

Pistachios

Ben Robinson

Introduction

Virtually all pistachio nuts consumed in Australia were produced in Iran or California, until 1994 when Australian production jumped from approximately 10 t to approximately 70 t. Only those Australians whose origins were in southern Europe or the Middle East or who had travelled in these areas had experienced the delights of the 'smiling' nut. There were no opportunities to eat the nuts freshly picked as they are too perishable to ship half way round the world.

There were early introductions of pistachio trees into Australia (NSW) in 1935, but it was not until the 1960s that a serious effort was made at CSIRO's Merbein laboratories to adapt the crop to Australian growing conditions.

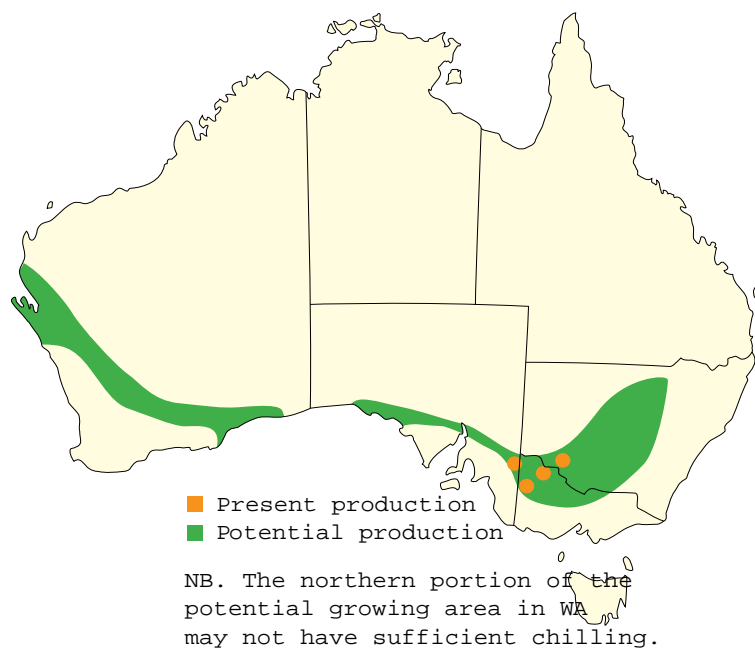
Among the potential strengths of the industry are the fact that pistachio is a new crop; hence, there is an opportunity both for import replacement and to introduce the nut to many more consumers. A full-scale hulling and drying capability (Pioneer Pistachios) has recently been developed which allows rapid processing and drying to achieve top quality. There is good industry cohesiveness.

Perhaps the most important constraint on the industry is the fact that marginal winter chilling is experienced in southern Australia in some years and this results in delayed flowering and low crop. An unidentified limb and trunk canker has been noticed over the last four years in plantings as they reach maturity. Potential growers should recognise that rapid access either to the market (for fresh product) or to a huller/dryer is absolutely critical.

Most pistachio nuts produced in Australia are sold as dried, salted and roasted nuts. This market has been growing at about 10% per year as supermarkets place

pistachio nuts in their produce departments. There is a niche market in the larger cities for fresh nuts, which are sold through the market system or directly to specialist greengrocers. The nuts in this form are very perishable. This market can be expected to grow slowly.

The major areas of commercial pistachio orchards are along the Murray River in NSW, Victoria and SA, but there are other orchards scattered through southern and central NSW, Victoria and the SA mallee. There is some interest in development of the crop in WA.



About the author



Ben Robinson is a principal of Scholefield Robinson Horticultural Services Pty Ltd. He has worked for the last nine years with major pistachio growers and the Pistachio Growers' Association to help adapt management practices developed overseas to the industry's needs in Australia.

Australia's production of pistachio nuts and fruit is only about 25% of current domestic sales. Most nuts for the Australian market come from Iran and the USA. The proportion supplied by each country varies with the price.

