



Pruning to Meet Your Lychee Goals

**A report for the Rural Industries Research
and Development Corporation**

By Terrence Campbell and Yan Diczbalis

December 2001

RIRDC Publication No 01/180
RIRDC Project No DAQ-268A

© 2001 Rural Industries Research and Development Corporation.
All rights reserved.

ISBN 0 642 58399 4
ISSN 1440-6845

Pruning to meet your lychee goals
Publication No. 01/180
Project No. DAQ-268A

The views expressed and the conclusions reached in this publication are those of the author and not necessarily those of persons consulted. RIRDC shall not be responsible in any way whatsoever to any person who relies in whole or in part on the contents of this report.

This publication is copyright. However, RIRDC encourages wide dissemination of its research, providing the Corporation is clearly acknowledged. For any other enquires concerning reproduction, contact the Publications Manager on phone 02 6272 3186.

Researcher Contact Details

Terrence Campbell
Queensland Department of Primary Industries
PO Box 1054
Mareeba QLD 4880

Phone: (07) 4048 4600
Fax: (07) 4092 3593
Email: campbet@dpi.qld.gov.au

RIRDC Contact Details

Rural Industries Research and Development Corporation
Level 1, AMA House
42 Macquarie Street
BARTON ACT 2600
PO Box 4776
KINGSTON ACT 2604

Phone: 02 6272 4539
Fax: 02 6272 5877
Email: rirdc@rirdc.gov.au
Website: <http://www.rirdc.gov.au>

Published in December 2001
Printed on environmentally friendly paper by Canprint

Foreword

The adoption of new technologies into complex growing systems is one of the great challenges for researchers and industry development proponents. The research can only be developed and tested in a limited range of environments and cultivars, but for greatest return for the research investment a large proportion of the industry must adopt the research results.

This publication reports on innovative approaches to improving the adoption of new technology. It used expert panels of lychee producers from all the important growing regions in Queensland to review the results of research on canopy management in the light of their own experiences and overseas practices and then to devise pruning strategies that best suit their own situations and goals.

Current best practise canopy management techniques are presented for lychee industry.

This project was funded from industry revenue, which is matched by funds provided by the Federal Government.

This report, a new addition to RIRDC's diverse range of over 700 research publications, forms part of our new plant products R&D program, which aims to facilitate the development of new industries based on plants or plant products that have commercial potential for Australia.

Most of our publications are available for viewing, downloading or purchasing online through our website:

- downloads at www.rirdc.gov.au/reports/Index.htm
- purchases at www.rirdc.gov.au/eshop

Peter Core

Managing Director

Rural Industries Research and Development Corporation

Acknowledgments

We would like to thank;

- The participants of the 'Expert Panels' who freely gave of their time and experience to discuss the complex issues and outcomes associated with lychee canopy management.
- Drs Christopher Menzel (QDPI) and Trevor Oleson (CSIRO) who provided us with presentation material for the workshops.
- Irene Kernot (Senior Extension Officer, QDPI) for her assistance with developing the regional pruning scenarios and tree shape diagrams.

Abbreviations

MKP – Mono Potassium Phosphate

QDPI – Queensland Department of Primary Industries

CSIRO – Commonwealth Scientific Industrial Research Organisation

RIRDC – Rural Industries Research and Development Corporation

Contents

Foreword	iii
Acknowledgments	iv
Abbreviations	iv
Executive Summary	vi
1. Introduction	1
2. Objectives	1
3. Methodology	1
4. Detailed Results	2
4.1 Pruning decisions	2
4.2 Scenarios for Lychee Pruning	3
4.3 Panel Comments on the Canopy Management project Findings	3
4.4 Future Research	12
5. Discussion of Results	13
6. Recommendations	14
7. Appendices	15
Appendix 1 Mean monthly, maximum, minimum and average temperatures for a range of lychee growing areas.	15
Appendix 2 Draft DPI Notes with revised recommendations for pruning and canopy management.	23
8. References	35

Executive Summary

This project was developed as a response to the review of the six year RIRDC funded project “Improved canopy management to maximise market opportunities for tree crops lychee, longan and rambutan” DAQ-177A.

The review identified that the essential and immediate task was to extend the findings of the project to the industry through an extension project in which there is a high degree of industry ownership and emphasis on action learning.

To meet this aim, the project adopted the expert panel approach. This extension approach focused on the identification and training of expert grower panels in six regional locations to review the results of the research trials, to critically analyse the results for their cultivars/locations and to develop pruning strategies for local conditions.

Participants were presented with the results of recent research on lychee canopy management and crop manipulation and shared experiences on overseas and local management practices. Through the identification of key issues on pruning, three scenarios were developed to facilitate the development of industry wide recommendations. These scenarios took into account the constraints of time, machinery availability and the participants’ aversion to the risk of a nil crop in a season where environmental conditions did not favour flowering.

Participants welcomed the opportunity to discuss the results of previous work and to put these results into the context of their local conditions and cultivars. While there was high confidence in the results of previous work for the cultivar Kwai May Pink in southern growing areas in Queensland, there was less confidence in the applicability for other cultivars and growing areas. Strategies to manage the risk of nil flowering included pruning immediately after harvest to allow two flushes to develop. There was strong support for the use of defoliating chemicals to remove unwanted autumn flushes and information from this project has been used to support an industry application for approval to use these chemicals.

The results of the research were adapted by growers experience and recommendations were developed for the three scenarios; managing large overgrown trees, pruning small trees from planting to cropping and pruning for regular cropping. These recommendations have been prepared as DPI farm notes which is an accessible format and will be distributed to all members of the Australian Lychee Growers Association.

Recommendations for future research and development work on canopy management in lychee were discussed. No single industry issue was identified to be the focus of a large project. Rather a diverse range of industry issues was raised. Further work on crop manipulation could be incorporated into a developmental project addressing a range of the issues in a DOOR or on farm research approach.

The use of the expert panel approach was found to be an effective method to help integrate complex research results into an equally complex growing system. Participants were able to adapt research findings for different environments and cultivars. It is recommended that this approach be further developed in similar projects.

Introduction

This project was developed as a response to the recommendations of the panel that reviewed the six year RIRDC funded project “Improved canopy management to maximise market opportunities for tree crops lychee, longan and rambutan” DAQ-177A.

The panel was unanimous in its view that the essential and immediate task was to extend the findings of the project to the industry through an extension project in which there is a high degree of industry ownership and emphasis on action learning.

The primary aim of the extension project would be to implement and if necessary modify the proposed strategies under farm conditions and to allow surrounding management, financial, varietal and regional issues to be addressed. Particularly important will be gaining an understanding of the financial benefits in terms of regular flowering, tree size control and harvesting costs.

Knowledge gaps and technical problems identified during implementation could well become the basis for future R&D.

The challenge for this extension project is to mobilise the industry to be able to understand and adapt the results of the research project to their own cultivar/location, to have **confidence** to trial the options developed and to evaluate these strategies over a wide range of locations.

To meet this aim this project was developed using the expert panel approach. This extension strategy focused on the identification and training of expert grower panels in six regional locations to review the results of the research trials, to critically analyse the results for their cultivars/locations and to develop pruning strategies for local conditions.

Objectives

- Improved crop production and profitability of Lychee through better understanding and adoption of pruning and cincturing strategies.
- Improved pruning and cincturing recommendations for the cultivar/location interactions for growing environments in Queensland.
- Begin preliminary trials for minor use registration of Ethrel for crop manipulation
- Testing and demonstration of the Expert Panel Technique for the integration of complex research results into production, harvesting and marketing systems.

Methodology

Expert Panels were assembled in six major growing regions of Queensland to review the results of the canopy management project (DAQ 177A). The objective was to assemble groups of lychee producers who had trialed the project recommendations or had expressed interest in lychee pruning to combine their practical experience in lychee pruning with the results of the project. The expert panels were assembled using recommendations of ALGA representatives and local Extension workers.

The meeting was facilitated in such a way that open discussion was encouraged and that grower experience was just as valuable to the discussion as the project results. Each meeting followed a set format.

- Introduction of workshop aims and introduction of participants. As a warm up exercise participants were asked to describe their lychee-growing situation.
- Participants were asked to describe their most difficult decisions about lychee pruning. In particular they were asked to describe the decisions about which they had least confidence. This allowed the group to focus in on key pruning decisions.

- Scenarios were then developed to describe the situations that would later be used to develop key recommendations.
- Presentations on the results of the canopy management project, overseas pruning experience and grower observations. This allowed for discussion of confidence participants had in the pruning results and practices and the ease of integrating these practices into the current production system.
- Recommendations were then developed for each of the nominated pruning scenarios. While there was some attempt to gain consensus, individual variations to the recommendations were recorded.
- Recommendations for future work were sought from the participants. This involved listing all issues as well as those on canopy management. No attempt was made to rank the issues.
- Draft recommendations for managing trees were prepared as DPI Notes and distributed to participants for comments.

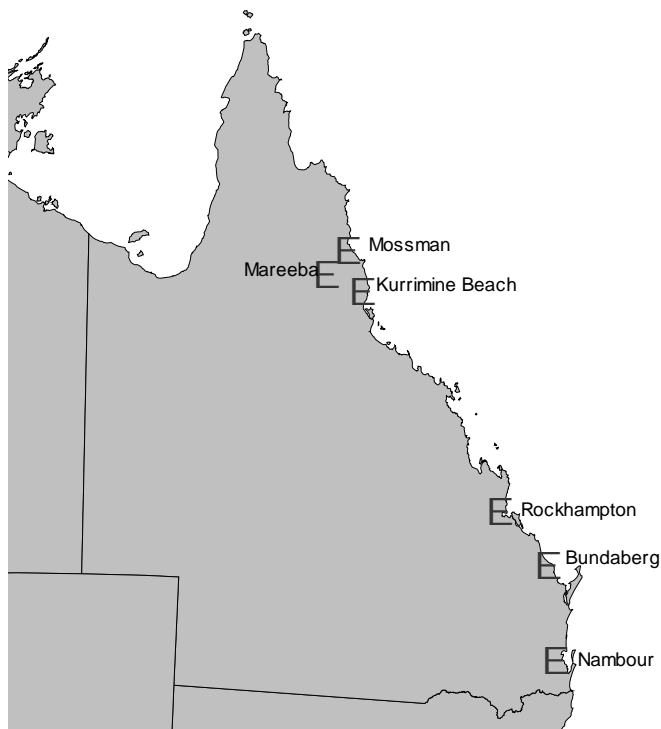


Figure One. Map of Queensland showing towns where the meeting was held.

Detailed Results

Pruning Decisions

Workshop participants listed the critical/difficult decisions in lychee pruning. There were large similarities between groups.

- Some participants in all groups expressed that lack of knowledge on timing and method was limiting their ability to manage trees.
- Large trees particularly the larger cultivars such as Tai Tso presented the greatest challenge and participants had least confidence in maintaining resultant cropping in these trees.
- Differences between the cultivars and the effect of rainfall, temperature and soil type on subsequent tree growth and cropping. Participants had more confidence with the Kwai May Pink cultivar in all environments.
- All groups agreed that pruning decisions must be made from early tree establishment and that many of the issues facing growers were a result of delaying structural pruning operations.

