

AUSTRALIAN NUFFIELD FARMING
SCHOLARS ASSOCIATION



1997 SCHOLARSHIP REPORT

By

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Topic: Growing, packaging and marketing of lychees and other sub-tropical fruits, as well as pruning and crop protection methods used to maximise cropping.

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Acknowledgments

As Secretary of the Far North Qld Lychee Growers' Association, I used to receive many letters from other organisations and individuals either offering or asking for help. When I first received a letter from the Australian Nuffield Farming Scholars Association, detailing the benefits of one of their scholarships, I was half inclined to simply ignore it. However being a responsible secretary, I decided to respond by requesting an application form, in the belief someone in my Association may like to apply. This duly arrived and was tabled at our monthly meeting, with no one showing any interest.

Imagine my surprise then when I received a phone call from David Thomson asking when my application was arriving. After some persuasive talking on his part, I somewhat hesitantly submitted an application, fully expecting to receive a negative response.

The rest is history. After getting through to the final interview in Melbourne, only to miss out to that year's Queensland recipient, Duncan McMaster, I was then asked to host a day for the next year's world conference in Queensland. I believe that was a very successful day and I was encouraged by many Nuffield people to try again in 1998. Again with a certain amount of reluctance I applied and this time was successful.

It is only now, on looking back at what I have seen and learnt both during the tenure of my scholarship and afterwards, that the enormity of the opportunity I had been given, strikes home. Professionally, culturally and personally, I have learnt so much.

Being awarded a Nuffield Scholarship has given me an opportunity to learn from fellow farmers, researchers, government officials, wholesalers, merchants and exporters. My heartfelt thanks to all these people, too numerous to mention by name, for all their help, encouragement and guidance, both then and in the future.

I would also like to pay special tribute to my wife, Sue and son, Nicholas for carrying on without me for so long and ensuring the farm did not suffer without my presence. Also to my neighbours, Chris and Greg, for all the slashing, spraying, fertilising, pruning and watering they did while I was enjoying myself. They must have done a good job - we had our best crop ever that year. Perhaps I should go away more often!

Thank you also to my host farmers in England, Liz and Niel Nicholson. They welcomed me warmly into their home and their kindness and understanding for a very weary traveller will long be remembered.

To my generous sponsors, Qantas and PIBA, I thank you so much for your financial assistance. This has given me, but more importantly the lychee industry in Australia, a real opportunity to advance our fledgling industry here in Australia so that we can compete more successfully on the world market.

I would also like to sincerely thank the Australian Nuffield Farming Scholars Association, its members and selection committees, for firstly encouraging me to apply, and then having the faith in me to grant me admission into the Nuffield family. I have encountered genuine interest and friendship from everyone I have met in Nuffield, and I will be forever grateful to everyone for their warm welcome.

Last, but by no means least, I would like to thank my fellow scholars.

Kerrie Richards	Qld
Andrew Barfield	Qld
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David Brownhill	NSW
David Harvey	SA
Kevin Old	NZ
Marise James	NZ
Christine Robin	France
Sarah Mackie	Scotland
Peter Hatendi	Zimbabwe
John Lohr	Canada

For 6 weeks we shared hotel rooms, cramped minibuses and dining tables. Most importantly we laughed, talked, drank and learnt together and supported each other through the difficult times. It was 6 weeks of my life I will never forget and I thank you all for making it such a memorable experience.

Nuffield has given me friends and colleagues throughout the world, both in the agricultural sector and beyond. It has opened up a world of challenges and opportunities, some of which I am now starting to pursue. As a result of this experience, I have been fuelled with a new sense of enthusiasm for lychee and tropical fruit growing and am looking forward to embarking on further related business opportunities that I have identified.

Objectives

My objective was to study the growing, packaging, transporting and marketing of lychee and other sub-tropical fruits, as well as pruning and crop protection methods used to maximise cropping.

To meet this objective, I aimed to look at packaging and marketing techniques both in the UK and Europe, by visiting packhouses, farms and fruit and vegetable markets in the UK, as well as various supermarket chains throughout the length of England and Scotland.

As far as the farming side of the study was concerned, it was my original intention to visit both China and Hawaii - China to look at the pruning, crop protection, fertilising, watering and other related farm management areas and Hawaii to learn more of a newly developed post-harvest technique claiming to maintain the red colour of fresh fruit longer than the present 2-3 days out of refrigeration.

However a combination of events led me to changing these plans to visiting Thailand instead. These events included further information regarding problems with the Hawaii technique, a singular lack of success establishing suitable and willing contacts within China, advice from Department of Primary Industry officers within Australia and fast depleting cash reserves brought about by the weak Australian dollar compared with the English pound.

This change, however, proved both prophetic and rewarding. Since this initial foray into the Thai lychee industry, I have returned twice more to further my studies there. Once was in the company of my family and recently in the company of 27 other growers, as well as a Department of Primary Industry Representative and our Marketing Coordinator here in Australia. I consider the facts and ideas generated on each of the visits to be part of my Nuffield studies, although the third visit was at my own expense. I have written an article for Queensland Fruit and Vegetable News detailing this trip and will also be presenting a paper at the triennial Australian Lychee Conference set down for Noosa in September, 1999. Of course the name of Nuffield will be given special mention there.

