# Californian pistachio study tour, November 2005

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Kyalite Pistaschios

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**Pistachio Growers Association of Australia inc.**

**Horticulture Australia project PSO5001**

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**The purpose of this report is to identify only key information coming from the study tour, which may influence the future of the Australian pistachio industry, or how the industry currently operates.**

**This report and any other information gathered on the study tour will be disseminated to growers via PGAI meetings, newsletters and field days.**

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**Media Summary**

University of California Cooperative Extension has run a Pistachio short course every five years since 1990. It is an excellent opportunity to keep abreast of current production techniques, and meet with growers, processors, researchers and extension staff. California is the second largest producer of pistachios in the world, and our Australian industry has been modeled on Californian practice.

The 2005 three day course covered all aspects of Pistachio production, from the economics of setting up an orchard, growing the crop, through to processing and marketing. The structure consisted of formal lectures followed by questions and discussion, and a field trip with speakers on various aspects of orchard management.

Lecture topics were as follows:

1. Economic considerations of Pistachio production
2. Costs and returns
3. Botany and physiological factors affecting yield
4. Site evaluation and soil modification
5. Planning and designing the orchard
6. Pistachio cultivars
7. Pistachio rootstocks
8. Rootstock production and budding
9. Planting and training
10. Weed management
11. Pruning mature bearing trees
12. Tree water requirements and RDI
13. Improving water penetration
14. Managing salinity, soil and water amendments
15. Diagnosing and correcting nutrient deficiencies
16. Fertigation
17. Harvesting, transport and processing
18. Orchard rehabilitation
19. Pest, disease and physiological disorders management
20. Integrated Pest Management

Some orchards were also visited following the short course.

**Expected outcomes**

California has a mix of small, medium and large scale operations. Most growers are enjoying high production by Australian standards, and there is significant new development occurring.

The study tour will provide guidance in achieving medium to long term industry goals:

1. Increase yields across all Australian orchards
2. Improve quality
3. Successfully develop new orchards

**Implications for Australia – discussion of some major topics**

## 1. Orchard Development

### 1.1 Choice of rootstock

The Californian Industry is still predominantly planting Pioneer Gold 1 (PG1) rootstock. There are now also some young orchards, up to 5 years old, using UCB-1 seedling and UCB-1 cloned rootstock. The young UCB-1 cloned orchards look equal to or better than similar PG1 orchards in terms of vigour.

UC trials from 1989-2002 show UCB-1 out performs PG1 in:

- Yield
- Salinity tolerance
- Frost tolerance

UCB-1 and PG1 perform equally under Verticillium pressure.

Yield data on a commercial scale of the UCB-1 clones will be available from 2006 California harvest.

The small number of UCB-1 trees currently growing at CSRIO Dareton, are displaying some nut quality concerns. Similar problems are occurring in P. *terebinthus* and P. *atlantica,* whilst PG1 is relatively free of the problem.

*The above quality problems exclude UCB-1 from immediate commercial planting in Australia, at least until local research and trial plantings can prove superiority over PG1.*

*The process of clonal propagation has good potential for an expanding Australian Pistachio industry*

### 1.2 Planting systems

Traditionally California has developed orchards by planting a 12 month old seedling in a 10 litre pot, cutting the tree at 500 to 600 mm at planting, and budding into a new shoot. Smaller container sizes have been used to a lesser extent before, but there is renewed interest in planting a smaller tree with significantly lower nursery cost:

Example of an orchard using the "Terreste" development method in California:

- UCB-1 seedlings are grown in cylindrical tubes, with root training ribs. (Similar size as typically used for Australian native trees).
- Trees are planted at 3-4 months old, approx 350-450 mm high.
- Opaque grow tubes, 600 mm high, are used to enhance early growth and train developing trunk.
- Planted in autumn, the young tree continues growing through the winter, and achieves buddable size for spring, summer, or late winter dormant budding. (The property visited actually budded late with dormant buds, with intention of buds not pushing until following season)

*Smaller containers are certainly feasible for Australian conditions. However, planting 400 mm PG1 rootstock in autumn may present a frost risk. UCB-1 has a higher cold tolerance than PG1, but there is currently some doubt regarding suitability of UCB-1 for Australian conditions.*

### 1.3 Tree training

The predominant Californian cultivar, 'Kerman', is structurally a stronger tree, with a more upright growth habit, than the Australian cultivar 'Sirora'. Despite this, Californian growers still place great emphasis on pruning to develop and maintain structural integrity of the tree.

Development of a sound primary scaffold is critical for future years, and most Californian growers are very good at doing this.

*Growing a vigorous single scion shoot the summer prior to a primary heading cut, seems to be the key to producing multiple well positioned primary scaffolds.*

The scaffold development stage is the best opportunity to develop a good upright tree, for long term structural integrity.

*Correct length and angle of primaries/secondaries is critical, managed with tying if necessary.*

Vigour at the primary and secondary growth stage is also critical. Summer tipping a rapidly growing shoot, or winter pruning a branch of sufficient girth, will result in multiple lateral branching. However similar pruning done on a low vigour tree may not produce desirable branching, and may in fact retard tree growth.