- There was a surprising scepticism towards the management of trees as hedgerows and the effect of heavily pruned trees on yield. Yield effect in such systems has not been quantified.
- Other factors influencing decisions was the availability of the machine pruning equipment, pruning time in relation to weather conditions and the need to manage the off year for yields.

Scenarios for Lychee Pruning Discussions

Scenarios were developed for each group to initiate and focus discussion on the important lychee pruning decisions and to develop recommendations based on the results of the canopy management project, overseas experience and individual grower experience.

Across all groups very similar scenarios were developed.

Scenario 1 Pruning/managing large trees, spaced at 10 x 10 m or greater, that had outgrown standard management practices. This was particularly important where netting was used or being contemplated. All groups noted that recommendation should be cultivar specific.

Scenario 2 Pruning small trees from planting to cropping. This was identified as critical to developing bearing structures.

Scenario 3 Pruning for regular cropping. This was important to provide regular yield and tree size maintenance from trees, which had been rejuvenated or developed using strategies from scenario 2.

In all discussion the recommendations needed to be developed for specific cultivars and environments. The Julatten group had the additional scenario of developing options for trees, which had little or no crop in a given year.

Panel comments on the Canopy Management Project Findings

Following discussions on the Lychee pruning scenarios as presented above the Expert Panels were presented with a summary of the major outcomes of the canopy management project. This text of the summary was provided by Drs. Christopher Menzel and Trevor Olesen while the presentation was made by the authors of this document. Considerable effort was made to explain the background and implications of the findings. A copy of the overheads presented and the discussion, which followed, is presented below.

Canopy management project - 1

- Leaf flushing in Lychee
 - For well-watered, well-fertilised trees free from pests (especially leaf eating caterpillars) the pattern of repeated flushes depends on temperature and radiation

RIRDC & Queensland Government (DPI)

All participants agreed that the statement on flush development in lychee was an accurate generalisation of what occurs. The participants from the Bundaberg/Childers region stated that in their region flush growth following pruning can be delayed if hot dry (low RH) conditions exist following pruning. This occurs regardless of how much irrigation water is applied and hence they felt flush initiation and development was also controlled by relative humidity.

Canopy management project - 2

- Factors affecting lychee flowering
 - Temperature is the only factor **known** to directly affect lychee flowering.
 - Average daily temperatures below about 20°C are needed during bud expansion (Bud size 4 mm or less)
 - No chemical treatment has yet proved to be an effective promoter of flowering. These include paclobutrazol in Australia and potassium chlorate in Thailand.

RIRDC & Queensland Government (DPI)

To assist in the explanation of the above overhead the graph below from Batten and McConchie (1995) was presented to explain the relationship between bud length and flowering. Batten and McConchie (1995) demonstrated that the process of flowering can occur in growing buds exposed to low temperatures. Their work suggested that the floral induction process was improved when the bud length at the time of exposure was between 0 and 10 mm. For the variety Salathiel, bud length greater than 4 mm resulted in a vegetative flush. There was considerable discussion on this finding in particular the requirement for average daily temperatures below 20°C. Long term average temperature records suggest that in coastal locations north of Ingham there are very few times when the **average** daily temperature is below 20°C (Appendix 1). Participants from the Wet Tropical Coast growing region felt that although cold temperatures are no doubt beneficial and advantageous the requirement for average temperatures to be less than 20°C for flowering was not correct for their area. Tropical wet coast participants stated that despite the less than favourable temperatures for flower induction experienced in their area it was highly unlikely that flowering would fail completely. They stated that over 10 years they would expect three good seasons, three average years and four poor years.

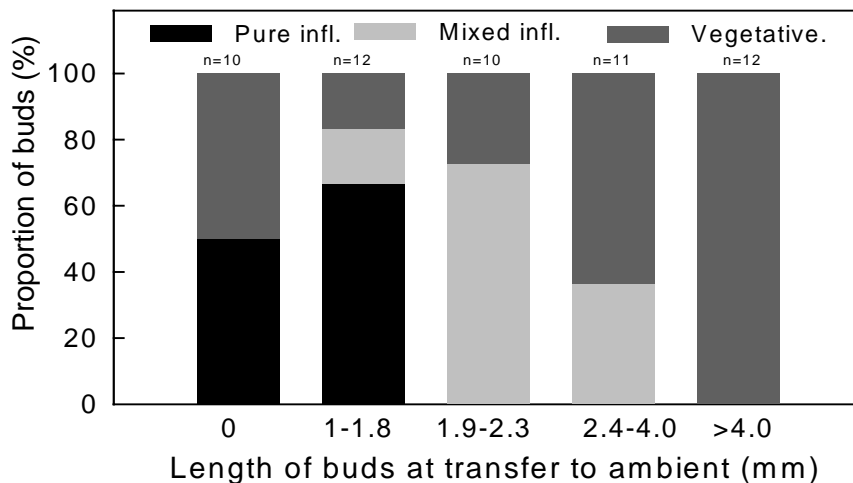


Figure 2. The relationship between bud length and flowering for the variety Salathiel (Batton and McConchie, 1995).

This suggests that the change in temperature rather than an absolute temperature during bud expansion may also play an important role in flower induction. There was also support for the requirement of a dormancy period prior to flowering with many participants suggesting that “good years” were characterised by a dormancy period pre-flowering. It could be argued that this dormancy period is associated with cooler seasons.

Canopy management project - 3

- Controlling tree size
 - For varieties (e.g. Kwai May Pink and Tai So), quite severe pruning can be done without jeopardising the potential for flowering.
 - Major structural pruning, such as the removal of large branches, is best done in early winter to avoid vigorous vegetative regrowth and dense canopies.

RIRDC & Queensland Government (DPI)

The third point the canopy management team raised was in relation to tree size control. Participants felt that the statement, “...quite severe pruning can be done without jeopardising the potential for flowering”, was correct for Kwai May Pink but not correct for Tai So. These thoughts were expressed in all growing locations suggesting that the sub-tropical growing regions were not necessarily a cure for all problems particularly when it came to managing the variety Tai So. In general there was agreement with the timing for major structural pruning, however, a number of participants believed that any pruning should be done as soon as possible after harvest. A number of participants made voiced the opinion that the practical nature of managing smaller lychee farms, generally on a part-time basis, means that pruning occurs when time and resources are available.

Canopy management project - 4

- Controlling tree size contⁿ
 - Mechanically hedged
 - this should be done at the recommended pruning times to allow for rejuvenation of the canopy, such that the hardened flushes are ready to move again in winter.
 - There are probably two windows for pruning in north Queensland, one or two flushes out from winter (i.e. hedge in either early January or early March). Further south, growers are limited to a single pruning time in most years.

RIRDC & Queensland Government (DPI)

In support of the statement on tree size control and mechanical hedging the recommended pruning time graph was presented and discussed (Fig 3). It was emphasised to the workshop participants that the pruning model was developed based on the combination of average temperature and solar radiation data for the growing areas and the flush development data collected from various experimental sites during the canopy management project. Hence it is a “best bet” based on long term weather records and knowledge of the solar radiation/temperature requirements for flush development. Pruning on the dates suggested by the model allows time for the full development and maturity of **one flush** prior to bud movement in winter under florally inductive temperatures.

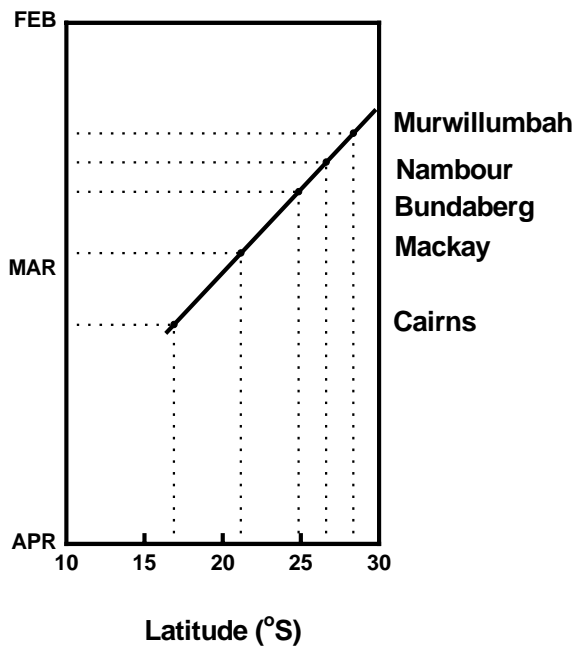


Figure 3. Latitudinal variation in the estimated optimum date of pruning for lychee in eastern Australia that allows for one flush to mature prior to the onset of winter (Menzel and Olesen 2000).

Participants in the north generally preferred to prune in January thus allowing two flushes to develop prior to the onset of winter.

Canopy management project - 5

- Controlling flowering
 - Light hedging might be done at the recommended times for mechanical hedging.
 - Alternatively, there are various ways of managing the unwanted and unproductive late autumn vegetative flushes.

RIRDC & Queensland Government (DPI)

Participants reported mixed results using the pruning recommendations to manage flowering. In most cases participants felt that the pruning model was generally correct for Kwai May Pink, this confidence increased with growing latitude. Regardless of latitude participants were not convinced that the model was of use for other varieties, in particular Tai So and Wai Chee. For the most part participants felt that pruning should occur immediately after harvest rather than wait until the recommended pruning time as dictated by the model. The earlier pruning ensures that at least one flush will develop and if conditions and latitude allow two flushes will mature prior to flowering. If unwanted late flushes occur, particularly in southern latitudes then these can be dealt with using methods developed by the project and discussed below.

Canopy management project - 6

- Controlling Flowering
 - Tip Prune
 - You can lightly prune off the flushes, taking care not to remove too many of the mature leaves from the previous flushes below, as the removal of these leaves reduces yield.

RIRDC & Queensland Government (DPI)

Generally participants felt that the recommendation for tip pruning of late unwanted flush was not suited to orchard management, despite its success on experimental trees. This response was based on the perception that the tip pruning process is labour intensive and hence not a practical management solution. However the development of a reciprocating blade pruners may allow tip pruning to be mechanised.

Canopy management project - 7

- Controlling Flowering
 - Chemical Prune
 - “Burn Off” the leaves of the most recent flush chemically, using desiccants (1 to 3 L of ethrel and 5 kg of urea per 1000 L of water). Desiccants have been used experimentally, but are not registered at this stage.

RIRDC & Queensland Government (DPI)

The participants were particularly interested in the ‘chemical tip pruning’ option. Generally this treatment was only well recognised in the Bundaberg area where considerable experimental work had been carried out. Naturally a major hindrance to the uptake of the technology was the lack of registration for the use of Ethrel as a chemical defoliant. Participants in the northern three workshop groups, in particular, expressed an interest in having more trial work conducted on chemical pruning in their growing area. There appeared to be a general fear that the treatment could cause leaf burn beyond the unwanted flush and hence effect yield potential. There was a general feeling that chemical pruning would become an important component of lychee orchard management.