The manager of a pistachio orchard should have a good knowledge of the production requirements of deciduous tree fruit or nut crops, together with a high degree of adaptability, because there are some aspects of the management of pistachio that require slightly different approaches. Special knowledge of tree training is absolutely critical in both the establishment and the production phases of the crop, and a potential grower should become familiar with the standard industry practice.



Australian pistachio orchard showing formal tree shape needed to allow access for mechanical harvesting.

Markets and marketing issues

Currently, Australian production is replacing imports. More than 90% of production is sold as dried, roasted and salted nuts. Dried, non-roasted nuts and fresh product make up the remainder of Australia's production.

Australian production was about 400 t of dried nuts in the 1997 season compared to Australian consumption of around 1500 t annually. The Australian consumption of pistachios has grown from around 500 t in the last 15 years.

Currently, after processing and packing, net farmgate returns are around \$4,750–4,900/t. These prices are determined by the world price for the nuts.

Production requirements

Pistachio is adapted to cold winters and hot summers. Pistachio pioneer Don Maggs has

defined a climatic band across southern Australia as having potential for the crop. However, in southern Australia, winter chilling in some years is less than is needed by Sirora, the variety upon which most of the industry relies (1000 degree hours below 7°C). Frost close to or shortly after bud burst will severely reduce the crop.

Pistachios are considered to be more salt-tolerant than other nut and tree fruit species grown in Australia. As with all tree crops, they are likely to do better in favourable soil conditions. Hence, soils that are close to neutral in pH, and that have a potential rooting depth of 60cm above clay or lime restricting layers are to be preferred. As is now widely recommended for any horticultural crop, a proper soil survey on a grid of about 100 m will provide a firm foundation for a long-lived orchard. A knowledge of the depth of the potential rootzone, and the textures within it, allows the irrigation system to be properly designed and managed to take

account of the readily available moisture held in the profile. Installation of soil moisture monitoring equipment should also be considered.

Most orchards are watered with under-tree sprinklers or drip irrigation systems. Where water is to any extent saline it should not be allowed to come in contact with the leaves of the tree. Salt damage following foliar uptake has been observed in trees irrigated with bore water.

Steep slopes may limit access by mechanical harvesting equipment, and in frost-prone areas care should be taken to ensure that cold air can drain through the orchard rather than pool in low spots and cause damage.

Varieties

The selection work done by Don Maggs and Don Alexander at CSIRO's Merbein Laboratories led to the selection of the cultivar Sirora which is more suited to Australian conditions than Kerman, the main variety grown in California. The pistachio is prone to alternately bearing light and heavy crops and Sirora, while showing a tendency to biennial bearing, shows less extreme swings than Kerman. Sirora appears to have a lower chilling requirement than many of the named varieties. The nut is attractive and tasty, but has the drawback of being slightly smaller than many of the nuts in world commerce.

There is continuing observation of the performance of trees in the CSIRO gene pool and in variety collections on farms which could lead to the selection of additional varieties suited to

Australian conditions. If the canker disease currently seen in mature plantings is found to infect some varieties more frequently than others, it is likely that there will be a serious effort made to select varieties which have canker tolerance or resistance as well as being adapted to the low chill conditions of southern Australia.

Rootstocks for pistachio are important for vigour, disease resistance and possibly drought resistance. Early plantings were grafted to *Pistacia atlantica*, and *P. terebinthus*. Many of the more recent plantings are grafted to Pioneer Gold rootstock the seeds of which are imported from California. This is a selection of *Pistacia integerrima*. The Australian industry watches carefully the research carried out by the University of California on the disease resistance, crop performance etc. of various other potential rootstock selections, and in future will no doubt adapt this knowledge to local conditions.

Key statistics

- E Imports are about 1,200 t/year.
- E Australian production is about 500 t/year
- E World production is estimated to be about 440,000 t/year and is increasing.

Pistachio nut imports into Australia 1995–96.

