



Growing lemons in Australia- a production manual - Readers' Note

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<http://www.dpi.nsw.gov.au/agriculture/horticulture/citrus/lemon-manual>

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CENTRAL COAST, NSW

General Information:

Ray Gibson at Kulnura has been growing citrus for fifty years. He presently grows oranges (navels, valencias) and lemons. Ray's property is also one of the sites for the National Lemon Trial which was used to evaluate three lemon varieties (Eureka, Fino and Verna), on six rootstocks.



Number of Trees:	1,200
Age Range:	3 to 18 years
Tree Spacing:	6 x 3m
Varieties:	Eureka (900 trees), Rough lemon, Fino and Verna
Rootstocks:	<i>P. trifoliata</i> ; Rough lemon and Benton citrange
Preferred Combination:	Taylor Eureka on Benton citrange
Why:	Because the trees are heavy croppers with multiple crops throughout the year.
Average Total Yield:	100 tonnes, 8 year old trees, yield 7 - 8 cases/tree.
Main Cropping Periods:	June to November
Life of Trees:	No longer than 20 years
Tree Height:	Maximum 4.5m, but would like them lower.

Young Tree Management

Planting:	In August, using bare-rooted trees.
Irrigation:	Microjets (7L/hr). Ray recently changed his irrigation schedule to irrigating for one hour every day, so that the fibrous roots in the top 30cm of the soil profile don't dry out. Previously, he watered for three hours every 7 - 14 days depending on rain.
Pruning:	At planting the tree is shaped with 3 - 4 leaders. Trees are then pruned annually until 5 years of age. The aim during this time is to strengthen the main limbs, remove water shoots (at base), weak and unwanted branches. Pruning is done in spring or autumn.
Main Pests/Diseases:	Red scale on some trees. Melanose and lemon scab on all trees.
Pest/Disease Management Program:	A copper spray at the spring bloom, plus 0.5% oil, followed by a second copper spray 2 weeks later. In December/January at flowering a copper and oil spray. By using the oil with the copper, it helps to reduce problems with scale.

Mature Tree Management

Pruning:	Pruning is done when harvesting to remove dead wood, watershoots and unwanted branches.
Pests:	Aphids in spring and a range of scale insects.
Disease:	Melanose and lemon scab.
Spray Program:	The same as for young trees, apart from an extra copper spray to coincide with flowering in April.
Weed Control:	Krovar® in May, which lasts for 12 months, with spot spraying using Roundup® twice a year.
Irrigation:	Same as for young trees. “If I was younger I would change over to drip irrigation”.
Nutrition:	Soil applied NPK fertiliser in July. Dolomite or lime in May. Foliar sprays of manganese, zinc and magnesium twice a year in spring and autumn. Added nitrogen in November. “Lemons need more nitrogen than oranges because they put on multiple crops”. Plant analysis is used every 2 - 3 years to monitor plant nutrition. The pH of soil is monitored regularly. Ray has been using soil and leaf analysis since the early 1970’s.
Crop Regulation:	Nothing used. “I have previously used GA, but the fruit hung on too long and was detrimental to the tree, and I still couldn’t sell the crop”.
Harvest:	Hand-picked using ladders and a cherry picker. The main harvest is July to September.
Markets:	Ray sells his fruit mostly to a central packing facility with a small amount going to a processor.

Gaps in Knowledge:

- “I would like trees to have a more predictable fruit size and shape. There’s too much variation in the trees and fruit.”
- “I would like to be able to manipulate the trees to crop in two distinct periods, July to September and late November to February.”
- “I would like to have smaller trees i.e. a dwarfing rootstock.”
- Comments from Lemon Variety Trial:
 - Likes all 3 varieties on Cox rootstock.
 - Fino is okay, but fruit are too small.
 - With Verna fruit shape is a problem.
 - Prefers Benton citrange and Cox rootstocks.