Canopy management project - 8

- Other Considerations
 - Control of flushing by reducing applications of fertilisers is unlikely to be successful because the response to the most common nutrients, such as nitrogen, phosphorus and potassium, is too slow and unreliable on most soils.

RIRDC & Queensland Government (DPI)

There was general agreement with the comment by the research team that nutrition management for flush control was not an appropriate means of managing flush development. However, in a few cases participants reported that a lack of or excess nutrition inputs did manipulate vegetative development and subsequent reproductive behaviour. In more northern growing areas comments were made in relation to leaf nitrogen levels and the possibility of excess vegetative growth prior to flowering. In general the issue of recommended nutrient levels for lychees grown north of the tropic of Capricorn was an issue which participants wanted included in the “Future Research” requirements list.

Overseas Lychee management practices

As part of the presentation with the “Expert Grower Groups” the issue of overseas management practices and grower observations while on overseas study tours was discussed. It was stressed that these practices were not necessarily appropriate for Australian growing conditions, however features of the practices could be considered for experimentation or inclusion into current practices if they were thought to be appropriate.

The first management calendar to be discussed was that of China. The Figure below was obtained from Zhang (1997) and represents a summary of Chinese lychee management practices.

Chinese lychee management practices

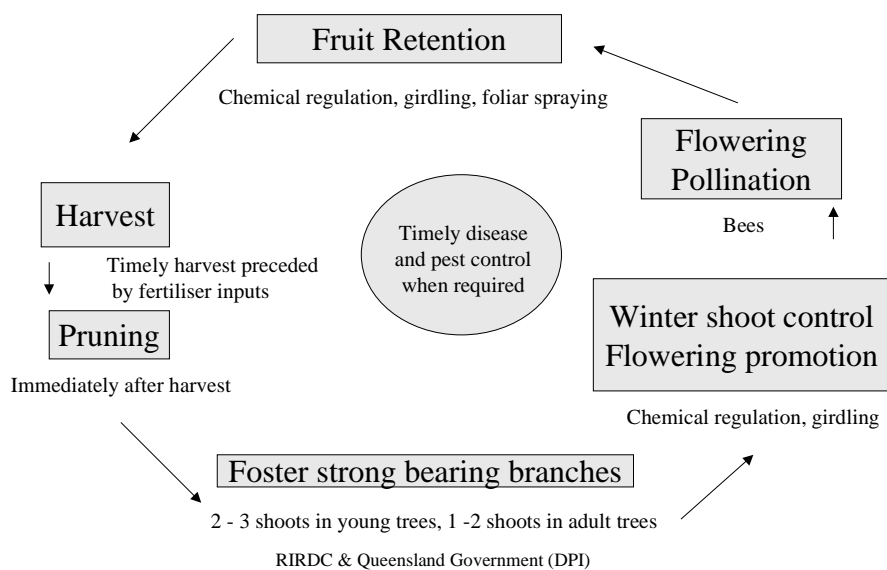


Figure 4. Chinese lychee management practices Zhang (1997).

The features of this calendar which were discussed included;

- Timely harvest preceded by fertiliser inputs. These inputs are aimed at promoting flush development after harvesting and pruning operations are complete.
- Pruning immediately after harvest.
- The use of chemical growth regulation chemicals and/or girdling (cincturing) pre-flowering to control flush development.
- The use of girdling post-flowering to improve fruit set.

The second management calendar discussed was from Taiwan. This calendar was developed by Nago and Paull (1998) following a study tour of Taiwanese horticulture research stations (Figure 2).

Lychee production strategy - Taiwan

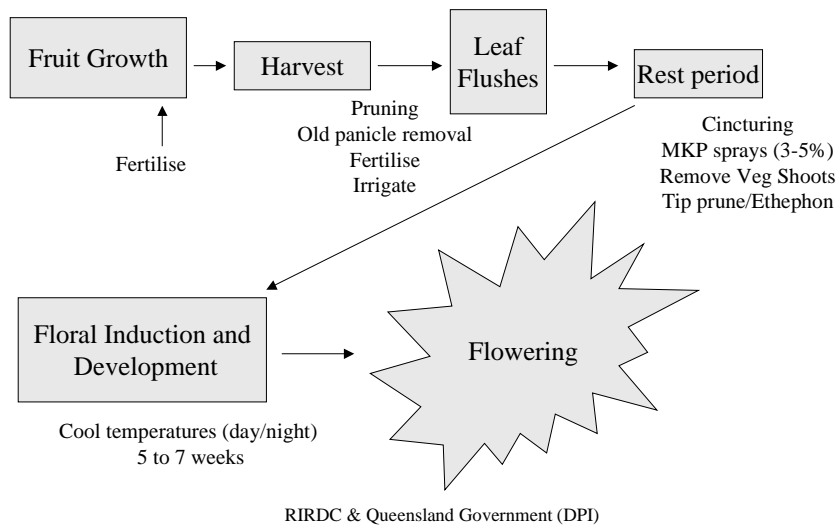


Figure 5. Lychee production strategy – Taiwan as per Nago and Paull (1998).

Factors discussed included the following;

- Fertiliser inputs prior to harvest to stimulate new flush development prior to harvest and post pruning
- Pruning and in particular removal of all old panicles immediate post harvest
- Encouragement of new flush growth
- The use of chemical and physical methods pre-flowering to encourage flowering. This include the use of mono potassium phosphate foliar sprays, cincturing and where necessary physical or chemical tip pruning to remove unwanted late autumn flushes.
- The requirement for a period of cool weather, no specified day/night temperature, for floral induction.

The third calendar discussed was from Thailand. This was synthesised from a report prepared by Hoger (1999) following a Nuffield Scholarship study tour of Thailand.

Lychee production strategy - Thailand (Chris Hoger)

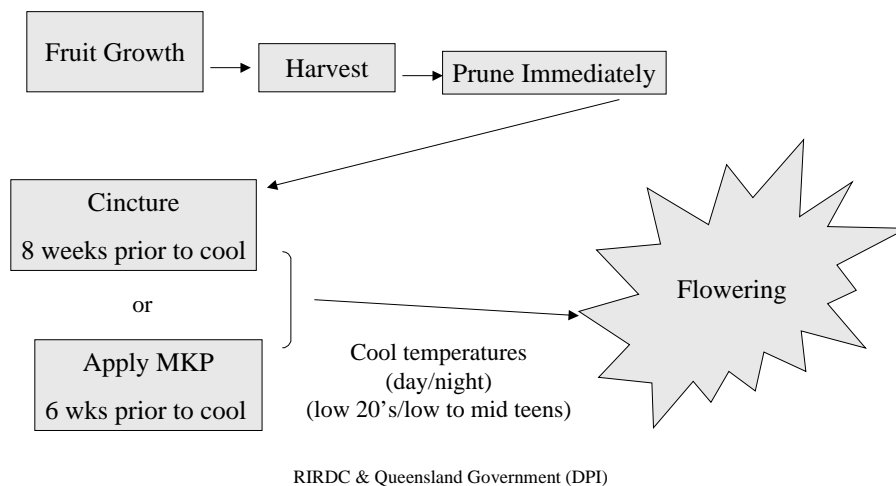


Figure 3. Lychee production strategy – Thailand as per Hoger (1999).

Points from the above calendar which were discussed in detail included;

- Requirement to prune immediately after harvest
- Use of cincturing or foliar sprays of MKP pre-flowering to increase the duration of flush dormancy prior to the onset of florally inductive cool day/night temperatures.

Common themes, which arose out of examination of overseas practices, were;

- Pruning is carried out **immediately** post harvest
- Use of management practices such as cincturing or foliar applications of MKP to increase the duration of flush dormancy prior to the onset of florally inductive cool day/night temperatures.
- Fertilising pre-harvest to encourage flush development immediately after harvesting and pruning operations
- Use of cincturing and/or chemical treatments post-flowering to enhance fruit set.

A number of participants who had had the opportunity to travel overseas had begun to experiment with various practices. The most common of these was early autumn cincturing. Discussions revealed that cincturing was viewed as a practice which had inconsistent outcomes and few growers said that they consistently incorporated the practise in to their management calendar. Those who did cincture consistently did so in conjunction with regular pruning immediately after harvest.

Future Research

At the end of each workshop, participants were asked to raise future research ideas. No attempt was made to allot priorities and participants identified issues outside the scope of this project. The issues ranged from flying fox and bird control, industry food safety arrangements, crop nutrition and crop manipulation and pruning.

At most workshops there was a simple listing of issues and ideas with some further investigation of the issues surrounding canopy management and crop manipulation.

Research issues raised

Canopy Management and Crop Manipulation

- Monitor outcomes of expert panel strategies in conjunction with environmental and crop management practices.
- Modify strategies where necessary and reapply and monitor out comes
- Monitor effects of canopy shape on productivity
- Compare yields from high and low density orchards
- Test and evaluate effect of chemical tip pruning, with particular reference to the tropical growing areas.
- Impose and monitor outcomes of a variety of physical treatments which assist in flush management
- Cincturing (timing and intensity)
- Root pruning (timing and intensity)
- Impose and monitor outcomes of a variety of chemical treatments which assist in flush management
- Investigate the use of Mono Potassium Phosphate (MKP) on flush maturity and development
- Investigate the use of growth regulators

Review of nutritional recommendations

- Particular interest to north Queensland growers who feel the levels developed for SE Queensland are not appropriate to northern growing areas.

Vertebrate pest control

Fruit setting and retention

- Effect of temperature on male and female flower ratio
- Use of chemicals to enhance flower retention
- Canopy manipulation practices to delay flowering and improve fruit set

Disease control in flowers and fruit

- Particular emphasis on the control of Pepper Spot (*Colletotricum sp.*)
- Pest and disease identification kit (photographic catalogue) with attached control recommendations.
- Improved registration options for disease and pest control

Tree productivity

- Comparison of high versus low density orchards.
- Yield comparison of allowing 1 or 2 flushes following pruning.

New varieties

- Import material from other lychee producing areas, in particular China.

Effect of grafting and rootstock on tree productivity

Irrigation management

- Effect of water stress on flowering

- Effect of frequency and volume on production
- Effect of partial root zone drying

Methods to delay flowering

- Effect of ethrel “tip pruning” sprays on subsequent flowering
- Timing and recommended practice to rejuvenate late varieties, eg. Wai Chee
- Management requirements of trees with a light crop to prevent fruit drop caused by competing vegetative flushes

Mechanical aids for;

- pruning
- picking
- packing

Management Benchmarking

- best practice management
- economics of scale (\$/ha)

No single industry issue was identified to be the focus of a large project. Rather a diverse range of industry issues was raised. Further work on crop manipulation could be incorporated into a developmental project addressing a range of the issues.