Source	Amount imported (kg)
China	5 287
Iran	649 796
Japan	12 746
UAE	12 500
USA	521 524
Others	3 192
Total:	1 205 045



Sirora nuts from the 1997 season. Characteristics of this variety are that the nuts are light in colour, show even splitting and have a good flavour.



Fresh pistachios are a new treat for the Australian consumer.

Pistachio is almost unique amongst the commonly grown orchard species in having separate female and male trees. The CSIRO workers examined the flowering times of a range of male trees and selected trees that usually flowered and shed pollen about the same time as Sirora. In Australia it seems that there is benefit in using three male selections to ensure that there is sufficient overlap in every season. The variability of winter chilling hours from year to year means that the actual flowering date of the female trees may vary sufficiently from season to season to make the use of a sole pollinator too risky.

Pollen is transferred from the male to the female trees by wind. Currently about one male is planted to each 11 female trees, but it seems that a lower ratio of males to females (4 or 5%) would be quite safe.

Specialist nurseries are able to supply rootstocks or grafted trees if orders are made far enough ahead. Bud wood for field grafting is usually purchased from established growers.

Agronomy

Before establishing a pistachio orchard, the prospective grower should obtain professional advice to be sure that soils, water and geographic position are suitable. A soil survey should be the basis for a professional irrigation design and chemical soil tests the basis for soil amendment and basal fertiliser applications. Trees should be ordered well ahead of time. Some training of management and key field supervising staff is essential particularly in the techniques of grafting and tree training.

Orchard preparation should involve ripping if there are restricting layers and installation of drainage if this is needed.

Orchard design will depend on the inherent vigour of the site. Closer spacing in the row is used to ensure maximum early yield on a per ha basis (6 m between rows and 4 m between trees in the row is a starting point). Some account should be taken of the inherent vigour potential of the site when deciding on spacing.

Any steps that can be taken to maximise early yield will be of benefit as the pistachio orchard takes so long to come into production.

Key messages

- E Australia has a small but developing pistachio industry.
- E The CSIRO selection Sirora is adapted to Australian growing conditions.
- E The main production threat is an unidentified canker which causes tree dieback and death.
- E Readily available transport to the metropolitan fresh market and to the processor should be a primary consideration when planning a new orchard.

Rootstocks are planted in spring and topped to about 25 cm. Stakes (usually 5 cm \times 5 cm hardwood and about 1.6 m long) are driven alongside each tree. The rootstocks can be budded in the field in January or February if sufficient vigour has been obtained. During the first year of growth some summer pruning is needed to ensure that a suitable trunk can be established. After the bud has been inserted there is an accepted routine of heading back the rootstock which is well described in the US Pistachio Production Manual. As the scion grows it is tied securely to the stake with poly-tape.

The main emphasis in the early years of a pistachio orchard is on the training and pruning of trees. This is more crucial than with most other tree crops. In a large orchard the objective is to ensure that the trees are suitable for mechanical harvesting. In a small orchard which may be too small to interest a mechanical harvesting contractor, more rapid and less formal canopy development should be considered.

At the end of the first growing season, the shoot is headed and positions for about three primary limbs are established. These grow during the second growing season. In the second winter trees are pruned to vegetative buds on the primary shoots positioned so that reasonably regular secondary shoots will be produced. These may need tying into position during the second growing season. In the third year tertiary shoots are established. It is only at this stage that the final shape of the tree begins to emerge.

As with any horticultural operation the final size of the planting will have a large influence on the amount of equipment that is purchased and the balance between work that is managed by farm staff or the owner-operator, and work that can be done by contractors. Orchard operations require access to a tractor, a spray plant for foliar applications, a slasher, a herbicide spray unit and pneumatic pruning equipment.

Shake and catch harvesting equipment will normally be contracted in once the trees begin to carry a significant crop, which may not be until the 5th or 6th growing season. Hand

harvesting is preferred on younger trees. Some growers will strip fruit from young trees to allow more rapid growth of the tree canopy.

