

COASTAL FRUITGROWERS' NEWSLETTER

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INSIDE

Sydney Orchardists Update Seminar Richmond 19th November 2006	2
Cittgroup field day report September and October 2006	7
Rutherglen bug - a common pest this season	10
Looking after your low chill stonefruit trees after harvest	11
Where can I get information about chemical user trainers?	14
News in Brief	15
Australian native bees for fun and profit	20
Managing citrus orchards with less water	22

No. 63 Summer 2006/2007

Dear Growers

Welcome to the final edition for 2006 - another year flies by!

In this issue there is a comprehensive report for stone fruit growers from a seminar held in Richmond in September.

There's also a report from the two Cittgroup meetings held in September and October.

Also there are some tips for citrus growers on managing their orchards with less water - maybe printing this article will bring rain.

So when you get a spare minute over Christmas - have a read.

Wishing you all a Merry Christmas and a Happy New Year.

Sandra Hardy



Coastal Fruitgrowers' Newsletter
Edited by Sandra Hardy
Design & Layout -
Cathryn McMaster

The information contained in this publication is based on knowledge and understanding at the time of writing. However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of NSW Department of Primary Industries or the user's independent adviser. Inclusion of an advertisement or sponsor's symbol in this publication does not necessarily imply endorsement of the product or sponsor by NSW Department of Primary Industries

Sydney Orchardists Update Seminar

Richmond 19th November 2006

Report by Sandra Hardy, NSW DPI Gosford.

Solutions for Damage to East Coast Orchards by the Grey Headed Flying Fox (GHFF)

Ed Biel, NSW Farmers.

Flying foxes cause significant damage to crops on the east coast of Australia, which is increasing every year. Twenty years ago the damage was 1 in 5 years but now it is every year. Farmers can no longer sustain losses and remain viable. Presently there are no other non-lethal methods to control flying foxes apart from netting.

The increase in damage from flying foxes can be attributed to the following:

- The range of flying foxes is moving southwards on the eastern seaboard, mainly as a result of land clearing due to population growth and development.
- This development is removing native food sources.
- There is competition from other flying foxes species displaced by development, which is also pushing the Grey Headed flying fox further south. The Black flying fox is now present in Sydney but was once only seen as far south as the Tweed River.
- Growers are unable to protect their crops due to State and Federal legislation (Threatened Species Conservation Act listing in 2001)

Population counts of flying fox were done annually in 2003/04/05 but counting is now only done every five years. Bats can forage up to 80 kms in a night.

Possible Solutions

Who is responsible for flying foxes? The bats are owned by the State and Federal Governments on behalf of the community. These beneficiaries, the community should also contribute to protection costs.

There are four possible solutions:

- **Restructure the industry** – and offer incentives for those who want to leave, or
- **Set up an insurance scheme** – with annual

contributions from the State (40%) and Federal (40%) Governments and growers (20%), or

- **Set up a compensation scheme.** Growers determine annual crop loss and are reimbursed by the Government. The scheme could be administered by NSW Department Primary Industries (DPI) or the Department of Environment and Conservation (DEC)
- **Set up a netting scheme.** Existing orchardists with a demonstrated GHFF problem would receive a one off government grant (40% State /40% Federal/20% Grower contribution) to install flying fox netting. Any orchardists who have put up net since 2001 when the legislation was enacted would be reimbursed. If this scheme was offered, it would mean no more shooting would be permitted. Netting grants are supported by all conservation groups – WWF, Humane Society Inc., RSPCA and the NSW Conservation Council.

The Grey Headed Flying Fox in Orchards – Damage Estimates

Kylie McClelland, Department of Environment and Conservation (DEC)

The Grey Headed flying fox is listed as a threatened species in New South Wales (May 2001), nationally (Dec 2001) and Victoria and its status is presently under consideration in Queensland.

The NSW Flying Fox Consultative Committee was established in August 2001 including representatives from NSW Farmers as well as two horticultural producers. Some of the activities initiated by the committee include a review of DEC licence policy, a 2002 Treasury submission for research and several student research projects.

A project was submitted by the Hawkesbury/ Nepean Catchment Management Association (CMA) which has been successful. Funding of \$397,000 from the Commonwealth is being matched by the NSW Government with \$430,000 as cash and in-kind support.

This project will allow us to obtain accurate crop damage information necessary for a National

Recovery Plan for GHFF, which is currently being prepared. It will also allow us to gather information on the foraging habits of the bats, the fruit industries affected, determine flying fox density - crop damage relationships and undertake an economic analysis of control options. We also need to assess non-lethal mitigation techniques and develop a method to estimate damage that can be used by growers.

The project will focus on detailed assessments of 10-12 orchards in the Sydney Basin, to provide information on flying fox density and damage and assessment of different mitigation techniques. The primary outcome of the project is to come up with sound and economic strategies for growers to control Grey Headed flying fox damage in orchards.

Two project officers will be employed to run the project. Dr Ho Dang based at NSW DPI at Richmond has already been appointed. A project steering committee has been established comprising Dr Peter Fleming, Dr. Peter Malcolm, Kylie

McClelland, Mark Silm, Ed Biel, and a CMA representative.

Carpophilus Beetle - Attract and Kill strategy – where are we up to
Dr. Mofakhar Hossain, DPI Victoria.

Carpophilus beetles cause significant damage to stone fruit and also carry and spread the Brown rot fungus. Carpophilus beetles are not normally visible in an orchard until fruit starts to ripen. Chemical control immediately before harvest is difficult due to Maximum Residue Limits (MRL) constraints. We are currently in the commercialisation phase of the project.

Use of Pheromones

The pheromone is an aggregation type, which attracts both female and male beetles. In 1999-2002 we put the pheromone and an attractant (rotten fruit) together in three stations in a 1 ha block, however the stations were not very user friendly to manage.



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In 2003/04, we developed a synthetic co-attractant, which is water soluble and twelve times more effective than the original attractant, which was based on fermented apple juice. If beetle populations were heavy, the trap bucket could be full in twenty-five minutes. We then needed to find a more suitable trap to house the attractant and pheromone and found a funnel trap worked best.



The funnel trap used in the Attract and Kill system

With the current project we are trying to develop an area-wide approach to control, and in 2005/06 a 100ha was treated with the Attract and Kill system, with growers in the Goulburn Valley paying \$350/ha to be involved in the trial. In the 2006/07 season we plan to treat 170 ha.

Using this system 300 mls of the synthetic food co-attractant is placed in the funnel trap along with the pheromone which is attached to the lid. Timing of trap placement is about five weeks prior to harvest.

The Attract and Kill system is not yet commercially available to growers because there is only limited supplies of the synthetic co-attractant and the pheromone. The cost of each trap will be about \$60. The trap is attached to a star picket and the attractant needs to be changed weekly and the pheromone fortnightly. You will need three traps/ha but as the area treated gets larger you need less traps. For 9 ha you would need only 20 traps. You can also place an insecticide pad in the trap, which will last all season.

The trap can also be used to monitor beetle populations by placing the synthetic food attractant or the apple juice/yeast mix into the trap. It is hoped that the Attract and Kill system will be available to purchase commercially next season.

Queensland Fruit Fly (QFF)

Andrew Jessup, NSW DPI, Gosford.

There are 6–10 generations/year of QFF in coastal areas, depending on the weather. Females lay about 200–300 eggs in a lifetime. Eggs take 24–48 days to hatch and the larva mature in 7–14 days. The larva then pupate in the ground for 10–20 days. It then takes about a week for the flies to mature, mate and lay more eggs.

The female fly injects a bacterium into the fruit after laying its eggs – which possibly causes the fruit to rot. Peaches and feijoa fruit are very attractive to flies. Three to four heavy frosts of minus 3°C can kill flies and drought also reduces fruit flies. Fruit flies like a humid moist environment so rainfall improves their survival. QFF can probably fly up to 1 km, but they can also be blown further by strong winds.

Orchard hygiene is critical to control QFF so remove any feral fruit trees and fallen fruit. It is important to monitor fruit fly numbers using traps to gauge treatment timing. Food based baits and traps target both male and female flies. The APVMA is currently reviewing a number of fruit fly control chemicals.

Amulet® Cue - lure fruit fly station

Richard Bull – Crop Care

Amulet® is an ‘attract and kill’ device impregnated with an attractant and a low dose of the insecticide fipronil. Amulet® will only attract male flies, which are then killed. Research trials have also found that male flies can transfer the product to female flies during the mating process. Female flies only mate once.

Amulet® comes in two pack sizes, large (100 units and 20 stations) and small (16 units and 8 stations). Amulet® has no impact on non-target species. It is made from recycled paper fibre and has an attractant radius of between 200–300 metres. Use protective gloves when handling the stations. The field life of the station is about three months, then they should be replaced. Seal unused stations in their original container and store in a cool place. To maximise control of female fruit flies, protein based bait sprays should also be applied.

Field use of Amulet® Cue – lure

By using Amulet® stations and bait sprays, you

should be able to cut out cover sprays. You need to set up an 'Exclusion Zone', the larger the area treated, the better the control. You cannot just use one in a tree and expect control.

