the life of the project it is hoped in addition to the above mentioned benefits that growers will have a sense of ownership and will therefore adopt the products more readily.

The AVOMAN software

The AVOMAN software is designed primarily to be used on farm by commercial avocado producers. The purpose of the software is threefold:

- Simplify and standardise the regular recording of descriptive and quantitative information relating to the management of avocado farms
- Utilise this information in accordance with predefined decision frameworks to make better decisions relating to crop production
- Provide a reporting facility which can be used for the purposes of quality and performance benchmarking

The program

The AVOMAN software is designed to operate on personal computers using the Microsoft® Windows™ operating system.

The farm records module

The farm recording software module was created to facilitate the storage of information relating to the management of avocado orchards. The user interface of this software is presented in three parts, namely the *planner*, *block details* and *farm details*. The planner enables users to comprehensively record details of orchard operations such as dates, costs and rates of nutrient, chemical and labour inputs. The block details section allows growers to record vital descriptive information about each block of trees such as variety, tree size, and number of trees, leaf analysis results, yield and quality. The farm details section is used to record weather, water quality and consignment information which relates to the whole farm. A relational database management system is used to efficiently store and access information. Regular updating of information in the block details enables the grower to develop an historical management profile of the farm (Figure 1). As this information is recorded electronically it can be used in many ways elsewhere in the program. For example it can be accessed when required by the

recommendations module to assist with the calculation of suitable chemical application rates. Alternatively it can be used to produce a variety of reports including those that are required by quality assurance systems and in benchmarking exercises.

The screenshot shows a software window titled "Block Details for Hass block". It contains a table with columns for Date, Variety, Trees, Treedist, Rowdist, Diam, Wide, Long, High, Iing, Spray, and Iing Source. Below the table is a text box containing the note "Trees pruned mechanically.".

Date	Variety	Trees	Treedist	Rowdist	Diam	Wide	Long	High	Iing	Spray	Iing Source
12/01/1994	Hass	200	8	10	3	0	0	3	60	600	Dam
11/07/1994	Hass	200	8	10	4	0	0	3.5	60	600	River
08/05/1995	Hass	200	8	10	4.5	0	0	4	60	800	Bore#1
15/06/1996	Hass	195	8	10	5	0	0	4	60	1000	Bore#1
16/12/1996	Hass	195	8	10	5.5	0	0	4.5	90	1500	Dam
20/04/1997	Hass	180	8	10	6	0	0	5	90	1200	Bore#1
11/08/1998	Hass	180	8	10	7	0	0	5.5	90	2000	River
17/07/2001	Hass	180	8	10	0	8	8	5.5	90	3500	Dam

Trees pruned mechanically.

Figure 1 The AVOMAN block measurements screen

The recommendations module

The recommendations module provides farm management recommendations that are customised for each block of trees defined. Detailed timing and rate information is calculated by combining descriptive farm information with intrinsic physiological and phenological knowledge. Where adequate quantitative farm records exist, these can also be incorporated into the decision process to seasonally customize the recommendation. AVOMAN will provide conservative recommendations in the absence of some key information; however the grower is reminded by means of a suitability rating that more accurate results will be achieved if all the appropriate data is entered.

The AVOMAN program contains growth cycles for different varieties and locations which are used by the recommendations module to determine appropriate timing of applications and other management activities. RPG members have collected much of the data used to develop these growth cycles. The inclusion of a chemicals and fertilizers database also enables cost information to be incorporated into recommendations.

Each recommendation that is developed undergoes several stages of validation amongst the project team, agribusiness professionals and collaborating growers. Software prototypes incorporating these recommendations are released to interested members of the Australian industry annually for wider scale evaluation and feedback. For example, during the testing of the 1996 prototype, growers noted that recording of

recommendation details was tedious since the recommendations and planner modules were not sufficiently integrated. Subsequently a system has been developed that allows users to commit all the details of a recommendation directly to the planner records using a single mouse click.

