Native foods

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Farmers today, both those in existing businesses and new entrants, live in an environment where they by necessity have to keep an eye on new opportunities.

Changes in commodity prices or new value chain opportunities, let alone changes in types of food or new products, demand a flexible approach to farming. Many crops themselves have a “fashion” element where a new variety of fruit or vegetable can be “in” for a period then “out” with the market. Consumers expect farmers to be able to continue to meet their needs in both food and fibre when they follow these new trends.

As well, diversification of cropping opportunities, within the limits of good business sense, provides an essential part of risk management in modern farming.

The Rural Industries Research and Development Corporation is tasked, within a number of its programs, with assisting agribusiness and the food industries to stay ahead of changes by looking at new crops and their management and potential in the food and fibre industries. Some of these crops are aimed at Australian markets, others are aimed at a mix of domestic and export.

Undertaking the research and supporting industries searching for new products is only the first stage of this work. Unless the work is communicated to the widest possible audience the potential of these new crops will never be fully realised.

This book contains the Native Food Chapters of RIRDC’s *The New Crop Industries Handbook* and is aimed at consolidating much of the recent research information into a handy format for those searching for the latest information on Australia’s native crops. I am sure it will prove to be as valuable to both potential and existing farmers as the first edition.

**Peter O’Brien**
Managing Director
The Rural Industries Research and Development Corporation

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Overview

Juleigh Robins

Acknowledgment is made to Caroline Graham and Denise Hart, authors of the chapter on bushfoods in the first edition of this publication.

Introduction

The native food industry has grown slowly since its inception in the mid—1980s. Native foods have proved difficult to commercialise. They have been difficult to commercialise agronomically because they are new crops without the benefit of existing established production systems, skills, knowledge and reliable plant material. And they have been difficult to commercialise in the marketplace because they are innovative products without an established market or general consumer knowledge.

Currently it is estimated that the industry has a gross production value (farm-gate and ex-nursery) of between $5 million for native foods (Fletcher 2003) and $10 million for native food and essential oils from native plants combined (Lester 2003). It is impossible at this time to extrapolate this to a total “industry” value.

The industry, although very small, has four major levels. It is not unusual for individuals or companies to be active in more than one level and they may be active in all four:

- nursery operators
- cultivators and wild harvesters
- commodity traders and value-adders—retail and food-service
- marketers—food-service and retail, domestic and export

The industry operates within a variety of commercial structures, including single-purpose enterprises, networks, cooperatives and vertically integrated supply chains. Commercial horticultural cultivation of native food species is expanding; however, managed wild harvest remains an important and integral part of the commercial supply of native foods.

Table 1 lists, at this stage of the industry’s development, the most commercially used native foods. It should be noted that the table represents current industry knowledge but does not take into account plantings that are not yet yielding fruit, leaf or seed product.

The majority of the produce is dried, frozen and/or further processed into value-added products. Native foods are essentially used in the broader food industry as a defining flavour to an existing food product or process—for example, condiments, sauces, biscuits and ice cream.

The main markets for native foods are in the hospitality and tourism food-service, industrial
Native foods overview

Within the past two years some native food brands have successfully entered and remained in the mainstream retail market. There has also been significant development in the industrial food manufacturing market, both domestically and internationally, over the same time frame.

The industry requires an ongoing and targeted focus on the further development of these markets in order to achieve critical mass and anticipated returns. It will only succeed commercially in the long-term if native food and native food products meet mainstream market needs.

The native food industry continues to face great challenges and must find timely solutions if it is to grow further. These challenges include:

- supply issues—over and under supply—not matched to market demand
- inconsistent and unreliable plant material—yield variability, attrition rates, etc.
- establishing efficient and sustainable ways to grow and harvest the crops
- under-capitalisation of the industry in general
- low economic returns to growers through high costs of production and limited markets
- low economic returns to wild harvesters due to climatic and geographic constraints
- low economic returns to processors due to high cost of ingredients and marketing costs in limited markets
- establishing food safety and quality standards
- low levels of cooperation, communication and information sharing within the industry
- identifying appropriate ways to incorporate Aboriginal interests in the native food industry
- increasing homogenisation of the food industry, which has the potential to marginalise niche foods/products
- ongoing product development
- market development and education—native foods are still largely unknown in the domestic and global marketplace
- establishing a market focus across all levels of the industry.

Some necessary steps towards a sustainable and prosperous growth in the industry are as follows:

- market driven, not production driven
- ongoing research and development in plant selection, sustainable production and post-harvest systems—for cultivated and wild harvest
- uptake across industry of food safety and quality standards
- increasing cooperation, communication and knowledge sharing between all levels of the industry
- product development to meet market needs
- clear and consistent industry marketing messages
- generic marketing initiatives to benefit the entire industry.

The native food industry offers opportunities at the agricultural level in farm diversification and the development of sustainable and environmentally appropriate agriculture.

Table 1. Commercially used native foods: supply status

<table>
<thead>
<tr>
<th>Species</th>
<th>Mainly cultivated</th>
<th>Cultivated/wild harvest</th>
<th>Mainly wild harvest</th>
<th>Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aniseed myrtle *</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Under</td>
</tr>
<tr>
<td>Bush tomato</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Under</td>
</tr>
<tr>
<td>Davidson’s plum</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Over</td>
</tr>
<tr>
<td>Kakadu plum</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Over</td>
</tr>
<tr>
<td>Lemon aspen</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Over</td>
</tr>
<tr>
<td>Lemon myrtle</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Under</td>
</tr>
<tr>
<td>Native citrus</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Over</td>
</tr>
<tr>
<td>Native pepper</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Under</td>
</tr>
<tr>
<td>Pepper-berrys *</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Under</td>
</tr>
<tr>
<td>Native mint *</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Under</td>
</tr>
<tr>
<td>Riberries</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Under</td>
</tr>
<tr>
<td>Quandong</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Over</td>
</tr>
<tr>
<td>Wattle seed</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Over</td>
</tr>
</tbody>
</table>

* Recent (since last edition) additions to commercial supply.
At the marketing level, native foods offer a unique point of difference to the food industry globally, adding value by product differentiation to potentially every area of food manufacture. There are potential nutritional and functional food benefits and intangible benefits to Indigenous and non-Indigenous stakeholders.

Fletcher and Collins refer to many of these in this handbook’s first chapter—desire for change, desire for improvement, creating real benefit, and an expectation of intrinsic worth in the activity.

Aboriginal people who are involved in the industry identify social, cultural, economic and health benefits arising from that involvement (Mr John Collyer, Chairperson, Indigenous Australian Foods Ltd). The meaningful involvement of Aboriginal people brings authenticity and integrity to the native foods industry.

### Key messages

- The industry should be market driven, not production driven.
- Ongoing R&D in plant selection, sustainable production systems and post-harvest systems is necessary.
- Industry commitment to food safety and quality standards is necessary.
- Foster cooperation, communication and knowledge sharing between all levels of industry.
- Market as an industry as well as individual entities.
- Keep commercial reality as the focus.

### Marketing overview

#### Identifying markets

All commercially used native foods are marketed to the Australian domestic and export markets in four major forms:

- **farm-gate commodity product**—limited value-adding can include drying, freezing, cleaning, grinding, etc.
- **value-added into a wide range of industrial food manufacturing flavourings and seasonings**
- **value-added into a wide range of hospitality food-service products**
- **value-added into a wide range of consumer products in mainstream, specialty and tourism markets.**

There is little or no interest at present in the mainstream market for native foods as fresh fruit or herbs, although this can change as production and post-harvest systems are improved.

### Table 2. Some indicative farm-gate prices, 2004

<table>
<thead>
<tr>
<th>Product</th>
<th>Form</th>
<th>($/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aniseed myrtle</td>
<td>Dry and milled leaf</td>
<td>38</td>
</tr>
<tr>
<td>Bush tomatoes</td>
<td>Dry whole or ground</td>
<td>20–24</td>
</tr>
<tr>
<td>Davidson’s plum</td>
<td>Frozen whole</td>
<td>2–6</td>
</tr>
<tr>
<td></td>
<td>Frozen deseeded halves</td>
<td>5–13</td>
</tr>
<tr>
<td></td>
<td>Frozen puree</td>
<td>9–10</td>
</tr>
<tr>
<td>Kakadu plum</td>
<td>Frozen whole</td>
<td>15–20</td>
</tr>
<tr>
<td>Lemon aspen</td>
<td>Frozen whole</td>
<td>8–12</td>
</tr>
<tr>
<td>Lemon myrtle</td>
<td>Whole fresh leaf on stem</td>
<td>2–10</td>
</tr>
<tr>
<td></td>
<td>Dried and milled</td>
<td>22–25</td>
</tr>
<tr>
<td>Native citrus</td>
<td>Desert lime frozen whole</td>
<td>5–15</td>
</tr>
<tr>
<td></td>
<td>Finger lime whole</td>
<td>25–80</td>
</tr>
<tr>
<td>Native pepper</td>
<td>Dry and milled leaf</td>
<td>38</td>
</tr>
<tr>
<td>Pepperberries</td>
<td>Fresh</td>
<td>6–20</td>
</tr>
<tr>
<td></td>
<td>Dried</td>
<td>30–70</td>
</tr>
<tr>
<td>Native mint</td>
<td>Dried and milled leaf</td>
<td>35–38</td>
</tr>
<tr>
<td>Ribberries</td>
<td>Frozen whole, seedless</td>
<td>13</td>
</tr>
<tr>
<td>Quandong</td>
<td>1st grade premium dried</td>
<td>40–60</td>
</tr>
<tr>
<td></td>
<td>Frozen deseeded halves</td>
<td>25–28</td>
</tr>
<tr>
<td>Wattle seed</td>
<td>Raw whole seed</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Roasted and milled</td>
<td>20–24</td>
</tr>
</tbody>
</table>

Table 2 provides some current indicative farm-gate prices for large-volume sales. These prices are indicative only and frequently volume users will negotiate a tailored price with suppliers. The pricing can be expressed as a range and can change at any time due to seasonality, shortage of supply, glut of supply, and so on. The most common forms for each of the native foods are also described in Table 2.