I should mention here that my report, written for fellow Nuffield Scholars of which I am the only lychee grower, contains material intended as background information, to make the reading of the results of my study overseas more meaningful and informative.

Introduction

The lychee industry in Australia is a small, but growing industry, supplying both the domestic market, but more increasingly a booming export trade. Demand currently exceeds supply, both within Australia and overseas, so that growers can demand high prices for premium fruit. Australian fruit is also recognised as the best in the world as far as quality and presentation is concerned, a reputation the industry is working hard to maintain.

Australia currently has plantings of the several different varieties, totalling around 300,000 trees. These are grown on approximately 400 farms, covering an area of some 1600 ha.

Varieties of Lychee Grown in Australia

Tai So	17%
Kwai Mai Pink	50%
Wai Chee	12%
Salathial	7%
Bengal	4%
Others	10%

Ages of plantings are as follows.

Aged 1 - 5 years	29%
Aged 6 - 10 years	21%
Aged 10+ years	50%

These figures suggest that approximately half the planted trees in Australia have not yet reached their peak production years (10+), but will do so over the next few years. Couple that with planned new plantings of 21797 trees over the next 5 years and it is obvious that production will soon start to overtake local demand. Hence the increasing push towards the development of reliable and stable export markets to maintain healthy returns to all growers.

Australia produces about 3000 tonnes of lychee, returning some \$A15 M to growers. Ignoring seasonal variations, this production will increase in line with the tree number increases as indicated above.

Presently about 800 tonnes are exported, mainly to Hong Kong, Singapore and the Pacific Islands, but some is also being sent to the United Kingdom and the European Community. Returns more than favourably compare with alternative crops such as macadamia, stonefruit and mango. The major problem with lychee is irregular flowering, poor fruit retention and biennial bearing in some districts. Harvesting and pest control in older orchards with large trees is also a problem. Work has been carried out in Australia, with funds from the Australian Lychee Growers Association and the Horticultural Institute Research and Development Corporation, to investigate these problems, but so far no practical, cost effective solutions have been identified.

Part of my study was to look at how these problems were being addressed overseas and then test their effectiveness in our orchards here in Australia.

Like all tropical and sub-tropical fruits, lychee are delicious to eat, but have a limited shelf life. Their attractive bright red colour is quickly replaced by a dull to dark brown colour within hours of their being removed from the tree, unless they are handled carefully and quickly and are refrigerated as soon as possible. This alteration of colour is caused by the inedible outer skin drying out and losing moisture, but does not effect the eating quality of the fruit inside. However bright red, attractive fruit sell much more easily than dull brown fruit - hence the efforts to maintain the "wet, cool" chain. This is particularly the case in developing markets like Australia, where the public recognition of lychee is not high. Being able to present a bright red, attractive fruit that appeals to the eye makes selling to first time buyers so much easier. After an initial purchase, the taste of the fruit ensures further purchases.

Hence my wish to study research activities being carried out overseas to maintain the "redness" of the fruit. While not allowed in Australia, the sulphur dioxide/hydrochloric acid treatment used by some overseas countries warranted further investigation, as well as a system developed in Hawaii. Since returning to Australia, I have been made aware of a new treatment developed by the Israelis which is supposed to maintain the colour for 4 - 5 weeks.

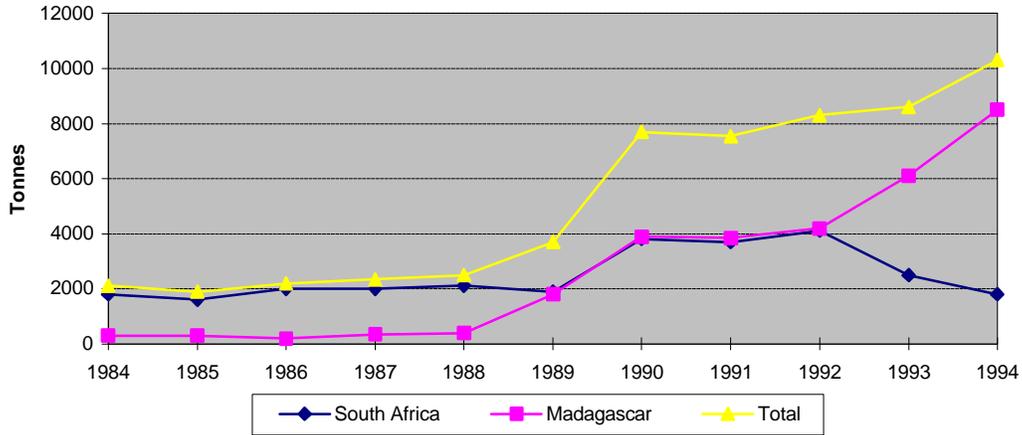
Myself, as well as three other prominent growers in North Queensland, are now in the planning stage of arranging a trip to Israel in July or August of 1999. We intend to study this process and if it is as successful as is claimed, import the machinery or technology into Australia.