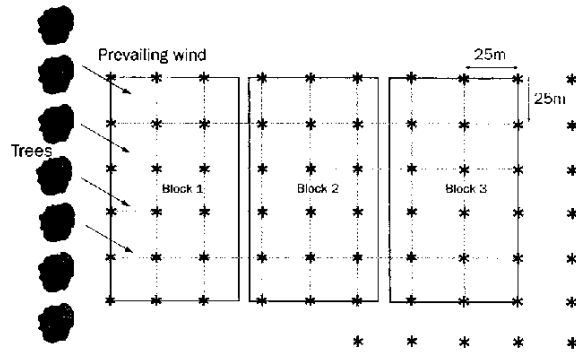
In commercial orchards stations are laid out on a 25 m grid pattern with a density of 16 stations/ha (see diagram). Start with the outside rows and end trees at a 25 m spacing. Stations do not need to be as close inside the block, especially if you are treating large areas e.g. 300 ha. In areas of high



Amulet® Cue - lure fruit fly stations are hung in trees.

fruit fly pressure place traps outside the orchard (32 m from orchard) in non-crop vegetation to intercept immigrant flies.

Stations need to be in place 5–8 weeks prior to the crop reaching the fruit fly susceptible stage. Stations should be placed in dense shade in the tree to minimise exposure to sun, wind and rain. Put on the eastern side of trees. Don't hang the station against or immediately above fruit because there are no maximum residue limits set (MRL's) for this chemical on fruit. In stone fruit we have observed a



Commercial orchard treatment layout. Treat entire orchard on 25 m grid starting and ending on outside rows and end trees (plus barrier).

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silvering of the fruit skin where the pad has touched the fruit. The application of bait sprays to attract female flies is also recommended.

You can also use Amulet® Cue-lure stations in Steiner type fruit fly traps to monitor fruit flies. Monitoring should be part of any good management program. Amulet® can only be used in Steiner type fruit fly traps. There is a great variation in the number of flies different traps catch. Bugs for Bugs in Queensland has produced and sells a copy of the Steiner type trap that Richard Bull developed.

Product Registration

Amulet® is currently registered for use in stone fruit, citrus, table grapes, for Area Wide Management and in Steiner type traps. They are currently applying for registration in strawberries and doing work in mango, avocado, pome fruit and blueberries crops.

They are also developing an Amulet® Gel fruit fly bait spray, which is highly attractive to immature



The Steiner type fruit fly trap baited with Amulet® Cue-lure

female flies and has 7-10 days activity on shaded leaves.

Naturalure Fruit Fly Bait Concentrate, Geoff Messer, Dow Agro Sciences – See CITTgroup field day report on page 7. 



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Cittgroup field day report

September and October 2006

Naturalure® Fruit Fly Bait Concentrate

Presented by Geoff Messer, Dow AgroSciences.

Queensland Fruit Fly (QFF)

In coastal areas there are at least 4–5 overlapping generations of QFF annually. In warmer areas the adults overwinter in sheltered sites, but in colder areas they die out and are reintroduced in spring.

The female fly lives for a few months. They lay eggs in fruit which hatch in a few days. The larva spend 1–2 weeks feeding, before they pupate in the soil for between 10 days – 2 weeks. After the flies emerge they take 1–2 weeks to reach maturity.

Control strategies

- **Baiting** - using a protein based attractant and an insecticide, which is applied to trees as bait spots or bands. Protein baits attract male and female flies.
- **Traps** – using protein based lures which attract males and females or cue-lure which attracts males only.
- **Cover sprays** – using a registered insecticide to kill QFF.
- **MAT** (Male annihilation devices) using cue-lure plus an insecticide which attracts males. MAT can also be used in traps.

Cue-lure is more attractant over a larger range – hundreds of metres while protein based baits work over a range of 30–50 m.

Naturalure® bait

Spinosad is the insecticide used in Naturalure® and is registered for control of lots of fruit flies around the world. This wide registration around the world minimises trade impacts. The bait uses low rates of the active ingredient (0.24 g active ingredient/ha) which is safe to the applicator, consumers and the environment. However, baits will impact on hover fly parasitoids, and some predatory wasps which can get stuck in the bait mixture.

Naturalure® was registered in February 2005 and has BFA organic certification. The bait is protein

based and includes short term and delayed volatile attractants which are specific to fruit flies, and repellent to bees. The attractants (which work over several metres) are corn protein and sugars which are pre-mixed with the insecticide. Mediterranean and Queensland fruit flies need protein to feed, and as this breaks down the volatiles are released attracting flies to the bait. The attracting distance is about 30–50m. The bait knocks out flies mainly in the first 24–48 hours after application. The bait is active for at least 7 days after application. There is no WHP.

Field use of Naturalure®

Naturalure® can be applied using a dilute or concentrate bait solution as a band or spot spray.

The bait should be applied using large droplets (4–6 mm in size) to the canopy around 1.2–1.8 m high in the tree. If the bait is applied to the ground it is only 40% as effective as putting it in the canopy. Bait the perimeter of blocks to catch flies coming in from surrounding areas.

The **dilute solution** is 1 part bait to 6.5 parts water. The **concentrate solution** is 1 part bait to 1.5 parts water. The concentrate solution is more suitable for spot spraying.

Spot spraying – Apply to every second tree. About 100–200 spots/ha is ideal. For the concentrate solution apply about 125 x 20 ml spots to 1 hectare. For the dilute spray apply about 150 x 50 ml spots to 1 hectare.

Banding – using either a concentrate or dilute coarse spray. Apply to one side of tree in every row or every second row.

Cost is about \$17/ha. Four litres of Naturlure® will do about 4 hectares. For a 44 gallon drum which does about 200 ha it costs around \$11/ha.

Precautions

- The bait can be phytotoxic if applied to fruit (particularly mangoes and pears which are very susceptible) especially under hot dry conditions. There haven't been any blemish problems with

citrus. Sometimes it can mark furry stonefruit such as apricots and peaches.

- The baiting sites may occasionally develop sooty mould. There are lots of sugars in the spray which can encourage sooty mould growth, especially if the bait is re-applied to the same spot on the same tree. Therefore it is important to rotate application sites.
- Do not use Naturalure® in traps.
- Apply the bait as high in the tree as possible.
- In crops where there is a possibility of fruit damage, apply the bait to the trunk or to material such as a piece of plywood hanging in the tree.
- Equipment must be cleaned. Drain the tank, then rinse tank, pumps, lines, hoses, filters and nozzles with clean water at least twice.

Confidor® Guard for control of scale, leaf miner and aphids on citrus.

Presented by Graham Nicol, Horticulture Area Manager, Bayer Crop Science.

Confidor® Guard is a new soil applied liquid insecticide which is root systemic. It has long residual control of leafminer, scale and aphids, especially in young trees.

Confidor® Guard is moderately water soluble and spreads well in the soil, moving in the direction



Application of Confidor® Guard to the soil around trees.

of the wetting front. As the spray dries it binds with the clay and organic matter in the soil, so it is relatively immobile. The percentage of clay in the soil does not affect control levels.

Confidor® Guard should be applied with some soil moisture which helps with penetration and uptake by tree roots. It is critical that the soil treated is weed free both before and after application and that the treated soil is not disturbed. Because Confidor® Guard breaks down in sunlight the tank mix should not be left exposed to sunlight for long periods.

Confidor® Guard should be applied evenly around the base of trees at 9 mls/tree of the active ingredient diluted in 1 L of water, to trees up to 4

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m tall. Only one application should be made per year and there is a 20 week withholding period. For leafminer control Confidor® Guard should be applied in late spring prior to the summer and autumn flush. Confidor® Guard provides 60–120 days control of citrus leaf miner in 2 m high trees.

For control of scale insects, monitor trees from late spring to early summer and apply prior to the onset of the crawler stage.

Although Confidor® Guard can be injected through the irrigation system, more targeted application using a spray jet to the root zone is preferred.

For more information phone Graham Nicol on phone 0417 374 863.

Using Copper sprays to control diseases in citrus.

Presented by Keith Fallow, Nipro.

Mode of action

With copper sprays good coverage is critical. The copper needs to be on the plant before the disease develops. Copper is a protectant fungicide and the layer of copper stops the development of fungal spores and it needs to stay on the plant to protect it from disease. Copper binds strongly with organic matter and can affect bacteria levels in the soil.

How copper works on the plant

All coppers work in the same way, they partially dissolve on the leaf and release cupric ions, so they need water on the leaf to make them work. The copper doesn't all dissolve at once, it remains on the plant surface and a little more dissolves with each new rainfall or moisture event.

Impact of pH

As the pH drops copper solubility increases. The pH of a plant leaf is about 5.8. Copper is almost insoluble at pH7. If you drop the pH of the spray water too low, then too many copper ions can be released. So don't use spray water below 6 or 6.5 and don't use a buffer. The larger the surface area the copper is applied to, the quicker it dissolves.

Types of copper

The Bordeaux mixture used in the past used higher rates of copper than the present day fixed copper formulations. There are different rates of copper

in each product therefore rates and costs vary. All types of copper can be very effective, it is the quality of the product that is the key. Look for high quality products as they:

- mix better and stay suspended longer
- have more even and generally smaller particle size
- usually have lower application rates = lower rates of cu/ha
- have lower levels of contaminants.