Table 2 shows generally high prices for native foods. While these prices can appear attractive to new entrants to the industry, they are based on the high cost of cultivation or wild harvest. Most food processors and larger scale commodity buyers within the native food industry will generally require tonnage (usually provided over an agreed time frame) and will expect fruit to conform to minimum food safety requirements. With increasing demands within the food industry to provide ever-
safer food products, growers (and traders) of native foods will increasingly be expected to provide microbiological data on their products, nutritional information, and the provision of specifications and conformation to those specifications. Specifications will describe the product—colour, flavour, typical size, (including micron for milled product), and so on—describe the packaging the product is provided in (which must be food safe) and provide storage instructions for food safety and optimum shelf life. Any known allergens must be identified on the specification sheet.

Smaller quantities can be successfully marketed in local markets and in some sectors of the native food industry this has become the prime market (see the quandong chapter).

**Market demand**

Reliable information on market demand is very difficult to obtain: as the industry remains fragmented and unwilling to share information. As Hugh MacIntosh points out in the native citrus chapter, there are still “significant amounts of semi- or sub-commercial activity. Further, the industry is too small to be considered in the normal horticultural production statistics”.

A recent analysis stated, “Claims for sales volumes and market leadership are difficult to substantiate and appear to be exaggerated in a number of cases. However, the native food industry, while small and still fragmented, is nevertheless thriving on a diverse number of fronts and the substantial industry growth predicted in the 1990s is likely to occur in the next several years.”

The industry continues to be driven by highly motivated individual ‘visionaries’, whose ideas for the industry generally vary widely” (Lester 2003).

One unifying “vision” throughout the industry (see the following chapters) is the recognition that, without mainstream processors and markets adopting the products, critical mass for the industry will not be achieved.

To encourage uptake by mainstream processors and markets, native foods must become affordable and sustainable to the broader food industry, which operates in a highly competitive marketplace. Consistency of supply must be guaranteed, regardless of variations caused by climate, harvest, handling and transport.

**Key marketing issues for native food producers include:**

- a lack of market awareness about native foods in general and about how to use native foods in particular
- developing a clear, industry marketing message that can be heard among the cacophony of mainstream food marketing
- how to match the economic viability of native food agriculture with the market’s need for affordable product.

**Key messages**

- Critical mass for the industry cannot be achieved without mainstream producers and markets adopting the products.
- Native food prices are generally higher than for other crops.
- Higher prices will generally inhibit mainstream producers and markets from adopting products.
- Native foods must have a clear marketing message that differentiates them from standard foods—a point of difference that users will pay for.
- Products need to be accessible—easy to use and understand.
- There is little reliable market demand information: research your market options.

**Species**

There has still been little genotype selection of improved plants, but the following species are at present the most commonly used and in demand. They are listed alphabetically and are not ranked.

**Aniseed myrtle** *(Backhousia anisata)*, a relative “newcomer,” is typically an east coast rainforest tree with dense foliage that has a strong anise flavour. It is used primarily as a herb or flavouring.

**Bush tomato** *(Solanum centrale)*, is a small shrub with grey-green leaves. The fruits turn from green to yellow when ripe and dry on the bush until they reach a reddish-ochre colour and resemble a raisin. It is an arid zone plant native to Central and Western Australia, growing on lighter soils in areas of extremely variable rainfall.

**Bush tomato** *(Solanum centrale)*, is a small shrub with grey-green leaves. The fruits turn from green to yellow when ripe and dry on the bush until they reach a reddish-ochre colour and resemble a raisin. It is an arid zone plant native to Central and Western Australia, growing on lighter soils in areas of extremely variable rainfall.

Fruit can be harvested mechanically and it has enormous...
potential for dry zone cropping (but needs water).

The fruit is intensely flavoured with a piquant, spicy taste balanced by fruit sugars. It is used primarily as a spice or flavouring.

**The Davidson’s plum** (Davidsonia spp.), is a native rainforest fruit predominantly from sub-tropical coastal regions of New South Wales and tropical north-east Queensland.

Davidsonia does best in deeper, high-organic-matter, friable soils but naturally occurs across a range of soil types. It is able to produce in semi-shaded conditions and can be appropriate for south-facing slopes.

The fruits are intensely and exquisitely sour and not suited to the fresh fruit market, but are ideal as a processing or culinary fruit. Colour is deep purple skin with bright magenta flesh.

**Kakadu plum** (Terminalia ferdinandiana), is a coastal tree growing from the Kimberley to Darwin. It produces pale olive-green, ovoid fruits with central wooden stone (similar to an immature olive). The fruit is fibrous and difficult to process but has an ongoing market as a value-added product.

**Lemon aspen** (Acronychia acidula and Acronychia oblongifolia), is an east coast rainforest tree bearing pale lemon fruits. It can fruit within two years of planting and will grow in a variety of locations. With a wonderful lemon flavour and secondary flavour of eucalyptus, it is used as a processing or culinary fruit.

**Lemon myrtle** (Backhousia citriodora), is probably the most intensely cultivated of all native foods, with 150,000 trees in New South Wales and a further 1 million in Queensland. Lemon myrtle prefers nutrient-rich soils of a medium to heavy texture in a well-drained, wind-protected, sunny position. It prefers acidic soils and areas recording more than 800 mm/yr of rainfall. Lemon myrtle has a distinctive lemon/lime grass flavour due to the extraordinary level of citral in the leaf. It is used as a herb or flavouring ingredient.

**Native citrus** (Citrus glauca, Citrus australasica and other spp.) Australia has seven native plant species that are true citrus. The wild lime (C. glauca) is endemic to the semi-arid regions of south-west Queensland, western New South Wales and South Australia. Finger lime (C. australasica) is endemic to rainforest habitats on the east coast. Like all citrus, native citrus prefer a well-drained soil. They will tolerate poor soils, dry conditions and cold (particularly the wild lime). Plantation-grown trees have been shown to respond well to both irrigation and fertiliser. The fruits have a distinct lime flavour but with that unique difference found in native foods—so difficult to describe. These are extremely versatile and excellent processing and culinary fruits.

**Native pepper** (Tasmannia lanceolata and other spp.), or mountain pepper, is found naturally in the wet forests and shrublands of south-east Australia and extending as far as the Hastings River catchment in mid-north New South Wales. It grows best in cool, sheltered environments free from water stress, on neutral, acidic soil,
preferably well-drained and fertile. Mountain pepper leaf and berries have a hot, spicy and aromatic flavour derived largely from a terpene compound, polygodial. The leaf is used dried and milled as a herb and flavouring. The berries are a processing fruit or are used dried and milled as a spice or flavouring.

**Native pepper berries**

**Native mint**

(*Prostanthera rotundifolia* and other spp.), a recent addition to commercialised and cultivated native foods, is predominantly grown in southern Victoria. The plant is a large bush with dense foliage that can be harvested three times a year, once established. The leaves have an intriguing minty flavour with a peppery finish. Native mint is used as a herb and flavouring.

**Riberry**

(*Syzygium leuhmanii*), with a range similar to that of Davidson’s plum, is mainly grown in northern New South Wales but has potential in many areas. Plants are established easily and there are some selections/hybrids available. The fruit is small and has a striking purple colour that fades to pink when cooked. Riberreries are strongly clove and spice flavoured. This is an excellent processing and culinary fruit.

**Quandong**

(*Santalum acuminatum*) requires a climate with high light intensity, low relative humidity and will grow in a range of soil types, including pH variations and high salinity. Soils must be well-drained: quandongs will not tolerate waterlogging. The fruit is a visually appealing red, tart tasting and dry textured. It is either dried or frozen and is a processing and culinary fruit.

**Wattle seed**

(*Acacia victoriae* and other spp.) Acacia grows throughout the country and many species are suitable for culinary use. The most popular wattle seed in the food industry is *Acacia victoriae*, which is found extensively throughout the Central Desert region and into South Australia, Western Australia and New South Wales. The seeds can be harvested mechanically. The flavour of wattle seed is nutty with coffee/chocolate overtones. The seed with aril intact is used and it must be roasted and milled before use as a herb/spice or flavouring.

**Other plants**

In addition to the above, RIRDC is supporting two projects researching tuberous plants, one based on *Adansonia* (boab) tubers, the other based on *Platyca* tubers, which can lead to field crops for fresh produce from native plants. The first project is in conjunction with AgWA and the second with the University of Western Australia. For further information, consult *Research in Progress* published by RIRDC.

**Agronomy**

In general, to make a good profit a producer needs a good knowledge of what management practices will yield good quantities of high-quality produce. In the native foods industry producers need more—they need to know they are planting reliable plants with proven yields. Harvest and post-harvest issues need to be identified and addressed with a focus of continual improvement. To gain this knowledge will take time and those entering the industry will need to take a long-term view.

Although commercial production of many native plant foods is still in development stage, sufficient demand for some species is encouraging commercial production (see Table 1). While basic establishment costs per hectare for most species are unavailable, Table 3, from Ryder (2004b) encapsulates some of the current limiting constraints and requirements for long-term success for each crop. Dr Ryder has been conducting research of a number of trial plantings of various native foods in South Australian and Victorian locations.