The authors propose that the project is undertaken in the DOOR/benchmark style with lychee groups throughout the regional growing areas.

Discussion of Results

This project identified that participants had varying levels of confidence in the results of the canopy management project and in pruning generally. Participants who were closely involved in the project had either adopted the technology or adapted it to fit their own situation/cultivars. Many participants had little or no knowledge of the outcomes of the project. In this group the project’s final report, extension publication or presentations made to industry workshops or field days were not mentioned as important influences on canopy management decisions.

Many participants have been unable to adopt or trial the technologies developed due to physical constraints and are very adverse to the risk of a nil crop in some years.

Participants also approached canopy management in a much broader sense than the original project scope. Methods to rejuvenate “overgrown trees”, develop tree shape in young trees and pruning for cropping received equal attention in all discussion.

The project has resulted in the publication of three DPI farmnote publications (currently in draft format attached in appendix 2). These include the recommendations for managing trees in the critical scenarios identified by participants. These will be distributed through the Living Lychee Publication to members of the ALGA.

This project found support for the use of chemical defoliation of autumn flushes in southern Queensland and a willingness to trial this technology in other areas.

An application has been made by the QFVG for approval of the use of Ethrel for Lychee. No further trial work was required for this application but project results have been used for departmental support for the application.

The expert panel technique trialed in this project has allowed these issues to be discussed. It has also attempted to give a systems approach to the use of new technologies. The approach has encouraged participants to try to integrate the technology into their diverse growing systems.

The challenge now is to have more of the industry review the current revised recommendations and to trial the technologies. This now has a greater chance of success as the recommendation have been developed with greater awareness of the constraints for individual producers and their adversity to the risk of a low crop.

The expert panel approach has been shown to be very useful in integrating complex research findings into an equally complex growing system.

Discussions on future work demonstrate that future work on lychee canopy management was just one of several project areas where R&D effort is likely to overcome constraints to lychee production and marketing. The proposition to undertake DOOR/benchmark work with lychee groups throughout the regional growing areas in many ways reflects this need to work on a range of issues that are requested by industry. This is also much more in line with the industries requirement to improve the entire production system and the use of a development teams to tackle a diverse range of industries issues.

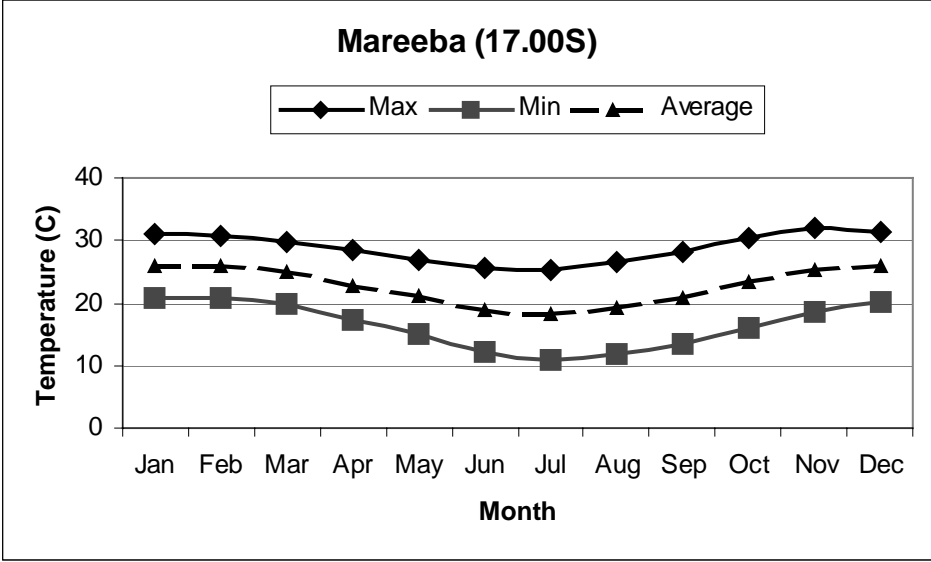
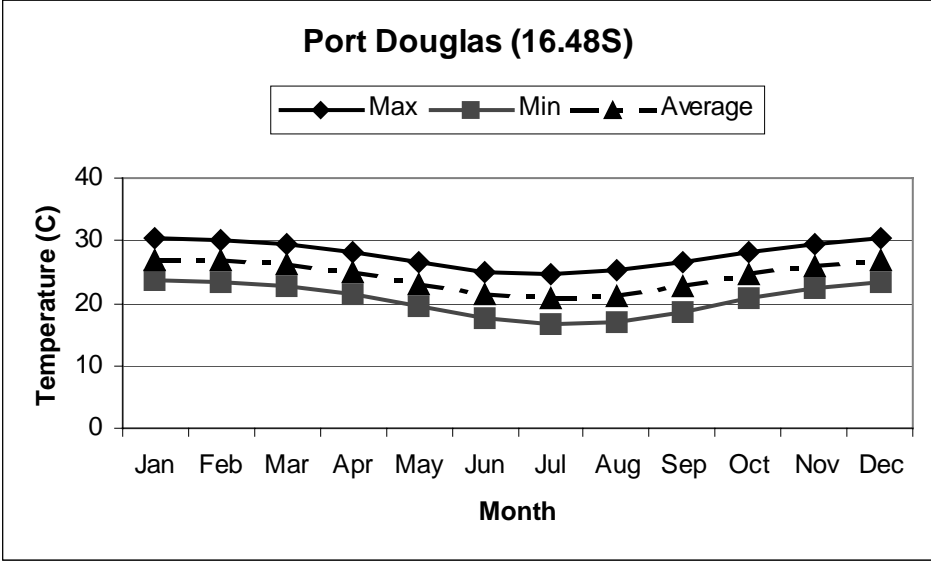
Implications

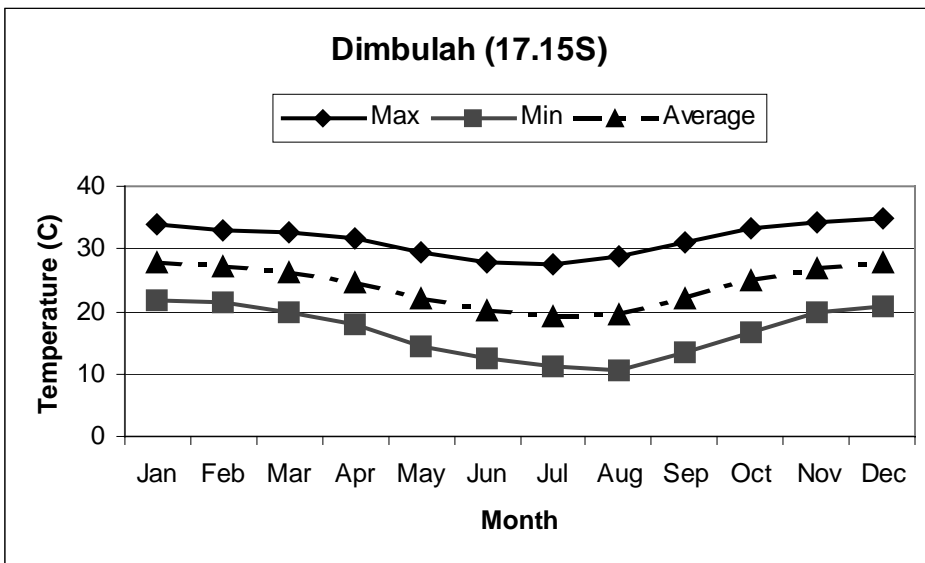
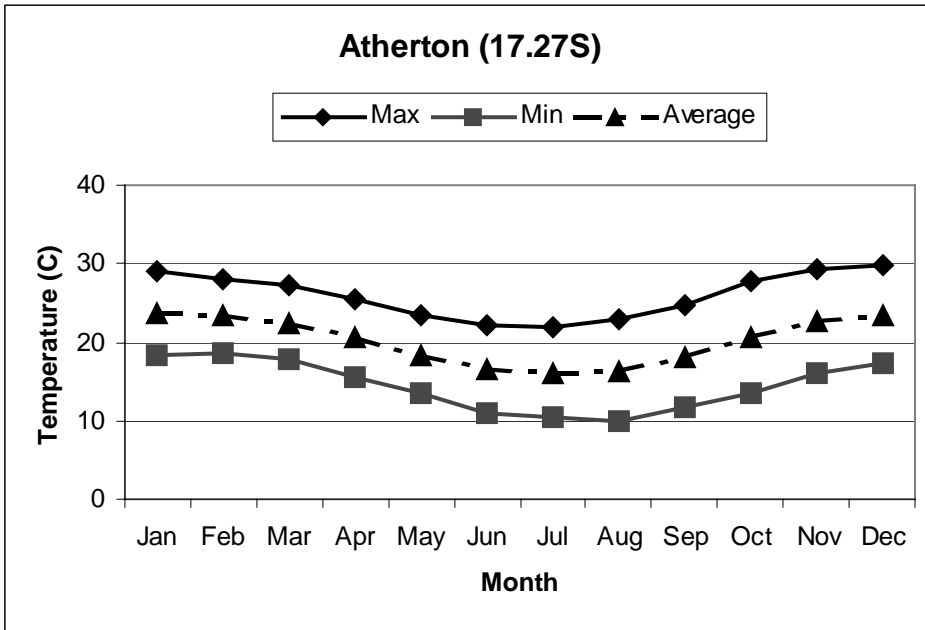
This project has resulted in specific industry recommendations for canopy management and cincturing of lychees. The expert panel method of developing these recommendations will lead to improved industry adoption of improved management techniques. This will lead on to improved crop production and profitability.

