Talking Avocados

The Australian Newsline

Vol 4 Number 2 May 1993

Avocados Being Infested With Queensland Fruit Fly

See Fruit Fly Article on Page 8

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AUSTRALIAN AVOCADO GROWERS' FEDERATION

PRESIDENT
Robert Mosse 066 283584

VICE-PRESIDENT
Ross Richards. 085 853178

EXECUTIVE OFFICER & SECRETARY/TREASURER
Bryson Dyke, P.O. Box 19 07 2132476
Brisbane Markets 4106 Fax 07 2132480

FEDERATION DIRECTORS

QUEENSLAND
Rod Dalton, Grantham 074 661316
Charles Dimes, Bundaberg 071 561207
John Bolton, Maleny 074 942219
David Rankine, Mt Tamborine 075 451046
Don Lavers, Walkamin 070 933733

NEW SOUTH WALES
Warren Meredith, Coffs Harbour 066 541658
Robert Mosse, Alstonville 066 283584
Keith Johnson, Alstonville 066 280106
George Gordon, Burringbar 066 771416

VICTORIA (Sunraysia)
Marion Matthews, Nangiloc 050 291576

SOUTH AUSTRALIA
Ross Richards, Renmark 085 853178

WESTERN AUSTRALIA
Dave Duncan, Wanneroo 09 4075383

STATE ORGANISATIONS

ATHERTON TABLELAND AVOCADO GROWERS' ASSOCIATION
President Jim Kochi 070 542188
Secretary Don Lavers, P.O. Box 205 070 933773
Walkamin QLD 4872 Fax 070 933954

BUNDABERG SUBTROPICAL FRUIT GROWERS' ASSOCIATION
President Derek Foley 071 513377
Secretary Garry Fullelove, Sulley Rd 071 556244
Bundaberg QLD 4670 Fax 071 556129

SUNSHINE COAST AVOCADO GROWERS' ASSOCIATION
President Ron Lawrence 074 468435
Secretary Ralph Hoskin, Winston Road 074 450428
Palmwoods QLD 4555

WEST MORTON AVOCADO GROWERS' GROUP
Convenor Rod Dalton, Sandy Creek Road 074 661316
Grantham QLD 4347 Fax 074 661497

TAMBORINE MOUNTAIN AVOCADO GROWERS' FEDERATION
President Geof Eldridge 075 451446
Secretary John Williams, P.O. Box 128 075 452762
North Tamborine QLD 4272 Fax 075 452762

NSW AVOCADO ASSOCIATION INC.
President Warren Meredith 066 541658
Secretary Orf Bartrop, 61 Clives Circuit 075 986434
Currumbin QLD 4223 Fax 075 986434

SUNRAYSIA AVOCADO GROWERS' ASSOCIATION INC.
President Marion Matthews 050 291576
Secretary Robin Lloyd, P.O. Box 1620 050 240224
Mildura VIC 3502

SOUTH AUSTRALIA AVOCADO GROWERS' ASSOCIATION
President Ross Richards 085 853178
Secretary Colin Fechner, Box 346 085 412819
Ramco SA 5322

AVOCADO GROWERS' ASSOCIATION OF WESTERN AUSTRALIA
President John Galatis 09 5252066
Secretary Alan Blight, 85 Carabooda Rd. 09 4075100
Carabooda WA 6033 Fax 09 4075070

Calendar of Events

May

17 **Brunswick Branch of the NSW Avocado Association** - meeting Mullumbimby Ex Servicemen's Club commencing 4.00 p.m. Proposed changes to the Constitution will be discussed.

20 **Coffs Harbour Branch of the NSW Avocado Association** - meeting Coffs Harbour Catholic Club commencing 7.30 p.m. Proposed changes to the Constitution will be discussed.

June

1 **Sunraysia Avocado Growers Association** - meeting Louis Fruits, Malaluca Avenue, Buronga NSW commencing at 8.00 p.m. The demand, usage and design of "SUNAVO" fruit stickers will be discussed. All avocado growers and packers are invited to attend. Contact: Marie Karanicolos 050-222277.

2 **Sunshine Coast Avocado Growers' Association** - meeting Palmwoods Memorial Hall commencing 7.30 p.m. Mike Temple, Workplace Health and Safety Inspector will be discussing the Code of Practice for Chemicals. Contact: Ralph Hoskins 074-450428.

3 **Tweed Branch of the NSW Avocado Association** - meeting Murwillumbah Services Memorial Club commencing 6.00 p.m. Proposed changes to the Constitution will be discussed.

July

20/21 **Sunshine Coast Avocado Growers' Association** - field trip to Northern NSW to look at orchard management and marketing practices. Contact: Ralph Hoskins 074-450428.

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Editor and Publisher
Orf Bartrop

AHC Co-ordinator & Advertising Manager
Suzanne Conley

AAGF Co-ordinator
Warren Meredith

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All advertising inquiries should be addressed to Mrs Suzanne Conley, Communications Manager, Australian Horticultural Corporation, Level 14, 100 William Street, Sydney NSW 2011. Telephone 02-357 7000 Fax 02-356 3661.
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From Your Federation

By Bryson Dyke, Executive Officer, AAGF Inc

Congratulations are in order for the promotional program run by the Shepard Group. On what turned out to be a very limited budget, they certainly undertook a successful program and got their name to the forefront of the avocado buying public.

The value to the whole industry of these short bursts of promotion should not be underestimated. They heighten awareness of the avocado in the minds of the consumer and more importantly, they promote the Australian product.

The promotion campaign was organised and financed entirely by the Shepard growing group and contrary to some belief, the AAGF did not commit any funds to the program.

Along with the high profile of the Shepard growers have come some accusations that the AAGF in its negotiations with New Zealand could have aided these growers to the detriment of other groups marketing at that time.

If this did happen, it was never the intention of the AAGF that it should. The New Zealand negotiations were purely designed to aid an orderly marketing situation from December through to March by the exchange of crop production estimates. This allowed both Australian and New Zealand growers to market their fruit at such a rate as to prevent severe price fluctuations which, in the long term, are of detriment to the industry as well as individual growers.

In response to this criticism the AAGF at its meeting on 6 April 1993 resolved to be only involved in issues which benefit the whole of the Australian avocado industry.

From financial information just available the levy leakage factor is being stemmed. It is now anticipated that the AHC levies will reach the budgeted estimate of $276,000 this year and will likely reach $375,000 in 1993/94.

All growers should check their agents' returns periodically to ensure that levies are being deducted and paid to the AHC (Australian Horticultural Corporation) and the HRDC (Horticultural Research & Development Corporation). If there is an anomaly, growers can contact their local AAGF director who can take the matter up with the Levies Management Unit.

Levies are the life blood of the industry which allows research and promotion programs to be operated to ensure that the industry maintains its efficiency and avocados can compete successfully against the multitude of other food industry products confronting consumers.

Recently a preliminary promotions program for 1993/94 was presented to the AAGF.

Based on an expenditure of $150,000, it includes instore demonstrations of avocados in Brisbane, Sydney and Melbourne, the production of point of sale leaflets such as recipes, mobiles, etc., and provision for a special research project to determine consumer acceptance of avocados.

Almost $100,000 will be used for advertising in major national magazines for women. The main advertising periods will be in July, August, September, April and May.

Funds will also be used to produce a leaflet to address the advantages of the use of avocados in food for babies.

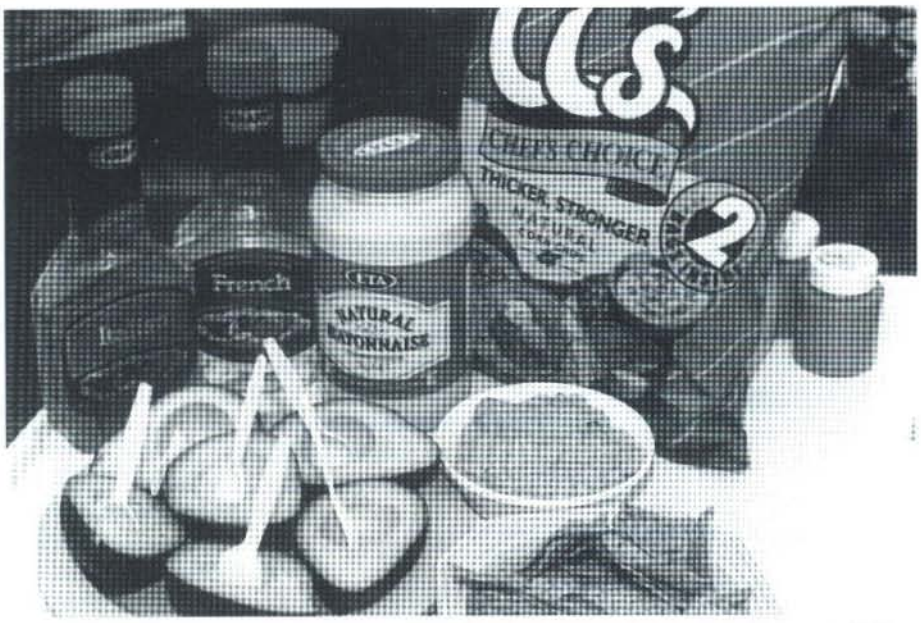
Another initiative of the Federation is to pursue joint promotions using such products as CC's and other snack foods. This has reportedly worked well in Western Australia and South Australia.

During the April meeting, your Federation approved the expenditure of $105,000 for funding of various research projects. As it is the Federation's role to make recommendations to the Board of the HRDC, details cannot be published at this stage. A description of the projects will appear in the next issue of "Talking Avocados".

The next conference of the avocado industry will be held in May or June 1994 at Bundaberg in line with the industry's requests from the last conference in 1992. This conference will be of a "field day" nature and will involve doing and seeing rather than just hearing.

Lastly, the editor of this magnificent publication, Orf Bartrop, would like to hear some feedback from the growing community. "Talking Avocados" is designed to be a two way communication channel, so please don't be afraid to contribute in any way that you think fit. Your comments regarding any issue in the avocado industry are most welcome.

See you next issue.



Avocados being promoted at the 1992 Royal Adelaide Show. CC's and other complementary products were used in the promotion.

LETTERS TO THE EDITOR

Dear Editor,

Congratulations on the latest production of Talking Avocados. The journal is informative and printed in an attractive and attention getting manner.

Dull journals are only read by a few; bright informative and well laid out ones are read by many. The February '93 issue is certainly one of the latter.

And now a comment on the page 18 story by Mr T Campbell regarding Phos Jec. Many growers are experiencing difficulties with the extended use of injections. In fact in my situation I feel that it is no longer viable due to the lack of response after a few years. Perhaps you could run something on foliar spraying of Phos Jec, and on a different tack, something on IPM strategies that can be employed in Avocados.

Ted Knoblock
Coffs Harbour

The continuing use of Phos Jec has had mixed results. Hopefully our next issue will have something on this subject as well as IPM. Editor.

Australian Round-up

Sunshine Coast Avocado Growers Association (SCAGA)

At the time of writing, harvesting of early varieties is getting underway. Yields appear to be average and prices reasonable. There was some anxiety over light rainfall earlier in the summer and the "wet" was late in starting, causing irrigation systems to be used later than usual. There has been reasonable rainfall since mid February although still somewhat below average.

Nambour Regional Productivity Group (RPG)

Under the auspices of the AVOMAN project, the Nambour RPG started some 4 months ago and so far all 8 contributors are SCAGA members. The RPG's objective is "to increase net return per tree by 25% by the end of the 1994 season". The Group meets approximately monthly at a contributor's orchard. The main thrust towards meeting the objective is by improving general orchard management and by investigating the economies of group marketing and group purchasing.

Each meeting starts with a constructively critical walk around the host orchard which all contributors have found to be a most helpful management/improvement exercise.

Purchasing economies of scale are under investigation. A production recording form has been designed which may find its way into the AVOMAN system after modification in the light of experience. It will be used initially to record a 1991/2 production base line against which our 1993 and 1994 improvements can be measured. The Group is also seeking to establish whether it has the minimum 20,000 single layer tray capacity considered necessary to establish a viable Group Marketing Scheme.

Although the existing contributors are SCAGA members, the RPG is not exclusive to the Association and other contributors would be welcome from within or without the Association. Please contact the convenor, Alex Banks at MHRS Nambour 074 412211, if interested. It is not too late to join and records of work to date are available.

West Morton Region

A field day on the topic "Tree Size and Canopy Management" was held in March. A bus load of growers (50+) from Tamborine Mountain joined a good roll up of local growers to inspect four different orchards. The orchards were selected to show a range of approaches to tree size management.

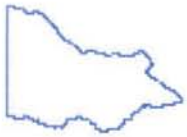
At Ray Feldhahn's property a block of large Fuerte trees which had been selectively pruned to open the canopy was inspected. The trees were carrying an impressive crop of very clean fruit. A block of Hass trees which had not been pruned was also inspected, a very interesting discussion taking place as to the best way to handle Ray's problem.

The convoy then proceeded to Rob and Keith Brain's property where the problem of tall overcrowded trees had been attacked twelve months previously. The tops had been cut out and as much of the lower canopy as possible maintained. This method attracted comment as the trees were carrying a good crop, meaning production losses normally associated with pruning orchards were minimised. The amount of sunburn damage to the main stems was of concern to some.

At Rod Dalton's orchard where the trees were not as old or as large as on the previous farms, light pruning between trees and between rows has been used to control tree size. It was conceded that the trees had reached their optimum height, therefore more severe pruning would soon be necessary depending on future crop loads.

Up the range to Henk Vankerkwijk's orchard in Toowoomba and the group discussed Henk's excellent yield data which showed that a severe biennial bearing problem had developed in the orchard. The fact that the orchard was planted on 6 m x 6 m spacing and had not been thinned or pruned until too late was accepted as the prime reason for the problem. One block had been staghorned and an interesting discussion took place amongst those present as to the best way to manage the regrowth. Alec Kidd provided some very interesting ideas based on his experience and approaches being used in California.

Overall, a very interesting day which probably raised more questions than it provided answers. The input and assistance of Alex Banks must be acknowledged.



The weather pattern since the beginning of Spring last year has been most unlike our normal weather. Frequent Spring rains continued into Summer giving Sunraysia its wettest on record. In fact the Spring, Summer, Autumn period has been the wettest, coolest, most overcast and humid, that many grower have experienced in their lifetime. Although dried fruit growers may not have been appreciative of this change in weather, avocado growers found that overall their crop looks good.

Promotion

The Sunraysia Avocado Growers Association is looking at promoting avocados from its own stand at the ten day Royal Melbourne Show.