Marketing and Packaging Lychee in Europe

Lychee have only been exported into the European countries since the early 1980's. Imports of about 2000 tonnes were supplied by South Africa using fruit treated with the newly developed sulphur dioxide system. However as this system started to be used by neighbouring countries such as Madagascar, South African product became less dominant. This had two possible causes. Firstly, the development of a group of 'collectors', entrepreneurs who act as a link between producers and exporters. Secondly, the construction of enhanced transport systems in Madagascar including air freight terminals, sea freight terminals and improved internal road systems.

Madagascar's behaviour in another form was the other issue of the 1980s. Efficient shipping schedules were established and an orderly marketing program developed. Good prices resulted. Unfortunately, the Wall Street greed creed of the 1980s was echoed in far off Madagascar. The good prices encouraged the entry into the industry of less-than-professional collectors. Orderly marketing gave way to disorderly marketing. Prices dropped. In the third season the gestating disaster was born with intense price competition. Less efficient collectors disappeared from the industry and the cycle started again.

European Imports, 1984-94



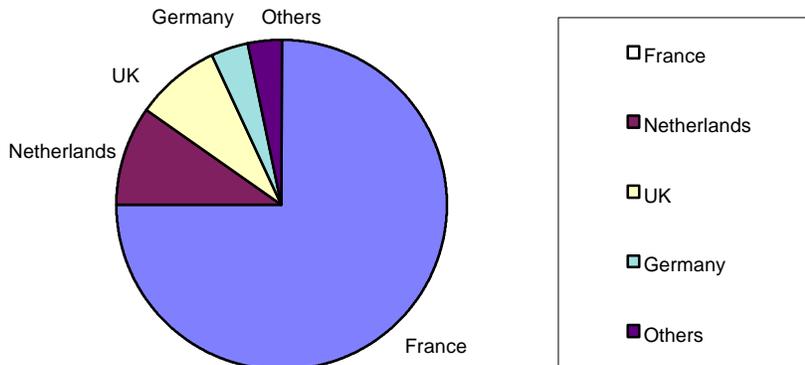
Presently lychees are a major import item into Europe. Total volumes exceed passionfruit and are comparable with papaya. France continues its position as the region's largest importer. This can be attributed to:

- the historical colonial ties with the three Indian Ocean republics and the commercial linkages which result from that history;
- the development of a sector experienced in the handling, technical and commercial aspects of the product; and
- the large Asian population in Paris.

However a large number of other countries are now consuming lychees. Wholesaling of lychee is now taking place in these European countries:

- | | | |
|---------|-------------|-------------|
| Austria | Belgium | Denmark |
| Finland | France | Germany |
| Italy | Netherlands | Norway |
| UK | Sweden | Switzerland |

Major European Lychee Importers



Paralleling the increase in the number of destinations has been the increase in the number of suppliers. The present supply calendar is presented below. Madagascar's lack of discipline in the late 1980s continues into the present. The 1993-94 season was a disaster. About 1000 tonnes arrived by air. Unfortunately the 7600 tonnes which came by sea was highly erratic. The monthly maritime arrivals were:

November	1993	84 t
December	1993	5528 t
January	1994	2039 t

At one stage four ships with a total of 3900 tonnes arrived within a few days of each other. Compounding the problem was the fact that they were not sweet. As a result prices collapsed. Fortunately most lychee growers in Australia have recognised the disadvantages of such an antiquated individualistic approach to marketing and have formed marketing cooperatives to regulate the supply and markets.

Wholesalers and retailers in the United Kingdom reported to me the qualities they looked for in purchasing lychee. These were

- Red colour
- Large fruit - around 3cm diameter
- Clean, undamaged with no decay or insect stings
- Well presented pack
- Small seed and sweet fruit
- Continuity of supply

The major stumbling block for the lychee industry in Australia to overcome then is the first of the above. I was assured by the majority of buyers in the United Kingdom that the Australian fruit is far superior to fruit from all other countries - it is the colour problem that causes most concerns. Australia has now been exporting small quantities of lychee into the European community since the early 1990's. This has been limited by the high freight costs associated with air transport (presently around \$3.00 per kilo) and competition from treated fruit from South Africa and Madagascar. However we have rapidly acquired a reputation for having the best lychee in the world, if a little expensive.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept
Mauritius		*	*	*								
Reunion		*	*	*								
Madagascar		*	*	*	*							
RSA			*	*	*	*						
Thailand								*	*	*		
Israel										*	*	*
Australia		*	*	*	*							
Vietnam								*	*	*		
India								*	*			
China								*	*	*		

We presently supply a high cost “niche” market in more fashionable parts of cities. However as our competitors raise their quality standards and the new “colour fixing” technology becomes more widespread, this niche market will disappear and because of freight costs, our competitive edge will be lost. For this reason, I believe the long term future for Australian lychee export lies in our Northern Asian neighbours and the Pacific rim countries.

Packaging of fruit and vegetables throughout Europe and the UK was aimed at the housewife doing her shopping 3 or 4 times a week. Produce was displayed in small, individually wrapped packages allowing retailers no contact with the product until after purchase. Selection was made on a visual inspection only. There was little chance of a smell test and certainly feel and taste tests were actively discouraged. Many of the larger fruits were precut and sold per piece or with a medley of other fruits. Vegetables were also sold in this way - already washed, peeled and cut - so that the housewife only had to tip them from the packet to use them.