Retention of copper

Factors that affect copper retention include:

- rainfall – loss from dislodgement or solubilization
- wind – small particles >3–4 microns can blow off
- growth of the fruit/plant dislodges particles.

Application

Don't apply copper to wet fruit – when the plant cells are turgid. Research from South Africa indicates that in December, due to physiological changes within the fruit, they are more prone to damage.

Timing is also important with application, apply when the plant surface is between 25°C – 35°C and not in cool, slow drying conditions.

The water rates for application need to ensure good coverage of plant surfaces. Every time the fruit diameter doubles the surface area of the fruit quadruples. You need at least 2,500 L/ha for good coverage. For dense trees open them up to improve coverage.



Rutherglen bug - a common pest this season

Sandra Hardy, NSW DPI, Gosford.

Rutherglen bug, *Nysius vinitor*, is a small grey brown narrow bodied winged bug (4 mm) that sometimes swarm in large numbers. The bugs move from dried out weed growth to other succulent plants and fruit looking for moisture. They can cluster thickly on flowers, leaves and fruit, sucking the sap and causing damage in a short time.



Adult Rutherglen bug (4 mm)

Rutherglen bug is a small native sap sucking insect. Females lay up to 400 eggs on the soil, plant debris and flower heads of weeds and crops. The eggs hatch after a week and there are five nymph stages. Wing buds develop in the fourth and fifth stage. The life cycle from egg to adult takes about 4



Rutherglen bugs swarming on ripe nectarines

weeks and adults live for 4 weeks. There are several generations between spring and autumn.

On stonefruit the effect of feeding depends on the stage of development of the fruit. If fruit is still green, long thin tendrils of clear gum are produced which hang from fruit, which then fails to mature and shrivels. On almost ripe fruit the affected area is left dried out, leathery and tends to remain poorly coloured.

Control


Chemicals registered for the control of Rutherglen bug in selected fruit crops are contained in Table 1. Be sure to check the withholding period (WHP) of products if fruit is close to harvest. 

Table 1: Registered products for control of Rutherglen bugs in selected crops

Crop	Active ingredient	Trade names	WHP
Citrus	maldison	Maldison 500 Hy-Mal	3
Deciduous fruit	fenthion	Lebaycid	7
Pome fruit	trichlorfon	Dipterex 500SL Lepidex 500	2 2
	endosulfan	Endosulfan 350EC Endosan Thiodan EC	28
Stone fruit	trichlorfon	Dipterex 500 SL Lepidex 500	2

Source: Infopest, November 2006

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Users of agricultural chemical products must always read the label and any Permit, before using the product, and strictly comply with the directions on the label and the conditions of any Permit. Users are not absolved from compliance with the directions on the label or the conditions of the Permit by reason of any statement made or omitted to be made in this publication.

Looking after your low chill stonefruit trees after harvest

Dr A P George and R J Nissen

Extracted from Low Chill Stonefruit Grower Issue No 4/06, November 2006.

Summer pruning

Summer prune two to three weeks after harvest. With early varieties, do this before mid-January and again in February if you need to avoid any delays in flowering in the following season. The aim of summer pruning is to allow light to penetrate the tree. This ensures good flower bud development and induces the growth of new fruiting wood close to the leaders for the next season.

At summer pruning

- Remove strong water shoots in the tree centre. Leave weak lateral growth to protect limbs from sunburn.
- Top trees to framework height or reaching height for open vase.
- Remove some laterals if growth is excessive.

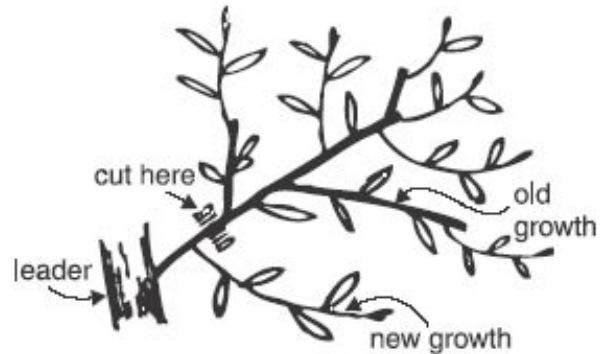


Figure 1. How to summer-prune laterals.

- Do not allow old fruiting wood in the body of the tree to develop into heavy branches. Where potentially fruitful new laterals have been produced along an old lateral, remove wood outside the selected new growth (Figure 1). Where there is no new growth, prune the old spent wood to a stub carrying two or three buds. These generate growth in the following few months and bear fruit the next season.

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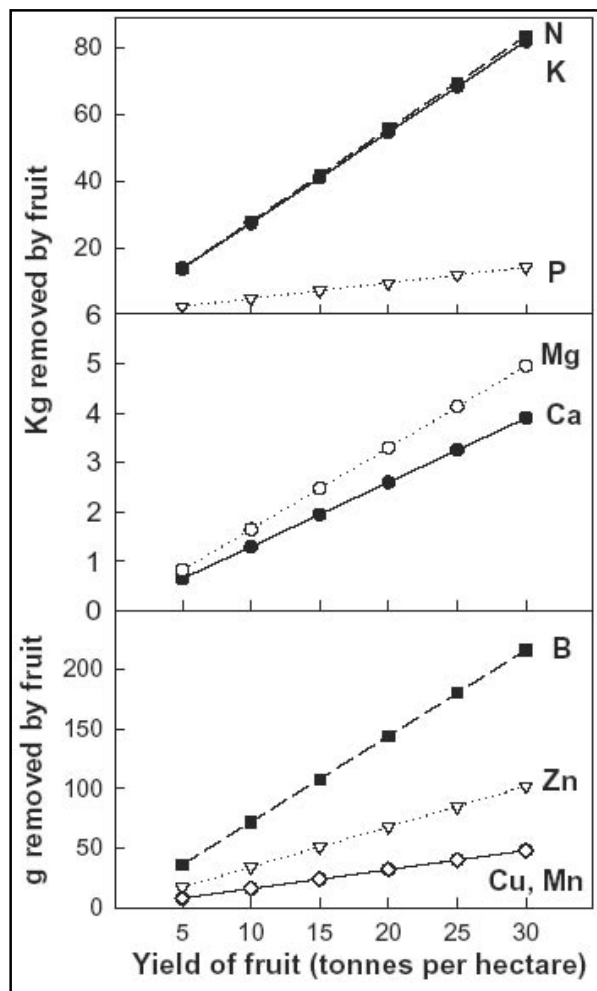
- Remove old fruit and dead shoots.
- Remove all growth, including suckers, within 500 mm of the ground.

Post harvest topping

Post harvest topping differs from summer pruning in that it involves pruning the tree back to the main scaffold branches. Post harvest topping has been used as a management tool to control tree size in low chill stonefruit (Crocker et al. 1982). Higher yields than can be expected with standard systems can be achieved. Young and Crocker (1982) recorded yields of 32 t/hectare with post harvest topped Flordagold. Post harvest topping can increase fruit size as much as 15%.

However, the major disadvantage with post harvest topping is the strong compensatory regrowth which follows topping. Due to delayed floral bud differentiation, flowering and subsequently fruit maturity may be delayed. In studies conducted

Figure 2. Nutrient removal by low-chill stonefruit fruit



in Australia and Florida (McDermott et al. 1987) the period of delay is not exceptionally great, usually between 5 - 12 days. George et al. (1992) were able to show that paclobutrazol can control compensatory regrowth normally associated with severely post-harvest topped trees. Limited observational studies indicate that if post harvest topping is carried out by early summer then trees will have sufficient time to regenerate new fruiting wood without delay in flowering or fruiting in the following season.

Post harvest topping techniques would be suitable to use with very early maturing varieties and for trees that are planted at higher densities than normal. It would also be an ideal technique to use in regions with a distinct wet season. In these regions leaf surface area on the tree may be severely reduced as a consequence of strong wind and leaf diseases. Post harvest topping will result in regeneration of new, healthy leaf that will be more resistant to leaf drop.

Fertilising mature trees

Stonefruit remove significant quantities of the major elements N and K and the minor elements B and Zn. Whilst it is desirable to base fertiliser rates on the amounts of nutrients removed by the crop (Figure 2) many other factors must be taken into account to determine the correct quantities of nutrients to apply.

The amount of fertiliser applied to an orchard needs to be based on these factors:

- the amount of nutrients removed from the orchard in fruit, leaves and prunings;
- the amount of nutrients leached from the soil or washed from the soil surface;
- the amount of nutrient unavailable in the soil due to fixation;
- recent leaf and soil analysis data;
- visual leaf nutrient symptoms and tree growth.

Consequently the rates of nutrients to apply for different soil types, locations/regions may vary by a factor of up to 2-3 fold; thus both leaf and soil nutrient analyses are the most essential tools for adjusting fertiliser rates. Do a leaf and soil analysis at the end of year 2 and then every year at about two weeks after harvest.