Specific agronomic information for selected species will be found in chapters that follow. The species discussed in depth are:

- bush tomato
- lemon myrtle
- native citrus
- native pepper
- quandongs
- the Davidson plum.
### Table 3. Native food crops: limiting factors and requirements for success

<table>
<thead>
<tr>
<th>Species</th>
<th>Current constraints</th>
<th>Needed for long–term success</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quandong</td>
<td>Not easy to cultivate, market development</td>
<td>Cultivation methods, market and product development</td>
</tr>
<tr>
<td>Acacia</td>
<td>Improved planting material, harvest methods, market development, product awareness</td>
<td>Improved planting material, market development, product awareness and education</td>
</tr>
<tr>
<td>Citrus</td>
<td>Product development, market development, education and awareness</td>
<td>Mechanical harvesting, market and product development, education and awareness</td>
</tr>
<tr>
<td>Mountain pepper</td>
<td>Improved planting material and cultivation methods, market development, education and awareness</td>
<td>Improved planting material, mechanical harvesting, market development, education and awareness</td>
</tr>
<tr>
<td>Lemon myrtle</td>
<td>Education and awareness, market development</td>
<td>Education and awareness, market development</td>
</tr>
<tr>
<td>Lemon aspen</td>
<td>Improved planting material, cultivation methods, market development</td>
<td>Improved planting material, cultivation methods, market development</td>
</tr>
<tr>
<td>Riberry</td>
<td>Improved planting material, cultivation methods, long lead-time to fruit (some locations), market development</td>
<td>Cultivation methods for fruit set and development, market development</td>
</tr>
<tr>
<td>Bush tomato</td>
<td>Improved planting material, cultivation methods, harvest methods, education and awareness</td>
<td>Improved planting material, cultivation and harvest methods, education and awareness, market development</td>
</tr>
</tbody>
</table>

Source: Ryder, M. (2004b)

### References


### Key messages

- There are native food species enjoying commercial use and some success.
- Focus on those species that have an established demand.
- Grow what the market wants.
- Be aware of all issues that contribute to or inhibit success.
- Be prepared for a long-term investment and involvement—native food production is not an overnight success story.
About the author

Juleigh Robins is co-owner and director of Robins Foods Pty Ltd, manufacturers and brand marketers of Outback Spirit products. Juleigh has worked extensively on the native food supply chain, strategically at the inbound supply end and the outbound market end.

Juleigh has also written two native food cookbooks, *Wild Lime* and *Wild Classics* published by Allen & Unwin. Robins Foods won the 2003 Rabobank Agribusiness Award for Excellence Rural Industries Research & Development Corporation Agribusiness Value-adding Award. Juleigh was also a Victorian finalist in the 2003 Telstra Business Women's Awards Westpac Group Business Owner Award.

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**Introduction**

Bush tomato is a common name for the arid land species *Solanum centrale* that is found naturally throughout the Central Desert region of Australia. Bush tomatoes are the fruit of the plant and are usually sun dried on the bush before harvesting. Post-harvest the dried bush tomato is usually ground into a fine powder or coarse granule depending on application. There are many *Solanum* species in Australia, not all edible. *S. centrale* is by far the most common edible species used in the food industry but further research and product development work is being focused on *S. chippendalei* among others.

Bush tomatoes are essentially a herb/spice product, and a major strength of the bush tomato is its unique and intense flavour, which retains its integrity in many applications and in relatively small ratios to total ingredient mass. This characteristic is a double-edged sword for the bush tomato “sector”. On one hand, it is an attractive and marketable flavouring ingredient providing a distinctive flavour difference at a relatively economical use and cost to the manufacturing or hospitality consumer; on the other, it is a difficult crop for the agricultural sector to commercialise due to the high costs of production combined with the relatively small quantities currently required by the food industry.

The current demand for bush tomato is being met mostly by the wild harvest sector. The wild harvest sector, while operating under particular climatic, cultural, geographic and economic constraints, is, however, an important supply chain partner to existing users of bush tomato and provides a valuable income source to its largely Aboriginal members. It is unlikely that wild harvest can continue to meet the growing demand except in the very short term.
The current uptake of bush tomato into the food manufacturing and food-service industry is encouraging, and further demand is expected over the short and long term. It is clear, however, that the professional agricultural sector, while identifying bush tomatoes as a potential alternative crop suited to low rainfall and arid regions, will limit investment in bush tomato production until the demand is sufficient to make broad-acre production viable. It is also clear that the agricultural sector is seeking reliable plant material with consistent and demonstrable yields. Managed wild harvest activities and small-scale cultivation in particular regions and circumstances will need to fill ongoing and growing demand in the short term.

**Markets and marketing**

Bush tomatoes, particularly *Solanum centrale*, are proving to be one of the most marketable products emerging from the burgeoning Australian native foods industry.

Bush tomato–flavoured and –seasoned products are now successfully ranged in mainstream categories in supermarkets nationally in Australia.

Chris Mara, Chairperson of the Coles Indigenous Food Fund (a Coles Supermarkets initiative) says bush tomato products are the most popular native foods purchased by consumers and are commercially successful in Coles’ supermarket range of native food products.

Bush tomato–based seasonings and flavourings are now available extensively throughout Europe, the United Kingdom and Asia and are experiencing growing acceptance in the industrial food sector.

Mr Geoff Gordon, Managing Director of Hela Schwarz Australia, exports high volumes of native food–based flavour bases, pre-mixes and seasonings for distribution throughout Europe and Asia and identifies bush tomato as one of the most versatile of all native ingredients currently available. According to Mr Gordon, bush tomatoes have been successfully incorporated into flavour bases because they “impart a fascinating flavour twist to so many standard herbs and spices”.

The broad supply chain for bush tomatoes is described in the flow chart below.

At present the supply is largely sold direct to the food industry for further on-sale or value-adding. Bush tomatoes are currently marketed to both the Australian domestic and export markets in three major forms:

- prime ingredient/commodity as a whole dried fruit or ground/powdered dry ingredient
- value-added into a wide variety of industrial food flavourings and seasonings
- value-added into a wide variety of value-added consumer products (saucers, chutneys, herbs and herb blends, breads, biscuits, and so on.

In some cases companies using bush tomatoes in their own value-adding production are also acting as commodity warehouses and suppliers to other parts of the food industry. A clear sourcing and warehousing capability has yet to be developed in the bush tomato supply chain. Given the small size of leading companies in the native food industry the overlapping roles can be a major constraint to marketing effectiveness as precious financial and time resources are spent largely on inbound supply chain activities and storage rather than the outbound marketing activities. Suppliers of bush tomatoes could gain a competitive advantage by developing a warehousing capability. This would fit supply more closely to customer needs.
demand by supplying bush tomatoes as required, rather than in bulk seasonally.

As a broad generalisation, the demand for bush tomatoes in the short-term is greater than available current supply and future demand is expected to grow significantly. However, it is impossible to provide an exact figure for the total value of bush tomato production (wild harvest and/or cultivation) in Australia today. Recent analysis suggests that annual volumes of bush tomatoes traded are between 8–10 t, of which up to 2 t can be from cultivated sources. The total value of the bush tomato crop per annum is currently fairly modest but expected increases in demand can see the value of the bush tomato crop increase significantly—but of course only if the crop is available to fill demand.

The recent supply of bush tomatoes has been severely affected by drought in the Central Australian region. Prices have moved upward from the range of $15 to $20/kg three years ago. It is now common for wild-harvest fruit to fetch around $20.00 to $24.00/kg (depending on fruit supplied as whole or partially value-added by grinding and so on). Good conditions (rain when the plants need it) in Central Australia can see wild harvest prices ease marginally. Cultivated fruit is similarly priced, at approximately $22 to $24/kg and this price is significantly higher than some in the sector had anticipated.

While these prices can sound attractive, they clearly reflect the high costs currently involved in either wild harvesting or commercially cultivating these plants. For the bush tomato “sector” to continue to grow it is important that we find ways to make this product economically sustainable in both the cultivated and wild harvest sectors. Barriers to increased cultivation, and therefore large-scale supply, are high initial set-up costs, low and inconsistent yields and perceived small market demand. Prices for broad-acre cultivated crops are unlikely to reduce until these barriers are removed and bush tomato production must provide commercially acceptable returns to bush tomato suppliers.

It is critical for the future viability of the bush tomato sector that the industry focuses on demand to pull production. However, in order to stimulate demand, bush tomatoes need to be more affordable and viable to the food industry, which operates in a highly competitive marketplace. Bush tomato products are expected to compete successfully against mainstream food products using ingredients from supremely well-developed supply chains—perfected over years, if not centuries.

Matching and meshing these needs will be essential for long-term bush tomato sector growth.

Production requirements

Climate

The bush tomato is an arid zone plant native to Central and Western Australia and grows in lighter soils in areas of extremely variable rainfall. The plant will normally grow, flower and fruit after a sufficient rainfall event. Regrowth from below ground is favoured by soil disturbance. Although frosts are common in the natural range of bush tomato,
The plant itself and the ripening fruit are susceptible to frost damage. The plant is best grown as a perennial in warm, dry, frost-free or low frost-risk locations, but can be grown successfully in a wider range of conditions. Bush tomato can also be grown as an annual crop but must be planted early (in spring) because of the extended ripening period in autumn. Bush tomato fails to thrive or even to establish in colder, wetter areas (such as the south-east coast of South Australia).

Most of the current crop of bush tomato comes from wild harvest in Central Australia. Note that within the same geographic range there are closely related species that are similar in appearance to *S. centrale* but produce poisonous fruits. Similarly, it is important to note that the fruit of *S. centrale* in the green (immature) state contains the toxins solanine and solasidine (similar to the toxin in green potatoes). Green fruit should not be harvested for human consumption. Yellow and mature dried fruits have very low, acceptable levels of the toxin.

**Soil**

Lighter, well-drained soils are preferred. Mounding (0.3 to 0.5 m high) to assist drainage is very likely to be beneficial. In heavier soils, mounding will probably be essential. Deep ripping to 0.5 m is also likely to aid bush tomato production. There is a view that for large-scale (broad-acre) production in well-drained soil mounding is unnecessary.

**Water**

A water supply is required, either from natural rainfall or from irrigation. The plant does appear to have a reasonable tolerance of saline water supply.

**Topography**

Bush tomatoes have been cultivated with some success at several locations in Central Australia and in South Australia (for example, Reedy Creek Nurseries and associated growers in Indigenous communities, Simarloo Pty Ltd, farmers in the mid-north of South Australia and Tangentyere Council, Alice Springs). They have also been grown successfully on a small-plot trial basis in locations from Ceduna in western South Australia through to Junee on the western slopes of New South Wales.