Such a sterilised retailing of fresh produce has certain advantages for the retailer. Reduction of waste, cleaner selling floors, less pilfering and fresh product being sold by the unit (with their own barcode) rather than by weight. However the major consideration for retailers is the food safety aspect. Being wrapped affords little chance of contamination after delivery, as well as in many cases providing the grower’s name and address on the wrapping. If a consumer falls ill after eating a piece of fruit, it is easy for the consumer to trace the source back to the grower. If this were not possible, the retailer would bear much of the responsibility and hence legal costs.

This does, however, put added responsibility back onto the grower. The use of only registered chemicals, keeping accurate and detailed records of spraying, fertilising etc and maintaining clean, orderly packhouses is now essential to the modern farmer. However it is in the use of packaging where the grower faces his greatest challenges. Supermarkets in the United Kingdom and Europe and increasingly so in Australia, are demanding prepackaged, traceable and high quality produce that involves very little handling on their part.

In the United Kingdom I saw various systems used to satisfy these demands. Kettle Produce in Scotland contracted growers in the area to grow various vegetables, which they then washed, peeled, cut, diced and combined into various mixes, all hygienically sealed into their own branded bags and delivered to the supermarkets. A strawberry importer in Kent (who wanted to source lychees from me and treat the same way) imported punnets of strawberries from Spain that were unbranded. He then simply put the supermarkets own stickers on them (Sainburys, Marks and Spencer etc) as they ordered and shipped them to the relevant stores. In one case he was even putting on the supermarkets stickers and then putting a “Reduced” sticker over the top, as well as their ‘new’ price. Other smaller soft fruit growers punnetised their own produce, labelled and barcoded, which were then delivered to the supermarkets buyers.

In Australia lychees have traditionally been packaged in a 5kg box, which on delivery to the retailer is emptied out and sold by weight. This process has actually been detrimental to the keeping qualities of the fruit. On entering the European market in the early 1990's we then developed a 2kg box, so that we could compete directly with the South African fruit which was already being marketed in this way. After my Nuffield Scholarship visit to the United Kingdom and Europe and hearing my report on packaging, my marketing organisation set about developing our own package design incorporating individually branded and barcoded punnets. These were put onto the Australian market last year for the first time and although only small numbers were marketed, were warmly received by most retailers, especially in the peak production times. The initial costs of producing this packaging process was quite substantial and it also increased the grower's direct packing costs, but growers were happy in the knowledge that they were instrumental in determining their own packaging initiatives and did not have the process forced upon them by retailer's specifications.

Lychee Growing and Marketing in Thailand

Thailand is one of the major producers of tropical fruits in the world and recently the government, in cooperation with the Department of Agricultural Extension, Ministry of Agriculture and Cooperatives, has been actively pushing the export of most of these fruits throughout the world. Luckily for growers here in Australia, seasonality of all tropical fruits means that the Thais do not compete directly with us. With this knowledge in mind, I set out to study lychee production in Thailand and in the process hope to forge ongoing cooperation between growers and researchers in both countries.

I would like to take this opportunity to thank the following Thai people for their help, encouragement, and understanding, but most importantly for their continuing friendship during the course of my three visits to their country to learn more of the lychee industry.

Sainarong Rasananda - Chairman, Longon Growers Association of Thailand
Dr Ravie Sethpakdee Ph.D. - researcher, Kasetsart University, Bangkok
Dr Nantarat - lychee researcher, ChiangRai Horticultural Research Station
Prempree Nasongkhla - editor, Kehakankaset Magazine (Horticulture)
Pradoldej Kalayanamit - tropical fruit grower, Thaton River, Mae Ai, Thailand
Ladarat Kruajun - travel coordinator and interpreter
Thongchai Yantarasri - Postharvest Engineering Laboratory, Chiang Mai University
Montri Wongrakpanich - Fruit tree subdivision, Dept of Agricultural Extension, Bangkok
Dr Anawat Suwanagul, research officer, Thai Institute of Scientific and Technological Research
Samphan Kantiphan - lychee grower, Phayao, Thailand
Dr Sing Ching Tondee - researcher, Kasetsart University, Bangkok
Praphun Kunawong - assistant manager, Boonrawd Farm, Chiang Rai
as well as the many other smaller growers I met in my travels throughout the Kingdom.

Thailand is the second biggest producer of lychee in the world after China. Lychee orchards in Thailand cover an area of approximately 19 000 hectares and this figure is increasing on an average of 19% per year. Production figures vary considerably each year, but a figure of around 50 000 tonnes is the norm. Compare that with the Australian production of 3000 tonnes and it is easy to see where we stand on the world's lychee 'pecking' order.

Lychee in Thailand has traditionally been grown in the northern region where the weather is cool during the winter. However, lychee orchards have also successfully been established in the central plains, especially in the Samut Songkhram province, using a cultivar tolerant of warmer weather. This variety, known locally as 'Khom,' produces a smaller, thick skinned fruit which, frankly speaking, was a little disappointing. Its great advantage however, is that it comes into production considerably earlier than other varieties and so demands a premium price. While I was initially keen to import this variety into Australia, I feel its poor eating quality would detract from the better varieties coming into season at a later date.