Table 1. New fertiliser rates and timing for Australia

Nutrient	Fertiliser rate (kg/hectare)*			Total rate per year
	Budbreak (late winter)	Post harvest (early summer)	Early autumn	
Nitrogen	66	22	22	110
Phosphorus	9	3	3	15
Potassium	66	22	22	110
Calcium	150			150
Magnesium	42	14	14	70

*These fertiliser rates are an average rate and will require further adjusting for different soil types and leaching rates. Adjustments should be based on leaf and soil analyses.

To work out what fertilisers need to be applied, simply compare your leaf and soil analysis results with these standards. Only apply nutrients where your leaf and soil levels need to be adjusted to bring them into line with the standards. In fertile soils, nitrogen is likely to be the only nutrient that needs to be added on an annual basis. In less fertile sandy soils, phosphorus, potassium, calcium and magnesium, as well as nitrogen, may need regular adjustment.

Having worked out which nutrients need adjustment, rates of fertiliser used are best based on replacing those nutrients removed in the fruit, leaves and prunings. This has been calculated for crops of varying yield and adjusted to take account of pruning and nutrient losses from soil leaching. As an example, a broad program of fertiliser use for a crop yielding 25 tonnes per hectare is shown in Table 1. The figures assume full nutrient replacement is required. In reality, nitrogen may be the only nutrient required.

Nutrient leaching losses and fixation, heavy rainfall, excessive irrigation and runoff can leach valuable nutrients from the soil. Normally, leaching is greatest in soils that are light in texture with little clay and low in organic matter (Table 2). Because

soil type and weather conditions vary so much, it is difficult to assess with any confidence how much nutrient loss is suffered due to leaching. The following losses can occur:

- 30-70% of applied nitrogen and potassium lost by leaching
- 50-80% of the phosphorus applied could become unavailable to plants by fixing or washed away by runoff.

The figure for phosphorus may be low and will be dependent on soil type. In a podzolic soil 75% of applied phosphorus may become unavailable to plants, while in krasnozems, 95% could become unavailable. Stonefruit phosphorus requirements are low and the probability of a deficiency occurring is remote. Incorporating phosphorus into the soil profile before planting assures its availability over a long period. Nutrients supplied by fertiliser can be lost to the atmosphere. For example, if urea, or fowl manure based fertilisers are not incorporated into the soil by either cultivation or water then significant ammonia loss (up to 40%) can occur.

Timing

The optimum time to apply fertiliser for low-chill cultivars appears to be in late winter/early

Table 2: Estimated leaching losses (%) for different soil types and rainfall

Soil type	Low rainfall (<1000 mm)	Medium rainfall (1000-1600 mm)	High rainfall (>1600 mm)
Sand	30	35	45
Sandy loam	25	30	40
Loam	20	25	30
Clay loam	10	15	20

spring at the time of budbreak (Goldspink, 2001, pers comm.). Up to 60% of the trees fertiliser requirement should be applied at this time. A small amount of nitrogen needs to be applied post harvest and again in early autumn to maintain leaf health and to reduce the build up of leaf diseases in this period. However, excessive applications of nitrogen after harvest should be avoided otherwise trees

will produce several vegetative flushes into the late autumn which will delay floral bud initiation and flowering.

Fertiliser placement

Mature tree roots extend into the middle of the row so the whole of the orchard should receive some fertiliser. Set up the fertiliser spreader to place most of the fertiliser under the tree canopy.



Where can I get information about chemical user trainers?

There is a range of training available to suit all types of pesticide users. In most cases, the training involves a two-day course (some providers may offer part of the course by home study) based on the National Rural Production and Amenity Horticulture Training Packages.

You can also become qualified by demonstrating to a registered training provider that you know how to use pesticides in your job or business.

Information on training courses, providers and assessors can be found in the Yellow Pages. Some organisations that you can contact for information about training courses may include:

- ChemCert (NSW) Ltd
Phone: (02) 9387 4714
Website: www.chemcert.com.au
- Department of Primary Industries (formerly NSW Agriculture)
Phone: (02) 6391 3317
Website: www.lg.tafensw.edu.au/smarttrain
- TAFE NSW
Phone: (02) 6393 5900
Website: www.lg.tafensw.edu.au/smarttrain
- Arilan Training
Phone: (02) 4928 4008
Email: arilan@bigpond.net.au
- GM Rural Training
Phone: 1800 444 228 or (02) 6658 1894
Website: <http://www.gmtraining.com.au/>
- NewTRAIN Inc
Phone: 1800 338 586
Email: training@newtrain.com.au
- SPRAY SOLUTIONS™
Phone: (08) 8835 1390
Email: rsta@bigpond.com
- Australian Training and Consulting
Phone: (02) 6766 9040
Email: admin@austrain.net
- NSW Farmers' Association
Phone: (02) 6884 8822
Website: www.nswfarmers.org.au
- FarmCare Training
Phone: (02) 9387 8432
Website: www.farmcaretraining.com.au
- Hunter Councils
Phone: (02) 4978 4013
Website: www.huntercouncils.com.au

Disclaimer: This list of registered training organisations has been prepared in good faith for general information only. DEC does not warrant that the list is complete, nor vouch for the quality of the training or information that may be provided by any of these parties. The provision of this information about registered training organisations does not imply that DEC has endorsed or approved the registered training organisations or the courses run by the registered training organisations..

News in Brief



◆ **Budwood certification scheme – Call for expressions of interest**

Extracted from Auscitrus Newsletter Autumn 2006

Initial trials of a citrus budwood certification system are to begin in Spring 2006. This will be based around the issue of a certified, trademarked label with each Premium bud sold through the Auscitrus scheme.

Auscitrus is seeking expressions of interest from nurseries who would like to be involved in the trial of certified labeling for Auscitrus budwood.

The cost of the labels will be born by the nursery, and will be included on the invoice for the budwood. The initial cost will be 6 cents per label, plus an administration & handling charge of \$2.50 per variety. Postage may be additional for large orders.

The trial will aim to identify any issues with the production and distribution of the labels. A trial audit will also be conducted on the nurseries involved at the end of the budwood season, to identify issues with auditing the use of the labels.

Interested nurseries should contact the Auscitrus office and register their interest to be involved in the trials.

Four nurseries will be selected by the Auscitrus management committee. Involvement in the trials will be conditional on the nurseries involved signing an agreement which, among other things, will prohibit the use of the labels in any marketing until after the labels become available to other nurseries.

At the completion of the trials, consideration will be given to offering the certification system to all customers for the 2007/08 budwood season.

Note that the Auscitrus name and logo is trademarked, and Auscitrus is looking carefully at it's rights under trademark law. In the future, unsubstantiated claims that trees are propagated using Auscitrus material may be pursued through

the Australian Trademark office.


Budwood sales 2005-06

Although there are still a few budwood orders left to be distributed, expected sales for 2005–06 will be down from previous years.

Expected final bud sales will be 679,590 buds, for both spring and autumn sales combined. This is down approximately 18% from last year, although last year saw a record number of buds sold.

The top ten selling varieties for 2005-06 were:

Imperial mandarin, Hamlin, Washington navel, W. Murcott Afourer mandarin, Late Lanes, Tahiti Lime, Murcott mandarin, seedless Valencia and Navelina (7.5).

Sales of W Murcott Afourer have relaxed somewhat, from over 100,000 last year, although demand remains strong. Sales of Common Hamlin and Salustiana remain significant as propagations continue for the North West development for juicing oranges. 

◆ **Withholding tax for back-packers**

Source: HAC's Drip Feed

It seems some growers are confused about the level of withholding tax for back-packers. While the extension of the working visa has made seasonal work, for example, more attractive, HAC and other grower groups are continuing advocating the same level of tax for backpackers as other workers.

In the meantime, however, all horticultural industries need to withhold 29% for back-packers, rather than 13% tax, on overseas workers. Making a mistake on this can cause growers serious trouble when audited, as they then need to pay a fine as well as all the unpaid taxes back to the ATO – and an audit can go back 5 years!

The pink form Special Tax Tables for Individuals Seasonally Employed in the Horticultural Industry NAT1013-6.2000 is available from newsagencies and explains it all. Or visit <http://www.ato.gov.au>



News in Brief



◆ **Summerfruit industries biosecurity plan**

Extracted from SAL Weekly News, Week 43, 2006.

A preliminary draft biosecurity plan for the Summerfruit industry has been prepared. This plan represents the Summerfruit industries commitment towards providing insurance against an exotic pest/disease incursion. Summerfruit is one of 18 member industries that are signatories to the Exotic Plant Pest Response Deed or DEED. The DEED is a legally binding document that details the obligations and cost sharing for affected parties should an exotic pest be detected in some State or region in Australia.

Under the DEED, affected industries, States and Commonwealth share the costs, according to an agreed formula, of eradicating the pest. For its share of the cost, an affected industry gets compensation for growers whose crops are destroyed during an eradication. Once an exotic pest has been identified, the State or States in whose jurisdiction the incursion has occurred is legally required, under State and Commonwealth quarantine legislation, to proceed with eradication. Industries who are not signatories to the DEED have no means of ensuring that affected growers are compensated for crop loss.

Legislation has now been passed in the federal parliament that allows the Commonwealth to cover the initial industry cost of eradication. Legislation has also been passed allowing affected industries to implement a levy to repay the Commonwealth for the industries share of the cost.