Promotion of avocados at the Show in September is considered very important. During this promotion, the public are offered free samples of avocado and avocado dip, free recipes, and have the opportunity to buy avocados with dressing, whole avocado fruit and the Complete Avocado Cookbook.

Avocado recipes are also demonstrated by professional demonstrators who are familiar with avocados. This provides a person-to-person contact with the public, undoubtedly the best way to overcome the problems of the non avocado eater.

While statistics may say people either love or hate avocados, it is only at promotions like this that you find out why!

At the Melbourne Show promotion we continually find that the confirmed avocado eater is looking for more recipes and a good meal to eat at the Show.

On the other hand, the non avocado eater walks by the stand, and when offered a sample of avocado, turns up their nose and says, "no thank you, I don't like avocado".

It is at this point that you must ask, "why do you not like avocados?". You must continue with the questioning until you have been told why! You will be surprised at the variety of reasons given—"I've got high cholesterol", "they're fattening", "I don't like the taste"—these are just a few of the responses you will get.

When you have found the reason, then you go about solving the problem. If you are told that they don't like the taste, then ask, "how have you eaten avocados before?". The answer to this question will often reveal the problem. Often people have a bad first time experience and have not tried the fruit again. This is when you

need to advise the people on how the fruit should be purchased, handled, stored, ripened and used. Don't forget to give them a taste of the avocado dip and some free avocado recipes. You will find that people are generally appreciative of your advice.

Melbourne being one of our country's biggest potential markets for avocados, it seems logical that we should be spending money on promoting in this market. Should the Sunraysia Avocado Growers Association go ahead with 1993 Royal Melbourne Show promotion, it will be at a cost of around $15,000. This will be totally unfunded by the AHC or the Queensland Fruit and Vegetable Growers as their funds are already committed elsewhere.

Should there be other regional avocados associations with available funds to help support this Melbourne Show promotion, their support would be gratefully received. A detailed budget for the promotion can be provided as well as information on the activities to be carried out during the promotion. Contact: Marion Matthews 050 291576.

Farm Chemical Users Course

NSW Agriculture advise that they are considering running Chemical Users courses in the Coffs Harbour area. They will be of two days duration and include integrated pest management. Cost is $165 which includes notes, accreditation, lunch, and light refreshments. Anyone interested in attending a course should contact Alison Carmichael on 066 240352 or Greg Ireland on 066 519040.

Handbook - Avocado Conference 1992

Reprints of the Conference '92 Handbook are now available from Branch Secretaries for $20.

Annual General Meeting

NSW Avocado Association held its Annual General Meeting (AGM) at Alstonville on the 31st of March.

The postal ballot for Additional Members to the Committee resulted in Phil Connor (Brunswick), Allan Campbell (Richmond) and Keith Johnson (Richmond) being elected. They will join the Branch delegates, Tony Lawrence (Tweed), Rob Mosse (Richmond), George Gordon (Brunswick) and Warren Meredith (Coffs Harbour) in forming the Committee.

The President reported that the main emphasis during 1992 had been on joining AHC and ensuring the industry had good national Marketing and Research and Development programs.

The financial position of the Association is not good. Loss of the voluntary NSW levy has meant that Association reserves decreased considerably in 1992. At the anticipated minimal expenditure rate, the Association will have exhausted remaining reserves in another two years.

Other subjects covered at the meeting included the need to debate 'Resolutions' at Branch level; the curtailment of promotion during 1992 due to industry's bid to join the AHC; and dissemination of research and development progress reports.

Mr Malcolm Irving, Chairman of the AHC attended the AGM. Mr Irving discussed the work being undertaken by his organisation and its relationship with the avocado industry.

Several members who had posed questions relating to the AHC had these answered by Mr Irving.

Mr David Rankine, immediate past President of the AAGF, addressed the meeting listing the pros and cons of being in the AHC. He stated that it was too early to determine if the AHC would live up to expectations but if being a member of the AHC was not going to be of benefit to the industry, he for one would recommend severing ties.

NSW Farmer Association

The NSW Avocado Association is an associate member of the Fruit Committee of NSW Farmers. This Committee has been following the progress of the Industries Commission Inquiry into Australian Horticulture and has been less than happy with the result.

Twice, a detailed submission was made by NSW Farmers and each time it was virtually ignored. These submissions covered; land, labour, quarantine, food standards and labelling, taxation and anti-dumping measures.

ERRATUM

A misprint was published in the February edition of *Talking Avocados*:

Page 22 - column 1, first sentence after the sub-heading, "How Much Nitrogen Should Be Applied?". The sentence should have read - 750 g of urea for 6 m diameter trees, not 150 g.

NSW Farmers has a number of specific committees aided by professional staff whose expertise cover the above subjects from the farmer's point of view. Instead it appeared that the Commission only took note of submissions from Commonwealth Government Departments.

A case in point, on page 55 of the report released on 3 April states, "The Commission has been unable to identify institutional or regulatory impediments to the efficient allocation of land for horticulture." Yet a month before this the NSW Minister for Agriculture made a media release which outlined a policy on the protection of rural land. The release covered two pages outlining the problem. Subjects like the right-to-farm and compensation for compulsorily acquired land have been around for quite some time.

NSW Farmers intend taking the matter up with the appropriate Commonwealth Minister.

Protect Your AVOCADOS

Protect tour avocados produced by the Queensland Department Of Primary Industries is a guide to managing a number of avocado pests in Queensland conditions.

The book includes a pest management system for mature trees, integrated management of phytophthora root rot and cultural and chemical methods of managing pests.

Pests discussed include fungi, mites, bacteria, insects, viroids, birds and mammals, nematodes and weeds. Successful pollination, post-harvest pest management, correct pesticide application and pesticide safety are some of the other areas covered. A list of recommended pesticides is provided.

This book is a valuable manual for commercial and home-garden avocado growers, agribusinesses, researchers, market specialists, students and horticultural advisors.

Protect your avocados costs $23 plus $4 postage within Australia and can be obtained from QDPI Publications, Department of Primary Industries, G.P.O. Box 46, BRISBANE 4001, telephone 07 239 3100 or Fax 07 239 3760.

THE LAST 7 COPIES OF THE PROCEEDINGS OF CONFERENCE '92 ARE AVAILABLE FOR SALE FOR $20 (POSTAGE PAID)

Please send your cheque payable to Australian Avocado Growers' Federation Inc,
P.O. Box 19,
Brisbane Markets QLD 4106

World News

Avocado Growing In Israel

By Aaron Priel, California Grower, February 1993

Citrus and avocados, once the two major components in Israel's export basket, are losing their position. Ignoring market demands for new varieties of citrus easy peelers, and fierce competition from Spain, Morocco, Turkey and other suppliers; coupled with the liberalisation of the centralised marketing and export structure which led to fierce competition among the Israeli exporters on foreign markets last season, diminished Israel's position as a major supplier of citrus to Europe.

In the case of avocados, a relatively new crop in Israel, is more or less the same, but for different reasons. Some 30 years ago, a short news item published in several newspapers in France claimed that "research showed that eating avocado makes males distinctly more virile". Potency, subtly mentioned in ad campaigns, served ever since as the prime promoter for the disproportionately large avocados consumption in France, compared with other European countries.

For over two decades, Israel was the leading supplier of avocados to France, the most lucrative avocado market in Europe. Israel, however, lost its dominant position when Spain started to supply large quantities of avocado to the European markets in the mid 1980s.

1986-87 was an all-time record year of avocado yields in Israel: 130,000 tons from 13,000 hectares, of which 87,000 tons were exported. Almost 60% of the fruit exported in that season was marketed in France. During the following years, owing to climatic disasters, an acute shortage of water and a sharp decline in the profitability of several varieties, some 3,000 hectares of avocado plantations have been uprooted.

Moshe Besser, in charge of the avocado growing department at Israel's Fruit Board; explains that, "Growers are now replanting avocado varieties according to controlled and regulated procedures, namely, suiting the variety to regions which were found to be optimal cultivation areas for that particular variety". The prerequisites guiding the new planting procedures are suitability to a given region's climatic conditions, yields, and consumers' preferences, says Besser.

Altogether, Israel's avocado plantations cover 8,000 acres, situated from the Maon Region in the northern Negev, along the Mediterranean coastal plain, the Jordan Valley, Western Galilee, and Jezreel Valley.

The main varieties are the indigenous variety Ettinger (25%), Fuerte (30%), and Hass (30%); the others are Reed, Nabal, and Pinkerton. Pinkerton, a fruitful and tasty variety developed in California, is a relative newcomer to Israel. It was found to be particularly high yielding in Upper Galilee and in the Jordan Valley, with yields over 12 tons per acre.

"We are fortunate that there is a very short distance between the laboratory and the growers, who hasten to apply in their own plantations the recommendations of the scientists," says Besser. In order to create new varieties for the future, Israel has spent the past decade propagating different and novel avocado strains which are tastier, have smaller seeds, and are better equipped to endure the rigours of transportation.

A recent breakthrough is the introduction of new avocado strains suitable for cultivation in arid regions, and which can be irrigated with saline water, containing 1,500 mg chlorine per litre, compared with fresh water containing between 200 and 250 mg chlorine per litre, commonly used to irrigate avocado plantations.

Diseases, which often attack avocados, do not exist in Israel because the country has a drier climate than in many other countries cultivating the fruit. With regard to pests, Israel has developed a unique biological control system, capable of eliminating pests inhabiting avocado groves. By employing this technique, Israel has managed to avoid using pesticides. "This means that Israeli avocados are grown naturally in a carefully regulated ecosystem which keep them at the peak of health," says Besser.

After many years of trials and tribulations, in an attempt to find the optimal structure for cultivation, marketing and exporting, the avocado growing sector is today managed by the growers. "The growers decide on planting, marketing and export policies. This administrative structure serves as an incentive to the growers."

For all practical purposes, the avocado industry in Israel resembles that of California, adds Besser: "We have a similar climate, we grow the same varieties except for the Ettinger, and we are witnessing a

rapid and continuous increase of avocado consumption on the local market."

Israeli avocado growers, following the policy of "if you can't beat them, join them", are co-operating with avocado growers in Spain and South Africa. This co-operation is expressed in joint research projects and exchange of information. In particular, Besser points to the "fruitful co-operation", as he terms it, with Spanish growers, Israel's main competitors on the European markets, especially in France. It is estimated that Spain's avocado export in 1992 amounted to 20,000 tons, half the quantity that Israel plans to export this season. There are reports that an Israeli marketing organisation will market in France, about 4,000 tons of Spanish avocado.

"The development of the avocado sector in Spain has been curbed by losses due to low yields and to the stoppage, in 1989, of government grants and loans", explains Besser. This put an end to the massive avocado planting in Spain, which resulted in the planting of other exotic and more profitable fruit such as mango and litchi.

In Spain, as in Israel, avocado consumption on the local market is on the increase, although there is a big gap in the consumption level between the two countries. Average

per capita annual consumption of avocados in Spain is 400 grams, vs. 5 kilograms in Israel.

Israel's main marketing target this season is to promote the sale of small-size avocados. Benny Ravet, deputy manager of Agrexco's marketing division, explains that there are two factors which contributed to the disproportionately large quantities of small-size avocado this season. One reason is the large number of different varieties comprising the average avocado plantation in Israel, and the other is the "old age of the trees".

Consumers in Europe, except in Scandinavia, prefer big avocados. Agrexco, Israel's agricultural export company, this season is launching sales promotion campaigns throughout Europe, to promote the sale of small size avocados. "It is not an easy task", admits Ravet, "to change consumers' preferences overnight". Be that as it may, the success, or failure, of this year's Israeli avocado sales in Europe depend to a large extent, "on the small-size avocado".

Export Competitor Profile: South Africa

By Suzanne Conley, Australian Horticultural Corporation, Sydney

Sub Tropical fruits are one of the showcase crops of South African agriculture with production and exports growing rapidly. Overall the industry is about fifty percent larger than the Australian industry and far more export oriented.

The growth in this industry contrasts with the Agricultural sector as a whole which is struggling to hold its own in the face of the recent drought and rising costs. In 1992 total production of sub-tropical fruits was 47,000 tonnes with exports totalling 32,000 tonnes. Although production was handicapped in 1992 by the drought, exports of these fruits still exceeded R580 Million (about $AUD270 million).

Sub Tropical fruits are seen as one of the few growth areas in the local agricultural scene. Production and exports are expected to show further growth although limited irrigation water will be a constraint.

Avocados are of growing importance with about 2 million trees planted. Production is roughly three times that of Australia and has been tending to rise but will be down about 20 per cent this year as a result of the 1992 drought.

South Africa's exports of sub-tropical fruit are marketed mainly in Europe. Other markets including Asia are being actively explored.

One of the growth areas of the country's agriculture is the Eastern Transvaal (essentially from Nelspruit in the South to Tzaneen in the North) Region boasts several very large and efficient fruit farms. Major crops are citrus, avocados, mangoes and litchis and all are seen as having significant growth potential.

Westfalia is the largest avocado producer in Africa with avocado plantings of 600 hectares and exports in 1992 of 1.4 million cartons (about one fifth of South African exports). This is a highly impressive farm practising micro-irrigation techniques, sophisticated biological controls and advanced handling and cooling methods. Westfalia devotes over 2 percent of gross turnover to research and in this area has close contacts with the CSIRO.

Other farms are slightly smaller but also impressive with the bulk of production coming from large units using the latest technology. These commercial farms are backed up by applied research at the subtropical fruit research institute at Nelspruit.

USDA Proposes to Allow Mexican Avocados Into Alaska

California Grower, January 1993

The U.S. Department of Agriculture (USDA) Plant Protection and Quarantine Service (PPQ) has published for comment a proposal to allow fresh Mexican Hass avocados into Alaska under certain conditions and for consumption only in that state.

The reasoning behind the proposal, according to the USDA, is that although certain species of fruit flies and seed weevils are known to attack avocados in Mexico and present a significant risk to many crops in the U.S., none of these pests could become established in Alaska due to the cold weather. Host Alaskan crops, such as apples and pears, would also be unaffected due to the cold weather.

The PPQ proposal contains additional safeguards. Shipments would only be allowed from Michaocan and would he inspected to ensure that those being exported into Alaska are free from seed weevils and fruit flies. Personnel in Michaocan would be required to inspect the avocados for export during growing, harvesting and packing and to certify that they are pest free. Avocados in compliance would be packed and sealed. The sealed box would be packed in an enclosed container or vehicle or remain under a tarpaulin cover while in transit.