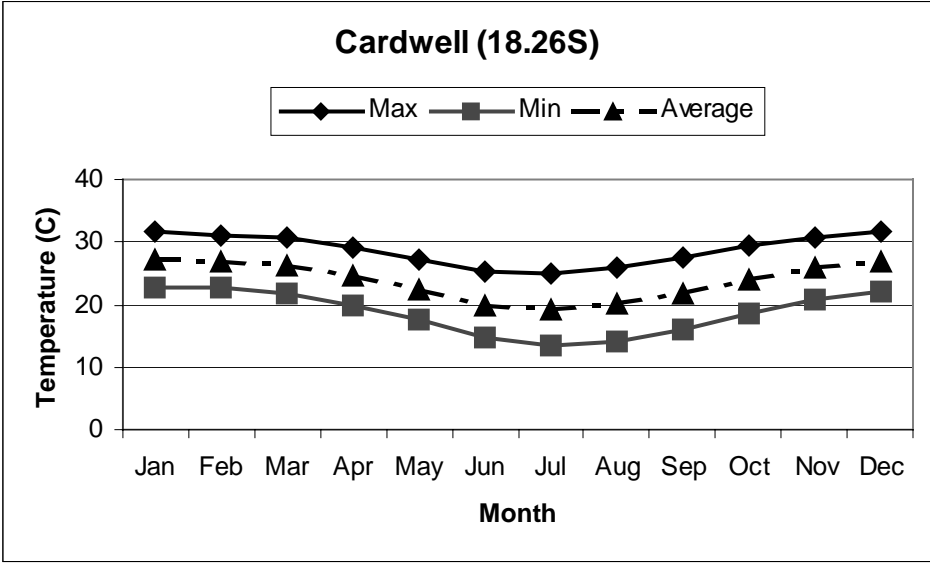
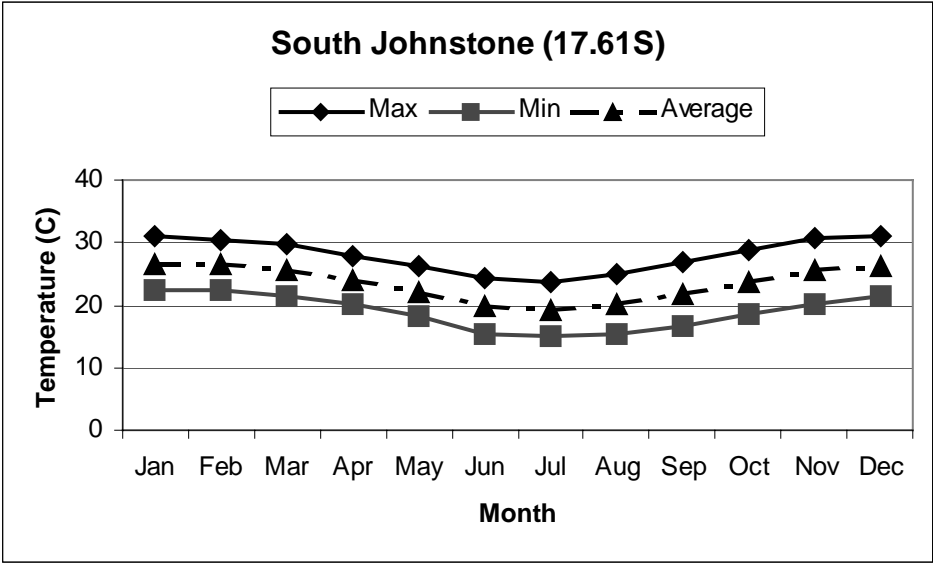
Recommendations

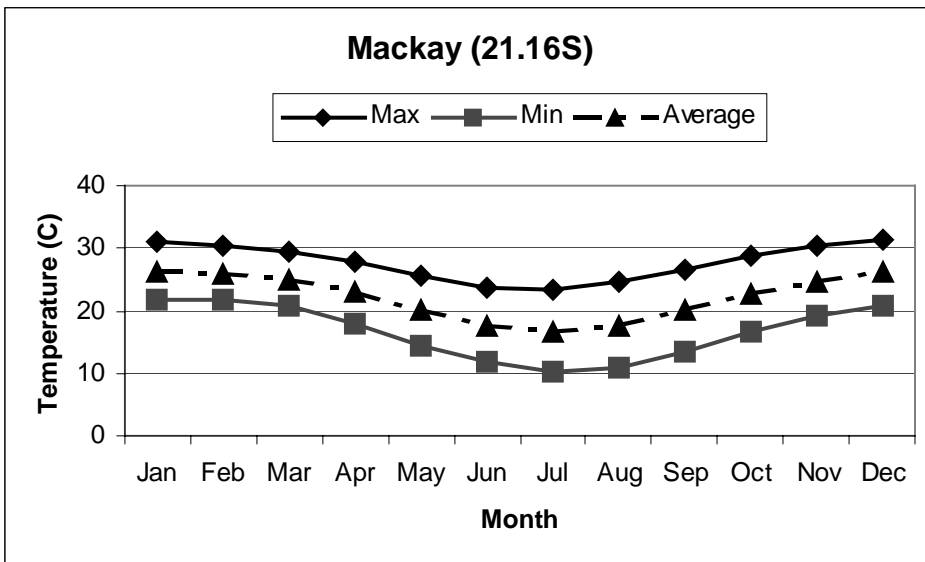
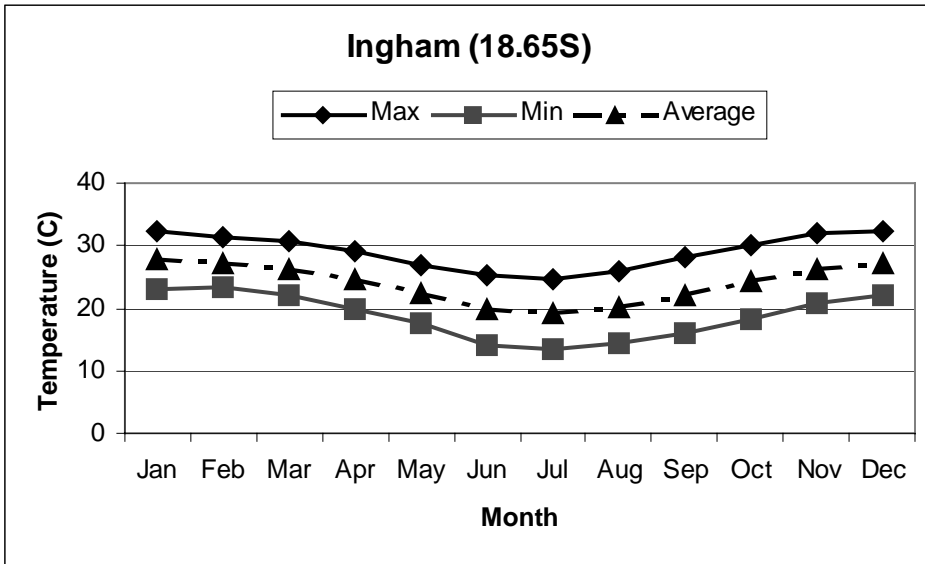
- Ensure wide spread dissemination of three DPI Notes
 - Pruning lychee orchards to meet management goals
 - Rejuvenating lychee orchards with large trees
 - Cincturing lychees for yield
- Further develop the use of “expert” industry panels for the use and application of complex research findings.
- Future work on crop management to be part of a development project based on DOOR/benchmarking processes.

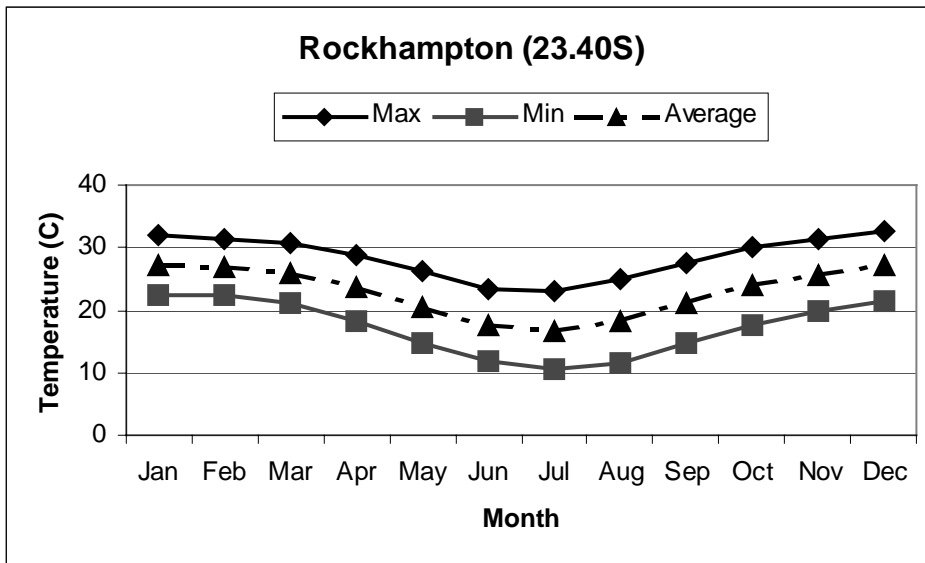
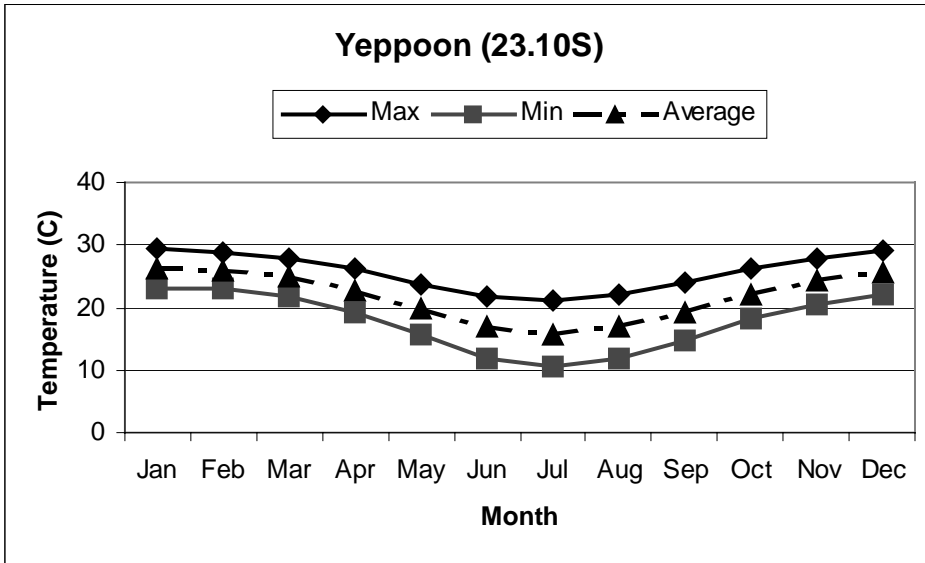
Appendix 1. Mean monthly maximum, minimum and average temperature for a range of lychee growing areas.