Soil management is usually effected by using a weed-free strip along the tree row maintained with knock down and pre-emergent herbicides, together with a sward between the tree rows maintained by slashing (or in the case of drip-irrigated orchards, allowed to go dormant under the influence of water stress during the summer).

The nutrient requirements of pistachio trees are not too different from those of other tree crops (such as almonds or citrus). Before planting, phosphorus will be needed on many Australian soils. On reasonably well-buffered soils a basal dressing of superphosphate in a band along the planting row will be all that is required for many seasons of growth. On sandy soils more frequent though smaller applications will be needed. As a rule of thumb, on low P soils apply about 0.5–1.0 t/ha to supply a long-term reserve. Potassium will not be needed on all soils but if the site is sandy, as much as 50 kg of actual K may be needed annually by a mature orchard. Sufficient nitrogen is needed to achieve the required vigour. This should be applied during the growing season. Most of the nitrogen used by the pistachio tree is taken up during the portion of the season which follows the grand period of shoot growth (after shell hardening). There seems to be only limited uptake during the postharvest period.

Foliar zinc is applied before the first growth flush has hardened.

Pistachio has a higher requirement for boron than most other trees and nuts. If treatment is needed (leaf analysis) a late dormant spray is applied (after bud swell and before green tips are visible) to the trees (2 to 5 kg/ha Solubor has been shown to be safe). Copper deficiency is seen in vigorous orchards. Shoot dieback occurs on the summer growth flush. A preventative spray of copper EDTA at about 0.5 kg/ha has been successfully used.

Bud burst in pistachio occurs in early October, and flowering occurs shortly after bud burst and continues for a week to 10 days.

The first major growth flush continues until about mid-December when shell hardening is complete. A second flush may occur in late December and continue into February. Embryo growth (nut fill) occurs after shell hardening. Before harvest a high proportion of nut shells split (which is desirable). Water stress at this stage can reduce the percentage that do split, so careful irrigation is needed at this time. Harvest is in March.

Pest and disease management

Pistachio trees are known to be susceptible to a number of root, leaf and shoot and fruit diseases. For example:

Verticillium (impact minimised by choice of resistant or tolerant rootstocks)

Alternaria (not recognised as a problem in Australia at this time)

Botryosphaeria (probably present but currently no recommendations for treatment in Australia)

The Californian literature is very helpful in understanding the range of diseases we might expect to see.

The only disease or disease complex that has received any attention from plant pathologists in Australia is an unidentified canker and tree dieback which has been observed on some male trees and on Sirora female trees. It leads to gumming on trunk and scaffold limbs, a dark xylem canker and in some cases pockets of black ooze beneath the bark. The latter is thought to be caused by secondary infection of non-pathogenic organisms.

A bacterium (*Xanthomonas* spp.) has been found by researchers from Agriculture Victoria in some samples and there is some visual similarity to *Verticillium* but neither has been confirmed as the cause.

Pistachio is also known to be host to various plant-sucking bugs and scale insects. Reference to the Californian literature will demonstrate how broad the range of plant-sucking bugs may be. In particular they are known to cause fruit damage, either to the epicarp (hull) or to the developing embryo (eventually the meat of the nut). A research program has been under way for three seasons to try to associate epicarp lesion and nut drop in pistachio with plant sap-sucking bugs in Australian orchards. Recent progress reports from Agriculture Victoria suggest that two native species, Rutherglen bug and Apple Dimpling bug, may be involved. Damage may be caused to the developing embryo by Green Vegetable bug. Losses as a result of insect attack may not be large, as there seems to be a good deal of fruit drop

with no specific cause in this species. Research work is in progress.

Harvest, handling and postharvest treatment

Nuts which are to be sold fresh are hand picked, cooled and manually sorted over a belt. A cold chain must be maintained from tree to retail shop if the fruit are to be attractive at the retail end. There is no standardised packing container, and growers are developing different sorts of packages in an attempt to make the product more widely accepted.