Also, only commercial shipments defined as having been produced for sale or distribution in mass markets would be permitted and the boxes would be required to be labelled "Distribution limited to the State of Alaska " Eligible shipments could only enter though the following ports: Galveston, Houston, Nogales, Brownsville, Eagle Pass, El Paso, Hidalgo, Loredo, and ports in Alaska. USDA would require APHIS inspection at the U.S./Mexican border, at any stops in the United States en route to Alaska, and at the port upon arrival in Alaska to ensure the integrity of the seal.

According to the USDA, the economic impact to the California avocado industry would be insignificant, as Alaskan consumption of avocados is less than one per cent of California's total available supply.

The California Avocado Commission has expressed concerns over the ability of the local industry to handle a pest management program in such a way as to ensure that plant pests are not introduced into the United States. The Commission intends to express its views to USDA in the rule making process, and as of early November was preparing comments to be submitted by November 18 to the USDA.

Curing Hass Avocados For Cold Storage Disinfestation Against Queensland Fruit Fly

The research project undertaken by Mr Andrew Jessup at the NSW Agriculture Horticultural Postharvest Laboratory, Gosford and funded through the HRDC and the AAGF has been completed. This article gives an insight into the tests carried out and the results obtained.

Introduction

The purpose of the project was to determine if a method could be found to rid avocado fruit of the Queensland fruit fly using cold storage techniques.

The trial started in 1989 and continued with the last fruit tested being harvested in December of 1992.

The project studied the effects of varying the dip temperature, the fungicide, fruit maturity, fruit colour, fruit origin and fruit quality. It also examined the presence of chilling injury symptoms and Anthracnose development during cold storage. These tests were carried out immediately after removal from cold storage, during ripening at ambient temperatures and after fruit attaining optimum edible ripeness.

Growth of Queensland Fruit Fly

In 1989, late-season 'Hass' avocados from Alstonville were harvested and sent to Gosford in a half-tonne field bin. One hundred fruit were infested with Queensland fruit fly eggs and stored at 26°C and 75% relative humidity. Daily, a sample of five randomly chosen infested avocados (see Back Cover) were dissected and live larvae recovered by flushing with a jet of water. The lengths of 20 larvae were then measured to determine the larval instar reached by that day.

The Effect of Curing and Cold Storage on Queensland Fruit Fly Infesting Avocados

A bin of second quality late-season 'Hass' avocados was harvested from Alstonville and the first trial began four days later.

On arrival at Gosford, 500 fruit were randomly selected, the rest being stored at 5-7°C until required. Of the 500, severely damaged and over ripe fruit were discarded, leaving 451 fruit which were kept at 26°C overnight to be infested with Queensland fruit fly eggs the next day.

To facilitate infestation through the hard skin, fruit were punctured using a hand-held wooden block studded with an array of 30 fine nails which facilitated oviposition. Fruit were then placed on a nylon mesh cage housing about 15,000 three to five week old Queensland fruit fly adults at a sex ratio of 1:1 (see Front Cover).

One hundred and sixty fruit were randomly removed from the cages and stored on a 1 cm^2 plastic mesh suspended over dry sand which acted as a pupation medium.

Twenty fruit were placed on each mesh tray and weighed. Trays of fruit treated this way were labelled as controls and stored at 26°C and 75% relative humidity. By sieving the sand under the infested fruit, the number of pupae that developed in each piece of fruit and for each kilogram of fruit weighed, could be determined. These figures were then used to estimate the potential survival of Queensland fruit fly in untreated avocados.

Dip at 46°C for 3 minutes, dry at ambient for 2 hours and store at 1°C for 16 days

Fruit to be treated were removed and subdivided into six groups of 48 to 50 fruit and placed on 1 cm^2 plastic mesh over sand at 26°C and 75% relative humidity. Each group was labelled with the number of days storage (at 1°C) it was to receive.

These fruit remained at 26°C for 24 hours and were then weighed and placed into a controlled temperature storage room set to 1°C. At this time all insects in the fruit were at the egg stage. Temperature was monitored via mini-thermistor probes connected to a computerised digital data logger. Each probe was inserted into the flesh of randomly selected avocados in the 1°C room.

Insects treated at the first, second and third instars were treated the same way as those treated as eggs except that cold treatment commenced at days 2, 4 and 7 after oviposition for first, second and third instars, respectively.

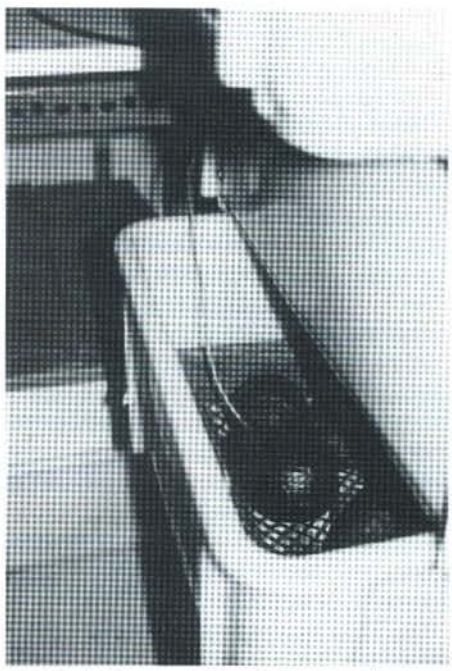
For each Queensland fruit fly life stage there were approximately one fifth of the total number of fruit allocated to the controls. Prior to being placed at 1°C all fruit, both treated and controls, were dipped for 3 minutes in 0.05% benomyl at 50°C.

Infested fruit were removed from cold storage at intervals up to ten days after commencement of storage at 1°C. These fruit were then stored at 26°C and 75% relative humidity to allow any surviving larvae within the fruit to mature and pupate in the sand beneath the mesh tray. Sieving the pupae from the sand took place at about the tenth and seventeenth day after removal from cold storage.

The average number of pupae formed from each kilogram of avocados and the average number of pupae formed per fruit were calculated and the results used to estimate Probit 9 mortality (approximately equal to 99.99683 % mortality) of Queensland fruit fly in hot-dipped avocados after storage at 1°C.

Confirmation of Treatment

In 1991 and 1992 'Hass' avocados from Alstonville were infested with Queensland fruit fly and stored until larvae had reached the third instar. The methods used were as for those used in 1989. Data logging probes monitored fruit core temperatures. Treatment commenced when the warmest fruit core temperature reached 1°C.



Mini-thermistor temperature probe inserted into an avocado.

Infested fruit were stored at first for 12 days then, when survivors were found, for 14 days.

After removal from 1°C, fruit were stored at 26°C for pupation of survivors over a sand pupation medium. The sand was sieved three times over six weeks to collect survivors (normal puparia).

For each separate infestation approximately one fifth the number of fruit infested were used as infested controls. These fruit were handled the same way as the treated fruit (i.e. infested on same Queensland fruit fly cages on the same day and dipped the same way in 50°C 0.05% benomyl for three minutes) but were not cold-stored.

'Hass' avocados proved to be an excellent host of Queensland fruit fly with an average of about 30 larvae per fruit or 200 larvae per kilogram surviving to pupation.

There were fewer survivors in heat-treated fruit than in the control fruit. This implies that the heat treatment caused the death (or absence) of insects. The hypothesis is that the act of dipping the infested fruit in the hot solution both washes some eggs from the fruit and kills others.

However, the hot dipping appeared to have a protective effect on the eggs of Queensland fruit fly. When heat-treated fruit were subsequently stored at 1°C insect survival followed the reverse trend to above—more insects survived the heat-treatment plus cold-storage than those that were just cold-stored. The heat-treatment would still kill or wash away some eggs prior to cold storage but it appears that those insects which do survive the heat are better able to survive the cold. It seems that the formation of protective "heat shock" proteins reported to be formed in heated fruit may also play a part in protecting the infesting insect. The implications are that cold disinfestation schedules developed for quarantine requirements in the absence of heat may have to be modified if heat-treatments (such as dipping in hot fungicides) are involved.

Tests showed that heat-dipping infested avocados caused 22% of insects to die and a subsequent 2 days at 1°C caused a total of 59% of insects to die. Avocados receiving no heat-treatment and 2 days at 1°C suffered 73% insect mortality. Therefore by deduction, 14% of the insects that would have died after 2 days at 1°C survived due to a prior heat-treatment.

Based on figures for insect survival per kilo of fruit, Probit 9 (99.99683 %) mortality was reached at between 10 and 11 days at 1°C. This was for fruit that was hot benomyl dipped for the third instar larvae which were seen to be the most tolerant of the four lifestages studied. Estimates based on insect survival per fruit indicated that Probit 9 mortality would be reached after storage of avocados infested with third instar Queensland fruit fly for 12 days at 1°C.

A storage period at 1°C for 12 days was insufficient to kill 100% of third instar Queensland fruit fly larvae in heat-treated avocados. There were 28 survivors from an estimated 28,306 third instar larvae treated. When stored at 1°C for 14 days there was 1 survivor from 56,996 insects treated. This single survivor necessitated a further replicate at 14 days to investigate the possible need to conduct three more tests at 15 or 16 days. This was done and no survivors resulted from 199,820 insects treated at 1°C for 16 days. United States Dept. of Agriculture scientists allow 1 survivor from 100,000 or 3 from 1,000,000 insects treated to confirm adherence to Probit 9 security.

Differences Between Growing Regions

Studies previously reported under this Project have found no significant differences in response to hot-dipping and cold storage in early, mid or late season fruit from one orchard. The following experiment was designed to test for differences between mid-season fruit produced in two different regions, namely the Atherton and north Tamborine.

Ten fruit at a time were dipped in the hot fungicide solution in a 29L thermostatically controlled water bath. Fruit were dipped for 5 minutes (Atherton fruit) or 3 or 5 minutes (north Tamborine), allowed to air dry on paper towelling at ambient temperatures (20-22°C) for at least 2 hours then placed in cold storage in their cartons with lids at 1°C. Mini-thermistor temperature probes monitored the core temperature in one fruit per carton and cold-treatment commenced when that fruit core temperature recorded 1°C (i.e. there could have been up to 10 different treatment commencement times as there were 10 cartons).

After completion of 16 day cold-storage, fruit were removed from the cool room and stored at ambient temperatures (18-20°C) and examined daily for:

- colour;
- lenticel darkening;
- other external damage except rot;
- shrivelling;
- firmness; and
- overall external acceptability

At each examination, three fruit that had reached the edible ripe stage were dissected and assessed for internal quality:

- rot development ("bruising" or Anthracnose);
- vascular browning;
- tissue greying/browning;
- red stain; and
- overall internal acceptability.

Two replicate experiments were conducted on north Tamborine fruit and three replicates were done on Atherton fruit.

Results and Discussion

The fruit from north Tamborine were Class 1 and were very well-packed in plix trays. All fruit were very firm and shiny-green with no fruit showing signs of ripening. Up to 10% of the skin had slightly blackened and/or sunken lenticels. Internally, these fruit showed very slight watery vascular tissues and an average acceptability score of 8.67 out of 10 (3 fruit dissected).

Fruit from Atherton were of poorer quality prior to treatment. They were loosely packed so could have suffered some vibrational damage in transit. They were not marked as any quality class. All fruit were very firm but 28 out of the 109 received were up to 50% coloured indicating the onset of maturation. Half the fruit were of the typical small, oval 'Hass' shape, most of the rest were of an elongated pear shape with a long neck (but still apparently the 'Hass' cultivar) and still a few more were almost perfectly spherical. On dissection these last fruit were found to have very large seeds whereas the rest had quite small seeds. Most of the fruit had up to

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Normal Cold Storage

When unripe but mature avocados are stored for prolonged periods below 6°C, chilling injury symptoms may occur. Injury can be seen both during storage in the form of uneven skin colouration with the formation of dark brown to black spotting on the skin, and after removal from cold storage when pitting and softening can occur.

Severe internal damage can occur such as the darkening of tissue surrounding vascular strands and the grey discolouration of the flesh particularly around the seed cavity called "mesocarp discolouration". The vascular strands, themselves, may darken prematurely due to browning of tracheid elements in the vascular tissue. Often cold-injured avocados fail to ripen evenly on removal from storage, resulting in uneven colouration of the skin of dark-skinned avocado cultivars, and in the development of patches of firm flesh within the otherwise soft fruit.

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40% of the skin with lenticel darkening and/or pitting. These fruit were of a duller green than those from north Tamborine. Internal acceptability scored 8.69 out of 10 (the same as north Tamborine fruit).

Results show that there were few differences in responses to the treatment by north Tamborine fruit whether dipped for 3 minutes or 5 minutes. The exception was in skin colouration where fruit dipped for 5 minutes were less coloured than those that had been dipped for 3 minutes even though they were all at the edible ripe stage.

The external appearance of dipped, cold-stored fruit was better for north Tamborine fruit than for Atherton fruit although internal acceptability did not differ between growers. This variation could be due to the original quality of the fruit prior to the commencement of treatments.

Vascular browning, the predominant symptom of chilling injury reported for avocados, decreased after the hot benomyl dip in both region's fruit but was more severe in north Tamborine fruit whether dipped or not than in the Atherton fruit.

Dip Temperature and Skin Scalding

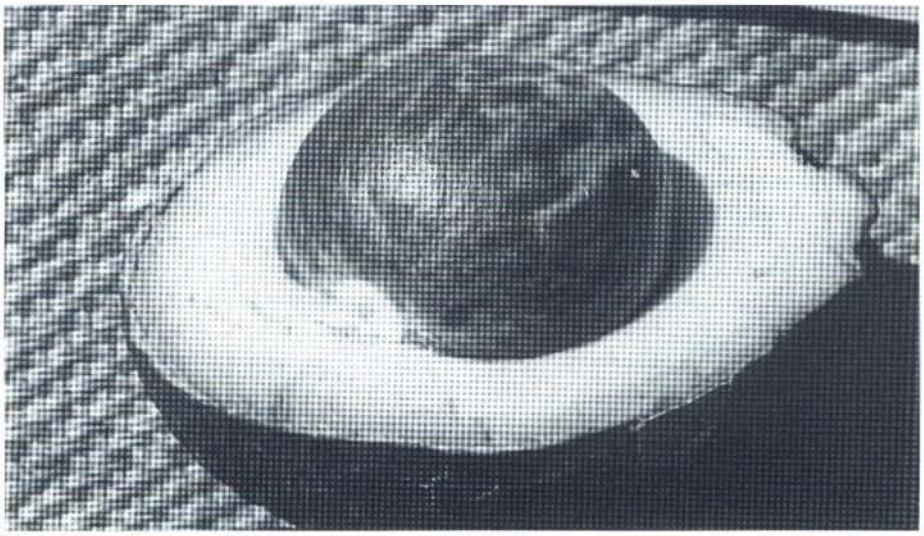
Results showed the effects on the appearance of avocados of hot-dipping at a range of temperatures from 46-54°C. No skin damage occurred on 50°C-treated fruit at that time. Since then, in 1991, some fruit treated at 50°C did show skin scalding attributable to hot water damage. Internal quality following a 16 day period at 1°C was excellent.