Californian summers possibly provide more consistent ideal growing conditions than Australia.

*It is therefore important when summer pruning to be aware of current and expected vigour. If insufficient growth occurs as a result of a summer prune cut, it may have been better to leave the branch growing, enabling more choices and better wood to prune back to in the winter.*

Vigour remains of utmost importance up to year 4/5, setting the tree up to maximise its first crop in year 5/6. It remains a major challenge to produce the first crop any earlier than this. It is difficult to imagine trees grown better than some orchards visited in 2005, and yet they are still not cropping any younger.

Whilst we did not observe trees cropping sooner than year 5/6, we did see significant differences in the *quantity* of first crop. The transitional period between vigorous vegetative growth and reproductive development can possibly be managed with pruning and nutrition. Encouraging short lateral spur growth at year 4/5 will maximise early crop yields.

## 2. Mature orchards

### 2.1 Manual pruning

Californian growers generally put more time into pruning mature trees for shape and vigour, than Australian producers generally do. This is despite Kerman being a structurally stronger, more compact and upright tree than Australias' Sirora. Up to US $250 per acre prior to off crop, and US $350 per acre prior to on crop, is spent by *some* growers in mature orchards.

*Achieving good tree shape is a constant challenge growing Sirora. Australian growers should possibly review current levels of pruning, to achieve tree shape they desire.*

Recent studies by a UC graduate student, Tim Spann, have led to the concept of *preformed* versus *neoformed* shoots. Preformed shoots refer to short lateral spurs growing distant from the branch terminal. These shoots only grow to the extent of predetermined nodes, differentiated during dormancy, and usually become highly fruitful.
Neoformed shoots refer to the longer growth on the periphery of the tree. These too begin as a preformed shoot, but then apical dominance takes over, and providing other factors are not limiting, growth flushes continue.

*If mature trees are producing lots of long neoformed "whips", it may mean trees are being over pruned (tipping), at the expense of short more fruitful spurs. Some shift in Australian pruning techniques over the past two winters are reaching similar conclusions.*

Another method of reducing the vigour of long shoots was demonstrated, and termed a "knuckle cut". This refers to purposely tipping a shoot just above a "growth flush ring". The resulting multiple branching slows down the neoformed growth whip, producing a group of fruitful spurs for the following season.

### 2.2 Mechanical Pruning

Mechanical pruning in California has progressed steadily over the past 10 years.

- In 1995 UC was conducting significant trials of both hedging and topping, but many growers considered it not well suited to Pistachio trees, and was not being adopted commercially.
- UC was continuing trials in 2000, the focus still using severe side hedging to mitigate the effects of alternate bearing. However by now a number of large growers were also beginning to use hedging and topping as a management tool.
- By 2005 mechanical pruning, in particular side hedging, was becoming more widely accepted.
- There has been somewhat of a shift from severe hedging to mitigate alternate bearing, to moderate hedging as a canopy management tool.

Current UC trial results now show that moderate "maintenance" hedging has little effect on yield, and unlike severe hedging, is not important if done prior to an on or off year. Done on a two year cycle, it will help maintain tree shape, and create a mixture of fruiting and vegetative growth.

*This could be a valuable tool for Australian orchards:*

- *Where light is or will become limiting*
- *To assist canopy management of our more pendulous Sirora cultivar*
- *As a cost saving alternative to manual pruning*

Moderate mechanical topping has also become more widely accepted commercially, but UC are yet to recommend it as a management tool. Growers adopting mechanical topping are doing so in several ways:

- Topping at 17 feet (5.2m) to manage tree height – will require re-topping the next year. Initial topping usually spread over 2 or more seasons.
- Moderate topping, designed to replace manual tipping. Done on an "as required" basis. Does not seem to significantly reduce yield.
- Topping new growth of 5-6 year old trees. In uniformly developed orchards achieving strong growth, this seems an efficient practice.

*There has been little topping done in Australian orchards. Managing tree height has not yet been an issue, but soon will be.*

*Topping may become a useful tool:*

- *When tree height becomes a problem*
- *In uniformly developed orchards, to compliment manual tipping*
- *In younger developing orchards*

### 2.3 Tree tying

Some growers in California have adopted tying of branches to enhance tree shape. It can basically be divided into three stages.

- Primary development stage – Early tying is widely accepted in California, and ensures upright scaffold angles for future tree strength. This is a short term tie.

*Future tree shape is determined at this stage. Given the relatively low cost in time and materials, this should be standard practice in Australia.*

- Circle tying at 5-6 year stage. Growers doing this typically use a strong nylon cord, circling the tree taking in structural branches only. Upright tree shape is maintained, and pruning requirements may be reduced. The tie stays in place until it breaks (up to 5 years).

*New orchards should give this consideration. Because Sirora is more pendulous than Kerman, maintaining good shape at this stage may overcome some branch splitting problems mature trees are currently experiencing in Australia.*

- Second Tier tying. Not widely adopted across the industry. Done at about 10-12 year stage, using a circle tie of UV stabilised truck rope. Using long aluminum poles to push limbs up, a tie is positioned on structural branches high in the tree.