Although the chances of an exotic pest incursion for the Summerfruit industry are low, it should be noted that during the last decade a number of exotic pests have been detected in Australia which have impacted severely on some industries. These include: citrus canker, sugar cane smut, blueberry rust, fire ants, papaya fruit fly and the fire blight detections in Melbourne and Adelaide botanic gardens.



◆ **Organics initiative launched at Bathurst**

A new \$250,000 Organic Industries Initiative package has been launched at the NSW Department of Primary Industries' (DPI) Bathurst Agricultural Research and Advisory Station.

The Initiative will fund two new organic agriculture positions and new infrastructure at Bathurst as well as the creation of the NSW Organic Ministerial Advisory Council.

The Council's role will be to advise the Minister for Primary Industries on important matters facing NSW organic industries and help harness the full potential of prospering organic markets.

The NSW organic farm gate value is \$29 million and the national retail value is about \$300 million.

The two new staff at Bathurst will take a proactive roll in exploring market development opportunities to help the State's 350 certified organic farms see this market share grow.

The Initiative aims to achieve this by finding solutions to supply chain issues for organic meat, soil fertility improvement in organic systems and facilitation of group marketing of organic produce.

Work at Bathurst will complement organic research underway at Yanco Agricultural Institute including looking at optimising the quality and yield of spelt and other specialty grains under organic production.

Organic research being undertaken at Bathurst is testing different crop varieties' suitability to organic farming systems including strawberries. A new varietal trial involving hazelnuts is about to get underway. Staff at Bathurst are also working with the State's olive industry to investigate opportunities for an organic industry and potential for expansion into this area.

The Advisory Council will provide advice to DPI on strategic development priorities and assist in their implementation. The council consists of organic industry experts, marketers, researchers and organic producers.



News in Brief

◆ **Disease threatens Australian avocado industry**



Media release from Avocado Australia

Avocados Australia has uncovered a major threat to the Australian industry. An exotic disease has been uncovered in New Zealand during the development of the Australian industry's biosecurity plan.

The disease Avocado Blight, affects most avocado producing countries in the world, but Australia is free of this devastating fungal disease.

Avocados Australia notified Biosecurity Australia of the discovery and asked that Biosecurity Australia implement the appropriate measure to ensure Australia's protection from the disease. The protection systems proposed by Biosecurity Australia lack the rigor of science to back up the method being applied. Avocados Australia is preparing a challenge to the systems proposed and we expect that as an interim measure, that all avocados from New Zealand be stopped from entering Australia until a robust scientifically based system is put in place.

Avocados Australia only expects the protection from disease that other countries such as New Zealand are constantly imposing on Australian fruit and vegetables into their markets.

For further information contact:

Henry Kwaczynski, Avocados Australia Chair on 07 5442 1767 or 0409 261 461 www.avocado.org.au

Avocado blight – What is it?

Avocado blight, *Sphaceloma perseae* is found throughout Michoacán and it is considered an endemic pest. Avocado blight or "roña" is also found in Florida, where it is the second most important pest, Puerto Rico, Brazil, Africa, Peru, Cuba, Haiti and California.

The *Sphaceloma perseae* fungus attacks the fruit (in all stages), leaves, and young branches. The affected fruits present brown corky lesions with round or irregular shapes at first. When these

lesions grow and come together, they can cover a large part of the fruit or the whole fruit, and cause fissuring in leaves and branches. In leaves, the disease forms small individual stains of dark brown color of less than 3 mm in diameter. When the attack is severe the leaves and nervations are also distorted. In nervations or green branch barks, the lesions are elongated and slightly prominent. In the fruit, the damage is exclusive of the exocarp, while the fruit remains healthy. However, the lesions can be an entry point for other organisms (Gallegos, 1983).

The *S. perseae* fungus requires a high relative humidity and high temperatures for its proper development. The most susceptible stage of the fruit is when it reaches a third or a half its normal size, because when the fruit ripens, the exocarp hardens. Fruit damage caused by insects, rodents or mechanically allow entrance of the disease, which produces spores on the attacked tissue. The spores are carried away and disseminated by the wind, rain or insects.

From all the cultivars grown in the Michoacán region, Fuerte is the most susceptible to the disease but Hass can also be severely affected.

◆ **The avocado industry is making profitable business decisions**

Source: Avocados Australia


The avocado industry is leading the charge to provide growers with reliable and timely market information to assist in their marketing and management decisions and potentially reduce sharp dips and spikes in supply, which are not good for anyone in the supply chain.

Infocado is a web based data collection and reporting program developed by Avocados Australia, monitoring overall throughput in the Australian avocados sector. The system, launched late last year, is now collecting and reporting up to 85% of avocados, marketed throughout Australia. This includes imported product and is categorised by variety, size and market destination.

News in Brief

Packhouses and grower/packers are now contributing their actual throughput figures, their forecast estimates for coming weeks and also forecasts for the next season. The aggregated figures are then reported back to all contributors in weekly reports. This is providing packhouses and their growers another tool to assist them in their marketing and management decisions.

The avocado industry is the first horticultural industry to implement such a system and other industries are showing a great deal of interest in following the lead.

For more information about Infocado you can contact: Antony Allen, Avocados Australia CEO on 0438 132 477 or ceo@avocado.org.au or Joanna Embry Avocados Australia Infocado Program Manager on 0448 113 007 or infocado@avocado.org.au or at www.avocado.org.au 

◆ **The freshcare environmental code of practice is here!**

Source: Guacamole Vol 2 No 13.

The new 'Freshcare Environmental Code of Practice' provides an auditable standard for Australian growers to demonstrate responsible on-farm environmental management.

Following closely on the release of the national Guidelines for Environmental Assurance in Australian Horticulture, Freshcare's Environmental Code of Practice provides the ideal tool for growers to demonstrate how they are linking production targets to their care for the environment. As a key partner in the Horticulture For Tomorrow Project, the launch of the Freshcare Environmental Code delivers a breakthrough additional service to industry.


The Freshcare 'Food Safety Code' changed the face of Australian horticultural food safety programs when launched in July 2000 and has since been adopted by over 3500 Australian growers. The launch of the innovative 'Environmental Code' is also expected to re-shape the way growers and

other stakeholders develop on-farm environmental management programs.

The Freshcare Program already provides industry with an independent certification service to demonstrate food safety and quality standards are maintained on-farm. The addition of the Environmental Code expands the range of certification services offered.

The 'Food Safety Code' and 'Environmental Code' can be used separately but they are also designed for seamless integration, so a single audit can cover both programs without any duplication of documentation and record keeping.

Freshcare is already working on further modules to cover farm safety/worker welfare and bio-security for the program. These will also build on the existing structure and be integrated with the one system-one audit approach desired by growers.

The Code provides the basis for Freshcare to be strategically recognised by international benchmark systems such as the EurepGAP program, required for market access to European customers. 

◆ **Finger limes fend off fruit fly**

Andrew Jessup, NSW DPI, Gosford.

Researchers at NSW DPI have concluded that Australian finger limes are not a host to Queensland fruit fly, opening up potential new marketing opportunities for the native fruit.

Internationally accepted tests on several cultivars and colour variations of the fruit, replicated over time at DPI's Gosford research station, showed zero survival of Queensland fruit fly in finger limes.

Australian finger lime growers were interested in exporting their product interstate and overseas without the requirement for postharvest treatments against fruit fly. Until now, the only option for exporting Australian finger limes from fruit fly endemic areas was to store the fruit at 1°C for 16 days. Such a treatment affects the fruit's shelf life

News in Brief

and causes a delay between the time of harvest and when the consumer can purchase the fruit.

Anecdotal evidence from finger lime growing districts in Australia indicates a complete lack of fruit fly infestations in finger limes. Some fruits are not host to fruit flies because of the chemical make-up of the fruit, such as unripe papaya, or for physical reasons such as skin impenetrability.

A series of experiments on the host status of finger limes to Queensland fruit fly was carried out by scientists at NSW DPI, Gosford. The results supported the submission that all cultivars and colours of Australian finger limes be classified as non-hosts to Queensland fruit fly.

The Victoria market has accepted these results and is changing its requirements for the entry of finger limes into the State. It is hoped other markets will follow suit.



◆ **Re-appointment of DNE as single importer of citrus to the US**



Extracted from ACG members' newsletter 15 November 2006.


HAL and ACG are pleased to announce that DNE World Fruit Sales (DNE) of Fort Pierce, Florida has been selected as the sole importer of Australian Citrus to the US under HAL's Export Efficiency Powers.

The appointment of DNE follows a rigorous process in which 'requests for proposals' were sought from potential US importers. An industry representative skills based steering committee was established by HAL to oversee the process.

Nine companies in the United States were invited by the committee to submit their response to the 'request for proposal' of which eight formally responded. Each of these respondents was evaluated against the selection criteria and three companies were short listed by the committee.

An extensive series of interviews took place with the short listed companies in the US in mid

October. On 2 November in accordance with its Export Efficiency Powers, the HAL board considered the recommendation of the committee and appointed DNE as sole importer of Australian citrus to the United States for a period of 5 years commencing with the 2007 season, subject to annual performance review.