**Varieties**

When grown from seed, bush tomato plants vary a great deal in morphology (leaf colour, the presence or absence of spines and so on). This indicates that there is a great potential for plant improvement, which has barely begun. Plants are usually supplied in seedling trays and, depending on the supplier, will consist of highly variable unimproved material or more uniform, improved (selected) planting material. Reedy Creek Nurseries has begun selecting bush tomatoes for increased fruit size and other desirable characteristics.

There are very specific requirements for good germination of bush tomato. This has been investigated scientifically and by various plant propagators in nurseries. Scarification of the seed, soaking and smoke treatment all promoted germination, but there were also differences in response between seed lots.

Plant material is available from:
- Australian Native Produce Industries (Paringa, South Australia; Tel. 08 8595 8129)
- Steve Ross, AZEC (Broken Hill, NSW Tel 08 8087 8023).
- Reedy Creek Nurseries (Kingston SE, South Australia) sells to Indigenous communities (Tel 08 8768 7220). Plants are available from August onwards.
- Tangentyere Council Nursery in Alice Springs supplies a variety of native food seedlings, including...
selected bush tomato (10 Brown St, Alice Springs, NT; Tel. 08 8952 6644).

**Agronomy**

**Site preparation**

It is recommended that the soil is ripped and mounded (0.5 m) where possible, to aid drainage, especially on heavier soils and in cooler environments in southern Australia. Where mechanical harvesting is used, the planting layout should be designed to suit the type of harvesting equipment. Some growers practise weed control by use of weedmatting.

**Equipment**

Equipment is required for ripping the soil along the planting line and for soil mounding.

**Good cultural practices**

Some growers advocate planting rows of other *Solanum* species every third or fourth row, to attract pollinating insects, since bush tomato is bee pollinated. Native bees appear to be the preferred pollinators.

Row spacings are commonly in the range 1 to 2 m, with 0.5–1 m between plants within the row. At Tangentyere, about 1/3 ha was planted with 10,000 seedlings— that is, a rate of 30,000/ha.

The bush tomato can be grown as a perennial, with the second and later year crops coming either from persistent above-ground growth, or from suckers that regrow in spring after the plant has died off in winter. The plant grows best as a perennial in warm, dry locations that have a low incidence of frost. In less favourable locations, the crop can regrow from suckers but will be harvested later because

suitable location, harvest should occur the next autumn. In places where the plant is a perennial, the yield can be expected to rise in the second and third years. Quality can decrease after that, so Reedy Creek Nursery and associated growers plant the crop on a three-year cycle. Expected yield figures vary from 25 to 100 g of fruit per plant in year 1. Depending on the conditions (and especially where the plant is perennial), this can increase to twice the initial figure in years 2 and 3 (50 to 200 g fruit per plant). However, note that there are examples where yields were similar in years 1 and 2 (around 0.7 t/ha) and then decreased dramatically in years 3 and 4. Where unimproved plant material is used, the variation in yield between plants is likely to be very high.

**Pest and disease control**

Establishment rates of bush tomato in cultivation can be very variable. They can be excellent, but complete failures have also occurred. The failures were possibly due to soil-borne pests and/or diseases, although no research has been done into the cause and control of these problems. Small trial plantings are therefore recommended for new areas.

Sooty mould on the foliage and fruit has caused problems when grown in moister (especially moist coastal) locations.

**Harvest and post-harvest**

Harvest is by hand or mechanical. The crop should be harvested when the fruit is either dried or at least yellow in colour and ideally when it reaches a rich
Ochre brown. Green fruit in the harvest should be avoided because these contain higher levels of solanine. In summer, individual plants very often carry all stages of fruit development from flowering through to ripe fruit. It is therefore more efficient to harvest late in the season when the fruit is more uniformly ripe. When handharvesting, protection from the spines of the plant is necessary (gloves). Mechanical harvesting has been achieved by adaptation and modification of grain crop headers.

Fruit that has not dried out to a very dry state or is still yellowish in colour will need to be further dried after harvesting. Fruit must be protected at all times from moth and insect infestation.

Financial information
Cultivation of bush tomatoes has only been practiced on a small scale to date. Tangentyere Council in Alice Springs, Northern Territory, pioneered the successful trial of cultivated bush tomatoes on three plots at Tangentyere Town Camps around Alice Springs between 2001 and 2003. Tangentyere Council has provided a table of typical set-up costs for a plot of 3,500 m² (Table 1). The plot comprised 35 rows of 60 m each, with a 1.5 m spacing between rows.

Table 1. Bush tomato horticultural production establishment costs, Alice Springs

<table>
<thead>
<tr>
<th>Cost centre</th>
<th>Cost ($)</th>
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<tbody>
<tr>
<td>Fencing</td>
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<tr>
<td>Weedmat</td>
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<tr>
<td>Trellises</td>
<td>770</td>
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<tr>
<td>Irrigation system</td>
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<tr>
<td>Hire equipment</td>
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</tr>
<tr>
<td>Consultants fees</td>
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</tr>
<tr>
<td>Freight</td>
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<tr>
<td>Fuel</td>
<td>500</td>
</tr>
<tr>
<td>Office supplies</td>
<td>100</td>
</tr>
<tr>
<td>Phone/fax/Email</td>
<td>250</td>
</tr>
<tr>
<td>Remote area fee</td>
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<tr>
<td>Travel allowances</td>
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</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>26,863</strong></td>
</tr>
</tbody>
</table>

Source: Peter Cowham, Tangentyere Council, 2001-2003

Acknowledgments
The authors acknowledge very helpful discussions with Noel Sims (Simarloo Pty Ltd), Peter Hoffmann (Eudunda, SA), Peter Cowham (Tangentyere Council, NT) and Mike Quarmby (Reedy Creek Nurseries). We also acknowledge very helpful discussions regarding the markets for bush tomato with Chris Mara (Chairperson, Coles Indigenous Food Fund, Coles Supermarkets) and Geoff Gordon, (Managing Director, Hela Schwarz Australia).

Key statistics
- The estimated harvest for value-adding in 2002 was 4–8 t.
- Most of the produce is wild harvested, although up to 2 t comes from cultivated sources.

Key messages
- The industry is currently market driven and bush tomato is in demand because of its flavour profile.
- Bush tomato can be grown as a perennial crop, yielding up to 0.7 t dried berry per hectare in good conditions.
- Cultivation systems are at an early stage of development and yield is highly variable.

References


BUSH TOMATO

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About the authors

Juleigh Robins is co-owner and Director of Robins Foods Pty Ltd, manufacturers and brand marketers of Outback Spirit products. Juleigh has worked extensively on the native food supply chain, strategically at the inbound supply end and the outbound market end. Indigenous Australian Foods Ltd (an Aboriginal-owned and -controlled supply company), is a unique and tangible outcome of this focus and has enabled Hela International, Kez’s Kitchen and Cooka’s Country Cookies to become valued Robins’ supply chain partners. Coles Supermarkets also supports Robins via the distribution of the Outback Spirit range in 600 supermarkets nationally and through partnering Robins Foods in Coles Indigenous Food Fund.

Maarten Ryder has a PhD in Agricultural Biochemistry and Plant Pathology from the Adelaide University. He has worked in soil biology research at CSIRO since 1986. More recently (1999) he began working on the cultivation of native food plants and joined the Desert Knowledge Cooperative Research Centre in 2003, where he is working on “bush produce”.

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Bush tomato
Lemon myrtle

Sibylla Hess-Buschmann

Introduction

Lemon myrtle (*Backhousia citriodora*) is a medium-sized native tree (3–20 m), discovered by Baron Ferdinand von Müller in 1853.

It originates from coastal rainforest areas 50–800 m above sea level in Queensland, between the latitudes 17°30′s and 27°S.

Joseph H. Maiden reported on the potential use of lemon myrtle for commercial production in 1889 and a German company, Schimmel & Co., was the first to identify the ingredient, citral. This ingredient, comprising up to 90% of lemon myrtle essential oil, gives it a distinctive lemon fragrance and taste; other lemon-flavoured oils have less citral, such as citrus (3–10%), lemon grass (75%) and tropical verbena (74%).

Although lemon myrtle essential oil has been used from early last century for lemon flavouring, it could not compete with the much cheaper essential oils distilled from lemon grass and tropical verbena.

In the early 1990s, lemon myrtle was rediscovered as a promising culinary herb in the emerging Australian cuisine, fusing native flavours into a variety of dishes. This led growers to view the crop as a potential new enterprise for the Northern Rivers region of New South Wales.

By 1996–97 farmers in New South Wales had planted over 150,000 trees, hoping to satisfy a market demand anticipated during the Sydney 2000 Olympics.

More than 1 million trees have also been planted in Queensland.
Lemon myrtle trees are particularly frost and drought tender and require irrigation during dry spells. The tree prefers neutral instead of acid soil and is prone to yellowing in alkaline soils. Once established, the trees are relatively hardy and recover quickly from dry spells.

Although trees have been grown in Victoria and South Australia, most of the crop is located in northern New South Wales and south-east Queensland, in areas recording more than 800 mm rainfall. A well-managed mature orchard in northern New South Wales with rich soil and ample water can achieve a yield of 5.5 t/ha dry leaf per year.

Flat, free-draining ground is essential for mechanical harvesting. River flats are not suited, as the trees succumb to waterlogging. The tree is prone to snap off in wind-prone areas.

**Varieties**

There are two main commercial clones being planted. The line commonly referred to as Limpinwood is hard to strike but shows superior ornamental presentation, high biomass and high oil and citral content. Although the Therapeutic Goods Administration of Australia has listed lemon myrtle essential oil as an active ingredient for external application, no health benefit claims can be made without the appropriate TGA approval.

Australian production statistics are unavailable due to the reluctance of key producers to share information.

Prices for lemon myrtle (as fresh leaf on stem) at the farm-gate have recently fallen sharply, from $10 to $2/kg, perhaps as a result of the advent of mechanised harvesting.

**Markets and marketing**

Since 1997 the lemon myrtle industry has been production driven, with growers not realising their anticipated returns.