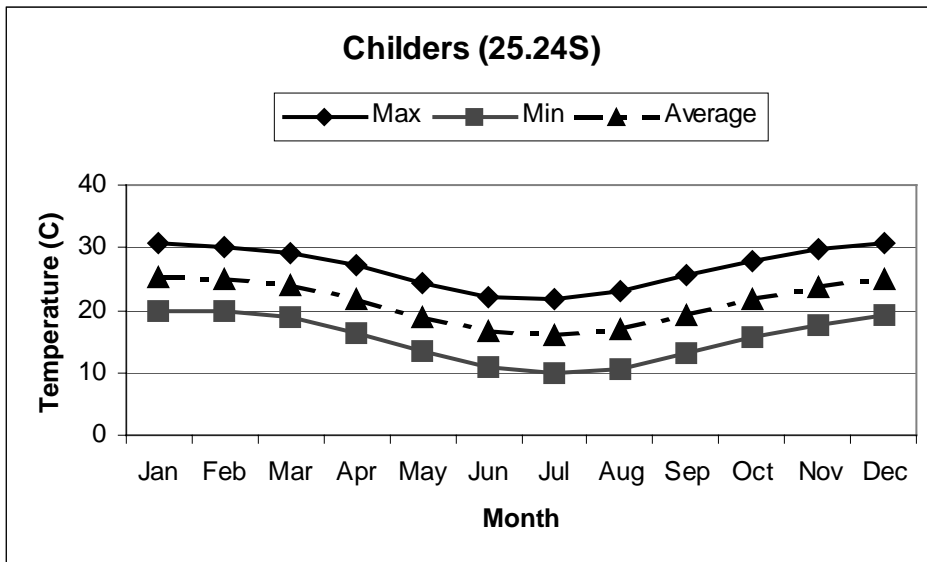
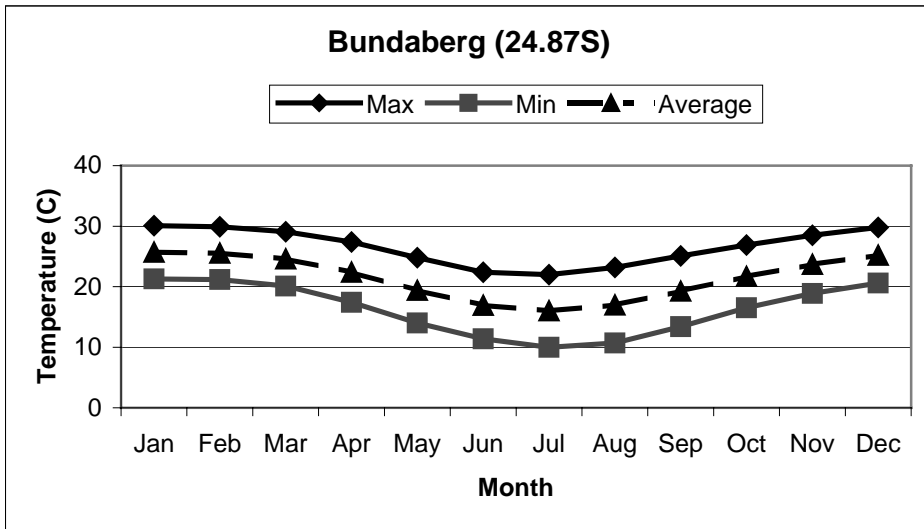


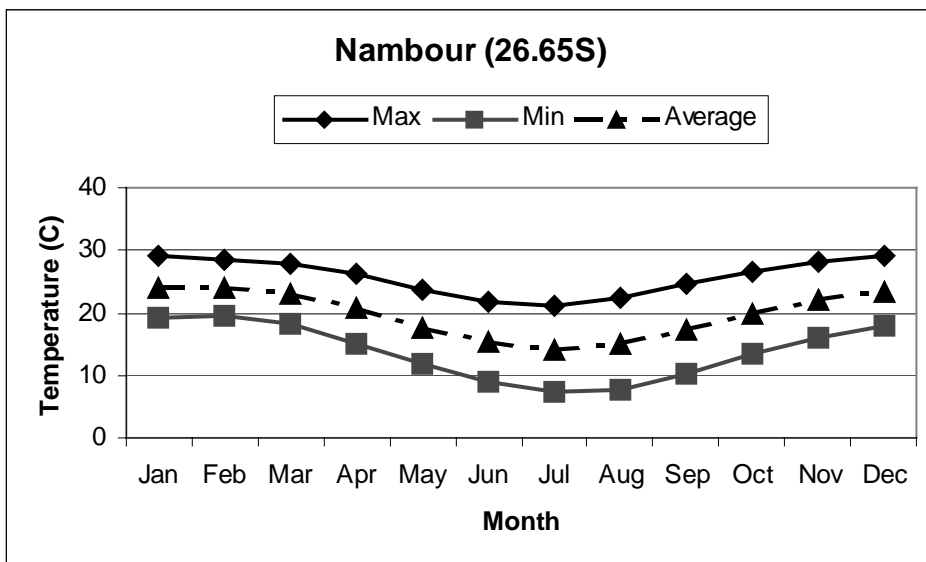
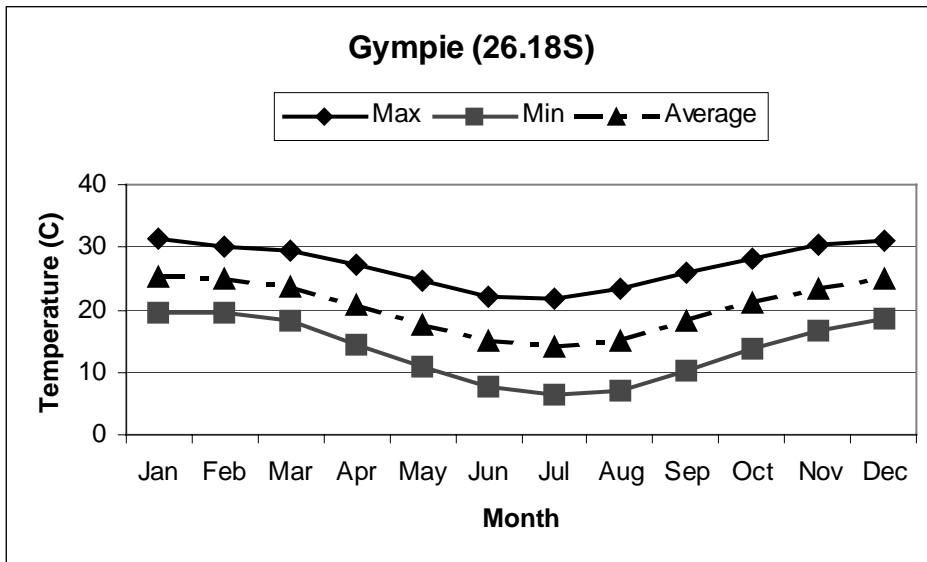


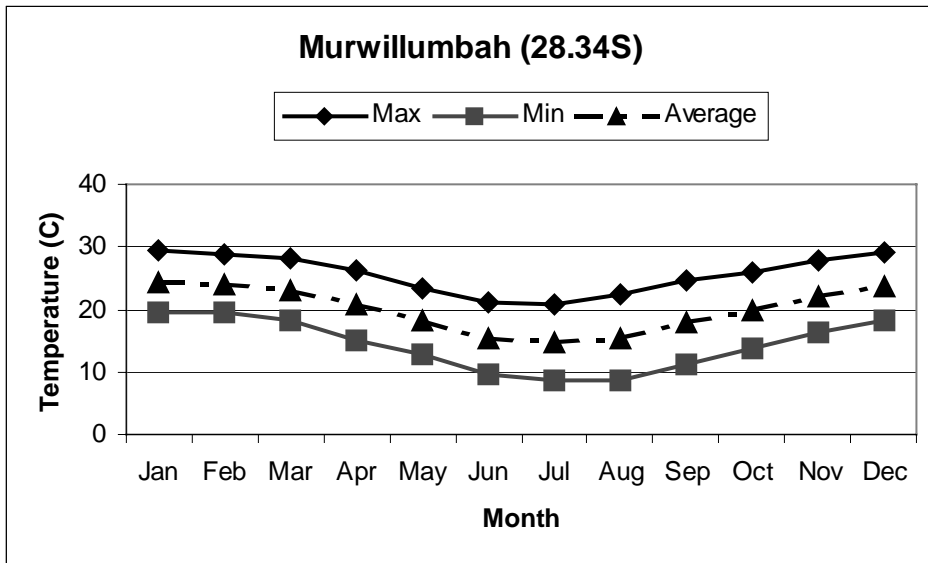












Appendix 2. Draft DPI farm notes with revised recommendations for pruning and canopy management

References

Batton, D.J. and McConchie, C.A. (1995). Floral induction in growing buds of lychee (*Litchi chinensis*) and mango (*Mangifera indica*). *Australian Journal of Plant Physiology*, 22, 783-791.

Hoger, C. (1997). To study the growing, processing, packaging, transportation and marketing of Lychees and other sub-tropical fruits, as well as pruning and crop protection methods to used to maximise cropping. A report for the Australian Nuffield Farming Scholars Association, Ascot Vale, Victoria, Australia.

Menzel, C., Olesen, T. et al. (2000). Optimising canopy management in lychee, longan and rambutan. RIRDC Research Report No. 00/29.

Nagao, M.A. and Paull, R.E. (1998). Observations of tropical fruit technologies in Taiwan. Proceedings of the 8th Annual International Tropical Fruit Conference, Hilo, Hawaii, Oct 16-18.

Zang (1997). Litchi Pictorial Narration Cultivation. Zhanewei Zhang (ed). Pomology Reseach Institute, Guangdong Academy of Agricultural Sciences.



Notes

Rejuvenating lychee orchards with large trees

Terrence Campbell, Yan Diczbalis & Irene Kernot, Queensland Horticulture Institute

The information presented in this note was developed from a series of workshops reviewing the canopy management of lychee trees. The lychee industry and the Rural Industries Research and Development Corporation funded these meetings to integrate the findings of an intensive canopy management research project into the production system for lychee.

At each of six regional workshops, experienced growers in the area, identified the key decisions they faced in managing lychee. Most areas identified the difficulty of managing large trees with high vigour. These trees (generally over 6.0 m) were often from early plantings that had reached a size that was difficult to harvest and protect from pests.

The participants developed recommendations for rejuvenating these trees. These recommendations are based on the results of the canopy management investigations as well as extensive grower experience and overseas observations.

The integration of this information by lychee producers has allowed the development of these recommendations, which are cultivar and region specific.

The rejuvenation program

Key points from the discussion were;

- Large trees were difficult to manage and in high vigour environments difficult to rejuvenate. For example on the wet tropical coast it may be better to remove trees and replant.
- The first task of any rejuvenation program is to bring the trees back to a manageable height (4.0 m). It is best to reduce tree height over two or three years rather than cutting the trees all the way back in one operation.
- Major structural pruning is best done during winter when regrowth is less vigorous. You may only miss one year's crop with a May/June prune.
- Alternatively take the opportunity to prune varieties such as Tai So more heavily in an off crop year. Prune the trees early during September. This will allow the tree plenty of time to recover from the pruning and the tree should set a good crop in the following season.
- A third alternative is to complete the major structural prune earlier in January and then hand thin the resulting regrowth before flowering.
- Because heavy pruning reduces subsequent bearing, the removal of major limbs should occur over two or three seasons rather than in one season.
- Two systems were identified depending on the vigour of trees in the orchard.
 - In vigorous environments (tree flushes as many as four or five times during the growing season and the flushes are around 50 cm in length) rejuvenation is done by selective limb removal.
 - In less vigorous environments or with Kwai May Pink, which responds well to pruning, a second system using mechanical pruning for the of the trees is possible.

The main steps to take are listed below;

In the first year;

Limb removal (Figure 1)

- Hand prune to selectively remove internal branches. This thinning will also keep the tree height down. Take out whole branches rather than topping. Aim to take out no more than 20% of the branches.
- If you have regrowth in the pruned trees thin this before flowering. Leave two shoots with wide crotch angles at each pruning point and remove other shoots including those from lower on the branch.
- Manage internal water shoots for a replacement canopy. Keep branch length between 40 to 60 cm by pruning to encourage branching.