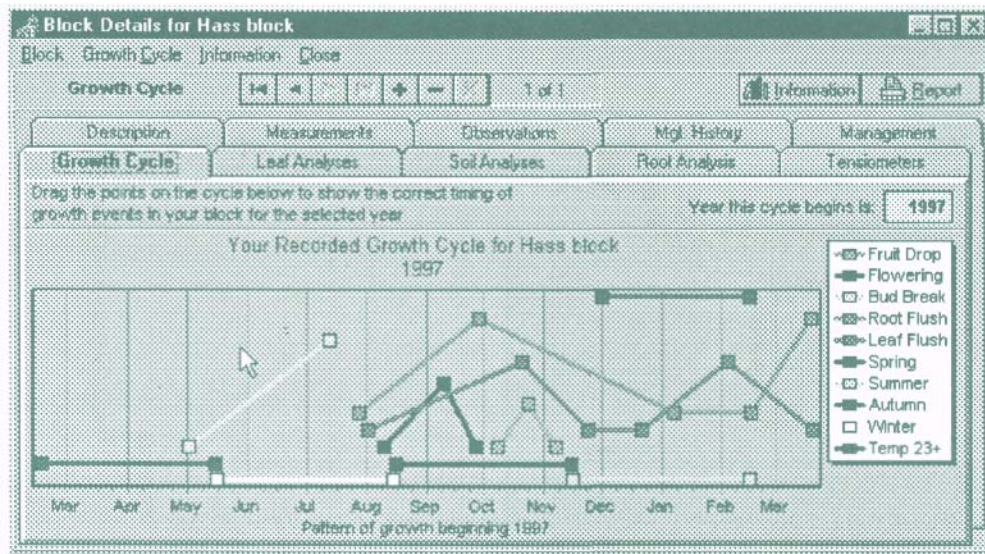


Figure 2 An AVOMAN dynamic growth cycle

This development called for a change in the way timing of recommendations is delivered because an exact application date is now required. In the previous prototype, the timing of a recommendation was presented as descriptive text (eg "at flowering") and now an exact calendar date is given. The timing of each recommendation is linked to one or more specific growth cycle events. When a recommendation is sought the program identifies the date of the event from the growth cycle and establishes the correct timing. It is therefore critical that the growth cycle being used is appropriate. Clearly, it would be impossible for AVOMAN to provide predefined growth cycles to cover every variety, location and season. The solution has been to make the growth cycles adjustable so that the user can modify them where necessary to accurately represent the phenology for that season (Figure 2). The growth cycles have therefore become dynamic and can be saved each season for future reference.

Recommendations are presented in a balance sheet (the right hand side of Figure 3) which displays tree requirements on a weekly basis. While the end result of a recommendation is a set of values representing weekly tree requirements, a number of tools are available to users to enable them to match these requirements with suitable products (the left hand side of Figure 3). By selecting a product, the program can recommend a rate at which that product should be applied to meet tree requirements. One of the advantages of a balance sheet is that recommendations can now account for the use of products with multiple benefits such as nitrogen, phosphorus and potassium fertiliser blends and broad spectrum pesticides. The balance sheet can for example show the complete nitrogen, phosphorus and potassium requirement of a block for each week of the year and is able to recommend the most suitable product to match the

combined elemental requirements, according to a user defined bias towards one or more of the elements.