Lemon myrtle essential oil is not commercially produced anywhere in the world and the product is largely unknown in the global marketplace.

Lack of research into growing, processing, storage and product use has severely challenged the industry, which faces a glut of raw material and no market. In the past 10 years many more uses of lemon myrtle have been discovered, though it is still only a niche market product, currently oversupplied.

Lemon myrtle product is mainly traded as a specialist culinary ingredient to be added to food for its unique flavour. Some food manufacturers use small amounts of either dried milled leaves or essential oil to flavour pasta, oils, sauces, ice creams or tea. Without mainstream food processors adopting the product, critical mass for the industry will not be achieved.

Lemon myrtle essential oil in vitro has been shown to be superior in antimicrobial and anti-fungal action to the now popular tea tree essential oil.

It can have a future as an antiseptic, surface disinfectant or perhaps for inclusion in foods as a natural antimicrobial agent. Although the Therapeutic Goods Administration of Australia has listed lemon myrtle essential oil as an active ingredient for external application, no health benefit claims can be made without the appropriate TGA approval.

**Production requirements**

Lemon myrtle prefers nutrient-rich soils of medium to heavy texture in a well-drained, wind-protected sunny position. Young trees are particularly frost and drought tender and require irrigation during dry spells.

The tree prefers neutral instead of acid soil and is prone to yellowing in alkaline soils. Once established, the trees are relatively hardy and recover quickly from dry spells.

Lemon myrtle orchard—year 4 (Photo: Stephen Carle)
Lemon myrtle is very competitive and currently oversupplied.

Lemon myrtle is a perennial tree crop typically planted in rows. Site planning requires that there is easy mechanical access year round. The land preparation required for lemon myrtle is deep ripping, followed by rotary hoeing. It is essential to clear the rows of weeds before planting. Lemon myrtle is most commonly planted in late spring or early autumn. Young trees are transplanted at 30–40 cm tall, placed 1.5 m apart with a 3.5–4.0 m spacing between the rows. Ample moisture, mulching and weed control are essential for successful crop establishment.

The nutritional requirements for lemon myrtle are not well understood, but the trees grow best in rich, fertile soils and need increasing amounts of organic fertilisers as they are maturing. The trees can be cut up to three times each year and, as each harvest removes a large amount of biomass, it is essential to return nutrients for long-term productivity.

In New South Wales trees are tip-pruned for the first 18 months to encourage leaf production. After 24 months, the trees start to form hedges, that can be mechanically harvested.

Specialised harvesting and post-harvest machinery is not available off the shelf and the prospective grower needs to consider investing substantial resources in mechanising harvesting.

Good cultural practices and good manufacturing practices are paramount as the product is a food ingredient. Traceability, HACCP and product specification, including microbial or residual counts, are now becoming an essential part of virtually any food business. Farmers need to be very diligent about the integrity of their products if they want to sell them.

**Pest and disease control**

Lemon myrtle has not so far been significantly challenged by pests or diseases in northern New South Wales. There is no chemical pesticide approved for the crop.

**Harvest and post-harvest**

Growers of lemon myrtle need to consider economy of scale or critical mass to be cost-effective, to be able to assure consistently high-quality supply in quantity. This can only be achieved by mechanised production and processing. The capital-intensive nature of the production and processing chain, coupled with the high cost of establishing markets, poses risks for the grower.

Lemon myrtle mechanical harvest for dried leaf product is done by specially designed and custom-built harvesting machinery cutting the tips of the tree in an angled position. The cut material falls onto a conveyor belt transporting it into a stainless steel bin. Some people in the industry still hand cut and hand strip the leaf from the stem, but this will not be a viable situation for the future.

The leaf-on-stem material is dried as is and is de-stemmed after drying or is mechanically stripped wet, to then be dried in herb drying rooms or custom-designed driers.
Due to the high volatility of the citral component, it is imperative to dry lemon myrtle at low temperatures (less than 35°C) as quickly as possible. Ideally, the product is placed into the drier within one hour of harvesting to prevent the product heating up, deteriorating and becoming contaminated with a significant microbial load.

After drying, the leaves are ground to customer or product specifications and stored in a cool, dark environment until dispatch.

For essential oil, specialised machines cut the stems and leaves into smaller particle sizes. This cut material is then fed into a stainless steel bin and placed in a steam distillation unit. The essential oil is very corrosive to plastics, and stainless steel or glass containers are commonly used for cool-room storage until dispatch.

**Financial information**

The estimated start-up cost per hectare, not including land, machinery, clearing, labour or structures, is about $14,000–$16,000 including operating costs for one year. Plants can be obtained from specialised nurseries for $150–$450 per hundred, depending on size. Weed control, mulching, irrigation and fertilising are the main costs in the two-year establishment phase. While the need for weed control diminishes as the plants mature, harvested trees require application of more fertiliser with age.

Capital outlay for lemon myrtle cultivation needs to include tractors, trailers and mowers. However, the capital outlay for specialised equipment such as custom-built harvesters, stainless steel bins, conveyors, specially designed units to remove leaves from stems, drying units and distillation equipment (such as boilers, condensers and separators) are very high. Furthermore, suitable structures for processing need to meet the requirement to comply with HACCP.

The size of accessible markets is limited and the marketing cost for a new crop not previously grown commercially anywhere in the world is very expensive. Economic analyses for lemon myrtle, as for all new crops, need to be treated with extreme caution. The lemon myrtle industry in Australia is still in the early stage of development and reliable statistical information is unavailable.

Lemon myrtle is one of the most cultivated species of the native food industry, excluding macadamias. It shows wonderful potential as a specialist food ingredient, functional food and cosmetic ingredient. However, its financial viability will depend on mainstream food industries using the product.

**Key references**


Sibylla Hess-Buschmann is Managing Director of Australian Rainforest Products Pty Ltd, a company specialising in growing, processing and marketing Australian native specialised ingredients to food, cosmetic and pharmaceutical industries.
Key messages

- Lemon myrtle is a versatile native herb.
- It has multiple uses in different categories.
- Promising bio-actives are present.
- The market is currently oversupplied.

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Native citrus

Hugh Macintosh

Introduction

Most Australians would be surprised to learn that there are seven native plant species that are a true citrus. Despite this abundance, the cultivation and use of native citrus was largely ignored until the 1960s when CSIRO began investigating the use of some species in its citrus breeding programs.

The application of these native species was primarily in developing new rootstocks suited to Australian conditions to support the growth of traditional citrus species (Sykes 2000). The native species’ unique characteristics, especially relating to salt and drought tolerance and disease resistance, were of particular interest.

Wild limes have often been cited as one of the native foods with the most potential for commercial development. However, it is only in the last 10 years that researchers have been developing new crop plants based on the native species. Commercial producers such as Australian Native Produce Industries (ANPI) have seen the potential in these new varieties and secured the right to commercialise them.

At the same time other commercial producers have been developing plantations based on selections taken from better performing wild plants. In some instances these selections are being grafted onto specially selected citrus rootstock.

High-quality native limes are now being harvested from orchards, reducing the need to collect limes from the wild, improving the reliability of supply and minimising any detrimental impact on wild populations.

While production issues continue to demand research attention, it is the market that ultimately determines the success or otherwise of a product. Producers, processors and marketers need to continually ask themselves whether the product satisfies a demand in a particular target market.

As with many young industries, the native lime sector suffers from
a general lack of understanding of existing and potential markets and the forces that drive these markets. This can lead to participants not focusing their energies and scarce resources on the potentially most rewarding sectors of the market.

**Markets and marketing**

Reliable market demand information and statistics are difficult to obtain as the wild lime industry remains fragmented, with a significant amount of semi- or sub-commercial activity—for example, small-scale operations that collect fruit and sell it to local restaurants. Further, the industry is too small to be considered in the normal horticultural production statistics.

The domestic market for native citrus-based products is relatively small at present, but there seems to be significant export market potential for both processed and part-processed product. Until recently, most of the native citrus supplies have come from wild harvest, which has constrained industry expansion as annual yields are highly variable. The emergence of significant plantation-grown quantities of limes means that the industry is beginning to establish a base from which to develop a reasonable market presence.

Market development will require a significant capital base from which to develop a range of products and to establish an efficient marketing and distribution chain. The industry structure includes:

- wild harvesters
- commercial growers
- wholesalers
- processors
- marketers
- retailers
- nursery operators
- food-service operators.

Native citrus, and indeed native foods, usually comprise only a small part of the business of many of these operations.

Depending on the variety, native citrus are usually sold as either fresh or frozen whole fruit. A number of specialist processors are currently marketing processed native citrus products. The major companies include:

- ANPI/Red Ochre
- Australian Desert Limes Pty Ltd
- Australian Harvest Fine Foods Pty Ltd
- Byron Bay Native Produce Pty Ltd
- Cherikoff Food-services Pty Ltd
- Kurrajong Australian Native Foods Pty Ltd
- Rainforest Foods Pty Ltd
- Rainforest Liqueurs Pty Ltd
- Robins Australian Foods Pty Ltd
- Taylors Food Pty Ltd
- Tuckombil Native Foods Pty Ltd.

Most of these companies operate at more than one level in the supply chain. The major processor, ANPI, is a grower, wholesaler, processor, retailer and marketer of a range of products. ANPI sources most, if not all, of its limes from plantations, predominantly from plantations it owns or controls.

Taylors Food is a “mainstream” food processor that also produces a range of native food products under the “Wild Taste” brand.

There is still some product being sold directly from growers/harvesters in unprocessed form to restaurants.

The industry is constrained by a lack of critical mass, largely due to a lack of commercial quantities of raw material, and the lack of any real supply chains.

In common with the native food industry generally, the main marketing issues affecting native citrus are:

- the large number of brands relative to the size of the industry.
• an unclear market position relative to the mainstream food categories
• the relatively small volume of assured supply from plantations
• a general lack of market awareness about how to use the raw product.