Dip Temperature and Skin Bronzing

On the day of removal from 1°C there was no skin bronzing on any fruit from Atherton or north Tamborine, or on fruit from either fruit maturity level. By day 4 in ambient storage skin bronzing was evident on fruit from both regions that had been treated at the hard green maturity but only on those fruit that had been dipped at 48° and 50°C. There was no skin bronzing on fruit from either of the regions after any dip treatment where fruit had been treated at the firm, semicoloured stage.

Differences Between Growers

While still in cold storage, an assessment on fruit ripeness (softness) was made on fruit grown by different growers in the same growing region. The results show that some of the fruit treated at the hard but semicoloured stage were able to soften to the edible ripe stage while in cold storage particularly if they had been dipped. Fruit treated at the hard green shiny-green stage did not soften appreciably during storage at 1°C.



One of the fruit after 16 days of cold disinfestation.

Assessments made on fruit firmness on days 0 and 4 after removal from 1°C and during storage at 21°C were recorded. At day 0 there was a gradual decrease in firmness as the dip temperature increased for fruit treated at the semicoloured stage from both grower lines. This trend was not apparent in fruit treated at the green stage at days 0 or 4 or in the semicoloured fruit at day 4. Very few of the green fruit softened at all during storage at 1°C. At day 4 the green fruit were only slightly firmer than the semicoloured fruit.

The effects of dipping and cold storage on fruit skin colour were noted. Results indicated that there is little difference in skin colour between grower lines after 4 days at ambient following the cold storage period. At day 0 fruit dipped at the higher temperatures appeared to be more coloured than the others.

These results indicate that dipping at 48 or 50°C may in some instances result in skin damage in the form of unsightly bronzing. This damage is easily seen only when the fruit is still green or semicoloured. It becomes invisible when the fruit colours to the normal 'Hass' purple-black. Green-skinned varieties may be severely affected. In some severe cases when dipped at over 52°C the skin of the fruit becomes smooth and more brown than black. It appears that hard, semicoloured fruit do not bronze as do hard, shiny-green fruit which are a little less ripe. Even when severely bronzed the internal quality of the fruit is not affected at all.

Conclusions

The research has shown that 'Hass' avocados can be dipped for 3 minutes in 46°C, 0.05% benomyl, dried for two hours at ambient temperatures and then stored at 1°C for 16 days at least. Not only are the fruit in good condition both internally and externally without any adverse effect on storage life, any infestations of immature stages of Queensland fruit fly will be eradicated.

Some fruit ripened to an edible stage in 4 days after removal from cold storage and remained commercially acceptable for a further 5 days. Other fruit took 5-6 days to ripen and remained acceptable for a further 3 days.

Chilling injury as vascular tissue browning, flesh blackening or greying and uneven skin colouration and flesh softening does not occur in cold stored fruit following the warm fungicidal dip. The fruit are in good condition both internally and externally without any adverse effect on storage life. Staff members at the laboratory commented that the treated fruit were of a higher quality than that normally found in retail shops.

It has been hypothesised that the reason for the observed benefits of the pre cold storage warm fungicidal dip is the formation of "heat shock proteins". This hypothesis has not been tested.

Contrary to normal commercial practice where avocados are stored at no less than 5°C to 13°C (depending on cultivar)(see insert on previous page) 'Hass' avocados can be dipped for 3 or 5 minutes in 46°C, 0.05% benomyl, dried for two hours at ambient temperatures and then stored at 1°C ±0.2°C for at least 16 days.

Research has shown to the satisfaction of Japanese and US quarantine experimental protocols that any infestations of immature stages of Queensland fruit fly will be eradicated by this treatment.

Before avocados can be exported to Japan or North America, research will have to prove that the Mediterranean fruit fly can be eliminated by cold storage disinfestation, hopefully the same program used for Queensland fruit fly.

Long Term Storage Of Avocados

From a paper presented at 1992 Conference by L.G. Smith, R.A. Jordan, P.J. Hofman, M. Jobin-Decor, S.N. Ledger of the Horticultural Postharvest Group, Hamilton and G. Zauberman, Agricultural Research Organisation, Israel

Current markets for Australian avocados generally do not require long-term storage/transport. However, opportunities exist to expand export markets and the domestic out-of-season period from December to February. Both markets will require reliable long-term storage, and these are most likely to be provided by cold and controlled atmosphere (CA) systems.

The current Australian cold and CA recommendations are derived from overseas recommendations. The most common storage temperatures are 5-10°C, however the QDPI currently recommends 7-8°C, although there is some indication that 1°C is possible (see article page 8). CA research on avocados has often used 10% CO_2 and 2% O_2, while preliminary Australian research has indicated 5% CO_2 to be satisfactory. It is recognised however, that storage performance varies with variety and locality of production, so that storage recommendations must be developed for Australian avocados if long-term and predictable storage life is required.

This paper summarises the research of the Horticulture Postharvest Group (HPG) on development of long-term storage procedures (cold and CA). It will indicate that current recommendations are probably not those that provide maximum storage life, and that a significant extension in reliable storage life is achievable under more appropriate conditions.

Cold Storage

'Hass' avocado fruit were obtained from commercial orchards in the Atherton, Bundaberg and Nambour regions of Queensland, between May-August 1990. The fruit were treated with prochloraz and stored at 2, 5 and 8°C for 4 weeks. Fruit firmness, Newtons (N) force, was measured at regular intervals. Greater than 20 N represents a hard fruit, and 5-8 N fruit are eating ripe. Softening (sprung) fruit can first be detected at a firmness of 18-20 N. Skin colour and internal fruit quality were visually assessed by a panel of 5 people.

Results of these experiments indicated that storage for longer that 2 weeks at 8°C is unsuitable for Australian 'Hass'. Fruit commenced softening after 1 week, and were almost at eating ripe firmness by 4 weeks. Skin started to darken by 3 weeks, and fruit that were ripening at this temperature generally did not attain an acceptable black skin colour, and had moderate to severe flesh disorders (Table 1).

Fruit stored at 5°C were all acceptable after 3 weeks storage, with some significant softening and injury symptoms developing only at 4 weeks in a moderate number of the fruit.

Storage at 2°C gave excellent results, with little sign of softening or skin colour change during storage for 4 weeks, and no injury symptoms after ripening at 22°C (Table 1).

Production region had a significant effect with Bundaberg fruit softening more rapidly in storage with reduced fruit quality after storage than fruit from the other two regions. This does not mean that fruit from this region are not suitable for long term storage, since the results have not been confirmed. However it does indicate the significant effect other factors may have on storage life and outturn quality, which will influence the consistency of a storage regime.

The promising results obtained with 5° and 2°C storage were examined further by storage for 5 weeks. Preliminary trials indicated that 5 weeks at 5°C was associated with mild skin colour and grey pulp development during storage. However, 2°C storage for the same period produced green fruit at outturn, with no flesh disorders at eating ripe. These results suggest that a storage temperature of less than 5°C (and possibly as low as 2°C) may allow storage times of longer than 5 weeks, and certainly considerably longer than those obtained at 7-8°C.

Controlled Atmosphere Storage

Preliminary investigations at HPG over a number of years indicated that avocado storage life could be significantly extended by CA, with about 5% O_2 and 5% CO_2. being fairly suitable. Industry interest stimulated a static trail in a commercial CA container, using gas composition monitoring and maintenance systems similar to those used commercially. Fifteen samples of avocados from 9 growers from the Sunshine Coast region were placed in the CA container under 5% O_2 and 5% CO_2 at 7°C. The container was filled to approximately half capacity with fruit and the remaining volume filled with

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Table 1. Effect of storage temperature and time on "Hass" avocado skin colour at removal, and flesh quality and chilling injury at ripeness.

Storage Temp (°C)	Weeks in storage	Skin Colour (at removal from storage)	Flesh Quality (after ripening at 22°C)	Chilling Injury Symptoms
8	1	Green	Good	None
	2	Green	Good	None
	3	Mixture of green and breaking	Good	None
	4	Changing or dark purple	Good	Good
5	1	Green	Good	Good
	2	Green	Good	Good
	3	Green	Good for harder fruit, poor for other	Grey pulp, vascular browning, failure
	4	Green mostly, only very few changing colour	Mostly good, with some slight injury	Small spots of grey pulp, vascular browning, failure of skin to darken
2	1	Green	Good	None
	2	Green	Good	None
	3	Green	Good	None

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empty cartons. All fruit used in the experiment were mature, ranging from 26-30% dry matter. Unstored fruit ripened in 7 to 10 days. Fruit firmness immediately after harvest averaged 65 N.

Approximately 25 fruit were removed for assessment at 4, 6 and 8 weeks. One quarter of these fruit were immediately ripened in air at 20°C. The remainder were stored at 7°C in air for either 4, 7 or 11 days, or at 7°, 10° and 13°C for 0, 4 or 7 days (at 4 week removal only) before ripening at 20°C. These conditions simulated various handling procedures (from immediate marketing at ambient temperatures to various times under refrigeration) after removal from CA.

Table 2 indicates that fruit firmness decreased by 20%, 37% and 46% after 4, 6 and 8 weeks storage respectively. Fruit stored for 4 or 6 weeks in CA could be stored for an additional 7 days in air at 7°C without any significant softening, but those stored for 8 weeks were already approaching the "sprung" stage, and were not suitable for additional air storage.

CA storage increased fruit defects (either rots and/or chilling injury) from 0% before storage to at least 2%. Fruit ripened immediately after CA had similar defect levels irrespective of storage time between 4 and 8 weeks (Table 2). However, subsequent storage in air at 7°C increased defects levels, and this was particularly so for longer CA storage times. Only 4 weeks CA stored fruit could be subsequently air stored at 7°C without adverse defect development.

Table 2. "Hass" avocado fruit firmness (Newtons) at removal, and percentage of fruit with defects (rots or chilling injury) at full ripe, after CA storage at 7°C and storage in air at 7°C. Firmness of greater than 60 N is harvest firmness, less than 20 N is sprung, and 5-8 N, eating ripe. Fruit firmness and percentage defects before CA storage; 65 N and 0% respectively.

Weeks of CA storage	Days at 7°C in air							
	0		4		7		11	
	Firmness (N)	% Defects	Firmness (N)	% Defects	Firmness (N)	% Defects	Firmness (N)	% Defects
4	52.7	2.0	50.6	2.6	50.1	2.0	41.9	5.5
6	41.1	2.6	38.1	4.9	38.7	6.1	33.7	8.1
8	35.3	2.3	30.9	6.4	30.4	8.9	25.6	12.8

These results are the average response of fruit from the 9 growers. Again, there were grower differences, with fruit from some growers showing no defects after CA and air storage.

Thus, CA storage at 7°C can delay ripening, with little significant defects, for up to 8 weeks. However, fruit stored for this period softened and developed defects on removal, even when stored at 7°C in air after removal from CA. This would represent a fairly short distribution and sale time. The risk of defect development and the need for adequate distribution times may limit storage life to no more than 6 weeks under these conditions. Also, fruit should remain at lower temperatures (preferably at or below 7°C) after CA to further delay fruit ripening (Table 3).

The recent development of automated CA research systems at HPG allows for critical re-examination of CA storage of avocados. The system allows simultaneous storage under a large number of different atmospheres, so that a general picture of the effects of CA can be obtained.

'Hass' avocados from the Sunshine Coast (September 1990), were treated with prochloraz, and 20 fruits stored at 6°C in each of 36 chambers maintained at different atmospheres ranging from 2-10% O_2 and 0-10% CO_2. An additional 20 fruit were also stored in air. Ten fruit were removed from each atmosphere at 7 weeks and ripened at 20°C. The remaining 10 fruit in each chamber were removed only when the fruit had been producing detectable ethylene for two days. Increased ethylene production by mature fruit indicates the onset of the ripening process. Thus fruit remained under CA for as long as possible, but were removed before significant progression of ripening. Skin and flesh visual appearance were recorded, and eating quality determined.

Most of the atmospheres tested were able to maintain fruit at a firmness greater than 20 N for 7 weeks. High CO_2 concentrations were particularly effective in preventing softening, and virtually all fruit stored at concentrations higher than 4% CO_2 had firmness greater than 50 N. There were no symptoms of chilling injury, and no significant effect on disease under these conditions.

Storing fruit until the start of ripening (increase ethylene production) again indicating the strong influence of CO_2. Concentrations of 4% and greater delayed ripening. Storage life was also enhanced at low O_2 concentrations, with maximum storage life (at least 75 days) obtained at 2%O_2 and CO_2 greater than 4%. At 2% O_2, CO_2 between 4 and 10% provided similar storage times, suggesting that relatively crude CO_2 control is sufficient provided it exceeds 4%.

Fruit were generally of good internal and external quality when removed from storage on the basis of detectable ethylene rise. However, disease may again be the limiting factor, particularly for those treatments that delayed ripening the most.

Fruit Differences in Storage Potential

Each fruit or batch of fruit has a different inherent storage life, and maximum storage life depends on largely unidentified characteristics of the fruit. These differences are very important for maximising storage life and reliability because of the capacity of avocado fruit to trigger ripening of adjacent fruit through the ethylene produced during ripening. Thus, storage life of a mixed batch will be largely determined by the shortest storage life of the individual fruit. Removal of these fruit before storage, and storage of those fruit with the longest inherent storage life, may significantly increase total storage life of the batch.

In order to determine the extent of fruit-to-fruit differences, 'Hass' fruit were harvested at three dates from 5 trees in a single commercial block. Individual fruit were stored in isolated containers at 22°C, and the time to full ripeness (shelf life) of each fruit determined. Time to full ripeness was indicated by the time of maximum ethylene production. This indicates shelf life, but this generally relates directly to maximum potential storage life.

The indications were that there can be very significant differences in shelf life between fruit harvested from adjacent trees on the same day and time. There was little difference in the average shelf life between harvests (about 13 days), but there was far greater variation in individual fruit shelf life with later harvests (8-20 days for June fruit, and 2-26 days for November fruit).

These results indicate the potential for further extending storage life by storing only those fruit with maximum storage potential. This may also explain the apparent contradiction between findings of this research (no effect of maturity on average shelf life of individual fruit) and other reports stating that more mature fruit have have reduced shelf/storage life.