CHILDERS, QUEENSLAND

Grower Details:	Wayne Parr, Childers. Three generations of growers - 28 years.
Other Crops:	Imperial, Satsumas, Navels.
Number of Trees:	12,000
Tree Spacing (or area):	12 hectares
Age Range of Trees:	4 years
Varieties Grown:	Eureka (some Fino and Yenben)
Rootstocks Used:	C. <i>Volkameriana</i> , Rough lemon, Benton and Cox.
Preferred Variety/rootstock Combination & Why:	We mainly prefer C. <i>Volkameriana</i> in new plantings and good soil types. We use Benton for replants and heavy soil areas - currently trialing Cox as a replacement for Benton.
Main Cropping Periods:	March to June
Life of Trees:	20 to 30 years
Height of Trees:	Hedged at 3 to 4 metres
Average Total Yield:	35,000 to 40,000 18kg cases per year.

Young Tree Management

Planting:	Best time is early spring, so the plant has the whole growing season to establish.
Irrigation:	Drip irrigation and fertigated twice a week.
Pruning:	Winter time. Tree training and rootstock desuckering.
Main Pests/Diseases:	Red scale, Mauri mite, Black spot, thrips, Leaf miner.

Pest/Disease Management

Program:	Pest monitoring and set program for fungicide sprays.
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Mature Tree Management

Pruning:	Winter pruning after harvest and hedging/select pruning later on for removal of unwanted water shoots.
Main Pests/Main Diseases:	Red scale, Mauri mite, Black spot, Thrips.
Management Program:	Pest monitoring fortnightly, and set program for fungicide sprays.
WeedControl:	Monitored - Roundup® or Basta® - side boom application.
Irrigation:	Monitored - drip irrigation - when required in summer 2 to 3 times a week.

Grower Case Studies

Nutrition: Monitored - a yearly program is prepared in June, and adjusted with monthly sap and soil tests. 60% ground application, and the rest applied through irrigation.

Crop Regulation: None

Harvesting: March - June main crop - contract picked for size and colour. Clipped early in the season.

Postharvest Practices: Normal practices, bins dipped after harvest, and postharvest fungicides at processing.

Markets: Domestic and export - Sweetee Group, Queensland.

Gaps in Knowledge:

- More work on new rootstock - Cox.
- Growth regulators for tree growth control.
- Better scion selections for fruit size and seedlessness.

GINGIN, WESTERN AUSTRALIA

Grower Details:	Taddei, West Gingin. Since 1960's at High Wycombe, West Gingin since 1992.
Climate:	Hot dry summers with low humidity and cool wet winters. Some frosts (6/year).
Soils:	Beach sand
Number of Trees:	1,800 (500 new)
Tree Spacing (or area):	700 trees/ha, 6 x 3 or 5 x 3.
Age Range of Trees:	From new plantings to 11 years.
Varieties Grown:	Eureka
Rootstocks Used:	<i>C. Volkameriana</i> and Rough lemon.
Main Cropping Periods:	June to August, December to February 60% of crop in winter. Five harvests per year.
Life of Trees:	20 years plus
Height of Trees:	2.5 metres
Average Total Yield:	80 tonnes/ha. Preferred sizes above 125.

Young Tree Management

Planting:	Spring
Irrigation:	Undertree sprinkler
Pruning:	Ongoing to manage canopy. Mature trees after summer harvest.
Main Pests/Diseases:	Leaf miner
Pest/Disease Management Program:	Two or three Oil sprays.

Mature Tree Management

Pruning:	Pruning is being used to manipulate cropping habit of trees. Trees are pruned annually and sometimes twice a year. Trees are pruned after harvesting the summer crop in January or in autumn. The focus is to try to reduce the amount of winter crop by reducing flowering and fruiting sites.
Main Pests/Main Diseases:	Red scale is the main pest. Some bud mite, bud moth and brown rot.
Pest/Disease Management Program:	1 x mancozeb, 1 x copper, 1 x oil
Weed Control:	Glyphosate in tree row, mow interrows.
Irrigation:	Undertree sprinkler, scheduled using soil moisture monitoring equipment.