Despite the industry’s infancy, there are some significant success stories in achieving export sales of processed products. ANPI and Robins have been successful in penetrating foreign supermarkets and department stores, particularly in the United Kingdom. Export sales have also been established in the United States, Germany and Canada.

Similarly, some of the more established native foods processors have been able to penetrate the domestic supermarket trade with their products. These include Robins and ANPI.

The continued establishment of plantation-based production systems is essential to the development of the native citrus industry. As demand increases a reliable supply of high-quality produce will be required. In the past, manufacturers have needed to cease production or reduce promotion of some products due to the unavailability of raw produce. The failure of the desert lime wild harvest in 1998 forced food processors to shift to alternative raw materials or to abandon desert lime-based products altogether (Cherikoff personal comm., 1999).

Industry sources suggest that production of native limes is around 25 t/yr, with at least 50% of this being from plantations. This excludes the harvest of hybrid varieties such as those used by ANPI.

Prices can be highly variable due to fluctuations in supply. Indicative price ranges are as follows:

<table>
<thead>
<tr>
<th>Variety</th>
<th>Product</th>
<th>Wholesale price ($/kg)</th>
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</thead>
<tbody>
<tr>
<td>Desert lime</td>
<td>Frozen whole</td>
<td>5–15</td>
</tr>
<tr>
<td>Finger lime</td>
<td>Whole</td>
<td>25–80</td>
</tr>
</tbody>
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The continued development of commercial plantations will see these prices fall to more reasonable levels, and will assist the market development.

Native limes are an extremely versatile fruit. They can be used in any product or process where “normal” limes are used, the main difference being their size and intense flavour. The typical uses of citrus are shown below.

### Production requirements

The five rainforest species of native citrus are all endemic to rainforest habitats on the east coast. Their distribution originally extended from Cape York Peninsula to the Clarence River on the north coast of New South Wales. Due to the impact of land clearing and urban encroachment, each species now has a limited distribution, with two of the species endemic to Queensland currently listed as rare in the wild.

The desert lime is endemic to semi-arid regions of south-west Queensland, western New South Wales and South Australia.

Like all citrus, native limes prefer a well-drained soil. They will tolerate poor soils, dry conditions (particularly the desert lime) and cold. Plantation-grown trees have been shown to respond well to both irrigation and fertiliser.

Research into plantation production is still relatively limited, and commercial growers closely guard many of the techniques they have learned by trial and error. The CSIRO Division of Land and Water has established trial plantations at a number of sites around Australia to research optimal production strategies.

Prices can be highly variable due to fluctuations in supply. Indicative price ranges are as follows:

<table>
<thead>
<tr>
<th>Variety</th>
<th>Product</th>
<th>Wholesale price ($/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desert lime</td>
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Research into plantation production is still relatively limited, and commercial growers closely guard many of the techniques they have learned by trial and error. The CSIRO Division of Land and Water has established trial plantations at a number of sites around Australia to research optimal production strategies.
In the absence of specific detailed research, intending growers should treat native citrus as they would a traditional citrus orchard.

**Varieties and cultivars**

Birmingham (1998) reports that there is a lack of standardisation of common names within the native citrus industries, with the seven different varieties and their hybrids listed as ‘native citrus’ or ‘wild limes’. Botanical names are the only positive method for identifying the true native species.

The finger lime and desert lime, in particular, hybridise easily with traditional commercial citrus varieties. Cultivated hybrids are generally referred to by their cultivated variety name or origin; for example, the Australian Blood lime is a hybrid between *Citrus* and *Microcitrus*.

There are two distinct genera of true native citrus in Australia. These were initially identified as *Microcitrus* (the five rainforest varieties) and *Eremocitrus* (desert lime). More recently there has been a move to re-name all seven varieties as *Citrus* species, bringing them into line with mainstream citrus varieties.

**Finger lime**

The finger lime (*C. australasica*) is found wild as an understorey shrub in the rainforests of southern Queensland and northern New South Wales. Its grows naturally in heavy shade in high-rainfall areas, but also appears at the edge of cleared forest where there is more sunlight. In their natural environment trees can reach 6 m in height.

The fruit is cylindrical, up to 10 cm long, and can be green, yellow, red, purple or black when ripe. The pulp is usually greenish-yellow although there is a variety—Sanguinea—that is red fleshed. Unlike other citrus the finger lime’s flesh consists of tiny, slightly sticky globules. Flowering generally occurs from February to May, with fruiting from May to September. Production is usually biennial.

Finger limes can be used as a fresh fruit for garnish and for processing into a wide range of value-added products. There are a number of commercial plantations in northern New South Wales, producing small quantities of fruit. Wholesale prices can range from $25 to $80/kg, although $8 to $12 is probably a more realistic price.

**Round lime**

Round lime (*C. australis*), also called the Gympie lime, is the most vigorous of the Australian native citrus, growing to a height of 18 m. It is endemic to south-eastern Queensland, in lowland sub-tropical rainforest.

The fruits are about 2–5 cm in diameter and have a thick, green-to-yellow skin and pale green pulp. This species flowers from August to November.

The round lime is suitable for processing into a range of value-added products. The skin is very thick (up to 7 mm) and has potential for culinary use, such as
grating into spice pastes, or for candied peel. The species can also have potential for essential oil extraction. Recent farm-gate prices range from $8 to $9/kg.

**Russell River lime**

Russell River lime (*C. inodora*) is a fairly rare species from near-coastal areas in Far North Queensland. Plants require shady conditions, plenty of water and organically rich, loamy soil although they will grow in poorer soils. This variety is very slow growing and only reaches a height of 2–4 metres.

Of all the native citrus, *C. inodora* looks the most similar to a traditional citrus. It is unusual in that there is a distinct lack of fragrance in the flowers. The fruit are green on maturity, oval (somewhat lemon-shaped) and up to 6.5 x 3.2 cm in size. This species is also classified as rare and is protected. The fruit is not commercially traded.

**Maiden’s Australian wild lime**

Commonly known as Maiden’s Australian lime, *C. maideniana* was originally described as a variety or subspecies of *C. inodora*. The two species have a similar distribution, limited to a small area in Far North Queensland. Fruit is not commercially traded.

**Mt White lime**

Mr White lime (*C. garrawayae*) is endemic to the foothills and upland rainforest of the Cook District on Cape York Peninsula. It grows in deciduous vine thickets as an understorey shrub and has been recorded at a height of 15 m. Due to its limited distribution, this species is now classified as rare and is protected.

*C. garrawayae* is similar to *C. australasica*, but has broader leaves. Fruit forms from April to November. The fruits are also “finger-shaped”, with a green skin and greenish-white pulp on maturity. The fruit can be used for processing into a range of value-added products, as for the round lime.

**Desert lime**

Also known as the wild lime or native cumquat, *C. glauca* comes from the semi-arid regions of eastern Australia, from Longreach in western Queensland, south to Dubbo in central New South Wales and west to Quorn in the Flinders Ranges of South Australia.

The desert lime has blue-grey leaves and prickles along the branches although above a height of about 2 m there are no more prickles on the branches. Plants are usually found growing on clay or heavy clay soils, often in clumps. They are occasionally found as single large trees to 5–6 metres in height.

The desert lime is extremely drought tolerant and able to withstand extremes of heat (45°C) and cold (−2 to −4°C).

The flower to fruiting time is the shortest of any citrus species, being 10–12 weeks. The species flowers mainly in spring and fruits ripen in summer.

Fruit can be picked when still green and has a pleasantly refreshing and tangy taste. Desert lime fruit is extremely popular and becoming well known within the native food industry. The fruit has a very thin rind, is often seedless and can be used whole in cooking. Fruit must be frozen within 24 hours of harvest.

Wholesale prices can range from $5–$15/kg.

**Citrus gracilis**

*C. gracilis* has recently been described and grows wild as a straggling tree in eucalypt woodland in the Northern Territory. It has a similar growth habit to the desert lime and produces round fruit up to 8 cm in diameter. Fruit has not been traded commercially. It is also known as the Humpty Doo or Kakadu lime.

**Other types**

There is one known native citrus hybrid, the Sydney hybrid (*C. australis* x *C. australasica*), which was developed by the US Department of Agriculture. This species is not known to be grown commercially.

In addition, there are four known cultivars of native citrus currently available.

Rainforest Pearl (©) is a selection of *C. australasica var. sanguinea* made by Erika Birmingham from Byron Bay Native Produce in northern New South Wales. The Outback Lime (©) is a selection of *C. glauca*
made by Dr Steve Sykes of CSIRO. Two cultivars of partly native citrus parentage have also been developed by Dr Sykes, the Blood Lime (a) and the Sunrise Lime (b).

ANPI has secured the rights to commercialise the three cultivars developed by Dr Sykes.

Plant stock is available from a number of nurseries around Australia (see the list at the end of this chapter). Rainforest Pearl is available from Byron Bay Native Produce, while the three CSIRO-bred cultivars are available from ANPI.

**Agronomy**

Commercial cultivation of bush foods is a very young industry and the cultivation techniques being used are, to a certain extent, experimental.

Plantations range from those mimicking the standard commercial orchard design to permaculture food forests. These forests have a mixture of species planted in a design that imitates the structure of a natural forest ecosystem. At the other end of the spectrum some growers are planting out using rows in the traditional orchard set-up, although until recently very few were planting monocultures.

Generally, orchards have up to 10 species, either planted in different rows or grouped in a certain part of the orchard to create a mosaic of species. The rows are often interplanted with a shelter belt of native species that also provides a refuge for insects.

The food forest structure is often used by growers who are using bush tucker species for revegetation programs. However, this type of orchard poses particular management problems.

Plants can be grown from seed (but the resulting plants can not be true to type); by cuttings, which are slow; or by budding onto citrus rootstock. Grafting buds (budding) on to citrus rootstock is the preferred method for most commercial plantation growers.

Budding allows growers to avoid the long juvenile period, and trees can bear fruit in their second or third year.

Selection of the best rootstock will need to be based on soil type and climatic conditions.