The factors contributing to this fruit-to-fruit difference in postharvest performance are not well understood. They may include physiological (nutritional), flowering date or disease, and could probably be manipulated by cultural means.

CONCLUSIONS

The results indicate the current recommended cold storage temperature is too high, and a temperature of between 2° and 5°C may allow up to 6 weeks storage in air. In addition the CA static trial (5% O_2, 5% CO_2) indicated a practical storage life of 6 weeks, but with limited post-storage life for market distribution. More recent results indicate at least 10 weeks storage at high CO_2 and low O_2. The CA experiments were conducted at 6-7°C, so combining the revised cold (2-5°C) and CA recommendations, may further extend storage life beyond 10 weeks. Storage of only those fruit with good storage potential would provide additional benefit and also increase the predictability and reliability of outturn.

Additional insights were gained on the behaviour of avocado fruit in storage. Both cold and CA research indicated that chilling injury at ripeness is usually associated with those fruit that were showing significant ripening during storage at low temperatures. Thus, 8°C was not sufficiently cold to prevent the start of ripening, and a large number of fruit at this temperature were ripening at removal. These fruit were usually associated with chilling injury at full ripeness. The practice of monitoring ethylene production during the CA experiment provided an effective means of detecting the start of ripening, and fruit removed at this stage were of very good quality. This concept may have important commercial benefits.

In summary, efficient access to both international and out-of-season markets is possible with appropriate storage procedures. The recent CA results indicating the benefit of high CO_2 over a fairly broad range (4 to at least 10% CO_2), may suggest the use of a cheap, less sensitive CO_2 controller system on CA containers with more accurate O_2 control.

Further refinement and verification of cold and CA conditions, commercial trials, and more detailed physiological and pathological studies are required to capitalise on these initial findings.

Table 3. Fruit firmness (Newtons) of "Hass" avocados at removal from CA storage for 4 weeks, and storage in air at 7°, 10° and 13°C.

Days in air	Fruit firmness (Newtons)		
	Storage temperature in air (°C)		
	7°	10°	13°
0	42.6	42.6	42.6
4	39.3	35.3	26.7
7	40.5	28.5	15.8

Modified Atmosphere Packaging To Extend Avocado Green Life: Preliminary Investigation

From a paper presented at the 1992 Conference by D.C. Joyce and A.J. Shorter CSIRO Division of Horticulture St Lucia

Introduction

Modified atmosphere (MA) packaging involves enclosing fruit in a film which restricts the exchange of water vapour and other gases between the fruit and the surrounding atmosphere. Films may be coatings, such as waxes, or wraps such as plastic. Loss of water vapour from fruit is reduced by films, usually more by plastic wraps than by waxes. The respiratory gases, oxygen (O_2, which is consumed by fruit) and carbon dioxide (CO_2, which is produced by fruit), are two gases whose exchange characteristics are significantly altered by MA packaging. Within a typical MA package, water vapour and CO_2 levels will be high and O_2 levels low, relative to their concentrations outside.

MA packaging is an extension of the principles of controlled atmosphere (CA) storage technology. MA implies relatively less precise control of gas levels than CA. Extended CA storage of apples is a comparatively old and well known practice. MA, in contrast to CA, can be used on a small scale. That is, an individual fruit, tray, carton, or pallet can be made the MA unit. This unit basis offers a number of advantages. MA conditions are maintained throughout the postharvest handling chain, the technology is relatively inexpensive in terms of capital and maintenance costs, and there is the possibility of mixed storage and transport of a range of commodities.

After a fruit is enclosed in a film, it generates a modified atmosphere which changes over time until a steady state condition is attained. The steady state concentrations of gases within the film will be determined by the permeability of the film to each gas and by the metabolic (respiration) rate of the fruit. Both of these characteristics are influenced by temperature. However, film permeability changes less with temperature than fruit respiration. Consequently, if a plastic wrapped fruit is moved from a higher to a lower temperature, steady state O_2 and CO_2 concentrations will slowly adjust to higher and lower levels, respectively, in accordance with the relatively greater reduction in respiration rate.

The physiological bases for the beneficial effects of MA are not fully understood. General effects of reduced O_2 and elevated CO_2 include inhibition of both the synthesis and action of ethylene, and reduced respiration rates.

MA packaging has been applied successfully to a range of horticultural commodities. It is particularly effective for melons, citrus also may benefit and the potential benefits have been demonstrated for avocados. MA packaging extends the shelf life of avocados in association with reduced water loss and increased O_2 and decreased CO_2 levels inside the packaging. Chilling injury of avocados stored at low temperature can be reduced by MA packaging.

The purpose of the present study was to confirm the benefits of MA packaging for avocados as a prelude to further research aimed at optimising the technology. MA technology has neither been thoroughly researched for, nor adopted by, the avocado industry.

Materials and Methods

Avocado Hass fruit were harvested from an orchard in suburban Brisbane during the 1991 season. Fruits were taken to the laboratory within 1 hour and the following treatments applied.

☛ 14

13 ☛

Treatments

Treatments were begun on the day of harvest (day 0). Wrapped fruits were enclosed in cling wrap (Gladwrap: 11µm thick LDPE[low density polyethylene] with an additive to promote self-adhesion). Cling wrap was smoothed up over the fruit and the sides were twisted together at the stem end and fastened with adhesive tape. In one experiment, fruit were single, double or triple wrapped.

The pedicel (stalk) was usually trimmed close to the fruit to leave a button. In one experiment, however, it was removed.

Where water was supplied to fruits after harvest, the pedicel was trimmed to 1 to 2 cm length. The pedicel stump (excluding the cut surface) was then covered in Vaseline and a soft plastic tube (15 cm long, 8 mm inside diameter) was fitted. The tube was filled with de-ionised water (6.5 mL) and capped with an aluminium foil cover.

Assessment

Experiments were carried out in a controlled temperature room (22°C). "Green life" was the time in days from harvest until ripening began. The onset of fruit ripening was judged by:

1. abscission — fruit separation from the pedicel under its own weight,
2. colour — first visible signs of darkening of the skin, and,
3. softening — slightly soft (on a hard, springy, slightly soft, soft, and over soft progression scale) as judged by hand firmness.

Relative fresh mass was monitored during the postharvest period and calculated as percent of day 0 (harvest) fresh weight.

Chlorophyll fluorescence was measured and FO (zero level fluorescence) and Fm (maximum level fluorescence) recorded. From these figures a Fv (variable fluorescence) was calculated.

Fruit water potential was determined for atypically small, but otherwise apparently normal (i.e. seeded) fruit. Relative water content (RWC) of skin and of pulp was determined on 1 cm diameter, 2 to 3 mm thick discs of tissue excised and sliced with a cork borer and scalpel blade, respectively.

For determining CO_2 concentrations around fruit under Gladwrap, 1 mL gas samples were withdrawn from a cavity created between the fruit and the wrap using a small piece of Blu Tac to raise the film away from the skin. To maintain the gas seal, the syringe needle was passed through a silicone rubber plug fixed onto a short piece of adhesive tape attached to the wrap.

Replication was 5 individual fruits per treatment. The completely randomised experimental design was adopted. Means, with their standard errors, were calculated but only the means are presented in this article.

Cling Wrapping and Infusion With Water

Wrapping almost doubled avocado green life, as judged by all three indices of ripening, compared to the control treatments (no button, + button). This finding supports previous experimentation.

The green life extension associated with cling wrapping was reproducible, although the degree of extension was less in the second experiment.

Supplying water through the pedicel of harvested avocados delayed softening only slightly. Similarly, passive infusion of water had little effect on time to abscission or colour development. A tendency towards green life extension is in agreement with the previous findings but in a second experiment, passive infusion of water was not beneficial.

Decreases in fresh mass and FO and Fv/FO chlorophyll fluorescence parameters were monitored for the fruit used in the first experiment. Wrapping decreased the rate of water loss (decline in fresh mass) from avocado fruit. Rates of water loss from control and infused fruit were similar. Research in 1974 determined that the rate of water loss from avocados and their green life are negatively and linearly correlated.

The FO level chlorophyll fluorescence showed little change during green life. However, when the control (unwrapped) and infused fruit coloured and softened (beyond day 10), a fall in FO was evident. Similarly, Fv/FO fell for treatments other than the wrap. Research carried out in 1987 suggested that a decline in FO for ripening fruit shows loss of chlorophyll, and that a fall in Fv /FO reflects a loss of photosynthetic competence per unit chlorophyll. In extending green life, wrapping appeared to delay the breakdown of avocado fruit chloroplast structure and function. The marked difference in the rate of water loss between the wrapped and the three other treatments was not matched by a difference in the rate of fall in Fv/FO during green life (up to day 10); thus, developing water deficit did not influence chlorophyll fluorescence.

Fruit Water Status

Before pedicel abscission occurred, it was possible to measure, non destructively, whole fruit water potential for very small fruit. In association with decreasing fresh mass, water potential fell from -500 (day 0) to -1500 kPa (day 6) in unwrapped fruit. In wrapped fruit, the fall in water potential was slower, reaching -1100 kPa by day 12.

There appear to be no other published data on avocado fruit water potential. In this experiment, the green life of the fruit was almost doubled by wrapping. Because the avocado fruit water potential data is unique, the water potential experiment was repeated. For control fruit, which took 3.6 and 6.2 days to colour and soften, respectively, water potential fell from -400 kPa (at harvest on day 0) to -1100 kPa by day 6. The water potential of wrapped fruit, which took 8.2 and 14.2 days to colour and soften, respectively, fell from -390 to -700 kPa by day 9.

To compliment the initial water potential study on small fruit, a parallel study on normally sized fruit was conducted. Fruit were destructively sampled at 3 day intervals for determination of skin and pulp RWC. A decline in both skin and pulp RWC was correlated with decreasing fresh mass of unwrapped fruit. Wrapping reduced the loss in fresh mass and the fall in RWC. It is curious that the RWC of pulp tissue was consistently lower than for overlying skin tissue, which is proximal to the relatively dry atmosphere. This difference may be an artifact associated with differential rehydration characteristics (TW determination) of the different tissue types. It is possible that when pulp tissue is released from the confines of the skin and rehydrated, some expansion growth occurs. The net effect of cell expansion on RWC would be a decrease in magnitude. In this experiment, avocado green life was increased only slightly by wrapping .

CO_2 Concentrations

When repeated measurements were made, CO_2 concentration declined from 5% (day 3) to 2% (day 9), and then rose again to 4% (day 15). This variation might reflect handling (the fall) and ripening (the rise) effects. Handling may result in small punctures in the film. The respiratory peak associated with ripening could increase CO_2 levels around the fruit. The fruit began to colour and soften on days 11.0 and 11.6, respectively.

In another experiment, where different lots of fruits were sampled on a serial basis, CO_2 concentrations were comparatively consistent. They were also comparatively high, increasing from 6% (day 3) to 8% (day 12). Some, but not all, fruit in the day 12 lot had started to ripen (colour, soften). Variation in CO_2 concentrations between experiments could have been associated with different operators applying the wrap differently. The 11µm thick LDPE is easily stretched and punctured, and twisting together and taping the ends of the film, to seal the fruit, is a subjective operation.

In a study of single, double and triple wrapped fruit, CO_2 concentrations

Report On 1992/93 Avocado Promotion

By John Pritchard, Manager Industry Promotions, Queensland Fruit & Vegetable Growers

The Queensland Fruit & Vegetable Growers undertook a promotional program on behalf of the avocado industry. The budget for 1992/93 was $150,000 made up of:

• In-store demonstrations	8,500
• Point of sale material	4,000
• Public relations	10,500
• Media advertising	102,000
• Generic promotion	7,000
• Administration (QFVG)	18,000
	$150,000

Media Advertising

Media advertising consisted of a national campaign in magazines such as Australian Women's Weekly, New Idea, Family Circle, New Woman, and Australian House and Garden. These magazines were chosen because of a much greater readership by higher socio economic groups who are known purchasers of avocados.

The advertisements consisted of food shots of Avocado Dip, Avocado Salad and Avocado Seafood. These ads were designed to increase awareness and to increase frequency of purchases amongst known avocado consumers.

We asked consumers to respond to the advertising by sending in a stamped and self addressed envelope so that we could forward avocado recipes to them. The response was excellent with many hundreds of requests being received, up to 50 a day. These responses were very encouraging because it required people to actually buy stamps, self address envelopes and then post their requests.

The first stage of the advertising schedule ran from July through to October 1992. The second stage is now under way with ads appearing in April and May 1993.

In-Store Demonstrations

In store demonstrations have been conducted in Melbourne, Sydney and Brisbane. The primary objective of these demonstrations were to show the extended use of the avocado and highlight the versatility of the fruit in hot and cold dishes. Selection and ripening are always a popular talking points as is nutrition.

There were some negative comments with regards to the avocado fruit. Some people said that "avocados did not ripen properly", "they seem to deteriorate before they were ready to eat", "fruit was not of a good colour" or "they were very pale". Some consumers felt that some avocados lacked flavour. Face-to-face demonstrations are the most effective means of educating consumers of avocados.

General Industry Promotion

Of the money allocated for General Industry Promotion, a consumer research project was undertaken. This research will help us to better target our advertising and to highlight any areas of concern.

The consumer research has identified several problems, in particular consumers misconception of variety and seasonality, the need for education in particular on how to tell when the avocado is ripe and the need to maintain interest in the product. All these factors have been taken into account in preparing the 1993/94 campaign.

On the positive side our research program also looked at a study of throughput and prices at the Brisbane Market. This indicates that avocados are in a very positive stage showing an increase in throughput and an increase in price.

Point of Sale

Leaflets and posters were prepared for distribution to retailers. The leaflet on one side detailed nutrition, selection and storage and on the reverse side a number of recipes. The posters were a mirror image of the magazine advertisements.

Public Relations

Public Relations activities have once again generated thousands of dollars of free publicity. Visits to leading radio stations resulting in free air time. Press releases throughout the season were sent to all major newspapers. Weekly market reports were issued to various media outlets and special promotions were held in association with retailers.

Other activities include a three-day taste, sampling and educational talks at Brisbane's Royal National show; appearances on Channel 9 "What's Cooking"; a feature article in the Age Epicure; several appearances on Channel 9 "In Melbourne Today" program; and articles in Jan Rackham's cooking column in the Sunday "Herald Sun".

In Sydney, avocados were heavily promoted during the Australian United Fresh race day promotion.

1993/94

The campaign for next year is currently being developed in association with the Australian Avocado Growers Federation and budget and promotional details will be released in due course.