Grower Case Studies

Nutrition: Use ammonium based nitrogen forms. Improving organic matter content of soils. Using nutrition in combination with pruning to manipulate cropping.

Crop Regulation: Nutrition and pruning used to manipulate cropping.

Harvesting: Target summer - December, January, February also June, July, August.

Postharvest Practices: Degreeen as required, usual postharvest fungicide treatment.

Markets: Local and export (South East Asia).

Gaps in Knowledge:

- IPM strategies for local pests.
- Scale control.
- Post harvest treatment and storage.
- Outlet for overrun fruit.
- Improved irrigation/nutrition.

GRIFFITH, NSW

General Information:

Bart Brighenti, Sumar Produce, Lake Wyangan and Myall Park, Griffith. Has grown lemons for 10 years and also grows navels, valencias and mandarins.

Number of Trees: 2,000 Eureka on Rough lemon which were planted in 1994 and 80 lemon trees of mixed varieties.

Age Range: 10 years and 4 years.

Tree Spacing: 7.3 x 3.7m and 6.7 x 3.4m.

Varieties: Eureka

Rootstocks: Rough lemon and trialling other rootstocks.

Main Cropping Periods: Winter

Tree Height: 3.5m and 2.5m

Young Tree Management

Planting: Spring with bare-rooted trees.

Irrigation: Drip and flood.

Pruning: Remove suckers and low shoots.

Pest/Disease Management

Program: Spring - micronutrient foliar spray, March - oil for scale control.

Mature Tree Management

Pruning: Prune rootstock suckers and low limbs to stop fruit touching ground and aid herbicide application. Skirt trees.

Pests/Disease: Spined citrus bug and scale pests.

Pest/Disease Management

Program: Use pest monitoring service. Release wasps and spray oil to control scale.

Weed Control: Roundup® in spring/summer/autumn (CDA application) and Krovar® in winter.

Irrigation: Drip 2-3 times a week. Flood every 8+ days.

Nutrition: Broadcast citrus mix late winter. Fertigate with calcium nitrate and urea bi-monthly.
Foliar - potassium nitrate and trace elements.

Crop Regulation: GA at colour break.

Harvest: The winter crop is strip harvested by hand. The summer crop is colour picked.

Postharvest Practices: Degreening. Storage wax and put in cool stores.

Markets: Local

Grower Case Studies

Gaps in Knowledge:

- Long term storage.
- Thinning of winter crop.
- Manipulation to increase summer crop.
- Size improvement.
- Nutrition.

LOXTON, SOUTH AUSTRALIA

Grower Details

Solora South, Loxton in South Australia. Has been growing lemons for 40 years and also grows large areas of mandarins and oranges and some grapefruit.

Number of Lemon Trees: 12,853 (2718 mature and 10,135 less than 6 years old).

Tree Spacing (or area): 7.3 x 3.65m or 6.7 x 3.65m.

Age Range of Trees: 1 to 40 years.

Varieties Grown: Eureka, Lisbon, Fino and Verna.

Rootstocks Used: Sweet orange.

Preferred Variety/rootstock

Combination & Why: It suits most of our soils and produces good quality fruit.

Main Cropping Periods: June to November.

Height of Trees: 4m.

Average Total Yield: 420 tonnes for whole farm.

Young Tree Management

Planting: Sept/Oct or March.

Irrigation: Drip or undertree sprinklers.

Pruning: We start only after 3 to 4 years so the tree can establish itself before we start to shape it.

Main Pests/Diseases: Leaf miner and aphids; earwigs are also a major problem as they chew buds, which stops new growth and reduces crop.

Pest/Disease Management

Program: (Typical annual spray program). Pirimor® for aphids; Lorsban® for earwigs. These sprays are assisted by keeping trees well pruned and inter-row weeds well controlled.