The next stage in the process, involving the citrus industry, is the finalisation of appropriate regulatory and commercial arrangements with DNE. 

◆ **Australian Citrus Growers 59th Annual Conference Renmark, 15-19 April 2007**

The ACG Annual Conference is a major event for the citrus industry; with delegates from regional associations, commercial providers, researchers, exporters, packers, growers and marketers in attendance.

The 2007 Conference, held in conjunction with the Citrus Growers of South Australia Inc., will focus on future directions of the export and domestic markets. Now that Australian citrus has access to the China market, increased demand of Australian citrus to the US and an increasing production of oranges and mandarins, the citrus industry must focus on expanding markets.

Two Agronomy specialists from South Africa will be guest speakers at the conference, to discuss and promote water efficiency within the citrus industry.

Maximise your exposure to the industry by joining us at this event on 15 – 19 April 2006, in Renmark, South Australia. Program details are available on the ACG website: www.australiancitrusgrowers.com 

◆ **Juice prices set to rise**

The 2006-07 Australian Valencia forecast is 207,000 tonnes, which is a 26 per cent decrease on 2005-06 figures, and only marginally bigger than the 2003-04 season - the lowest crop in 20 years.

The major factors attributable to this year's smaller crop are adverse climatic conditions during fruit


set and development; including significant frost damage early in the season, the current drought, and the severe cuts to water allocation, especially in South Australia's Riverland.

World shortages will also keep demand for citrus elevated, with US and Brazilian orange production down, and world prices for Brazilian frozen concentrate orange juice at the highest since 1992. ACG has assessed world parity prices for Australian Valencia oranges to be \$180 to \$200 per tonne, a stark contrast to the \$80 per tonne from previous seasons.

ACG suggests that given the lower Valencia crop forecast, supply may be tight relative to demand. However, this will largely depend on the packing

activities and the amounts available for processing.

In order to continue to increase the fresh juice market and avoid the situation in the past, ACG encourages growers to avoid the speculation of higher spot prices by liaising closely with their packer and/or processor for a best possible outcome. ACG continues to support this ongoing dialogue, as well as long-term contracts for processing fruit.

ACG encourages consumers to continue to support Australian farmers by purchasing high quality fresh Australian orange juice, looking for the 'Aussie Grown – supported by Australian citrus growers' logo, or the words 'not from concentrate', or 'Product of Australia'. 

Australian native bees for fun and profit

Doug Somerville, Apiculturist, NSW DPI, Goulburn.

This was the title of the recent inaugural conference on 'Australian Native Bees' held over the weekend of 14–15 October at the University of Western Sydney in Richmond.

There are currently 1647 recognised species of Australian bees, the majority of which are solitary. *Trigona carbonaria* is the most talked about social bee with many enthusiasts keeping them in the Sydney basin and north into Queensland. This bee has been found as far south as Bega on the coast of NSW, but it was clear from the discussions that this bee struggles in cooler climates. It would seem that larger trees offering substantial insulation from heat and cold are the preferred homes of this tiny bee.

In Sydney, *Trigona* are common as are teddy bear bees, blue-banded bees, the banksia bee, reed bees, resin bees, leaf-cutter bees, carpenter bees and persona bees. Nest sites were said to be one of the most limiting factors restricting the success of native bees. Floral resources were not mentioned as a major limiting factor and in fact the diversity of introduced plants in much of the Australian landscape would appear to provide an abundance of food for native bees.

Sting-less social bees

Most of the discussion was concerning the management and keeping of *Trigona carbonaria* bees. These are tiny social bees of which there are 10 species identified in Australia. Only one species would appear to have extended its geographic range into the cooler temperate zones along the NSW coast. World wide there are 400 species of social bees, which in most cases are confined to the tropics and sub tropic zones.

A colony of *Trigona* in the Sydney region was estimated to contain 10,000 individuals with queen, drones and workers demonstrating a similar colony structure to that of honey bees. It is possible to increase the number of *Trigona* colonies by splitting them in half. This is now a regular practice in an effort to increase their numbers, but the frequency is about one split per year. Colonies of *Trigona* are now actively traded and figures of \$250 per colony are being achieved.

A nest volume of 6 to 7 litres indicates that these social bees only require very small restricted cavities to nest. The maximum honey removed from these colonies was said to be only one kilogram, compared to honey bees in NSW where the average commercial hive produces over 100kg.

The total Australian honey production for native *Trigona* bees was estimated to be 100kg.

These small bees would seem to be very aggressive to each other with more than one presenter stating that colonies of *Trigona* should be placed at least 5 metres apart to prevent fighting. The honey fly, a minor nuisance to honey bees, is a major problem for *Trigona* bees which was stated as the worst pest that these native bees had to endure.

The value of *Trigona* as a commercial pollinator was promising but also limiting. A request for a 1000 colonies for export to Japan was not able to be met due to the lack of numbers available for sale and the slow reproduction rate of a colony. This bee does not 'buzz' pollinate which does not make it attractive for crops such as greenhouse grown tomatoes. It was said that they were effective pollinators of avocado.

Bees and pollination

Although honey bees are the most commonly used commercially available insect utilised for the pollination of a broad range of agricultural crops, indigenous bees around the world hold a lot of promise to also be developed for the same purpose. Examples of non *Apis* bees being currently commercially utilised include: carpenter bees in Brazil; blue-orchard bees in the USA; leaf-cutter bees in Canada, USA & NZ; alkali bees in the USA; several species of bumble bees; several species of mason bees and horn faced bees in Japan.

Seventy five percent of all crop species were said to be animal pollinated, thus the importance of a range of suitable animal pollinators to ensure profitable cropping systems is critical. Reliance on one species such as honey bees (*Apis mellifera*) is in the long term prone to significant risk factors. Some crops such as tomatoes are not well pollinated by honey bees but are well serviced by other bee species. The reason for this is the need to vibrate the flower (buzz pollinate) which honey bees and *Trigona* bees (small sting-less bees) do not do.

Carpenter bees are being studied by the University of Adelaide. They are excellent buzz pollinators but they have a significantly restricted natural distribution within Australia.

Teddy bear bees have some promise as a commercial buzz pollinator but up to now, studies

of this bee are limited. As such, it will take many years of research to investigate their life cycle and habits before they could be considered as a commercial viable pollinator.

Blue-banded bees have been the subject of a number of studies in recent years in Australia. They are a relatively common bee in a range of environments with a wide-spread natural distribution. They can often be seen in many gardens, particularly noticeable around lavender blossom with their distinct blue bands across their abdomen.

These bees nest in mud walls and tend to congregate in the same areas, where suitable nesting sites are abundant. Artificial nest sites have been successful with the possibility of transporting the developing bees to other sites. Thus the possibility of moving these bees into greenhouse tomato crops is a distinct possibility. As they vibrate the flower (buzz pollinate) to collect the pollen, they are a very effective pollination agent.

Brood development is approximately 8 weeks and the adults live for 6 weeks. Like all insects they are temperature sensitive, flying at temperatures above 18°C but better at temperatures above 21°C. Further studies are required to determine what temperatures are required to break diapause in the developing brood.

Conclusion

The interest in native bees, both commercially and lifestyle, is certainly gaining momentum as demonstrated by the workshop. For more information on native bees it is difficult to go past the web site maintained by Anne & Les Dollin, search www.zeta.org.au/~anbrc.



Managing citrus orchards with less water

This is only part of the complete document available on the ACG website at www.australiancitrusgrowers.com

Steven Falivene, Jeremy Giddings, Sandra Hardy and Graeme Sanderson, NSW DPI, December 2006.

Introduction

In situations of reduced water availability it can sometimes be more profitable to provide optimum water to part of an orchard and produce good marketable fruit, rather than watering the whole orchard and producing small unmarketable fruit. Managing your citrus orchard with a reduced water allocation requires planning. The following information outlines a number of management options and strategies that can be used in developing a plan of action.

Citrus water use

Mature sprinkler irrigated citrus trees grown in Sunraysia require around 1000 mm (10ML/ha) of water annually. Figure 1 depicts average water use by mature citrus trees based on long-term data collected at Dareton in south western NSW. This information can be used as a guide for determining water needs and planning for the coming season. An Excel water budget spreadsheet for Dareton and Griffith is available from the Australian Citrus Growers "Resources" web page (www.australiancitrusgrowers.com).

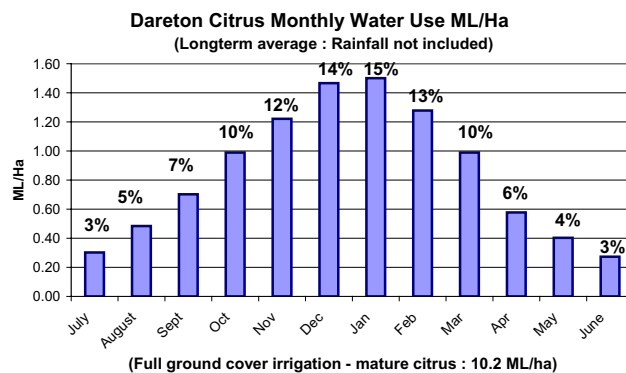


Figure 1: Long-term average water use of mature citrus trees with full ground cover irrigation and monthly percentage values at Dareton.