***Note:** The high prices received by growers during April at the Sydney Markets, indicate that past promotions may be paying off. Although supply was plentiful, up to $20/ tray was being received. Editor*

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measured for each treatment were similar on both days 4 and 8. The CO_2 concentration increased with each additional layer of film. A linear correlation is consistent with the fact that gas diffusion across a film is a linear function of its thickness. Green life was progressively extended by all three levels of wrapping. However, a fruit surface disorder appeared about day 8 on all double and triple wrapped fruit. Calluses grew from the lenticels, a phenomenon more apparent for triple, than for double, wrapped avocados. A seemingly similar disorder, termed oedema, has been described for the leaves of avocado plants grown under high temperature and humidity.

Conclusions

Wrapping in LDPE cling film consistently extends the green life of Hass avocados held at 22°C after harvest.

Fruit water status has been implicated as a factor determining the green life of avocados, and the relationship needs more investigation. It remains to be demonstrated whether the rate of water loss per se determines the green life of avocados, or whether ripening is initiated when some critical level in a component of water potential is reached.

Although MA packaging of avocados is promising, further research and development is needed to optimise the packaging for adoption by industry. This research should involve determining the relative benefits of modifying fruit water relations versus modifying internal gas composition. This task would best be undertaken for fruit of varying chronological and physiological age, and held at a range of temperatures. Fruit from different growing areas should also be evaluated.

An oedema-like disorder can occur on the surface of polyethylene wrapped avocados. Because this defect may have negative implications for MA packaging of avocados, research should seek to better characterise the disorder in respect to both atmosphere modifications and fruit physiology.

International Market Trends - The Implications For Australian Horticulture

The international fresh produce market is increasing in complexity and sophistication and it is against these international market trends that the future of the horticultural industry in Australia must be judged.

Speaking at Outlook '93, John Baker, Managing Director of the Australian Horticultural Corporation (AHC) said Australian Horticulture is at the crossroads—it can either face the challenges on the domestic and international market and be a major force in the future or gradually contract from its current position of the third most important agricultural industry in Australia.

Accepting the challenge will require a level of cohesion and unity of purpose not seen to date in Australian Horticulture. The benefit would include a major impact on the economic development and employment prospects of regional Australia.

Mr Baker said the key developments in international fresh produce marketing by the year 2000 will be increasing demand, growth in Asian supermarkets, transnational retail alliances, value-added convenience products, consistent quality and supply, and food safety and environmental issues. He said the challenges for the Australian fresh produce industry were:

- the development of an "Australian" branded product based on consistent quality, exceptional service, reliable distribution and effective promotion;
- improved market access in North Asia particularly Taiwan, South Korea and Japan; and
- industry restructuring to an export orientation, consolidation and specialisation.

"Developments in supermarket retailing, particularly Asia, provide an increasing opportunity for Australia to develop a significant brand presence. As a high cost producer and marketer, Australia needs to be at the top end of the market, with branded quality product."

Mr Baker said the implication is that unless Australia supplies bona fide branded products to the rapidly expanding markets of Asia, market share will be lost.

This has led the AHC to establish a specific Australian Product Identification program based on the development of an export brand strategy.

He said Australia's strengths in Asia included:

- proximity and resulting freshness,
- clean environmental image,
- counter-seasonal supply,
- well-educated work force,
- skilled business and financial service sectors, and
- similar time zones.

Mr Baker warned that unless businesses attempt to understand their market and the forces that will shape the market over the next decade, there will be little progress—sales will stagnate and margins will fall dramatically.

He said, "In an industry where market development cannot take place over short time spans and where competition amongst enterprises is high, those producers who plan their strategy accordingly will be the winners".

"Enterprises will need to compete on the basis of vertical integration, downstream control, geographic coverage, flexibility of production and management and brand development."

"With the increasing complexities and sophistication of international fresh produce marketing, it is totally unrealistic for the Industry Commission, in its current inquiry into horticulture, to suggest that it expects individual effort to continue to be the driving force behind export success".

"It will be a long term process to guide industry into the production requirements of horticultural products more closely related to consumer requirements, both domestically and internationally."

"A progressive restructuring of the industry, a consolidation of enterprises, a greater degree of specialisation, increased capitalisation of the packer/distributors and support for brand marketing will be required", Mr Baker said.

Plan To Improve Horticultural Statistics

A plan to improve Australian Horticultural Statistics has been devised by key horticultural and statistics organisations.

The 1993-94 plan, devised by a Horticultural Statistics Working Group, has recently received funding from the Horticultural Policy Council (HPC). The plan is designed to improve the quality of data collected and transform it into information that is easy to access and understand.

The Horticultural Statistics Working Group, initiated by the Horticultural Policy Council in 1990 is now co-ordinated by the Australian Horticultural Corporation. Its objective is to ensure the horticultural industry and other interested parties have access to reliable data on production, consumption, sales and costs, both domestically and overseas, including the international trade of horticultural products.

Derek Bone, AHC Market Analyst said it is vital to improving Australia's international competitiveness that the horticultural industry have accurate and up to date statistics for Australian and overseas markets.

Accurate statistics are vital to the industry particularly in relation to planning future plantings, projecting future crop production, planning domestic and international marketing for current and future crops, and evaluating the requirements at regional and national level with regard to employment, economic statistics and the importance of horticulture in the national economy.

He said that at present, the AHC often had access to more accurate information from competitor countries than from Australia.

The Horticultural Statistics Work Group comprises representatives from the HPC, AHC, State Departments of Agriculture, Australian Bureau of Statistics (ABS), Australian Bureau of Agricultural Research and Economics (ABARE), Australian Quarantine and inspections Service (AQIS) and Department of Primary Industry and Energy (DPIE).

Representatives of potential users of the information also participating in the work group are from Queensland Fruit and Vegetables (QFVG), Australian Citrus Growers Federation (ACGF) and Edgell Birds Eye.

Environmental Implications For Fresh Produce Packaging

A representative from major German importing group, Cobana Fructring, visited Australia in March this year and warned Australia's Horticultural industry about EC packaging requirements as a result of new environmental laws.

The Fructring group comprises 57 independent fruit traders based across Germany and its aims are for quality and freshness coupled with high efficient service facilities. The AHC was told that the Topfer Law in Germany was impacting on packaging throughout the EC, namely:

- no use of wax in cartons;
- cartons had to be glued, not stapled;
- metal angles and caps on pallets were banned;
- non toxic inks were required;
- the "100% recycling" logo should be visible on packaging;
- tray inserts should be natural, not coloured; and
- poly liners should be clear, made from polypropylene and stamped "100% recycling".

Meanwhile at the Outlook Conference in Canberra earlier this year, Woolworths National Produce Manager, Peter Pokorny highlighted the disposal of packaging as a major issue in Australia. Mr Pokorny said that fresh produce constituted around 10% of total business but 50% of total packaging waste. He said disposal of polystyrene in particular was a major problem.

A "Harvest" Of Information

As part of the Australian Horticultural Corporation's (AHC) communication program for 1993, the Corporation is producing a series of audio cassettes titled "Harvest".

The use of the audio tapes as a form of communication is currently being used successfully in the wheat, dairy, cotton and fishing industries and the AHC is keen to extend the idea to the horticultural industry. While primarily aimed at growers the tapes are not designed to replace regular newsletters but are another form of communication covering a diverse range of topics.

The tapes will cover a variety of issues concerning horticulture in domestic and international markets, issues of interest to specific commodity groups such as the avocado industry and information relating to day-to-day issues for running a horticultural business.

Levies - Retailers Supply Information For Collection

In the last issue of Talking Avocados, an article titled "Agreement with Woolworths on Collection of Levies" was published.

As stated in that article, Woolworths representatives are not in the position to collect levies at this stage. However they have agreed to supply names of their suppliers i.e. growers or packers, to DPIE's Levies Management Unit (LMU) in Canberra to facilitate collection of levies.

In cases where growers supply directly to retailers such as Woolworths, greengrocers, restaurants etc., it is the grower's responsibility to pay the levy to the LMU.

Where growers sell to a packhouse which supplies a retailer, the packhouse should deduct the levy from the grower's proceeds and pay the levy to the LMU on behalf of the grower.

Where growers or packers supply agents or merchants at a central market, the agent/merchant should deduct the levy from the grower's proceeds and pay the levy to the LMU on behalf of the grower.

The LMU is committed to reducing levy leakage and has been working with the avocado industry, AHC, HRDC and QFVG to address key issues.

Effective communication between LMU, industry and the Corporations, particularly in regards to statistical information on the numbers, names and addresses of all avocado levy payers and collections per market over time is important. As a result of the levies review, a draft communications strategy has been developed.

Quality Video

The AHC is producing an informative video to develop the horticultural industry's understanding of the practical benefits of Quality Management in Australian Horticulture. The 20 minute video features operations in Victoria, South Australia, Western Australia and Queensland that are in the process of quality certification.

The video outlines:

- the procedures, costs and benefits of implementing a quality management system;
- how the results can be used to improve practices in the orchard;
- how staff involvement and participation can be achieved;
- improving productivity and efficiency of packing systems; and
- how to use feedback from the marketplace to improve product and service quality.

The video, due for release in May 1993 will be available from the AHC.

Now Available - 1993 Statistics Handbook

The latest edition of the AHC's Statistics Handbook is now available. The handbook is an edited version of the "Profile of Australian Horticulture" and contains updated details on :

- major horticultural crops,
- production by state,
- production usage,
- major export markets, and
- Australia's competitor's in major export markets.

Copies are available free of charge from the Australian Horticultural Corporation, Level 14, 100 William Street, Sydney NSW 2011 or telephone 02 357 7000, Fax 02 357 3661.

1993/94 Avocado Plans

Planning for advertising, promotion and public relations activities for the avocado industry have commenced with the recent meeting of the AAGF Executive on 5 April in Brisbane.

New advertisements have been drafted by Queensland Fruit and Vegetable Growers (QFVG) and a special new project concentrating on infants has been commenced. At the request of the industry, the AHC has sub-contracted QFVG to implement the domestic promotion program until June 1994. Joint promotional activities with complimentary products are being examined to extend the promotional dollar.

The program is to be finalised at the next Avocado Marketing Forum to be held in July.

AHC Melbourne Office Relocated

As of the 1st April, the Melbourne office of the AHC has relocated to Shepparton, Victoria. Industry Development Manager, Richard Bennett can be contacted on 058 210 977, Fax 058 311426, until permanent arrangements are made. Mail should be addressed to 15 Welsford Street, Shepparton, Victoria, 3630.

AVOMAN - Alive and Growing !!

By Alex Banks, Shane Mulo, Scott Ledger and Tony Whiley, QDPI Maroochy Horticultural Research Station, Nambour (for the AVOMAN project team)

The AVOMAN project is up and running. Perhaps you haven't heard about the project. This first report will describe what the project is all about and how growers will benefit from it, then report on what has been happening and what is planned.

What is AVOMAN?

AVOMAN is the short name for a project that will assist avocado growers Australia wide to become more profitable. The full name of the project is "Improved Management of Avocado Productivity and Quality."

AVOMAN aims to help growers become better managers by providing them with a range of information, training and decision aids. Management areas covered include rootstock and variety selection, root rot control, fertilising, watering, crop forecasting, pest and disease control, fruit quality and product handling. All these areas of management are being linked into a "Total Management Package" called AVOMAN.

How does the project do this?

The key to the success of the project is the participation of growers in the development and "packaging" of information to be used by industry as shown in Figure 1.

Growers participate in the project by:

- Identifying their information needs.
- Gathering and sharing their observations and experiences.
- Reviewing the management packages being developed to make sure they meet their needs.

This information is provided to the project team either by key individual growers or through groups of growers in each of the main growing areas. The project team then arranges the information into management packages to be firstly tested by participating growers and then used by the whole industry. A diverse team consisting of extension officers from Queensland, New South Wales and Western Australia, two researchers and a consultant has been assembled to allow this process to occur.

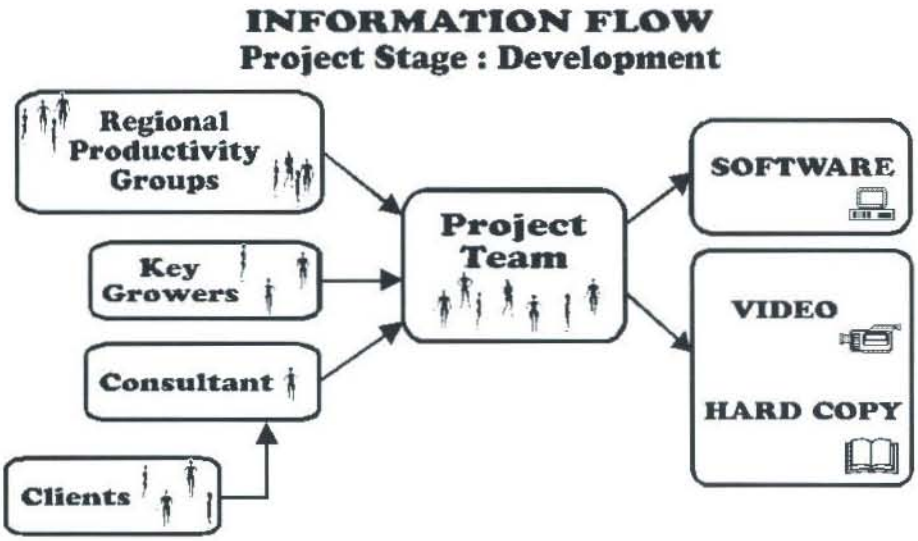


Figure 1. Avoman uses grower information to develop management aids.

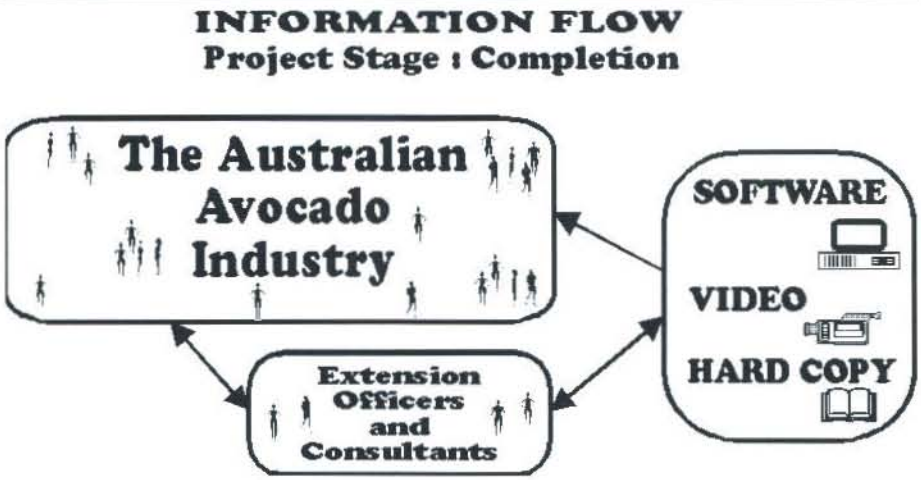


Figure 2. Growers can access the management aids directly or indirectly.