Mature Tree Management

Pruning: After picking we remove dead wood, branches that cross over and broken branches (every 2 to 3 years).

Main Pests/Diseases: Thrips and spined citrus bug.

Pest/Disease Management

Program: Spray for both thrips and spined citrus bug.

WeedControl: In May (before harvest) and in November before summer. Hyvar® and Diuron®.

Irrigation: Undertree using Challenger sprinklers. Frequency determined by plant usage monitored by soil dryness.

Grower Case Studies

- Nutrition:*** September - 400 kg/ha of NPK blend.
November - 100 kg/ha of ammonium nitrate.
January - 100 kg/ha of ammonium nitrate.
June - 300 kg/ha of superphosphate.
- Crop Regulation:*** Nil.
- Harvesting:*** May & June - hand picked using bags and ladders.
- Markets:*** Japan.
- Gaps in Knowledge:***
- Control of thrips.

MUNDUBBERRA, QUEENSLAND

Grower Details

The grower has been growing citrus for 60 years mainly mandarins on a property at Munduberra. Lemons have been grown for the past 8 years.

Number of Trees:	6,000
Tree Spacing (or area):	16ha
Age Range of Trees:	1-8 years
Varieties Grown:	Eureka
Rootstocks Used:	Benton citrange, <i>C. Volkameriana</i> , Rough lemon.
Preferred	
Variety/rootstock:	Eureka on Benton citrange
Combination & Why:	The best rootstock for poor shallow soils with an underlying clay layer.
Main Cropping Periods:	March-June; Aug-Sept; January.
Life of Trees:	15 year planting rotation.
Height of Trees:	3.5m
Average Total Yield:	(lemon production from whole farm) 20,000-25,000 18kg boxes with a 90-95% packout.

Young Tree Management

Planting:	Planted in September using bagged trees.
Irrigation:	Microsprinklers
Pruning:	Don't start pruning until 18 months of age when they shape trees. Until then they force feed trees to get good structural growth.
Main Pests/Diseases:	Leaf miner, soft scales and <i>Phytophthora</i> root rot.
Pest/Disease	
Management Program:	Control citrus leaf miner and scales using HMO's.

Mature Tree Management

Pruning:	In June-July they top trees annually to 3.5m. Trees are thinned out and opened up every 3-4 years.
Main Pests/Diseases:	Red scale would be the main pest. Other pests include white louse scale, thrips, mites (bud & mauri). Melanose and black spot are the main diseases.
Pest/Disease	
Management Program:	Copper, mancozeb, anthracol, benomyl for disease control. Abamectin, chlorpyrifos, HMO's and release of natural predators for pest control.
WeedControl:	Roundup® and Basta® when needed.
Irrigation:	Microjets, 6 hours a week on average. Irrigate twice a week in summer and once a week in winter for frost control. Use tensiometers to monitor soil moisture.

Grower Case Studies

- Nutrition:*** Use fertigation and basal applications of an NPK fertiliser plus sulphate of potash. Use foliar applications of potassium nitrate in November to help with fruit size.
- Crop Regulation:*** None. They have tried to water stress trees but it didn't work consistently and climatic events could not be controlled.
- Harvesting:*** Hand picked using ladders.
- Postharvest Practices:*** A postharvest dip of a fungicide to control blue and green mould and sour rot when there have been wet conditions. Otherwise they do not dip fruit.
- Markets:*** Both domestic and export markets with different brand names for the different markets. Export to China, Asia which prefer small fruit. The supermarket chains prefer lemons in the size range 100-113.
- Gaps in Knowledge:***
- Nutrition information specific to lemons.