Water and citrus growth

Under ideal growing conditions citrus trees require water all year round. Normally the peak demand for water is during the warmer months from October to March. Figure 1 depicts average water use by mature citrus trees based on long-term data collected at Dareton. Using this information typically 54% of the annual water use of citrus trees occurs between the months of November and February and this rises to 74% if we include the months of October and March. Water use normally falls during late autumn and winter with the onset of cooler temperatures and the slowing of tree growth.

Generally citrus trees adapt to insufficient water by reducing overall water use and fruit growth. Rootstocks also vary in their tolerance to water stress and salinity levels. Rough lemon, Carrizo citrange, and Swingle citrumelo have good drought tolerance, Cleopatra mandarin and Troyer citrange have moderate tolerance and P.trifoliata and Sweet orange have poor tolerance. Drought tolerance is related to rooting depth.

Soil water also affects soil aeration, temperature, salinity and the growth and health of tree roots. When soil water is depleted over an extended period root growth slows and feeder roots become thicker. Soil temperature also affects water absorption and tree transpiration ceases when root temperatures reach about 34°C. Most of the active rootzone of trees is in the upper 30-40cm of the soil and can vary between rootstocks.

Water stress can affect citrus at all development stages and stress can occur before any visual symptoms appear. Water availability strongly influences flowering and fruit set and can affect fruit drop, fruit size, yield, internal fruit quality characteristics and canopy development.

Water stress in spring (September-October) during flowering, fruit set and early cell division will have a big impact on reducing fruit numbers and overall yield. Water stress during late spring and summer (November-February) at the time of late cell

division and cell expansion, will have a big impact on fruit size. Water stress closer to harvest can influence internal fruit quality characteristics such as acidity, % juice, TSS and fruit maturity. Water stress can also restrict vegetative growth and reduce canopy development which is especially important in young trees and for next seasons flowering sites.

Citrus growth stages:

- Flower bud induction and initiation : mid May – July
- Flowering : mid September – October
- Stage 1 Fruit Growth (cell division) : November – December
- Stage 2 Fruit Growth (cell expansion) : Jan – April
- Fruit maturity : May onwards

Flower bud induction and initiation: mid May – July.

During this stage trees utilise about 10% of annual water requirements. Moderate water stress at this time can increase flowering. In fact in some regions (Northern Territory) water stress is a technique used to induce flowering in citrus. However drought periods of more than 30 days are usually required to induce a significant number of flower buds.

Flowering & Fruit set: mid September – October.

During this stage trees utilise about 13% of annual water requirements. Water stress during this period can reduce fruit set, cause excessive fruitlet drop, reduce yield and suppress the spring flush.

Stage 1 Fruit Growth (cell division): November – December.

Throughout this period trees utilise about 26% of annual water requirements. During this stage cells are dividing and up to 60% of final fruit size is determined. Small fruit size at the end of this period tends to be small at harvest. Water stress during this stage can cause excessive fruitlet drop and reduce fruit size. Fruitlet drop is usually more severe when water stress is coupled with high temperatures (>35° C). Trees carrying mature fruit at this time, such as Valencias, seem to be able to buffer this effect to some extent, so fruitlet drop is usually

more severe in navels. The summer leaf flush may also be suppressed which can affect next seasons flowering sites.

Stage 2 Fruit Growth (cell expansion): January – April.

During this period trees utilise about 40% of annual water requirements. The first few months of this stage (mid-December to February) is the critical time when fruit cells are expanding (cells can increase 1000 times) and final fruit size is determined. Therefore water stress in the early part of this stage should be kept to a minimum. An early sign of stress is that fruit stop growing, so it is important to measure fruit size regularly. From January onwards measure fruit size weekly at the same time each day (7-9am). If water is supplied at the first sign of a fruit growth decrease then fruit size may not be reduced.

The best window if any for extending irrigation intervals is during late summer and autumn. Minor water stress during the latter part of this stage can be tolerated without a major affect on fruit size. However prolonged water stress will reduce fruit size, and is more pronounced when the crop load is heavy. Prolonged water stress can also influence internal fruit quality characteristics, increasing the acidity and Total Soluble Solids (TSS) of fruit, while slightly decreasing percent juice. Mid-summer and autumn leaf flush will be suppressed, which can affect next seasons flowering sites.

Fruit maturity: May onwards.

During this stage trees utilise about 10% of annual water requirements. Moderate water stress will have a minimal impact on fruit size but it may bring forward fruit maturity slightly, reduce the shelf life of fruit and increase the incidence of stem end rind breakdown. The best strategy for reducing water use at this time is to slightly extend the timing of irrigation intervals.

Impacts of water stress on growth

The following information is a guide to the possible impacts of various levels of water reduction on the health and productivity of a citrus tree. Reducing water application rates can lead to increased soil salinity levels. Soil salinity should be checked regularly using soil salinity tests. The salinity of irrigation water can also increase in

times of drought, so water salinity should also be tested. Irrigating with saline water will increase the severity of stress on trees. Contact your local Horticulturist or Irrigation officer for more information about salinity management.

10-20% reduction in water application

In some situations a 10%-20% reduction in water application can be tolerated with minimal impact on fruit size and yield. Reductions of this capacity may be achieved by improving irrigation efficiency and scheduling and eliminating water losses due to deep drainage.

20 to 40% reduction in water application

Fruit size will decline and some crop reduction may occur. The vigour of leaf flush may be reduced. The following seasons productivity may be affected depending upon the severity and timing of water stress.

40 to 75% reduction in water application

Significant crop reduction, decline in fruit size and decline in leaf flush will occur. Depending on the severity of water reduction, fruit may be too small for traditional fresh fruit marketing. The trees may take a season or two to fully recover to optimum production. Recovery will depend upon the severity of the water reduction and how the current seasons leaf flush has been affected.

More than 75% reduction in water application

Total crop loss would be expected and the trees will be unthrifty with significant twig dieback and leaf drop. It may take a couple of seasons for the trees to fully recover.

Water saving practices

■ Basic strategies to implement in times of water shortage:

- **Do a water budget.** Estimate the monthly water requirements for your orchard. Using average water use figures (Figure 1) and your own irrigation records, you can predict monthly water requirements for each block. Combined with information on the long term plans and value of individual blocks this information can then be used to help prioritise irrigation applications. See page 6 for more information on developing a water budget.
- **Install irrigation scheduling devices.** It is critical to have some type of soil moisture monitoring device installed in order to more accurately check soil water levels. This will allow you to schedule irrigation applications more precisely and extend out irrigation intervals more confidently. If you don't currently have any devices, then tensiometers are relatively cheap, easy to install and use. More expensive sophisticated scheduling tools will allow you to be far more accurate and effective with your irrigation applications. However it generally takes a longer time to learn how to use and understand the information generated from this equipment, so these may be useful as a check only in the first season.
- **Check, manage and maintain the irrigation system.** Check your irrigation system and fix any leaks. Test the efficiency of your irrigation system. Check the accuracy of water meters by cross referencing readouts with application rates. If irrigation uniformity is below 75% contact an irrigation consultant for advice on how improvements can be made. The effect an inefficient system has on an orchard will be exacerbated during times of drought.
- **Stop leaching losses.** Ensure water is not applied and lost below the root zone by carefully monitoring soil moisture levels and irrigation depth.
- **Mulch the wetted strip.** Applying mulch help reduce soil evaporation. In large mature orchards this may be uneconomical, however it can be a useful option for young trees where large amounts of the soil surface is exposed. Overseas information has shown that plastic mulches can be economically viable for young trees. Ensure that the drip line is underneath the mulch. In plantings with sprinkler irrigation mulches may sometimes act as a barrier to effective water penetration.
- **Only irrigate the wetted strip.** This is most applicable to irrigators with low level sprinklers, and involves changing over to a model which only throws water along the tree line. For young trees, sprinkler types are also available which only distribute water in a very small area around the tree.

- **Full cover weed control.** Removing weeds and eliminating sods will reduce competition for water. Sods are best sprayed with herbicide and allowed to form a layer of mulch, protecting the soil and reducing evaporation. For drip irrigation systems it is best to slash the sod and throw the cuttings back over the wetted strip to form a mulch.
- **Irrigate at night.** Under tree sprinkler irrigating at night can make water savings of 20-30% compared to daytime irrigation by reducing evaporation losses. However the water savings with drip irrigation systems is variable depending on the amount of leaf litter and shade over the wetted soil surface.
- **Reduce water runoff.** If water runoff from the soil surface occurs (sprinkler irrigated systems) then break up soil crusts to improve water penetration and soil aeration.
- **Reduce or stop irrigating windbreaks.** This can save water but remember the long term importance of windbreaks, especially in reducing fruit scarring.
- **Re-use back-flush water.** Back-flush water from drip irrigation gravel filters (i.e. settling tanks) can be reused. Adjust the frequency of back-flushing to suit conditions.
- **Reduce crop load.** Reducing the crop load will help reduce the effects of water stress on fruit size. Trees carrying heavy crop loads will also suffer more stress. Monitor crop levels and fruit size and apply appropriate crop thinning strategies to decrease excessive crop loads. The choice of strategy depends on crop stage and includes winter flower suppression sprays, hedging, chemical fruit thinning and hand thinning. (The Fruit Size Management Guide Part 1 outlines when and how to implement these crop reduction strategies. It is available on the ACG website: www.australiancitrusgrowers.com)

■ Other strategies:

- **Reduce transpiration.** Kaolin clay based foliar spray products are claimed to reduce water losses through leaves. Demonstration trials have shown increases in the growth of young trees. However the use of these products can increase the incidence of scale insects, particularly red scale.