Figure 1. Tree before and after thinning to remove branches

Mechanical rejuvenation (Figure 2)

- Reduce the height and sides of the trees by removing up to 2 metres. This can be with a mechanical pruner or with pneumatic saws. Then follow the steps for limb removal and branch thinning to open the canopy further.

In the second and third years;

For all orchards.

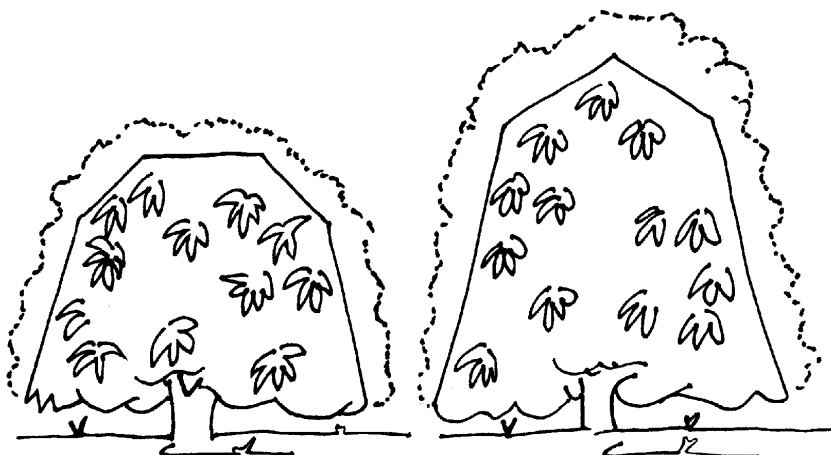


Figure 2 Suitable shapes for machine pruned trees

- Continue to open the centre of the tree by cutting out branches. Aim to see a small amount of broken sunlight under the tree after you have finished. This will indicate that enough light is getting through the canopy.

- Start the trimming program by cutting back the tops of the trees to about 60 cm below the height you want to maintain. This can be done by hand or by machine.
- If you want to get back to individual trees, reduce the sides of the trees by cutting back two metres. Reduce only two sides each year. If you are pruning to form a hedgerow you will not need to prune between the trees.

Tree removal

Although it is best to reduce the size of the trees for easier management, tree removal may be the only option if pruning is unlikely to restore the tree shape for efficient management and optimum yields.

If pruning is not an option remove every second tree within a row to improve light penetration in an overgrown orchard.

Further information

- For further information on lychee production contact the DPI Call Centre on 13 25 23 (local call) 8am to 6pm Monday to Friday or visit DPI Horticulture Information Centres in Mareeba, South Johnstone, Applethorpe, Gatton, Maroochy or Redlands.
- Lychee growers can join the Australian Lychee Growers' Association and subscribe to their newsletter, Living Lychee. Contact the editor, Henry Drew, 12 Tytherleigh Road, Palmwoods, QLD 4555. Secretary of the Association is Robin Amos, Rishworth Lane, Brooklet, NSW 2479
- The DPI library provides a personalised information search service that may be useful for producers seeking specialised information on lychees. Contact DPI InfoSearch on 07 3239 6989.
- Visit the DPI website on www.dpi.qld.gov.au for other DPI notes on sub tropical fruit crops. ■



Notes

Pruning lychees to meet lychee management goals

Terrence Campbell, Yan Diczbalis & Irene Kernot, Queensland Horticulture Institute

The information presented in this note was developed from a series of workshops reviewing the canopy management of lychee trees. The lychee industry and the Rural Industries Research and Development Corporation funded these meetings to integrate the findings of an intensive canopy management research project into the production system for lychee.

At each of six regional workshops, experienced growers in the area, identified the key decisions they faced in managing lychee trees. In most areas the difficulty of managing trees for regular cropping and to maintain small trees was identified. Irregular cropping is a significant problem in some cultivars and locations. Large trees and those with poor structures are difficult to manage for harvest and pest control.

The panels developed best practise recommendations for managing trees. These recommendations were based on the results of canopy management investigations, extensive grower experience and overseas observations.

In each workshop the need to begin planning a canopy management approach early in the orchard life was stressed by participants. These recommendations present the options for canopy management.

Preparing trees for planting

Shape trees before planting

Start shaping lychee marcotts before planting. After the marcotts have flushed once, they should be pruned to a single trunk. Remove all of the side branches below 45 cm as the crotch angles from marcotts are often too narrow and will become weak. The aim is to have a tree with a single stem up to 45 cm and no original branches. Encourage the growth of new buds above this height to form the framework of the tree.

Encourage the growth of new buds above this height to form the framework of the tree. Try to keep new branches that are offset from each other and at a wide angle from the trunk.

Varieties like Kwai May Pink will branch easily, while Fay Zee Siu may need tipping to encourage the growth of side branches at a suitable height.

Training and pruning young trees

Young lychee trees need to be pruned to develop a strong tree structure that will minimise wind damage and maximise the fruit bearing area. The pruning strategy used will depend on the growth habit of the variety.

Inspect trees regularly and take the following actions where necessary:

Remove weak branches

Although early shaping should minimise the problem, you may still need to remove branches with



Figure 1. A young lychee tree before (left) and after pruning.

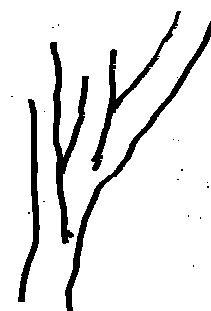


Figure 2. Remove branches with a weak crotch angle

weak, narrow crotch angles where the bark is folded into the crotch (Figure 2). The most susceptible varieties are Tai So and Fay Zee Siu. These branches can later split away from the trunk, causing severe damage.

Tip prune

Tip prune varieties which produce long branches or dominant leader branches such as Tai So and Fay Zee Siu.

Aim to keep branches between 50 and 80 cm long before they branch again. (Figure 3). This maximises the number of branches, which means more flowers and fruit. The risk of major limb breakage is also reduced. Thin out extra shoots if more than 2 or 3 branches start growing below the tip. Select shoots with a wide crotch angle that are well spaced around the branch.



Figure 3. Tip pruning

Skirt if required

Skirting trees is up to the individual management needs of the grower. Skirt trees from the third year onwards by removing branches to a height of 50 to 60 cm, leaving a clean single trunk (Figure 4). Only carry out minor skirting for the first three years while the trees are still establishing themselves.

Skirting helps minimise the twisting effect of high winds and prevents fruit and leaves touching the ground. This makes slashing and herbicide and fertiliser applications more efficient without damaging trees and avoids loss of fruit to insects and rots. Consider using tree guards to protect the trunk of young trees. Ant and scale control is also made easier by skirting the trees. Skirting too high reduces yield bearing area, hence the height of your skirt

Figure 4. Tree before and after skirting



needs to be a balance between ease of management and production capacity.

Support branches

In spite of the best pruning efforts, some varieties such as Tai So and Fay Zee Siu will still produce weak crotches that are likely to split. To minimise this risk use a strapping or bracing system using heavy gauge wire to link the main branches. Figure 5 illustrates one such system of strapping for trunks likely to split at ground level and wire bracing for multi-stemmed trees.

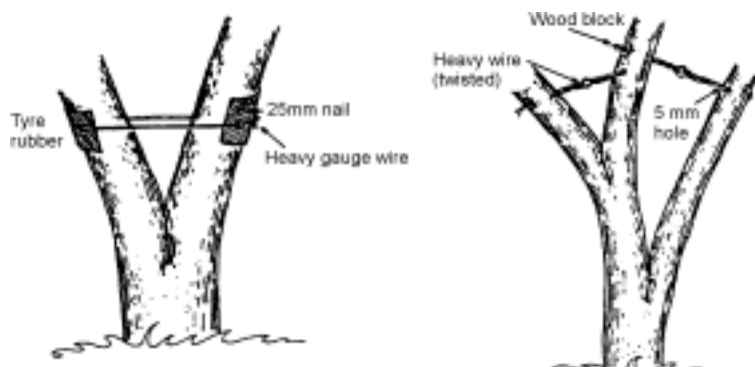


Figure 5. Strapping (left) and wire bracing (right)

Pruning bearing trees

Hedge rows versus individual trees

A major decision faced by lychee growers is the density of the orchard. A decision must be made to develop the orchard as a hedgerow or individual trees.

For hedgerows the high densities produce higher yields and a greater income stream earlier in the life of the orchard. Once trees start to touch, they intercept less sunlight and flowering and fruiting are reduced between trees. Some participants felt that trees become unproductive once trees start to overcrowd.

In lower density plantings the trees are kept as individuals with all surfaces exposed to light. Where land is not limited, participants felt that individual trees were easier to manage.

Regardless of the chosen planting density orchards will require decisions on tree structure and time of pruning.

Structural pruning maintains tree size and shape for easier picking, better spray coverage, better light interception and to keep the trees small for easier netting.

Strategic pruning synchronises the time of growth flushes to improve the cropping potential of the tree.

Because lychee tree growth patterns vary significantly with variety, soil type and climate, each variety should be treated differently. For instance, Kwai May Pink can be pruned heavily with out affecting the following crop. A heavy prune may affect Tai So, Wai Chee and Fay Zee Siu for several years.

Structural pruning

Tree shape

The amount of structural pruning required will depend on whether the trees are close planted and maintained as a hedgerow or kept as individual trees within the row. Tree height should be kept between 3 and 5 metres high. Trees in south east Queensland (Bundaberg and further south) can be kept shorter than trees grown in north Queensland.

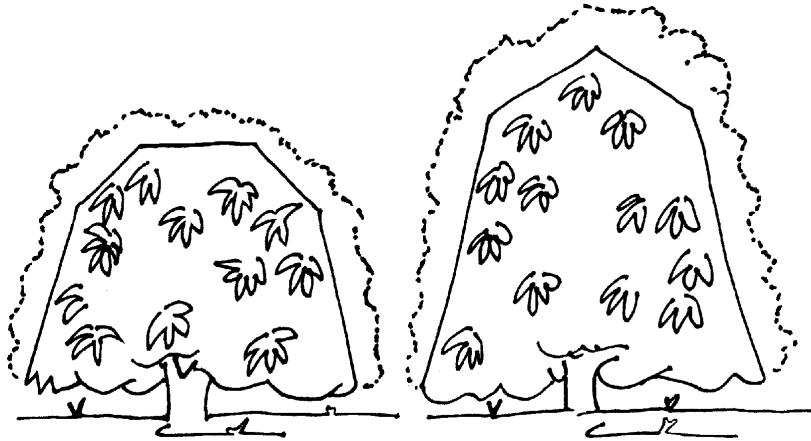
To maintain tree size, start a regular program to trim the tops and sides of the trees from the fifth to the seventh year. This can be done using mechanical pruning machines or by hand. A hedging machine can make the task much quicker and easier. Hand pruning is generally used where trees are maintained individually rather than as a hedgerow.