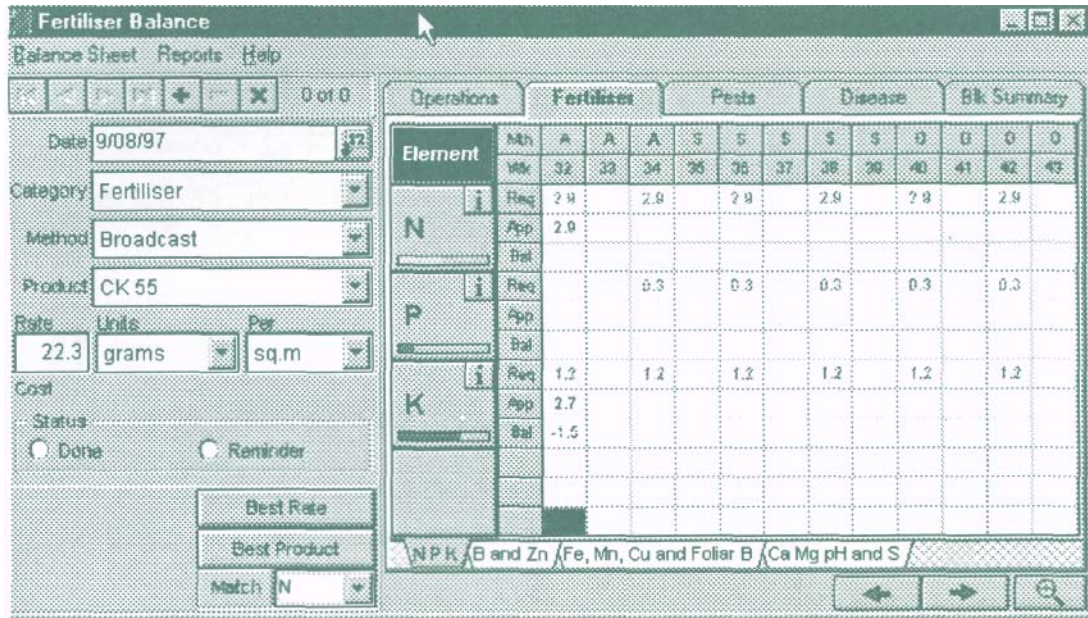


Figure 3 the AVOMAN recommendation screen

The system allows great flexibility because details of each recommendation, such as product, rate, method and date, can be set or altered by the user. Any variation from the recommended requirement will be displayed as a surplus or deficit for the week, indicating to the user how much their changes differ from the recommendation calculated by AVOMAN. Once the user is satisfied with the details of the recommendation it can be recorded as a reminder. It is possible to generate lists of reminders for any specified date range for use as work schedules. Once a task has been completed, the user can change the status of a job from "reminder" to "done" with one mouse click and, at the same time, update any of the associated job details to reflect any departure from the original recommendation.

The ability to view the date as well as material, rate and method of each recommendation in the balance sheet removes the need to have a detailed planner, as was provided in the 1996 AVOMAN prototype. The planner in the 1997 prototype will therefore become a visual summary of reminders and completed tasks.

AVOMAN reports

One of the new developments in the latest AVOMAN prototype is the facility to generate a number of reports and graphs. One of the benefits of keeping records in a computer system is that it provides great potential for generating a wide range of reports. Apart from providing handy summaries of important data for growers, reports can also be used as supporting documentation in quality assurance systems and in benchmarking exercises.

The AVOMAN team has concentrated on developing the reports most commonly identified by growers in the last survey. These include a spray diary, fertiliser application summary and soil and leaf analysis summaries and comparisons. The reports generated from AVOMAN provide a standard format on which comparisons may be made both on farm and within RPG's.

Other reports available include a jobs schedule, historical reports on block measurements and observations, and weather summaries. A jobs schedule lists jobs to be done over a selected date range and is generated from the recommendation and planner modules. Leaf and soil analyses reports may also be printed and these may also incorporate graphs displaying the optimal element ranges. The dynamic growth cycle within AVOMAN may also be printed and compared from season to season and between blocks and orchards.

Discussion

Initial development work concentrated on defining procedures for organising specialist research and development information into decision frameworks which could be built into credible recommendations in the software. More recently work has concentrated on providing further recommendations and reports and making the program more integrated and user-friendly.

The first wide scale release of the AVOMAN prototype software to industry occurred in May 1995. Over 120 growers throughout Australia evaluated the first software prototype and were called on to provide feedback. The second prototype was released in August 1996 and the number of growers testing it rose to 184. The response rate to the evaluation questionnaire reached over 60%. Hands-on training of collaborating growers is undertaken for each prototype released.

In addition to on-going development, refinements and modifications are being made to the existing AVOMAN software based on industry feedback. Great effort is made to ensure that the regular process of recording farm information is easy and intuitive. Similarly, despite their underlying complexity, farm recommendations must be simple to access and easy to understand. Comprehensive on-line help will be available throughout the program to further facilitate ease of use.

An undertaking such as this project requires a multi-disciplinary team approach as the level of detail which must be built into each recommendation necessitates input from a variety of specialists. The size and diversity of the Australian climate and environment also presents challenges to the development team as farm recommendations must accommodate the majority of conditions under which avocados are grown.

The first commercial version of the AVOMAN software is scheduled for release in 1998.

AVOINFO software

A large amount of literature exists on avocados but much of this information is scattered and remains difficult and time consuming to locate. Literature searches tend to be tedious tasks for scientists and much useful information is unknown or beyond the reach of the average producer. A new electronic information system called AVOINFO has been developed to provide a comprehensive collection of references for avocado

literature worldwide.