Pistachio nuts destined for drying are harvested with shake and catch machines similar to those used for prunes. Nuts are perishable and have a high respiration rate at harvest time so rapid removal of field heat is important if quality and shell colour are to be maximised. Transport to the processing

facility should be fast and the nuts should be held in cold storage if there is to be any delay.

Nuts are dehulled in specially designed machinery. They must be dehydrated to about 7% moisture before they are stable. This can be done in batch handling equipment or in more modern continuous flow equipment.

Flotation tanks and gravity tables allow the separation of blank nuts, and hand or electronic sorting equipment allows grading on the basis of colour. An ingenious 'needle picker' separates split from non-split nuts.

A range of different levels of sophistication in handling, packaging and storage exists in the industry which may be related to the scale of the orchard. Some growers handle and pack their own crop with simple equipment and there are processors that provide a hulling, drying and sorting service on a contract basis.



Mechanical harvesting of pistachio in the Murray Valley

Table 1. Pistachio gross margin and sensitivity analysis.

Table 1. (Cont'd) Pistachio gross margin and sensitivity analysis.

Economics of production and processing

Establishment costs will be similar to those of other orchard crops such as almonds except that the time between planting and first harvestable yield is much longer and this lag means that any serious development will need substantial financial reserves. Table 1 shows a summary of gross margin data for a typical production unit in 1997. A sensitivity table is also presented which shows how returns may be influenced by yield and/or prices received. These data should certainly not be used as a basis for making investment decisions. Much more detail should be incorporated in a proper development budget within the context of a whole farm plan.

Key contacts

Australian Nut Industry Council
P.O. Box 394
Yarra Glen, Vic. 3775
Phone: (03) 5797 8485

Dr Megan Edwards
Ms Cathy Taylor
Agriculture Victoria
Irymple, Vic. 3498
Phone: 03 5051 4500
Fax: (03) 5051 4523

Horticultural Pest Management Services Pty Ltd
P.O. Box 260
Fullarton, SA 5063
Phone: 08 8271 7800
Fax: (08) 8373 2442

Dr John E. Kenez
5 Rolls Court
Glen Waverley, Vic. 3150
Phone: (03) 9802 8670

Scholefield Robinson
Horticultural Services Pty Ltd
P.O. Box 145
Mitcham Shopping Centre
Torrens, Park SA 5062
Phone: (08) 8373 2488
Fax: (08) 8373 2442
Email: schorob@senet.com.au

Professor Margaret Sedgley
Department of Horticulture,
Viticulture and Oenology
University of Adelaide
Waite Campus
PMB 1
Glen Osmond, SA 5064
Phone: (08) 8303 7242
Fax: (08) 8303 7116

Dr Stephen Sykes
CSIRO Division of Plant
Industry
Merbein Laboratories
Merbein, Vic. 3505
Phone: (03) 5053 3100
Fax: (03) 5051 3111

The Australian Pistachio
Growers Association Inc
P.O. Box 34
Paringa, SA 5340
Phone: (08) 8595 5034
Fax: (08) 8595 5051

Key references

Ferguson, Louise (Ed) 1995.
Pistachio Production 1995. Center
for Fruit and Nut Crop Research
and Information, University of
California Davis, USA.

California Pistachio Industry
Annual Reports

Maggs, D. H. 1982. *An
Introduction to Pistachio Growing
in Australia*. CSIRO Melbourne.

Newsletter of the Australian
Pistachio Growers Association

Kenez, John 1995. 'Pistachios'.
In *Horticulture Australia*.
Morescope Publishing Pty Ltd,
Hawthorn East, Australia

Australian Nutgrower (Ed.
Jennifer Wilkinson)
P.O. Box 1, Dargo Vic. 3862
Phone/Fax 03 5140 1258

Pistachio Growers Association
Newsletter
(P.O. Box 34, Paringa SA 5340)