Many growers tend to use natural fertilisers and, if herbicides are used, generally this is restricted to glyphosate. Weed and grass control around the base of trees or shrubs is important, particularly during the early years of establishment.

Before selecting a species to grow, it is worth examining its natural range and determining whether your area has similar climatic conditions.

While there are a number of research projects under way to determine the optimum production systems for native citrus in a range of conditions, in the first instance new growers should treat their native citrus as

Three-year-old grafted *C. glauca* in south-west Queensland (Photo: Australian Desert Limes,
Native citrus

any other commercial citrus crop. In these early days of commercial production, irrigation, fertilising and management processes (pruning, and so on) need to be refined and improved based on personal experience.

### Pest and disease control

Many of the pests and diseases that afflict traditional commercial citrus orchards can not affect native citrus. There are, however, pests and diseases that will afflict native citrus orchards, particularly those that are planted as a monoculture.

One notable disease, “sunrise lime dieback”, emerged in some orchards during 2000. The disease is similar to die-backs that occasionally occur in other citrus varieties, although it appears that at present the disease is confined to the sunrise lime cultivar. The disease has been shown to be caused by a *Phoma* sp. fungus.

Control is best achieved through good management practices that minimise the incidence of twig death, physical injury or plant stress (for example, water stress, fertiliser burn and wind abrasion). Dead wood that can have been killed by the fungus or could be harbouring the causal organism should be removed and burnt. All pruning cuts should be painted.

Copper sprays, which are often applied to control fungal diseases in citrus, are also likely to be successful in native citrus.

As far as is known, no significant pests or diseases have been reported in plantations of the true native varieties.

### Harvest and post-harvest

Native citrus is harvested by hand, although some of the CSIRO-bred varieties reportedly may lend themselves to mechanical harvesting. Mechanical harvesting will significantly reduce the labour cost involved in harvesting and can be suitable for processing fruit, but it is unlikely to be useful for fruit destined for the retail or food-service market where appearance is important.

As with any fruit, it is important to minimise handling so as reduce labour costs and minimise the damage done to the product.

Harvesting should take place during the cooler parts of the day so as to reduce the effects of heat on fruit quality. In any event, fruit should be refrigerated as soon as possible after harvest and/or frozen within 12–24 hours of harvest (*C. glauca*).

Whether fruit is being supplied to food-service outlets or being used in manufacturing, it will need to be graded and cleaned of dirt, sticks and other foreign matter. In small orchards this task is done by hand, but this method becomes impractical as volumes increase.

There is no commercial grading equipment available, but some of the more innovative growers have developed their own unique grading and cleaning machines.

Fruit is generally packed into 500 g or 1 kg food-grade bags or punnets. Occasionally, larger packages can be used for supply to manufacturers. Different manufacturers can have particular packaging requirements, depending on the end use of the product.

The majority of the native citrus crop is used for processing into a range of value-added products, with a small amount being sold direct to restaurants.

### Financial information

The economics of production will depend on the production system being used.

However, the following indicative costs are provided as a guide. These costs assume the following:

- Plantings are in a monoculture orchard.
- Spacings follow “normal” horticultural practice giving a stocking rate of 625 trees/ha.
Grafted plantstock is used.

- The cost of land, water storage, packing shed and plant and equipment is excluded.
- Owner-operator labour is used.

Based on these assumptions, the indicative establishment cost for a 1 ha desert lime orchard will be in the order of:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost ($/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site preparation</td>
<td>500</td>
</tr>
<tr>
<td>Plant stock @ $15 per tree</td>
<td>9,375</td>
</tr>
<tr>
<td>Planting</td>
<td>2,000</td>
</tr>
<tr>
<td>Fencing</td>
<td>500</td>
</tr>
<tr>
<td>Irrigation</td>
<td>5,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17,375</strong></td>
</tr>
</tbody>
</table>

Ongoing operating costs will include chemicals, fertiliser, irrigation, harvesting, row maintenance and marketing. Again, on the 1 ha example orchard just outlined, the indicative operating costs (excluding labour, except in harvesting) will be in the order of:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost ($/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herbicide</td>
<td>50</td>
</tr>
<tr>
<td>Fertiliser</td>
<td>550</td>
</tr>
<tr>
<td>Irrigation (excludes water cost)</td>
<td>200</td>
</tr>
<tr>
<td>Orchard maintenance</td>
<td>2000</td>
</tr>
<tr>
<td>Harvest, grading and packing</td>
<td>3500</td>
</tr>
<tr>
<td>Marketing</td>
<td>3700</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10,000</strong></td>
</tr>
</tbody>
</table>

Assuming an average yield from mature trees of 15 kg per tree and a delivered price of $5/kg, the gross margin on this crop will be about $36,000.

As with most businesses, production is the easy part; marketing is the hard part. The big question is whether the 9.4 t of limes produced from the theoretical orchard can be marketed at an average price of $5/kg. The marketing effort needs to be well planned and should start well before the first fruit is picked.

While native citrus-based products are a novelty product in relatively short supply, they can be expected to attract a premium price. However, in the medium to longer term this premium will be eroded as supply increases and/or competing products emerge. The novelty value will disappear and native citrus-based products will have to compete on more or less equal terms with other more conventional product lines.

**Key references**


Sykes, S. (1997) Australian native limes (*Eremocitrus* and *Microcitrus*)—a citrus breeder’s viewpoint; *Australian Bushfoods Magazine* No. 3; Maleny.

**Acknowledgments**

Special thanks are due to Mr Jock Douglas of Australian Desert Limes, Roma and Mr Mike Saalfeld of the United Kingdom (www.saalfelds.freeserve.co.uk/HobbyCitrusGrowers.htm) for providing the photographs used in this chapter.

**Key statistics**

- Australia has seven varieties of true native citrus.
- Production of native limes is around 25 t/yr, with at least 50% of this being from plantation production.
About the author

Hugh Macintosh is Managing Director of IQ Agribusiness, a management advisory firm based in Brisbane. He is a founding partner and Director of Industry Data On-line Pty Ltd, a business providing online business benchmarking services to small to medium-sized enterprises and industry groups (www.industrydataonline.com).

Hugh holds qualifications in agricultural economics and business administration.

Key messages

• Plant breeders have developed a number of new hybrids based on the native varieties.
• A number of companies have developed export markets for native citrus-based products.
• An increase in the area of commercial plantations is reducing the reliance on wild harvest.
• CSIRO has established trial plantations at a number of sites around Australia to research optimal production strategies.
• Native citrus is usually harvested by hand.
• The majority of the native citrus crop is used for processing into a range of value-added products, with a small amount being sold direct to restaurants.
• Price premiums will be eroded as more plantation-grown fruit becomes available.

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Introduction

Native, or mountain, pepper products are obtained from the species *Tasmannia lanceolata*, found naturally in the wet forests and shrublands of south-east Australia, and extending, at higher altitudes, as far as the Hastings River catchment in mid-north New South Wales.

The commercial appeal of the species derives largely from the presence in both leaf and fruit of a hot-tasting terpene compound, polygodial, for which a wide range of biological activity has been demonstrated, including antibacterial, anti-fungal and insect anti-feedant properties. It is the hot taste to humans that has resulted in the “native pepper” description, thus the potential of both leaf and berries as culinary ingredients.

Most production currently derives from wild-harvested stands, mostly on previously disturbed sites where it flourishes as an early coloniser after removal of wet forest or rainforest canopies. Several substantial stands on previously cleared land in Victoria and Tasmania supply most of the traded product.

Figures on gross consumption within Australia are difficult to determine since both production
operations and the present market are small and dispersed. However, it would appear likely that total domestic consumption would be no more than 3 t of dry leaf, 1 t of dry berries and a small amount of fresh or frozen fruit, certainly less than 1 t.

**Markets and marketing**

Both leaf and berry are traded in the culinary market principally as dried products and leaf is sold mostly in milled or ground form. There is a small market for fresh or frozen berries and fresh leaf, the latter mainly as a garnish.

Food-service manufacturers use milled leaf in a range of prepared foods including relishes, sauces, mustards, cheese, meat seasonings and flour mixes.

Most pepper berries are used as an alternative to "normal" pepper, whole, as a condiment (in grinders) or milled and blended with other spices to produce novel spice mixes and specialty blends.

There is a substantial trade in retail gourmet and gift lines and packaged products for the tourist industry.

A proportion of the leaf produced is solvent-extracted for the food flavouring market, and some is sold as a raw material in the preparation of health products and nutraceuticals.

All of these markets are small and there is considerable "churn" among the smaller users.

There have been major changes to quality and safety requirements in recent years, and most larger buyers of native pepper products now require some supporting analytical and microbiological data, guarantees of safe and consistent product and avoidance of pesticides in the production systems.

While these changes have increased the costs of production and marketing in recent years, they have also helped rid the trade of some unscrupulous operators and led to major increases in efficiency among the more serious producers.

Prices obtained for pepper products vary widely, reflecting the range of producer types—from hobbyists with few overheads and no investment in production systems to a small number of more serious producers. Prices at the farm gate can range between $6 and $20/kg for fresh berries, from $30–$70/kg for dry berries, the low $30s to over $60/kg for milled leaf, dependent on quantity, quality and the specific requirements of the customer.

From 1994 to the present the average price for 25 kg of milled...
Native pepper leaf has fallen from $48/kg to around $38/kg—in real terms a very large reduction, reflecting increased competition for a slowly growing market and improved efficiency of production.

A major issue for production and marketing is the unreliability of wild fruit production between seasons. Between 1994 and 2003 almost no fruit survived to harvest in two seasons, while bumper crops occurred twice. The reasons for this are not clear, but from an ecological perspective the pattern is not unusual, with large crops of fruit or seed often occurring only infrequently, interspersed with small or negligible fruit set in other years. Environmental factors such as late frosts, temperature extremes and drought stress will obviously be important.

**Production requirements**

The species is typically found in higher rainfall regions of south-east Australia and grows best in cool, sheltered environments free from water stress, on neutral to slightly acid soil, preferably well-drained and fertile.