Only about 1.5% of land given over to tropical fruit production in Thailand is used for lychee. The major tropical fruits grown are mango (300 000ha), pineapple (90 000ha), longan (55 000ha), durian (130 000ha), rambutan (75 000ha), mangosteen (40 000ha), pummelo (26 000ha), papaya (25 000ha), and tangerine (42 000ha). There are few times in the year when at least half a dozen of these are not available. A tropical fruit lover's idea of paradise - it's no wonder I love the place!

Step 1 - Growing the trees

Australian tropical fruit orchards are traditionally grown on flat or slightly undulating land. This is primarily because of the costs of harvesting and tree management - a large expense given our high labour costs. In Thailand however, their good flat agricultural land is used for rice and vegetable production and the hillsides are reserved for fruit tree orchards. Obviously the low labour costs make this possible. Khun Pradoldej Kalayanamit, the largest lychee grower in Thailand with 8 lychee orchards, is also a mango, tangerine and strawberry grower. He told me he pays his workers 75 baht a day (about A\$3.10) for a dawn to dusk workday and has about 10 full time workers per farm. The all year round jobs such as slashing, spraying, watering and pruning are all then done by hand at little expense to the grower.

Watering

I observed several methods of watering in Thai orchards. Several lychee farms, as well as some mango and longan orchards I inspected, dug a shallow pit around each tree on the drip line, which was then filled with water by buckets. Other orchardists in the Thaton / Fang area whose trees are often grown on 50 degree slopes, pump water to the top of the slope and simply let the water run down the hill. Many of the more affluent orchardists used under tree irrigation, but used tall aluminium stand pipes (2 - 3 m) to spray high up in the tree. They claimed this spread the water further (?) and also added humidity to the air at the important ripening time, when fruit can dehydrate quickly, if not watered sufficiently. All farmers watered regularly but in small volumes. While most agreed to my way of thinking that water application was most important during early fruit set when cell division and development were

taking place and again on colouring of the fruit, few seemed to use practices to take this into account. The bucket brigade watered "when the soil dried out" and I had little faith in flooding from the top of the hill. However the farmers with a regulated and controlled system (under tree irrigation) most often explained they watered for one hour every three days. Couple this with an 80 litre per hour microjet, and each tree only got about 200 litres per week! I regularly give my trees between 750 - 1000 litres per week, but in one single application, increasing this to 1500 litres per week during the rapid fruit enlargement just prior to harvest. Tests carried out in Australia several years ago indicated that water stress on bearing lychee trees had little bearing until the last 4 weeks before harvest, when fruit failed to develop to any size, and a lot of fruit was dropped by the stressed tree. As this does not seem to be a common problem to the Thai growers, there must be some other factors at work in Thai orchards. Further investigation is warranted on this apparent inconsistency.

Fertilising

As is the case in Australian orchards, fertilising of lychee trees was dependent very much on the soil types on which the trees were growing and the weather and rainfall statistics for the area. To grow trees successfully, free draining and not overly rich soils were needed, so that the supply of water and nutrients could be more or less controlled, especially in the all important pre-flowering time. All Thai farmers used a complete N-P-K fertiliser, with the most common one observed being a 15-15-15 mix. Application time was late March - early April when fruit was at pea size, with the rate being 1 kg per metre of tree height. Most farmers also used a foliar spray once a week for 3 weeks before panicle emergence. These rates were increased significantly for the few growers with orchards on the flat land, especially if they were on river flats. While the use of fertigation is becoming increasingly popular in Australian orchards, I only saw one instance of this practice in Thailand. This was at the huge Boonrawd orchard near Chiang Rai in Northern Thailand. Owned by a major brewery in Thailand, money was not a limiting factor, so that recently sourced overseas technology was rapidly integrated into the whole farming enterprise. Here a 10-52-17 mix at 2500 parts per million was applied in two applications totalling 3kg. The first application was made just before the rainy season and the second during the rain. It was interesting to note the poor crop on these trees, which the owners attributed to the adverse weather conditions.

My own experience however, would suggest that applying fertiliser both before and during periods of heavy rain would be counter productive, with the fertiliser being washed away or carried so far down into the sub-soils as to be unavailable to the shallow rooted lychee trees. In summary then, Thai farmers operated under a similar belief to Australian growers, that is you fertilise to produce bigger and better fruit, rather than bigger trees. Fertilising both before and after fruit set is now widely practised in both countries, in the expectation that after harvest when trees are nearly drained in regard to available nutrients, the wet weather will result in only one or at the most two post harvest flushes, so that trees are kept smaller and in a fruiting rather than flushing state.

The use of organic fertilisers, though only practised by a small number of farmers at present, is, according to one grower I spoke to in Lamphun in Chiang Mai province, increasing rapidly. He uses a system called EM (essential micro-organisms) that he

buys in from Japan. The make up of this liquid is kept secret by the Japanese, but is claimed to be a mix of soil health promoting organisms that replace the need for any fertiliser application. This product is mixed in to rice husks, animal manure and whatever other biodegradable product is available, has molasses poured over it and is then left for three days covered with hessian bags. There was obviously some reaction taking place, as this mixture was very warm to the touch, even though it was in the shade of a large shed. This is then used as fertiliser at the rate of 10kg per tree 3 times a year. Neem oil mixed with the EM is also used as an insecticide whenever necessary. The farmer claimed he produced the biggest and best fruit in his area and was rapidly convincing more and more of his fellow growers to switch to his methods. Unfortunately I could not see any of his fruit because he had already completed his harvest and neither could I see his trees as his paddock was too wet! Perhaps some follow up visits may be appropriate when I am next in that area.