RENMARK, SOUTH AUSTRALIA

Grower Details:	Yandilla Park Limited – Renmark, Paringa, Nangiloc & Colignan. Company has been in operation since 1969. Grow all citrus types, mandarins, limes, valencias, navels, lemons, tangelos, grapefruit.
Number of Trees:	Approx 13,000 (based on around 300 trees/ha).
Tree Spacing (or area):	41.6 ha
Age Range of Trees:	1-32 years. Majority of trees are 12-16 years.
Varieties Grown:	Lisbon, Eureka, Fino, Verna
Rootstocks Used:	Rough lemon, Sweet Orange, Benton and Carrizo citrange
Preferred Variety/rootstock Combination & Why:	Eureka/Rough lemon if planting on virgin soil, high production. Lisbon/Carrizo citrange or Eureka/Benton citrange if planting in replant soil.
Main Cropping Periods:	Harvest commences early May for Japan. Majority of crop is picked by end of July. Some remaining crop is picked in September/October/November. Harvest is very much determined by the market available. Majority of crop is targeted at the Japanese market.
Life of Trees:	Once trees reach around 30-35 years, they begin to produce small fruit and suffer from collar rot.
Height of Trees:	3.7 - 4.3m
Average Total Yield:	1700 tonnes in 2002, 1300 tonnes expected for 2003.

Young Tree Management

Planting:	Planting normally in October. Potted trees.
Irrigation:	Will only plant on drip. All replant trees will be mounded.
Pruning:	In second or third year to remove any dominant limbs that are not growing in the right place. Continual disbudding.
Main Pests/Diseases:	Leaf miner.
Management Program:	Apply Confidor® to non bearing trees to control leaf miner.

Mature Tree Management

Pruning:	Hedge trees after harvest to maintain height. On average, we would hedge three times in two years. If we hedge after an early harvest, we may need to hedge in summer to control regrowth. Occasional side and shoulder hedging is required. Prune centres out on older trees every three years. Will not do any major pruning until about year seven.
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Grower Case Studies

- Main Pests/Diseases:** Thrips(No.1), leaf miner (live with), spined citrus bug (minor), elephant weevil in older plantings.
- Pest/Disease Management Program:** Control thrips using either Supracide® or chlorpyrifos depending on timing of application. Normally Eureka/Benton citrange Supracide® after flowering and chlorpyrifos closer to harvest. Need to consider withholding periods.
- Weed Control:** Glyphosate when required. Hyvar®, Diuron® and Simazin® as a residual spray. Solicam® is used on occasions
- Irrigation:** Drip on the majority. Some undertree and 6 hectares of overhead. Spring/Summer – Drippers 3-4mm every day, Sprinklers 40-45mm every 7-8 days. Currently, drippers 3mm every 3days, sprinkler 30mm every 3 weeks.
- Nutrition:** Approximately 170-200kg N/ha. Broadcast for sprinklers, fertigate for drippers. 20kg P/ha p.a for drippers. 40kg P/ha every 2 years for sprinklers. Fertiliser for drippers applied from beginning of August through until mid March. Three broadcast applications of N made in areas using sprinklers, Sept, Oct, Dec. K applied every 2-3 years in sprinklers. 30kg K/ha applied to drippers p.a. Some years up to 100kg will be applied. Three foliar sprays applied per year. Two in spring and one in autumn. Copper also applied in late March. Mg, Zn,Mn, K, N applied in foliar sprays. Some gypsum applied every 3 years for Ca. Ca also applied through drippers.
- Crop Regulation:** GA applied to patches that have a heavy crop (normally smaller fruit size) so these can be picked later. Fruit that has good size will be picked early for Japan.
- Harvesting:** All snap picked. Size picked early in the season for Japan, 57mm and larger. Harvest commences in early May.
- Postharvest Practices:** Normal fungicide treatments are used, with the exception of some lemon orders to Japan which have very strict standards for chemical use.
- Markets:** Japan, Korea, domestic market
- Gaps in Knowledge:**
- Peteca is a major problem for us on occasions and needs to be investigated further in Australia.
 - How to produce big lemons every year after a late harvest.

Grower Case Studies

- Why thrips are more attracted to lemon blossom. Currently being investigated in thrip project.
- Why some trees produce a summer crop, suggested it is the influence of GA.