How will growers benefit from the project?

Many growers have said it is difficult to get hold of the available technology or have found the information poorly presented and hard to understand and apply. The main benefit of the project is that growers will be able to say what information they want and in what form. The other great benefit, as shown in Figure 2, is that information will be gathered from around Australia and brought together into one, integrated package. Any avocado grower in Australia will be able to access that package either directly themselves or indirectly through their consultant or through extension officers. All these users will receive training in the use of the package.

Two further points should also be noted. Growers will have a choice of information formats—books and pamphlets, computer software and videos. Secondly, there will be constant and ongoing feedback from growers to update the package with new information.

What will AVOMAN do for me?

The different parts of the package allow growers to:-

- Keep orchard records in an easily usable format for decision making.
- Compare orchard yields, returns, input amounts and costs with regional averages and previous seasons to identify where returns can be increased and costs decreased.
- Predict tree growth stages and plan management activities (e.g. fertilising) to suit. It will also predict yields in terms of volume of fruit and expected sizes for the coming season.

- Select varieties to suit local conditions or desired market opportunities.
- Identify reasons in the field, shed and handling chain why fruit quality is not up to scratch.
- Obtain general and technical information about the industry and the crop.

How will I use AVOMAN?

The AVOMAN package is being produced in two formats. For those of you into computers, it will be a software package for use on IBM compatible machines. You will be able to use the package by:

- Sending your records to a computer facility by letter or fax. Note that the Nambour DPI office is investigating the purchase of a public access computer. This could be used directly by local growers or a person employed to run the program for any grower in Australia for the cost of a handling fee.
- Obtaining the program and installing it on your own computer. (Get your kids to run AVOMAN instead of playing games!).
- Getting your consultant (if you use one) to obtain the program and run it for you.
- Finding another avocado grower with a computer and arranging for them to run the program for you. Some grower groups may wish to explore this option together.

For those of you not wanting to use computers, some parts of the package will also be provided in a book/pamphlet format. These parts will provide technical information but will not be able to process grower records.

When will it all be ready?

Gathering and processing of information takes time. The project aims to have some books and pamphlets available in the second and third years of the project. Parts of the computer software, the videos and further books will be released as they are developed.

Who is paying for this?

The project is financed from grower levies matched dollar for dollar by commonwealth funds. All services and activities provided to regional grower groups have been funded by the project. Full details on the project's budget are available through AAGF.

What's happened so far?

Regional Productivity Groups (RPG's) formed and active

Eleven RPG's have been formed covering all the major growing areas. These groups have conducted planning meetings, assisted by project extension staff, where a range of issues have been identified, priorities and goals set, and action started to achieve these. In addition to this, these groups are also meeting to gather and exchange information on a range of topics covering growing and marketing. Extension staff are involved in conducting field days and farm walks to assist in this flow of information.

Development of AVOMAN

The project team has defined the basic layout and components of AVOMAN. Shane Mulo, the project computer programmer, has developed a layout for AVOGRO (the growth cycle and management indicator component of AVOMAN). He has also commenced work on AVOREC the recording component of AVOMAN.

Investigation of fruit quality problems

Information from an initial sample of fruit from several Brisbane retail fruit shops was used by Scott Ledger (co-ordinating the quality section of the project) to develop a method for assessing internal and external fruit quality. This method was used by Atherton Tableland growers during their recent tour of the Brisbane, Sydney and Melbourne wholesale and retail markets. Growers were able to sample a range of fruit. Quality was variable with some lines showing up to 100% of fruit with defects that would reduce their appeal to consumers. The next step is to decide why these problems are occurring and what needs to be done to overcome them.

What's planned for the future?

Regional Productivity Group activities

The RPG's will continue to meet to tackle issues they have identified. As components of the management package are produced, key growers and RPG members will be asked to give feedback on their content and layout. Once components have been developed, training in their use will be started with the grower groups and then later with the wider industry.

Development of AVOMAN

Two booklets are planned. The first is a description of varieties and their suitability for each growing region. The second will present growth cycles to suit the different varieties grown in the various regions. Work will continue in development of the growth model and recording system components of the computer software.

Grower market surveys

Three surveys of fruit quality using Sydney wholesale and retail markets are planned for the remainder of the current season. The tours would coincide with the peaks of Fuerte and Hass on the market. Surveys conducted will allow growers to assess quality problems in handling avocados. In addition to this, surveys of fruit quality at the farm gate are planned through the RPG's.

One final note

You may have noticed the AVOMAN logo at the top of this article. It is designed to represent the support this project will give to the avocado industry Australia wide in helping individual growers to become more profitable. We look forward as a project team working alongside growers to ensure the success of the AVOMAN project.

Australia And New Zealand Swap Information

Last year, for the first time, Australian and New Zealand avocado growers exchanged cropping information to the benefit of both countries.

The idea was formulated following the 1991/92 marketing fiasco that was brought about by New Zealand fruit being off-loaded in late February and March. New Zealand growers were obviously waiting for the price to rise. When it did not, they panicked and off-loaded far too much fruit too quickly for the markets to handle, depressing the price even further.

Initial consultations took place at the Avocado Conference '92 in September. Delegates from WA, SA, NZ, SE Qld, Sunshine Coast and Mareeba were involved.

Following a positive initial outcome the AAGF agreed to contribute $200 to fund a teleconference with New Zealand. During the teleconference, information on expected receivals from New Zealand and production from Australian districts was swapped.

This information proved relatively accurate and reasonable prices were obtained throughout the period from December to March.

The proposal to share market information across the Tasman prevents the market from reacting to rumour. Australian Hass growers who picked late in the season were previously put under pressure by agents saying in December, "the New Zealanders are coming", and similarly at the end of the season to New Zealanders it was, "the Shepards are coming".

The negotiations should not be construed as "giving the market" to the New Zealanders. Normal market conditions will still apply but without violent fluctuations as in the past.

Expectations are that this market window currently enjoyed by New Zealand will slowly close as Australia produces more later varieties. The real test will come if New Zealand enjoys a bumper crop and attempts to off-load 380,000 trays as it did in 1991/92 compared with 220,000 in 1992/93.

Preliminary Assessment Of G-755c Root Rot Resistant Avocado Rootstock On The Far North Coast Of New South Wales, Australia

By D.J. Firth, NSW Agriculture, Alstonville and R.N. Allen, NSW Agriculture, and Wollongbar

Root rot caused by ***Phytophthora cinnamomi*** is the main limiting factor to avocado production in most parts of the world. Control measures recommended in New South Wales have included close attention to site selection in regard to drainage, exclusion of the pathogen, judicious use of fertilisers and fungicides, and encouragement of biological antagonists through soil improvement. Choice of rootstock has not been of great significance, even though sources of mild resistance have been identified in Californian research and some of these sources have been available in New South Wales for many years. In 1984 however, a potentially highly resistant rootstock cultivar (G-755c) became available from California for evaluation under commercial conditions in New South Wales.

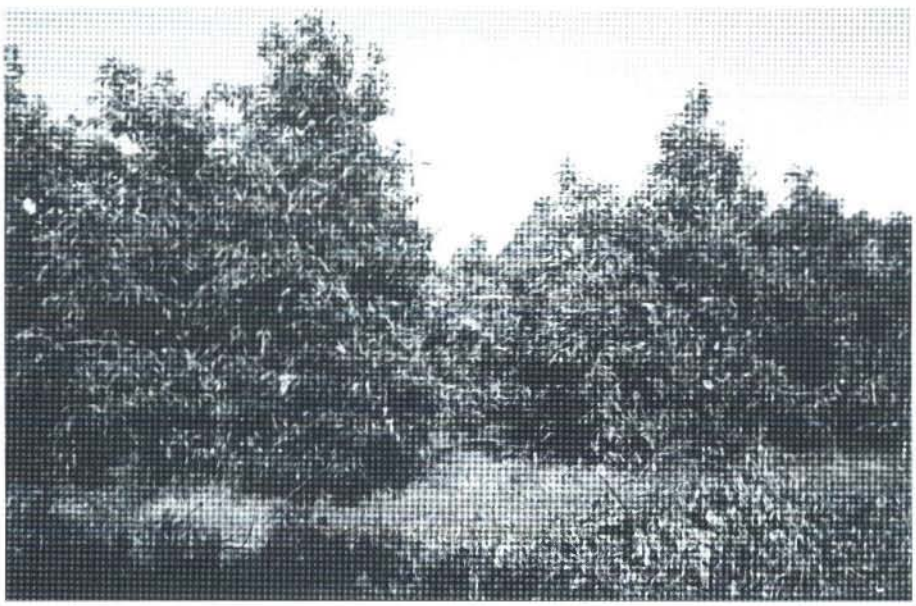
Materials and methods

G-755c (***Persea americana x P. schiedeana***) was imported under licence from the University of California, indexed in quarantine for avocado sunblotch viroid and ds-RNA, and propagated using the nurse seedling method of Brokaw. Sixty grafted Hass plants on G-755c rootstock were produced for field evaluation and compared with grafted Hass on Mexican seedling rootstocks. Trial plantings were made on three farms on red krasnozem soil near Alstonville (29°S) between February and May 1988.

Tree growth (girth, height, canopy diameter), health (1-healthy, 10-dead) and fruiting were assessed annually from May 1989 to August 1992 for both the clonal G-755c and standard Mexican rootstock.

Year	Rootstock	Health Rating*	Height m	Canopy m	Girth cm	Fruit per tree
1989	G-755c	1.0	2.5	2.5	25.7	0
	standard	1.8	2.6	2.5	26.7	8
1990	G-775c	1.0	4.3	4.0	47.6	7
	standard	2.0	3.9	3.7	41.4	40
1991	G-755c	1.3	4.9	4.6	64.3	81
	standard	2.3	4.6	4.2	54.9	103
1992	G-755c	1.6	5.8	6.4	87.0	152
	standard	2.2	5.4	5.9	67.8	176

* Health rating scale: 1 = healthy, 10 = dead



Hass on G-755 clonal rootstock and Mexican rootstock indicating no apparent difference in tree size (apart from girth).

Results

Growth and health data for each year are summarised in Table 1. The clonal G-755c trees were slow to establish compared with the standard Mexican seedling rootstock trees. Girth in the second year, for example, averaged 25.7 cm for clonals compared with 26.7 cm for standard stocks. By the third year however, superior growth rate in the clonals reversed this trend with a 30% greater girth than non-clonals by year 5 (Table 1). Overgrowths of the Hass scion at the graft union occurred on only 5% of the clonals compared with 23% on standard stocks. Tree health was on average better on clonal than standard stocks.

The superior vigour on the clonal G-755c stocks resulted in some reduced fruit production in the three years of bearing observed. The standard stocks began bearing in year 2, compared with year 3 in the clonals, and numbers of fruit per tree were greater on standard stocks at all three sites in each year. There was evidence however that differences in fruit production between stocks decline with increasing age of the trees.

Discussion

G-755c propagated satisfactorily under New South Wales conditions, and trees on this rootstock grew and produced fruit satisfactorily. Our results confirm observations in California that Hass on G-755c does not bear as well as Hass on seedling rootstocks. Under subtropical New South Wales conditions however, this yield difference is not as great as in California and could be offset easily in the long term by better tree health and greater longevity.

Pest Control

By engineering scorpion and wasp venom into a virus at a molecular level, biologists at the CSIRO Division of Entomology have achieved a world first with a technique for controlling beetle and locus pests without the use of chemicals.

The new viruses attack only the target pests and will not affect benign insects, birds, animals or humans.

The division has had previous success in engineering a virus to control the cotton bollworm.

History And Development Of The Avocado Industry In Australia

By Katrina Bond, Economist, Agtrans Research, Brisbane and Ian Wood, CSIRO Division of Tropical Crops and Pastures, Brisbane

Common Names

Avocado, Avocado pear

Species

Persea americana

Crop Description

Avocados are evergreen rainforest trees growing up to 18 metres tall. There are three main commercial varieties in Australia (Fuerte, Hass and Sharwill), of which Fuerte is the most common. While seedlings may take up to ten years to bear their first crop, grafted trees of selected scion varieties can begin cropping in three to six years.

Uses

The fruit of the avocado is nutritious and high in polyunsaturated oil, protein and vitamins. Avocado fruits can be cut or sliced into soups, entrees, salads and hot dishes. They can also be blended with icecream, mousse, lemonade or milk. The fruit can also be used as a base for dips. A 1990 survey of Australian consumers indicated that more than 50% of avocado buyers use them in salads, on their own, in savoury dips and/or in sandwiches. Use in cooked meals was less frequent.

History

Approximately 65% of Australia's avocado production is in Queensland, and around 25% is produced in New South Wales. Small quantities of avocados are also produced in Victoria, Western Australia and South Australia. Because of the geographical diversity of Australia's plantings, domestically produced avocados are available throughout the year, but only in very small quantities from mid-January to mid-February. Much of the supply from mid-January to mid-February is of poor quality as growers attempt to receive out-of-season premiums and do not pick fruit at optimum maturity. Imported avocados from New Zealand are also available during Australia's off-season.

Avocados were first grown commercially in Australia in 1930 at Nambour in Queensland. Further plantings were made in the early 1930s at Redland Bay and Tambourine Mountain in Queensland and Duranbah in New South Wales.

Production increased steadily during the 1960s and early 1970s, but in 1974 and 1976 wet seasons devastated many plantings in Queensland and Northern New South Wales. During the 1970s there was an increasing consumer awareness of avocados, and retail prices for the fruit increased with the rising demand. Prices increased further with production shortages caused by floods in the mid 1970s. The high prices encouraged interest in the industry and avocado plantings were high during the late 1970s and early 1980s.

Many of the investments in avocado plantings were by previously non-farmers, many of whom were attracted by the lifestyle. Most avocado growers have more than one source of income, such as other tree crops, nurseries or tourism. Avocado plantations are mainly owner managed. Although avocado harvesting and handling is only partly mechanised, prices received have generally been sufficient to accommodate high labour costs.