AVOINFO is a reference database that is designed to provide commercial avocado producers, researchers, extension staff and consultants with easy and intuitive access to the bibliographic details and abstracts of a wide range of published avocado literature and information. It is also suitable for use by the wider community through libraries and educational institutions. Customised search facilities which include the use of a standard key word set aid rapid location of specific references (Figure 4). No restrictions are imposed on the basis of language or publication date but abstracts of articles published in foreign languages are translated into English before inclusion. In addition to technical papers from international scientific journals, articles are also being included from conference proceedings, year books and other bulletins. All references included in AVOINFO appear with the permission of respective copyright holders.

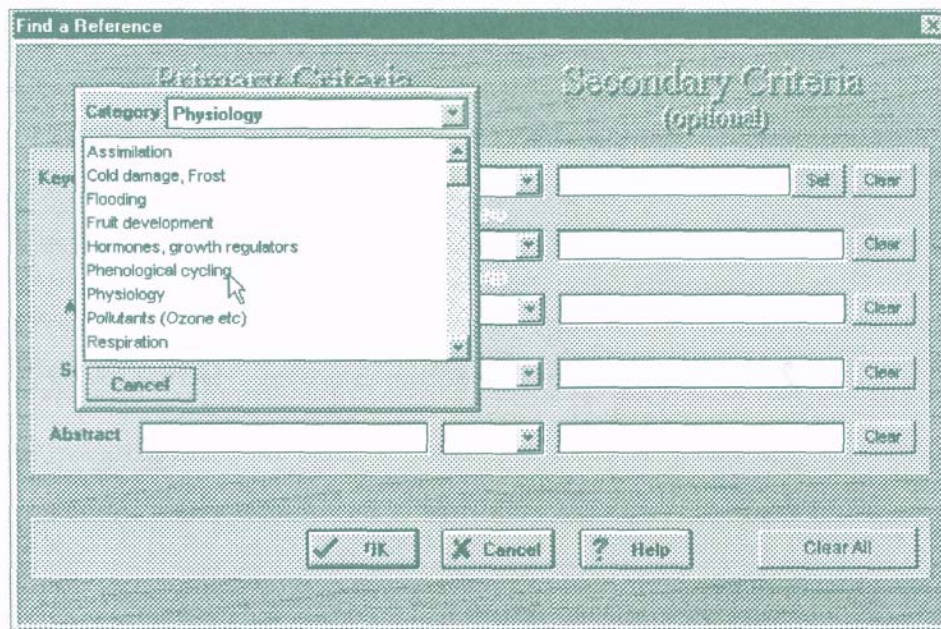


Figure 4 The AVOINFO search screen showing the key words selection box

The program

There are over four thousand references in AVOINFO, each of which includes bibliographic details (Figure 5) and, where copyright has been granted, abstracts. In some cases complete articles are reproduced. The details recorded are:

- Title
- Key words
- Abstract (where available and copyright approved)
- Author(s)
- Address

- Source (journal)
- Year of publication
- Language of publication
- Reference number

The program allows the user to search for references using one or more of these fields as selection criteria. For example a search can be based on one or more key words, title, author(s), journal, and abstract contents. The power and flexibility of the search mechanism is further enhanced by the inclusion of AND/OR join clauses linking up to two search strings per criterion. A facility to print full bibliographic records including the abstract for each reference is also provided.