Flowering induction

In Australia at present, getting trees to flower regularly and heavily takes up most discussion whenever lychee growers get together. This is especially a problem on the hotter and wetter coastal regions, rather than on the cooler Tablelands region where I grow these delicious fruit. Flower induction is brought about by a combination of two factors - the point of growth of the tree and the weather. The first of these we can try to control, the second we cannot. The ultimate is to have your trees just starting a new growth cycle as the cold weather starts. This means having buds around the 1-3 mm size with the arrival of cold weather (< 15 degrees C) during the night, and in the low 20's during the day. Buds bigger than 3mm will result in either all new growth or a mixture of leaf and flower and if the trees are not in a growth cycle and are dormant, they will likely stay dormant until the warmer weather arrives again and then be vegetative.

Farmers in Thailand have similar problems and have developed several methods to ensure they have good flowering at least 9 years out of 10. These are cincturing, the use of potassium phosphate and the use of potassium chlorate, calcium chlorate or sodium chlorate.

This method requires further investigation in the warmer growing areas of Queensland where flowering can often be irregular. Initial attempts at this practice have proved unsuccessful in Queensland in the one large scale trial that was conducted. However on talking to the grower involved in this, I believe the timing, so critical in this exercise, was not correct. While not being necessary on my own farm where I can more easily control growth, such a process needs to be revisited on coastal orchards in Northern and Southern Queensland. Already several growers in these areas to whom I have spoken, or who saw the process themselves when I took a group of growers to Thailand in May, 1999, have decided to put the process into practise on small areas of their own orchards for evaluation.

Potassium Phosphate

Depending on tree vigour and water availability, lychee trees can continue growth cycles well after the desired one or two flushes following the post harvest wet

season. This dramatically increases the chances of trees being in a growth or hardening off stage with the onset of colder weather, resulting in little or no flowering. This was a particularly bad problem in the Chiang Rai province of Thailand.

Cincturing

This is a method also practised in Vietnam and China, where trees are 'ringbarked' to stop all vegetative growth. Each tree in an orchard has a narrow cut made around each branch after the tree has divided into the 4 - 6 branch stage. This cut must be very precise as far as depth is concerned, because if it is too shallow nothing is achieved and too deep and the branch dies. This is why individual branches and not the whole trunk is cinctured - better to lose one branch rather than the whole tree. The cut must go down to the cambium layer and no deeper. This has the effect of stopping the trees growth, with all its energy put into repairing the damaged section. Once this repair has been made, the tree switches back into a growth cycle.

The Thai farmers, with assistance from their agricultural advisers, have found that if they cincture their trees in October each year, the exact date depending on their area, the trees will take around two months to repair themselves and then start a new growth cycle just in time for the new Thai winter, so that flower initiation occurs in January.

Chiang Rai Horticultural Research Station set out to find an easy solution for growers of large orchards where cincturing was not realistic.

Researchers there have found the use of the chemical potassium phosphate goes a long way to solving this problem. The chemical is applied through a misting machine at 5000 parts per million at 7 day intervals for 2 or 3 times, about 6 weeks before anticipated cold weather (and flowering). This has the effect of hardening off any flush on the trees in only 2 or 3 weeks, much shorter than the normal 5 - 6 weeks and putting the trees into a dormancy stage - exactly what you want. Then with careful manipulation of water, you can induce flowering at the right time. A fellow lychee grower in Sarina has already put this process into effect on his own property, because when he arrived home from Thailand with me, he found his trees covered in a brilliant flush. He immediately applied potassium phosphate, the flush hardened off quickly and his trees are now flowering well. The process seems to work well and further research is needed into its causes and long term effects. Growers now have some hope of generating flowering on trees that are overly vigorous at the wrong times in the year, trees, which dutifully flowered 6 weeks later, and then set fruit. I ate about 2 dozen of these fruit when I visited his home (he would not let me eat too many, because they were making him a fortune, being out of season) and we then inspected his nearby orchards where the chemical had been applied at the usual time. These trees were covered in the most beautiful flowering you could imagine and he was expecting a crop of around 50 tonnes (A\$165 000).

All the longan orchards in Thailand used this chemical, although no one else mentioned the out of season application to induce flowering. Opinions varied as to the best way to apply the chemical, with most farmers preferring the ground application method. One farmer I visited in Chiang Mai province physically raked all

the litter and mulch out from beneath his trees before applying the potassium chlorate. He did this to aid absorption of the chemical into the ground. The litter was then raked back into place. However the results seemed to be worth the trouble. His 1000 five year old trees had a magnificent crop of fruit, which he estimated at 75 tonne, worth A\$250 000.

In Chiang Mai I had the privilege of having dinner and a long discussion with two Thai horticultural advisers. They were private consultants working mainly in Cambodia, who informed me that both calcium and sodium chlorate were both just as effective as potassium chlorate in this process, but claimed foliar application was more effective than ground application. Their recommended spraying rate was 50g per metre of canopy (ie a 3m tree requires 150g), six weeks before expected flowering. This matched exactly the rates given by the Chiang Mai farmer discussed above, who claimed to use 150g per tree on his trees of 3 to 4 metres. (They also showed me pictures of high density apple orchards in Cambodia with 36 000 trees per acre. They were harvested like sugar cane and simply left to reshoot from the stump).