*This is an expensive operation, up to US $9 per tree. However, given the structural problems experienced with Sirora it may be worth trialing.*

## 2.4 Nutrition

- **Nitrogen**

Californian research has reached a point where recommendations can be made according to crop load and tissue analysis history. Generally rates used are lower than maximums used in Australia but well above average Australian applications. Rates are usually adjusted according to the on or off crop cycle, and it is believed higher rates are not only wasteful but possibly detrimental. We know Kerman nitrogen requirements differ from Sirora, from some Kerman trees grown in Australia.

Current Californian tissue analysis standards for Kerman have been reduced from optimum 2.5 – 2.9%, back to 2.2 – 2.5%.

In Australia we have a perception Nitrogen plays a major role in retention of fruit buds, and therefore biennial bearing. We also relate yellowing leaves sometimes seen distal to nut clusters, as a Nitrogen deficiency. Californian researchers don't necessarily agree with either viewpoint. Some researchers believe carbohydrate competition, and possibly hormonal signals, are more significant to biennial bearing than Nitrogen.

*Currently the higher producing orchards in Australia are applying up to 300 kg N/Ha, which is 20-30% higher than Californian recommendations. More research needs to be done to determine optimum rates for Sirora under varying crop loads.*

- **Potassium**

Californian research is still recommending up to 200 kg/Ha of K be applied in on crop, and 100 kg/Ha in off crop. Suggested tissue sample levels have been 1.8-2.0%, because most high producing orchards had levels 2% or higher. However extension staff and growers are now suggesting a tissue level of 1.4% or above is adequate.

*Recent Australian research has shown little or nil response to applied potassium. Soil reserves of 200 ppm +, considered "luxurious" for most crops, probably contribute to the lack of response.*

- **Phosphorous**

Californian soils typically have good reserves of Phosphorous, hence P deficiency is rarely a problem. Australian growers are well versed with the Phosphorous requirements of our soils.

- **Boron**

Australian growers have been following Californian practice of applying annual foliar Boron pre flowering, and generally our leaf Boron levels have been satisfactory.

*Pistachios have a higher Boron requirement than any tree crop, but care needs to be taken as excess Boron becomes toxic.*

- **Zinc**

Zinc deficiency occurs in California when a regular program is not adhered to. Foliar sprays of Zinc in either Sulphate or chelated form, during early-mid leaf development, are the most efficient method. Other timing in California is at bud swell stage, or as an autumn application. Both of the latter are done with high concentration rates of Zinc Sulphate. Autumn application is common using high concentration Zinc, with the intention also of inducing earlier defoliation. Early defoliation may be an advantage to get pruning started, but possibly shortens the time for nutrient recycling and building carbohydrate reserves.

*Australian growers regularly using 1 to 3 spring applications of Zinc Sulphate or Chelate seem to be overcoming deficiency problems.*

- **Copper**

Copper deficiency is relatively common in younger Californian orchards, and is prevented with spring foliar applications of Chelated Copper (EDTA).

*Australian growers have observed summer Copper deficiency in young trees, but those now applying regular Copper fungicides do not have a problem.*

### 2.5 Use of insecticides

The Californian industry has become heavily dependent on insecticides. Although they employ IPM strategies, they have probably removed much of the beneficial insect population. They now risk heavy losses by not spraying insecticides.

*Australia currently remains insecticide free, although we still do observe some minor insect damage. It is important we monitor insect damage, and remain insecticide free for as long as possible.*

An orchard was visited in the Mojave Desert, separated from San Joaquin Valley orchards by a mountain range. They reported remaining free of insect problems for more than 10 years, but had since become reliant on insecticides, as the rest of the industry has.

### 2.6 Use of fungicides

The most important fungal diseases for Pistachios in California are *Botrytis cinerea*, *Botrysphaeria dothidea*, and *Altenaria alternata*. Verticillium wilt remains a problem in older *atlantica* and *terebinthus* orchards. Botrysphaeria has the greatest potential for crop loss, and Dr. Themis Michailides has developed a winter bud monitoring program called BUDMON. Californian growers may apply several fungicide sprays during spring, particularly in wetter conditions.

Australian growers have observed some minor "blight like" symptoms, but have not positively identified Botrytis or Botrysphaeria. Minor Verticillium infections have been identified, and some northern NSW growers have identified Altenaria.

*Australian growers do observe some unknown fungal symptoms and we obviously want to keep ahead of fungal disease problems. There is a need for more careful observation/identification of existing symptoms, and possibly to start implementing a winter BUDMON program before it becomes an issue.*

### 2.7 Regulated Deficit Irrigation

University of California began trials of RDI in 1989, following the work done in Australian stone fruit. Two stress tolerant periods were identified:

- Growth stage 2 - Shell Hardening
- Post Harvest

No negative effects on production have been observed from applying mild stress during these periods.

Stress applied during growth stage 1 (prior to shell hardening), has been shown to increase shell splitting, but at the expense of nut size, and increased early split nuts. A positive effect of stage 1 stress in an on crop was significantly increased off crop load.

*Growth stage 2 and post harvest RDI may be significant for Australian growers experiencing water shortages.*

## 3. Acknowledgements

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