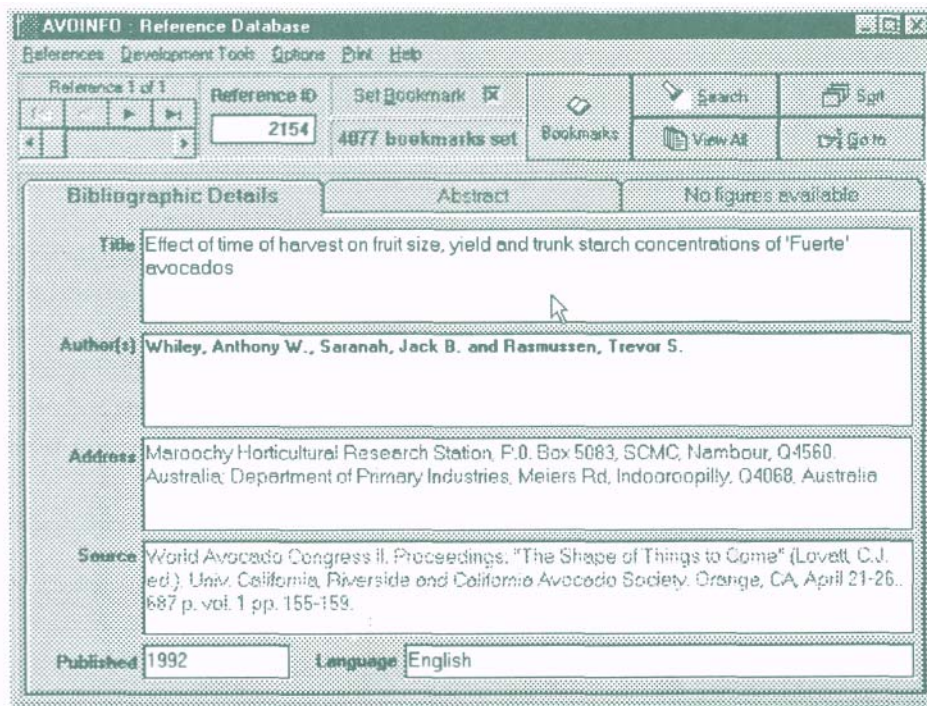


Figure 5 the AVOINFO bibliographic screen

Discussion

The global pool of avocado knowledge is constantly growing and in order for AVOINFO to remain useful it must be updated regularly. The frequency with which this is done will depend on how quickly new avocado literature and information becomes available. One advantage of using a computerized system is that it is relatively easy and inexpensive to maintain and update.

Apart from regular updating, accessibility and ease of use are also essential to the effectiveness of the package. AVOINFO is therefore designed to run on IBM compatible

personal computers using the popular Microsoft® Windows™ operating system.

Due to the size of the database AVOINFO will be distributed on compact disc (CD-ROM). A fully functional trial version containing a limited number of references was released in August this year. AVOINFO will be a potentially valuable resource for people working in or affiliated with the avocado industry.

AVOVARIETY GUIDE software and hardcopy

The AVOVARIETY GUIDE is being developed to provide growers with comprehensive information on each of the commercially significant varieties grown in Australia. The information includes an historical profile and a detailed varietal description which includes growth habit, fruit colour, typical size range, and seed and leaf shape. Descriptions are supported by full colour illustrations. Recommendations are given as to which varieties are most suited to the different producing regions around Australia and the typical times that fruit mature in each region. This information is linked to historical market prices so that an indication of expected returns can be generated. Phenological growth cycles for the varieties in each region are also provided for use as a management aid.

Wall chart recording system

The wall chart recording system has been developed for growers to use either as a forerunner to, or in conjunction with the AVOMAN software recording system. Its primary objectives are to offer growers a quick, easy and yet comprehensive system for keeping orchard records. Growers without access to computers can use the wall chart as their primary recording system. Others may have their farm workers make daily entries, from which data is later entered into the AVOMAN software. The advantages it offers are that it:

- Is very quick and simple to use
- Standardises record keeping
- Provides easy access to historical records

The wall chart recording system works on the premise that in most avocado orchards a small number of tasks are repeated several times during the season. These tasks often involve multiple inputs but the task itself does not usually vary. For example, a spray containing the same rates of copper hydroxide, endosulfan, and wetting agent is applied many times during the season on a typical Australian east coast orchard. The wall chart system facilitates the recording of tasks by allowing the grower to assign a one or two character code to define each standard job. This code can then be simply entered in the appropriate date cell on the chart each time the job is completed.

The wall chart recording system consists of one large backing sheet where job codes and details are listed, plus a number of slightly smaller twelve month calendar sheets that hang over it. The grower uses one calendar sheet per year for each orchard recording unit (often a block) and adds new ones over the top for each new season.

Consequently, records from previous years are easily accessible. In addition to recording the code for each task done, the calendar sheet also has designated spaces for listing vital descriptive information about the block such as block name, variety and tree size. It also provides space for recording growth cycle events. Compared to a diary system, the wall chart offers an excellent visual summary of jobs completed over the last twelve months, keeps block records separate, and can be enhanced by the use of coloured pens and stickers to record reminders, crop cycle events, completed tasks, weather and yield.

Summary

The AVOMAN project is now in its sixth and final year and commercial AVOMAN products will be released in mid 1998. Three prototypes of the AVOMAN software will have been released to industry in this time and 14 Regional Productivity Groups will have participated in the project's development. The involvement of growers via the RPG's has been a vital part of the project and has not only achieved a high degree of awareness but has also been an essential part of its development. It is the intention of the AVOMAN team to follow the development project with one which will concentrate on the adoption and correct use of the products in order to maximise the improvement in management, and hence quality, of Australian avocados.

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