The use of these chemicals in promoting flowering in lychees is now just starting to be investigated in Thailand. One large grower in Thaton tried it for the first time this past year and did not notice any appreciable difference in these trees compared to his others, as they all flowered well anyway. This year he is going to apply the chemical earlier to see if he can induce a early flowering and has promised to keep me informed of the results. Should such a process be as successful in lychee as it appears to be in longan, the potential for further development would be enormous.

Pruning

This process has been occupying the thoughts of Australian growers for several years now, as the Canopy Management Research team, with funds from the Australian Lychee Growers (ALGA) and the Horticultural Industry Research Development Council (HIRDC) have looked for ways to control canopy size in lychee trees, while maintaining production. For this reason, I was particularly interested to see how growers in Thailand pruned their trees to keep them manageable. The major point I gained from many growers with whom I spoke about this was -prune immediately after harvest and heavily. This was best illustrated with a visit to a small orchard at Mae Sai in the Golden Triangle area. His pruning theory was to remove all upwardly growing branches immediately after harvest, leaving his trees in a hollow mushroom shape. The trees then flush heavily for 2 flushes, at which time they are cinctured to prevent further flushes. He claimed figures of 200kg per tree on a regular basis, however I visited his orchard just after harvest and could not see this for myself. I did see his pruning taking place and may attempt his method on some of my larger trees in the near future. Other growers pruned the top out of their trees one year and the sides the next, claiming this was less stressful on the trees than a full prune each year. From what I have seen both overseas and in Australia, I would suggest that pruning, whether it be light or heavy, doesn't really matter as long as it is done straight after harvest and the trees are encouraged to flush heavily after that. The trick is to manage to stop them in time to provide a period of dormancy before flowering should commence.

Step 2 - Harvesting, Transporting and Processing the Fruit

While some similarities were evident in the Thai harvesting exercise, there were a great many differences. Thai farmers only picked from sunrise to around 10am, but whether this was to promote shelf life as is the case in Australia, or to meet deadlines for transport was not explained. Once in the packing shed the differences were considerable. The Thais use no machinery - all work is done by hand, mostly using imported Burmese people at around A\$2 a day. The fruit panicles are roughly graded and split or damaged fruit removed. The fruit is packed still on the panicle into 10 kg boxes, but not refrigerated. The whole process must be completed before 12:30pm, when the fruit is loaded onto a truck to be taken to the nearby depot, where it is loaded aboard a larger truck that leaves for Bangkok at 1:00pm.

Here it arrives at the markets in the early hours of the morning, where it is sold that day. There is no need for refrigeration facilities due to the rapid turnover of the fruit. Thai people adore lychee - they are no sooner on the shop shelves than they are walking out the door, so that new stock is required each day in large quantities. Thai supermarkets also have a very low mark up on local fruits, so that they may compete with the hundreds of street vendors also selling fruit. This of course helps to ensure rapid turnover and fresh product each day.

A visit to Talad Thai, the newest and largest Fruit and Vegetable Market in Bangkok, confirmed this. Despite the huge range of fruits available, it seemed every buyer there made sure they had lychee on their list. At 250 baht per 10kg box (farmers were getting between 17 and 19 baht per kilo) the fruit was very inexpensive by Australian standards, but the supermarkets were still retailing them at only 30 to 35 baht per kilo.

Fruit rejected at the farms as not suitable for fresh sale is sent to one of several canneries in the lychee growing areas. On a visit to such a cannery on the outskirts of Chiang Rai, I witnessed this lower grade fruit being processed into canned fruit, boiled down into syrup for the canned product or processed into juice. Nothing was wasted. The wage structures in Australia would preclude such an operation on a seasonal fruit being set up here. Instead our reject fruit is dumped on the ground to rot and be used as mulch - one of the prices we pay for growing a seasonal crop in a rich industrialised country.

Step 3 - Marketing the Fruit

In a free trade system such as exists in both Australia and Thailand, supply and demand are the important mechanisms determining price of most agricultural products. Unlike growers in subsidised countries, there is no minimum price growers can expect to receive for their product. Developing an efficient marketing system is therefore very important, especially for seasonal fruits which are very perishable by nature. In Thailand, the determination of prices is generally done by local traders who offer growers a buying price, based on market information of the previous day. I saw this in action in Fang in northern Thailand. Fruit bound for both the domestic and export markets were delivered by local farmers to the truck depot. Those supplying the domestic market presented their fruit in 10kg boxes, which were all inspected by a broker's representative. He then gave them a price for each box, depending on the quality of the fruit. This was dutifully recorded by his assistant, who immediately paid the grower for the total of his consignment. The grower seemed to have no say in the price being offered.