The cuts should be done at an angle that will create an inverted umbrella or cone shaped tree as shown in Figure 6. The tree should be shaped so that all parts of the canopy receive plenty

of light. Trees that are cut too square start to shade the bottom of the canopy as they grow. The timing of this pruning should be the same time as that for strategic pruning (see below).

Figure 6

Tree profiles for hedgerows



Canopy thinning

Thin the canopy by removing between 15 and 25% of the branches from inside the canopy. This is most important for dense varieties such as Salathiel and Wai Chee. Remove entire branches rather than shortening them.

After pruning you should be able to see some light through the tree canopy. Don't remove more than 15 to 25% of branches at any one pruning. This branch removal also helps to control the final height of the tree. Remove tall and long branches first.

In vigorous varieties long limbs that fail to branch should also be cut back to produce a more compact tree and to expand the number of potential fruiting branches.

Canopy thinning can be carried out at any time however the optimum time is in May/June, when the rate of regrowth is reduced.

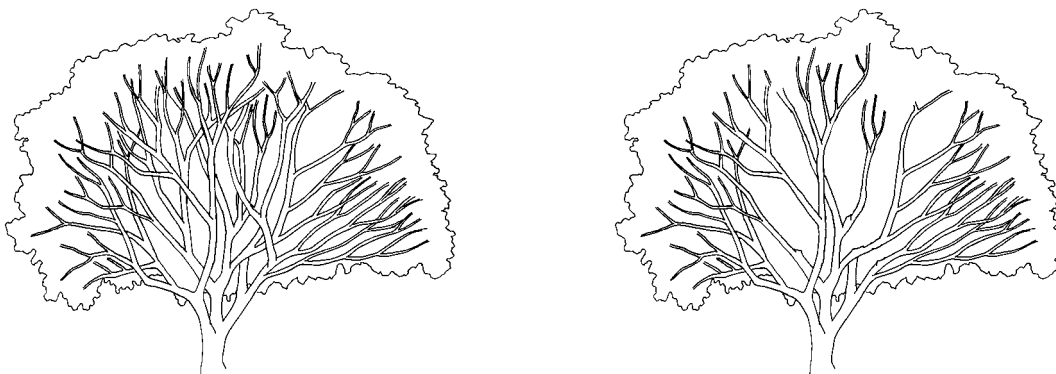


Figure 7. Tree before and after thinning

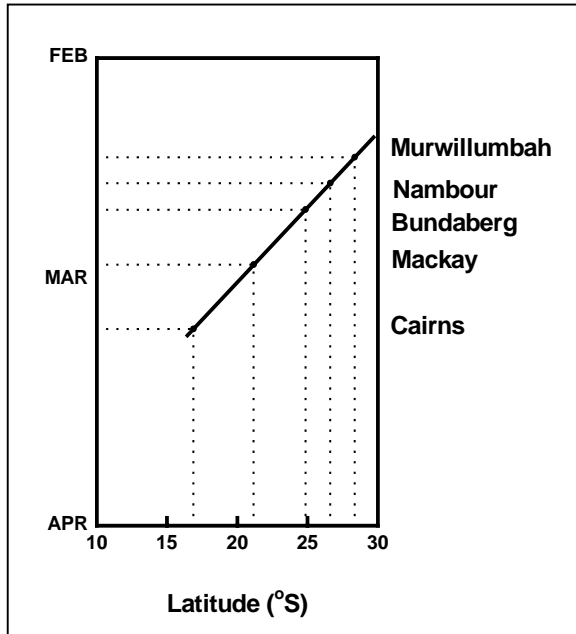
Skirting

Continuing to skirt mature trees is not essential. The skirting program for young trees can be continued after each harvest if required. Remove any limbs that extend down to ground level.

Routinely remove damaged limbs or twigs. At the same time, make sure the strapping and wiring used to support trees is not restricting growth.

Strategic Pruning

The recommendations in this section are based on the results of a canopy management project led by Chris Menzel and Trevor Olesen and many years of experience by lychee growers. The principle is that in a healthy tree, given warm conditions, plenty of light, soil moisture and nutrients, pruning will encourage a vegetative flush. The timing of this pruning is crucial to subsequent flowering.



Light pruning of the tree canopy at the optimum time will encourage an even vegetative flush which will be ready to flush again when winter temperatures are best for flower induction (average daily temperatures below 20°C).

Figure 7 shows the estimated optimum date of pruning that allows at least one flush to mature prior to the start of winter. In north Queensland (Mackay north) pruning in January will generally allow two flushes to mature before cool conditions slow growth. Workshop participants felt that this earlier pruning time reduced the risk of crop failure. Where strategic pruning is done in conjunction with structural pruning there is a risk that heavy pruning will reduce flowering in the subsequent season.

Figure 7 Estimated optimum time for pruning lychee (from Menzel et al 2000)

A way to reduce this risk is to prune alternate sides each year. In those years that pruning may reduce yield because the trees do not flush after the pruning, this will mean that the other half of the tree may still flower. The risk of poor flowering is higher in northern and central Queensland. Other strategies to reduce risk are to prune a proportion of the orchard each year.

North Queensland

Prune immediately after harvest in early January. This will give the tree time to grow two flushes before cooler winter temperatures slow tree growth.

In northern Queensland there is a second opportunity to prune Kwai May Pink in mid March. This will still allow time for a single flush to mature before winter.

Central Queensland

Prune the trees during the last two weeks in February or immediately after harvest.

In the Bundaberg area it will be particularly important to prune as early as possible in a very dry year with low humidity. Lychees can be slow to flush again under dry conditions. Earlier pruning is to maximise the time available for at least one vegetative flush time to mature.

South east Queensland

Prune trees in late February or March as soon as they have been harvested. This is particularly important for Wai Chee because it is harvested so late it is important to get the tree moving quickly after harvest. Prune the tree by removing the last two flushes at harvest time.

Managing a late unwanted flush

In some seasons lychee trees may flush during late autumn. This flush is likely to be unproductive, as it will not mature in time for the trees to flower during June and July.

There are two options to manage a late autumn flush;

- Hedge trees lightly taking care not to remove too many mature leaves from previous flushes. You should only need to remove about 5- 10 cm from the outside of the tree.

- Spray the flush with a mixture of ethrel and urea. This will “burn” off the new flush. The rate is 1-3 litres of ethrel plus 5 kg of urea in 1000 litres of water. The rate of ethrel depends on the maturity of the flush. The lower rate is sufficient for very new growth and the higher rate for flush that has expanded and lost its reddish colour.

Further information

- For further information on lychee production contact the DPI Call Centre on 132523 (local call) 8am to 6pm Monday to Friday or visit DPI Horticulture Information Centres in Mareeba, South Johnstone, Applethorpe, Gatton, Maroochy or Redlands.
- Lychee growers can join the Australian Lychee Growers Association and subscribe to their newsletter, Living Lychee. Contact the editor, Henry Drew, 12 Tytherleigh Road, Palmwoods, QLD 4555. Secretary of the Association is Robin Amos, Rishworth Lane, Brooklet, NSW 2479
- The DPI library provides a personalised information search service that may be useful for producers seeking specialised information on lychees. Contact DPI InfoSearch on 07 3239 6989.
- Lychee, longan and rambutan. Optimising canopy management. (*Menzel et al, 2000, RIRDC Research Report no 00/29*).
- Visit the DPI website on www.dpi.qld.gov.au for other DPI notes on sub tropical fruit crops. ■



Cincturing lychees for yield

Terrence Campbell, Yan Diczbalis & Irene Kernot, Queensland Horticulture Institute

Cincturing is an optional management operation that you may like to trial. Although widely used overseas, it is not a standard management practise in Australia. Irregular cropping in varieties such as Tai So or Fay Zee Siu can be improved by cincturing the trees, although results do vary. Success depends on correct timing, tree health, stage of leaf flush development and seasonal conditions.

Cincturing is a narrow, temporary spiral ringbarking of the tree that prevents starches produced in the leaves from being transferred to the roots. A build up of starches occurs in the canopy, which can stimulate the tree to produce flowers, resulting in a heavier crop than would normally occur.

To cincture your trees, take a hacksaw blade or similar tool and ringbark the main branches at base (Figure 2). The cut should be about 3 mm and 3 mm deep. Start the cut at a 15 to 20 degree and continue to cut in an upward spiral around tree until the cut circles the trunk. The top of the spiral cut should be about 30 to 40 mm above the you started. This small gap allows for a limited movement of starches that keeps roots alive and tree is less likely to die as a result of the cincture. Make sure the bark is removed from the as even the smallest amount of cambium (cells that transfer starches) remaining will cause the bark to regrow too quickly.

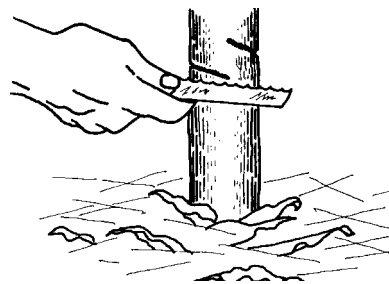


Figure 1 Cincturing with a hacksaw

their
wide
angle
the

point

the

cut

To help prevent disease, make up a thick paste of copper oxychloride with water and spread it over the cut.

Individual trees should only be cinctured every two years to allow a return to good health. If

you undertake a full cincturing program, treat half the trees in the orchard the first year and the other half the next. Do not cincture unhealthy trees or trees under six years old as death may result.

The aim of cincturing is to harden of the autumn flush so that it will flower in winter. Flowering is more likely to occur if the tree has not flushed just before winter. Be aware that cincturing can delay the next flush for two to three months.



apply cinctures on
main branches

Timing the cincture

You need to apply the cincture after the postharvest flush has matured. This will be

in March or April in northern and central Queensland. Flushing is generally too late in south east Queensland and northern New South Wales for cincturing to be successful.

There has also been some success with a late cincture in northern Queensland. This is applied in late June, about two to three weeks before the expected date of panicle emergence. This late treatment has no effect on flushing patterns but appears to assist flowering if weather conditions are marginal for flower induction.

We recommend you treat cincturing as an experiment. Record the stage of flush development, timing, resulting flowering and yield. Compare results to non-cinctured trees. You can then make an informed decision about continuing a cincturing program.

Further information

- For further information on lychee production contact the DPI Call Centre on 132523 (local call) 8am to 6pm Monday to Friday or visit DPI Horticulture Information Centres in Mareeba, South Johnstone, Applethorpe, Gatton, Maroochy or Redlands.
- Lychee growers can join the Australian Lychee Growers Association and subscribe to their newsletter, Living Lychee. Contact the editor, Henry Drew, 12 Tytherleigh Road, Palmwoods, QLD 4555. Secretary of the Association is Robin Amos, Rishworth Lane, Brooklet, NSW 2479
- The DPI library provides a personalised information search service that may be useful for producers seeking specialised information on lychees. Contact DPI InfoSearch on 07 3239 6989.
- Visit the DPI website on www.dpi.qld.gov.au for other DPI notes on sub tropical fruit crops. ■