- **Buy/trade water.** Buying in or trading water, if available, can be a viable option. Consider the long term value of the trees and crops compared to the cost of water.

■ Longer term strategies:

- **Install valves for each patch.** Install valves to separate patches that have different water requirements. This will allow you to more accurately match crop water needs with irrigation applications. Water use differs with tree age and variety.
- **Install more sophisticated scheduling equipment.** More sophisticated scheduling equipment (e.g. neutron probes, capacitance probes, Enviroscan) will allow you to be far more accurate in your irrigation applications and in gauging rainfall effectiveness. As well, leaching losses can be completely avoided while still ensuring that irrigations are fully effective. This equipment is more expensive and requires some time to learn how to use and understand the information generated.
- **Convert to efficient irrigation systems.** Drip irrigation is the most efficient irrigation system with savings of up to 40-60% in general, over furrow and overhead sprinkler systems and up to 30% on micro-sprinkler systems. Figure 2 shows the differences in monthly water application rates to oranges using drip irrigation and a low level micro-sprinkler system.

A new permanent drip system requires substantial investment and needs to be professionally designed. Consider the long term financial viability of taking this step. If there is a high probability that water restrictions will continue

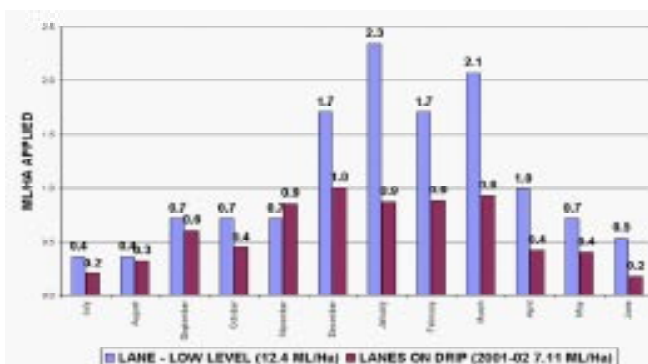


Figure 2: Monthly irrigation applications to oranges using drip irrigation and low level micro-sprinklers.

in the future, consider installing drip irrigation over the next winter period.

Most drip irrigation systems are preferably installed in winter because the irrigation system needs to be shut down during conversion. Some growers have successfully converted to drip irrigation during summer, however this carries a high risk if extended delays in the resumption of water occurs over the conversion period. A delay in irrigation over an extended period in summer can cause serious tree stress and crop loss. The trees will also need to be adequately irrigated to help them grow roots into the wetted soil drip line, which may initially require increased irrigation levels. The time for the roots to re-establish under the drip line can also cause tree stress. Contact your local irrigation officer to check if subsidies for conversion to drip irrigation are available in your region.

Strategies for managing citrus with less water

The following options can be used to develop a program that best suits your own situation (water supply, irrigation system, climate, soil type, variety mix and tree age, etc). Small fruit normally provide poor returns. In times of predicted water shortages, often the most viable option is to maintain your high value blocks in order to produce good sized fruit, at the expense of less profitable blocks. Before severely water stressing trees, removing, skeletonising or hedging blocks, discuss your plans with your packer/agent/processor, as these actions can have long term implications. The first step is to develop a water plan or budget for your farm.

Develop a Water Budget for your farm

A water budget is a plan of your orchard which identifies the present and proposed irrigation allocation for each block. These decisions need to be based on a number of factors, including:

- economic viability of the block;
- current and long term plans for the block/orchard;
- tree age, variety, crop load (on/off year) and growth stage;

- packer, processor or agent priorities – current and future;
- resources available;
- current financial situation;
- future water availability predictions.

The following steps can be used as a guide to developing your water budget:

1. Determine the typical monthly water allocation for each block based on historical water use.
2. Decide what additional water saving strategies or management practices will be undertaken.
3. Adjust monthly irrigation allocations to suit your plan.
4. Put the plan into action.
5. Regularly monitor tree blocks and readjust as necessary.

Additional tree management strategies:

Young tree management (0-6 years)

Significant water savings can be made on young trees if water is applied efficiently. Young trees have a smaller canopy and root zone than mature trees and can use up to 50% less water than mature trees. Monitor soil moisture and implement basic water saving practices, focusing on:

- Reduce leaching losses below the rootzone.
- Build a small basin around newly planted trees to trap water.
- Spreading mulches around the tree to reduce evaporation from the soil surface.
- If inline drippers are used, special clips can be used to block off drippers between trees where the roots have not yet established.
- Install sprinkler heads that have a small throw pattern.
- Schedule irrigations.

Mature tree management (>6 years)

■ Canopy Reduction

Tree water use is directly related to canopy size, so reducing the canopy reduces water use. The amount of tree canopy you remove for each block should be based on tree age, crop load, stage of

growth, long term block viability and how much water needs to be saved. Providing trees are given sufficient levels of water and nutrients they should recover to form a vigorous canopy that produces good quality fruit. In some circumstances resources (labour and machinery) may not be available to undertake canopy reduction, so alternatively old or unproductive blocks could be abandoned in preparation for replanting when water supplies resume.

Under restricted water conditions trees that have had their canopy reduced will recover more quickly than trees without any canopy reduction. Remember to adjust fertiliser applications to suit the tree canopy size and vegetative growth. A heavily pruned tree will require less fertiliser. Gradually increase the amount of fertiliser applied as the tree canopy re-grows. The best time to prune citrus is generally after harvest but can also be undertaken at other times throughout the year.

- **Skeletonising**

Skeletonising is the most severe form of canopy reduction, involving the removal of nearly all tree branches and foliage. This type of pruning is normally used to rejuvenate old trees. Trees that have been skeletonised will use a lot less water, but can take between 2-3 years to come back into full production. The exposed limbs will need to be painted with white wash (1 part plastic paint : 1 part water). The white wash can be applied quickly and efficiently by spray painting. As the trees grow the regrowth needs to be managed to select out the best positioned shoots to regrow the tree.

- **Hedging**

The best time to hedge trees is in early spring to reduce the risk of sunburn to the newly exposed limbs. A light hedging will not significantly impact on next seasons production, however a medium or heavy hedging can result in trees being out of production for 1-2 seasons. One option is to hedge only one side of the tree to reduce the impact on yield. If trees are heavily hedged in late spring/summer, the exposed limbs may require white washing to prevent sunburn. Sunburn can occur within a day in hot temperatures (i.e. above 35°C) and the risk increases significantly as temperatures further rise. Manage regrowth with summer pruning and select out the best positioned shoots to regrow the tree.

- **Pruning for regrafting**

Cutting back trees for grafting will also reduce water use. The nursing limbs should be removed as soon as the grafts have taken. The exposed limbs will need to be painted with white wash to prevent sunburn.

- **Reducing Crop Load**

- **Flower Suppression at budburst**

Flower suppression can be undertaken in predicted heavy crop years (“on years”) using a gibberellic acid compound (registered trade name Ralex®) at the time of flower initiation in mid June. Ralex is registered for use in mandarins and oranges. Refer to the Product label for directions on use and timing.

- **Pruning at flowering**

Pruning can be undertaken before or during flowering with an emphasis on removing weak/ dead branches, crossover limbs and water shoots. Hedging can also be used during flowering to remove excess flowers, however it is non-selective, so care should be taken on how much of the canopy is removed.

- **Chemical thinning at Stage 1 fruit growth – December**

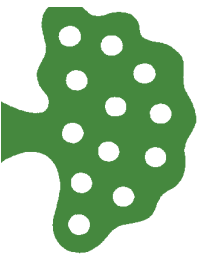
Chemical thinning using Ethephon (registered trade name Ethrel®) can be used when crop loads are heavy and fruitlets are 10-15mm in size. Chemical thinning has shown to be cost effective in navel and Valencia oranges and Imperial and Murcott mandarins. However the amount of fruit removed can vary depending on fruit load and application timing. Temperature and soil moisture levels are critical to success. Refer to the Fruit Size Management Guide Part 1 for more information.

- **Hand/mechanical thinning of fruit – January – harvest**

After the natural fruit drop has finished in December, a heavy crop load can be further reduced by hand thinning or light hedging. Hand thinning allows you to be selective and remove small, blemished or clustered fruit. Light hedging will remove fruit on the outsides of the canopy, but is not selective and caution is required.



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The Coastal Fruitgrowers' Newsletter is a quarterly publication distributed in Spring, Summer, Autumn & Winter. It is available free to all commercial fruit growers in the Sydney Basin, Central Coast, Hunter Valley, South Coast & North Coast areas.



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