Those supplying the export trade were given a number of plastic boxes on the previous day, the number determined by their expected pick. Again each box was inspected and priced and the farmer paid immediately. This fruit was then cooled in an ice bath before being loaded onto a refrigerated truck bound for Bangkok and then overseas. This was the only occasion on which I saw refrigeration being used for holding lychee in Thailand. Inquiries revealed this was because of the current lack of acceptance of sulphur treated fruit overseas. This process was previously the only method open to the Thais to prevent browning of their fruit, but they are now turning to the Australian developed cool, wet chain to try to maintain good colour.

The auction system for trading fruits as exists in Australia has not yet been adopted in Thailand. Each merchant in the market sells the fruit on behalf of the broker who has delivered it from the production area to the market. The grower is out of the equation, with very little if any say in the prices he receives for his fruit.

The traditional wholesale markets in Bangkok were Pak Klong Tadad and Wang Mahanak. Both these were in the centre of Bangkok making transport and infrastructure development costly and slow. Now the central markets have extended to other places which have been developed as centres of transport and communication eg Talad Thai.

In order to facilitate more efficient marketing and export services, particularly to the benefit of the growers rather than brokers as is the case at present, the Thai government has adopted a so called "one-stop" services policy. This aims to short cut the lengthy chain of handling, packaging, quality control and certification, customs formalities etc which presently have to be executed at different places (multi-stop system), by providing all these services at one central market. There is a need for a new physical marketing infrastructure, which adopts the auction system and integrates the services of the various government and private organisations concerned with fruit trade, to the benefit of growers and traders in the domestic and export markets.

The major fresh fruit exports for Thailand are durian, longan and lychee, followed by mangosteen, pummelo and mango. This is illustrated by the following chart for the years 1995 - 97. It should be noted that 1998 was a particularly bad year for lychee in Thailand and figures for that year would be very low, while 1999 figures are not available at the time of writing.

Items	1995		1996		1997		Three Major Export Markets	Growth	
	Qt (MT)	Val (M Baht)	Qt (MT)	Val (M Baht)	Qt (MT)	Val (M Baht)		Qt	Val
Durian	48716	1 004.10	65694	1 202.10	72987	1 399.60	Taiwan, Hong Kong, Malaysia	22	18
Longon	31719	882.10	61053	1 286.40	81632	2 119.90	Hong Kong, Singapore, Indonesia	60	55
Lychee	3257	118.60	11603	336.40	11158	327.10	Hong Kong, Singapore, Malaysia	85	66
Mangosteen	3117	65.70	2167	39.50	2812	62.40	Taiwan, Hong Kong, Japan	5	3
Pummelo	4776	56.10	6182	66.90	3247	44.40	Hong Kong, Singapore, Canada	18	11
Mango	3658	42.20	8250	120.10	8522	148.90	Malaysia, Taiwan Canada	56	88

These figures graphically illustrate the huge market in Asian countries that exist for Australian lychees. At a time when major producers China, Thailand, Taiwan, India and Vietnam are producing huge quantities, one of these countries can export nearly 4 times the total Australian production to three nearby markets. We have developed a sophisticated, professional approach to marketing - now we just need to adopt some of the growing techniques discovered in these countries to maximise our cropping and start to tap into this huge market in Asia.

Conclusion

The Australian industry stands ready to enter an exciting new era in its development. We are one of only a few countries in the Southern Hemisphere growing this delicious fruit and with millions upon millions of lychee loving people on our northern doorstep, being able to provide them with one of their most loved fruits when it is otherwise unavailable in their own countries is a great commercial opportunity. However, we do have problems. Getting our trees to flower and produce quality fruit each year has been a problem for many growers, especially in the warmer areas. Keeping pests from eating and destroying large percentages of our fruit before it can be harvested is another major difficulty, as is keeping the trees productive while at the same time maintaining control over their height. Having a professionally organised marketing structure able to adapt quickly and efficiency to changes in buyers needs, whether they be in packaging, transport or quality /food safety matters is vital. Being able to present the fruit to the buying public looking and tasting as delicious as the day it was harvested from the tree is essential. These are major problems which, once solutions to them all are found, will see renewed confidence in and expansion of the lychee industry in Australia.

I believe my Nuffield Scholarship has enabled me to put forward possible solutions to at least two of the above problems, and it is now a case of having to trial these solutions under Australian conditions. I refer of course to the flowering and pruning problems. The marketing and packaging aspects were also looked at closely while I was in both Europe and Thailand and already changes have taken place within my lychee marketing organisation here in Australia to reflect what I learnt in Europe, namely the development of a small, individually wrapped and barcoded punnet presentation box more suited to the supermarket trade. Our Marketing Coordinator also visited Thailand with me to try to access Thai lychees to send to our own buyers throughout Asia, thus ensuring a continued presence of our marketing name in these markets.

Perhaps the most important development is yet to come. As mentioned earlier in this document, I am soon travelling, along with three other major lychee growers from Queensland, to Israel. There we are going to observe and evaluate a new post-harvest treatment for lychees especially developed by Israeli researchers. It is claimed this treatment maintains lychees red colour for 4 - 5 weeks, while also preserving the eating quality. Just think of the extra marketing options this would provide to growers, especially on the export front. This invitation to my colleagues and me follows my discussions with various researchers in Bangkok who were actively involved in the development of this technology with the Israelis. Exciting times lie ahead.

The opinions expressed in this document are personal and not necessarily those of the Nuffield Farming Scholars Association or its sponsors.