Since the mid 1970s the industry has become very organised with respect to R&D and promotion. There are several local grower organisations and state grower associations in Queensland, New South Wales, Victoria and South Australia. The national body, the Australian Avocado Growers' Federation (AAGF), was established in 1974 and has played a significant role in R&D organisation and prioritisation. The AAGF has also organised four-yearly industry conferences since 1978 for the dissemination of information. Conferences have frequently featured guest speakers from California.

Prior to 1992 avocado R&D and promotion was funded by compulsory levies in

Statistics

Year ending March 31	Total number of trees ('000)	Number of bearing trees	Volume of production (tonnes)	Gross value of production ($ million)
1973	65	21	941	NRA
1974	71	21	688	NRA
1975	74	20	664	NRA
1976	92	23	710	NRA
1977	105	25	570	NRA
1978	118	33	662	NRA
1979	164	47	980	NRA
1980	181	65	1400	NRA
1981	239	91	1700	NRA
1982	303	118	2400	6.4
1983	356	163	3400	8.6
1984	425	202	5400	9.8
1985	460	157	6200	10.9
1986	406	149	7000	11.9
1987	455	195	9700	15.9
1988	454	217	9798	13.3
1989	462	267	11082	21.6
1990	472	304	11414	23.3
1991				

Source: Australian Bureau of Statistics
Notes: NRA = Not Readily Available from published ABS sources.

This case study on the avocado industry was part of a project supported by the Rural Industries Research and Development Corporation. Besides giving a brief history of avocado production in Australia, it aimed at identifying factors that have contributed to, and constrained the development of, the industry.

21 ☛ Queensland and voluntary levies in other producing states. Some commonwealth and state funds were also made available for avocado research. In January 1992, the avocado industry joined the Horticultural Research and Development Corporation (HRDC) and from June 1992 has been a member of the Australian Horticultural Corporation (AHC). Through these two bodies compulsory levies are now collected for research, development and promotion in all producing states. Industry research funds are matched by commonwealth funds.

Most promotions have been carried out by the Avocado Subcommittee of the Queensland Fruit and Vegetable Growers (QFVG). Avocado promotion has traditionally involved radio commercials and in-store demonstrations. In the past two years magazine advertisements have replaced radio commercials. In-store demonstrations remain a key component of promotion.

During the 1980s, promotion targeted the dispelling of myths about avocados. For example, stickers were placed in individual fruits advertising that they contained "no cholesterol". The avocado industry has purposely destroyed the image that avocados are a luxury fruit in order to expand their potential market size.

Much of Australia's avocado research has been based on existing knowledge of the Californian industry where avocado growing conditions are similar to those in Australia. Other research has been original and in some areas Australia's technology surpasses California's. Production and post-harvest handling knowledge has been built up through research by various State Departments of Agriculture, particularly the Queensland Department of Primary Industries (QDPI) and New South Wales Agriculture.

Some of the most significant production research has been the development of trunk injected phosphorus acid treatments for trees infected with root rot caused by *Phytophthora cinnamomi*. Australian research in this area has been carried out by the Queensland Department of Primary Industries and was based on previous research in France and South Africa. France had developed a phosphorus acid based spray to treat phytophthora in other crops, but the spray was incompatible with the use of copper sprays used commonly in the Australian avocado industry.

The development of trunk injection techniques in South Africa provided an alternative application method that was shown by the QDPI to be successful in treating phytophthora in avocado trees. This breakthrough has not eliminated phytophthora, but its effects, and the costs of treating it, have been reduced substantially since its adoption in the mid 1980s. For the best results, trunk injection should be accompanied by appropriate fertiliser, mulching and irrigation, but this is not well practised.

The quality of avocados is affected by the disease anthracnose which causes fruit to blacken. Anthracnose can be controlled by field fungicide sprays and post-harvest fungicide dips. Research into the control of anthracnose was carried out by NSW Agriculture and the QDPI in the late 1970s and the early 1980s. Current research by the QDPI aims at developing biological controls for anthracnose.

Other production-related research includes orchard design, water management and tree growth cycles. Post-harvest handling research carried out by the QDPI includes: the development of maturity indices and quality standards; optimising cool storage temperatures for avocados sold domestically; and investigating the potential for exports by sea using controlled atmosphere storage.

Much of the research has been either not well understood, or not widely adopted, at least partly because of limited or inappropriate extension services. The lack of utilisation of available technology and poor cultural practices has meant the quantity and quality of avocados produced and

Summary of Factors Influencing the Industry's Growth and Development

Production

Factors associated with production that were important to the industry's growth and development	Positive or Negative Factors?	Year(s) of impact	Importance (High, Med., Low)
Crop damage caused by phytophthora.	Negative	1950 -	High
Deterioration of fruit caused by anthracnose.	Negative	1950 -	High
Reduced impact of phytophthora due to use of trunk injection techniques.	Positive	1984 -	High
Reduced impact of anthracnose due to use of fungicide sprays and dips.	Positive	early 1980s -	Medium
Transfer of Californian production knowledge to Australia.	Positive	1950 -	High
Increased plantings encouraged by high prices received during the 1970s.	Positive	late 1970s and early 1980s	High
Reduced confidence in the industry due to falling prices in the 1980s.	Negative	mid 1980s - 1990	Medium

Processing

Factors associated with processing that were important to the industry's growth and development	Positive or Negative Factor?	Year(s) of impact	Importance (High, Med., Low)
Introduction of frozen avocado halves	Positive	?	Low
No equipment to halve and peel	Negative	?	Low

Marketing

Key factors associated with marketing (incl. transport etc.) that were important to the industry's growth and development:	Positive or Negative Factors?	Year(s) of impact	Importance (High, Med., Low)
Restricted exports due to the incidence of fruit fly in avocado growing areas.	Negative	1970 -	Medium
Variable quality of avocados reaching consumers.	Negative	1960 -	High
Organised promotion of avocados	Positive	??	High
Large number of individual growers marketing small quantities of avocados. Few packing sheds for organised marketing and quality control.	Negative	1950 -	High
Increased use of refrigerated transport.	Positive	1987 -	Medium
Exports restricted by the fruit's perishability, the high cost of air freight and the lack of reliable sea transport technology.	Negative	1950 -	Medium
Lack of accurate production and consumption knowledge within the industry.	Negative	1986 -	High

delivered to markets has been below potential.

A current project being carried out by New South Wales Agriculture, the Western Australian Department of Agriculture and QDPI, aims at improving grower understanding of research results and formulating a standardised set of recommendations for growers. Both technology transfer and variable fruit quality are key issues identified in the industry's strategic plan established by the AAGF and the HRDC this year.

The variable quality of avocados reaching consumers has been the industry's most significant marketing problem. According to ABARE (1992, p.59), each year "around 12 per cent of production is rejected for sale because of disease and blemishing". Furthermore, poor quality avocados that reach consumers deter repeat purchases. Variable and poor avocado quality has been attributed to:

- the fragile and perishable nature of the fruit,
- poor orchard management and incorrect handling of fruit,
- picking of fruit when it is not at optimum maturity in pursuit of out-of-season market premiums,
- unclear state grade standards and no national grade standards,
- ineffective endpoint inspection, and
- no quality assurance programs except in three packing sheds in Queensland.

Refrigerated transport of avocados has become more widely used in the last 5 years and this has improved fruit quality. In addition, quality assurance programs have recently been introduced to three packing sheds in Queensland and plans are for the expansion of such programs. The quality assurance program for the Sunshine Coast Fruit Growers Co-operative was designed by the QDPI and covers minimum quality standards, handling recommendations and staff training.

Progress in the area of uniform and adequate quality control has been limited by the industry's lack of integration and co-operation with respect to marketing. The lack of co-operative marketing has also limited export opportunities. However, the Sunshine Coast Fruit Marketing Co-operative, whose members include 80 avocado growers, exports 25% of avocados marketed through the co-operative. This compares to a national export figure estimated by ABARE at around 4% of total Australian avocado production.

Although the avocado industry is known for its progressive growers, many growers are suspicious of joint marketing groups. Furthermore, marketing problems are not widely perceived as urgent among growers. In 1986/87 strong fears of oversupply emerged when prices fell dramatically in response to the large volumes of avocados on the market, caused by large plantings in the late 1970s and early 1980s. Production has since grown more steadily and sustained oversupply problems have not been experienced. Production growth has been at least partly restricted by production and climatic problems. The real avocado prices declined during the 1980s but have shown some improvement during the 1990s. Accurate production and consumption information has not been collected by the industry since 1986, thus making industry planning difficult.

The lack of marketing organisation has also restricted export growth since individual growers are too small to develop a reliable export market. Export potential is also limited by the fruit's perishability and the high cost of airfreight. Avocado exports to some countries, particularly Japan, are prohibited by the incidence of fruit fly in Australia.

Government Involvement (excluding R, D and E)

Type of Government Involvement	Positive or Negative Factors?	Year(s) of impact	Importance (High, Med., Low)
Guaranteed matching of R&D money	Positive	1992 -	High *
Compulsory levies in Queensland	Positive	??	High
Compulsory levies throughout Australia	Positive	1992 -	High *

* Since the full impact of this factor will be determined in the future, the assigned level of importance is a preliminary judgment only.

Research, Development and Extension

RDE Activity	Organisation(s) Involved	Year(s) of RDE Activity	Positive or Negative Factors?	Year(s) of impact	Importance (High, Med, Low)
Development of maturity indices and quality standards.	QDPI	1970s	Positive	1970s -	High
Development of fungicide treatments for the control of anthracnose.	NSW Ag and QDPI	1970s - early 1980s	Positive	late 1970s	High
Investigation of cool storage and controlled atmosphere storage, and the development of a quality assurance program.	QDPI	early 1980s	Positive	1985 -	Medium
Control of Phytophthora.	QDPI	1980s	Positive	1984 -	High

Summary of Key Factors

Key factors that have been instrumental in the growth and development of the industry (in order of importance):

1. Transfer of Californian knowledge to Australia.
2. Organised R&D and promotion through the AAGF and the Avocado Subcommittee of the QFVG.
3. R&D carried out by State Departments of Agriculture.

Key factors that have constrained the development of the industry (in order of importance):

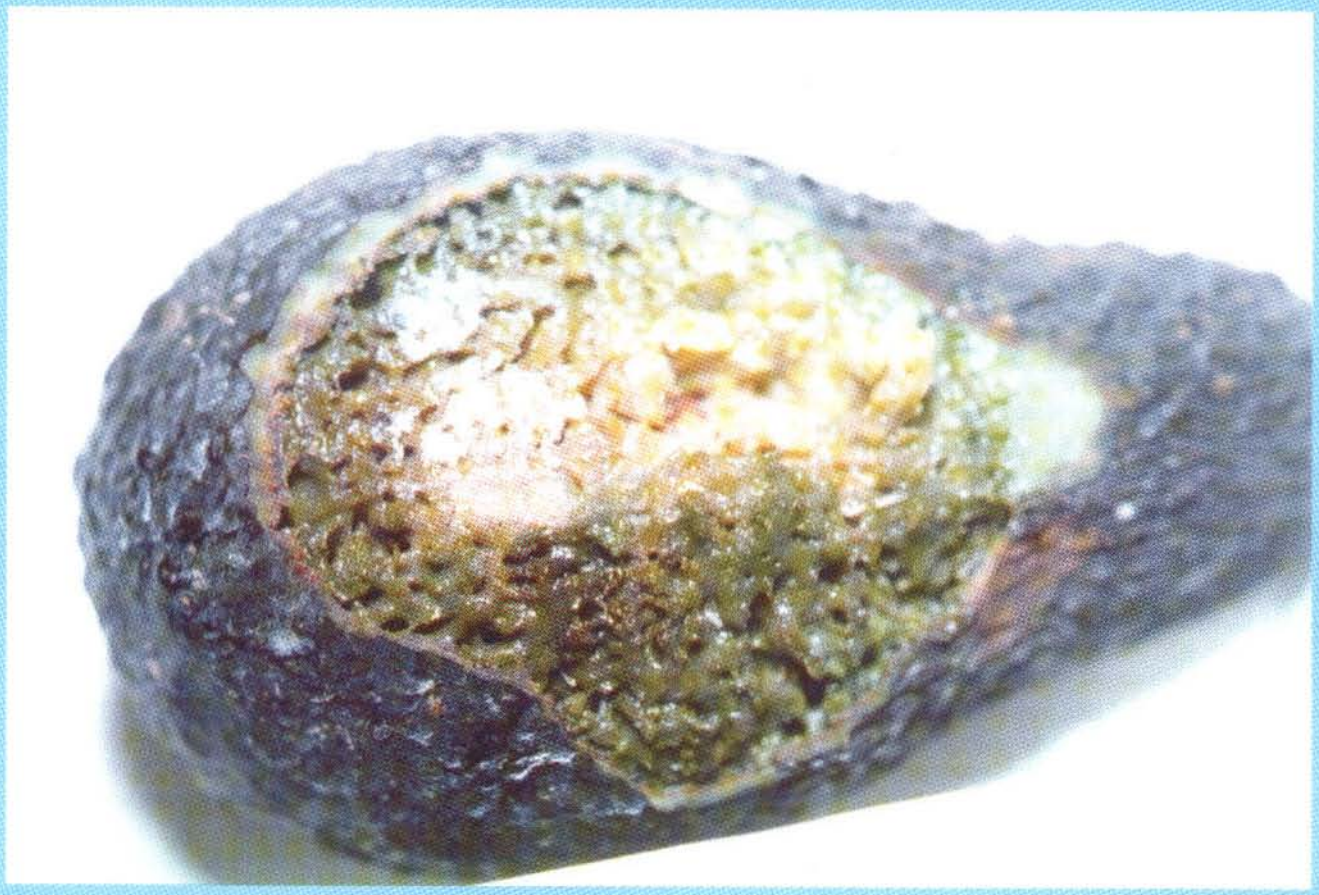
1. Variable quality of avocados reaching consumers.
2. Poor utilisation of available technology.
3. Large number of small growers and a lack of organised marketing at a state or national level.

Lessons and Implications

The major period of growth in avocado plantings in Australia was experienced in the late 1970s and early 1980s in response to a growing demand for the fruit and high prices being paid for it.

Australia's avocado industry has benefited from knowledge built up by the Californian industry, particularly since California has similar avocado growing conditions to Australia. Original research has also been carried out, and Australia has a strong avocado knowledge base. However, inadequate extension has contributed to a low level of adoption and/or understanding of many research results.

The industry has benefited from organisation in the areas of research and promotion. In contrast, there is very little organisation of the marketing of avocados. This has hindered quality control efforts and poor quality fruit reaching consumers has limited domestic avocado demand.



Hass Avocado Showing Entry Area Of Fruit Fly

Hass Avocado Infested With Queensland Fruit Fly