Of particular importance is protection from warm winds, which can kill plants even if water is being supplied at the time: the plant’s transport system and transpiration regulation appear unable to cope with extreme demand on hot days.

The species is quite frost hardy in the natural situation, although unseasonal late frost has been observed to burn newly emerging shoots in November–December, although the effect is slight and temporary.

**Varieties**

In the natural population, the species displays considerable diversity of form, vigour and chemotype, offering plenty of scope for selection of favourable types. Several producers have identified individuals with characteristics suited to their production location or practices, and it is likely that this will continue in the future.

Producers in Victoria, for example, have chosen a “Toora form”, and several Tasmanian growers have chosen forms either from nearby local stands or on the basis of analysis of leaf extract composition for yield of polygodial or the presence of undesirable constituents.

Plants are available from most native plant specialist nurseries in south-east Australia, since there is a small market for the plant as an ornamental shrub. Propagation for commercial production can be easily arranged with any competent propagator.
Agronomy

Most plantations have been established using rooted cuttings, for speed and convenience and to enable introduction of uniform material from selected plants. Seed germination is extremely slow (more than 12 months in some reports), and seedlings are very small, slow to establish and extremely variable in habit.

Sites should be well prepared, preferably on soils in the neutral to slightly acid range, having good drainage, protection from hot winds and adequate provision for irrigation. In most situations, some protection from browsing animals or rabbits which will dig up newly planted material, is advisable.

In some existing mixed plantations, T. lanceolata is grown as a semi-understorey plant, providing good protection from exposure. This practice reflects the common natural occurrence of the plant as an understorey plant in rainforests.

Weed control during establishment is essential, and mulch mats, hand weeding or careful use of glyphosate products are all effective methods.

Native pepper responds well to the application of side dressings or foliar application of nitrogenous fertiliser, but little is known of the long-term requirement for fertiliser in the situation where substantial quantities of leaf and berry are harvested annually.

Irrigation is required where natural summer rainfall cannot be relied on and, as mentioned, warm windy weather can cause serious damage to the plant, destroying all the new foliage and shoots or in extreme cases killing the plant. Symptoms of water stress are not easy to detect until too late: wilting can indicate a complete collapse of the transport system, and shoots can not recover at all, so it is important to monitor soil moisture and to anticipate hot weather with extra watering, shade or shelter.

In ideal situations, vigorous selections will yield fruit and limited quantities of leaf within two to three years.

Pest and disease control

While the hot compound present in the leaves of the plant has been shown to have anti-fungal and insect anti-feeding properties, in the natural situation a variety of insects appear to browse on the species.

Leaf miners and leaf rollers consume the leaf, while a tiny grub can be found in the fruit and seed. None of these have been observed in damaging numbers, however, and the plant is typically quite free from severe infestations of any kind in the wild.

No work has been conducted on the ecology of these insects from the point of view of management of commercial pepper production.

Harvest and post-harvest

At present all harvesting of fruit is by hand, while simple mechanical aids are usually used for removing leaves and other foreign matter from berries. Establishment of plantations will enable use of simple mechanical harvest aids, as the fruit is quite robust when ripe, and can be shaken from the bush.

Leaf material is currently either plucked from the plant or gathered using simple trimming equipment, after which leaves are dried then separated from the twigs and other woody material. Most producers employ home-made equipment for this purpose but, again, the development of plantation production will enable mechanisation of this process. Most leaf is traded as milled product.

Warm-air drying is typically used to achieve better than 93% dry matter and, as with any herb, must be achieved with good air circulation to prevent ‘stewing’ of the leaf. In more humid environments it can be necessary to use dehumidification equipment but this has not been the case in Tasmania and Victoria, where most leaf and berry is produced at present. The importance of adequate drying must be emphasised: high residual moisture will allow the development of spoilage bacteria and fungi and can compromise the quality of the product.

When properly dry, a handful of berries should not yield to a firm squeeze.

Product must be stored in a cool, clean, dry, dark and insect-proof environment to maintain the quality, particularly of the leaf, which discours quickly in sunlight.

Financial information

Intending growers should assess the key issues below and attempt to balance production and marketing issues in their approach to the enterprise.

Key issues for any new producer should be:

- to establish a sound marketing strategy
- to address the post-harvest and food safety technology issues for their enterprise
to devise a plantation system suited to their site and location.

The current market is quite small and marketing could include product development, networking with existing producers or approaching end users for potential partnership arrangements.

At present most producers are employing very simple, low-cost harvest and processing equipment in their operations, and any new producer would be well advised to delay major investment in this area until a firm market has been established. A cooperative approach to harvest and drying equipment is to be recommended, especially if the equipment can be used for other herb crops during the year.

The cost of establishing and maintaining a plantation will depend on the approach and resources of the intending producer. A stand-alone plantation on purpose-bought land might cost $50,000/ha to bring into production (four years), while a low-key pepper enterprise as part of a broader horticultural operation will be much less capital intensive. The decision on the area for production should be made in the context of the identified market and the estimated amount of product demanded.

Indications are that a single tree at 5 years old should produce (sustainably) at least 3 kg of fresh pepper leaf (about 750 g of dry leaf) or 1.5 kg of fresh berries per year, depending on the season. The mature yield will depend greatly on the extent to which the tree is allowed to develop a canopy before harvest of leaf material commences—that is time to first harvest and annual yield.

Key references


Key messages
- The market currently restrains growth.
- Pepper prefers a sheltered, moist site.
- Production and marketing networks do work.

Key statistics
- Leaf production (dry) is less than 3 t/ year.
  - Berry production:
    - fresh less than 1 t/ year
    - dried 1 t/ year.

About the author
Dr Chris Read owns and operates Diemen Pepper, a small pepper production and marketing business, from his mixed horticultural operation in southern Tasmania. He has worked in commercial horticulture as a field officer, consultant, researcher and commercial operator for more than 20 years, specialising in essential oils and cut flower production.

He is currently developing a small farm tourism operation based around a café and essential oil distillery on his property south of Hobart.
Quandong

Ben Lethbridge

Introduction

The quandong (Santalum acuminatum) is an Australian native shrub or tree that produces a visually appealing yellow-to-red, tart tasting, dry-textured fruit that is a significant component of the native food industry.

The flesh is amenable to most culinary purposes, including pie fillings, liqueurs and preserves. The kernel (nut) is also edible but as yet has attained little commercial significance.

Quandong is closely related to the arid zone sandalwood and, although the good-quality timber of the quandong tree is prized as a craft wood, it lacks the fragrant essential oils derived from the heartwood of most Santalum species.

The quandong is highly tolerant of saline water and drought but orchard production has been limited by having only a rudimentary understanding of the root semiparasitic nature of the plant, that is it requires a host plant for best production. This has restricted successful orchard production to those with some horticultural training.

The Australian Quandong Industry Association was formed in 1992 to help guide the development of the industry by organising an annual conference, producing a regular newsletter and collating relevant industry information.

Markets and marketing

The limiting factor to quandong fruit marketing has been a lack of quantity and quality of supply. The dominant market for the quandong is as processed product, usually dried or frozen immediately after being picked. Dried halved fruit can be stored indefinitely in an airtight container. Although the fresh fruit is visually appealing, there is virtually no market for the product to be consumed as fresh fruit. Most producers have been able to dispose of all fruit product to local tourist outlets and speciality stores.

Quandong production is currently an entirely Australian industry.
Quandongs have been rated conservatively at a $0.7–1.3 million industry (farm-gate gross estimates, 2001), with commercial planting of around 26,000 trees, which equates to 50 to 100 ha assuming average planting densities. This constitutes approximately one-third of the total production of 25 t (2001), with the remainder wild harvested.

It is unlikely that the high prices obtained for wild-harvested fruit in the past will continue and as orchard production rises the price is likely to fall to values more consistent with manufacturing-grade (mainstream processing) fruit. Quality product will always command higher prices (estimates of $40–60/kg dried fruit).

Production requirements

Quandongs require a climate with high light intensity and low relative humidity and will grow in a range of soil types, including pH variation and high salinity, but should be well-drained and will not tolerate waterlogged soils, where susceptibility to root diseases will be more prevalent. Mature quandongs have shallow root systems. The type of host plant chosen will dictate the irrigation requirements of the orchard. Prior to attachment to host plants, young quandongs are very prone to desiccation and will require a regular watering regime, shading and wind protection. Post-attachment, the irrigation should be matched to the host plant, with due consideration to the distribution and depth of the root system and water-holding capacity of the host and the quandong tree. The map shows the natural distribution range of the quandong and offers a very rough guide to the types of environments suitable for production.

Varieties

Two named varieties, Powells No.1 (provisional PBR) and Frahns Paringa Gem (provisional PBR) are available as grafted scions onto seedling quandong rootstocks. There is limited supply both in quantity and quality. Many new varieties from wild or seedling orchard selections are expected in the coming years, so check with the Australian Quandong Industry Association for latest selections and propagators.

Agronomy

The agronomy of quandong production is enhanced by the horticulturally unique semiparasitic nature of the quandong. This parasitism is non-specific and the exact nature of what determines a good host is not completely understood, although drought and salt tolerance are implicated. Because of their semiparasitic nature, quandongs are able to indirectly adopt many useful adaptive features of the host plant. For example, the nutrient-efficiency and atmospheric nitrogen-fixing ability of legumes such as *Acacias* make them good hosts in nutrient-starved soils, which are common to many Australian landscapes. *Acacia victoriae* (bramble wattle) is proving highly adaptable to many climates and soil types in orchard situations and is a relatively good host for quandong. Other useful species include other acacias and species of *Atriplex, Melaleuca, Myoporum and Allocasuarina*.

Many quandong growers have chosen to introduce quandongs into the orchard as potted plants whose root structure has been modified significantly and can retard the attachment to host plants. Young pre-attached quandongs require significant care to prevent desiccation, including shade and wind protection. Prior to attachment to a significant host (greater than 1 year old), quandongs require regular supplies of a general-purpose, water-soluble fertiliser for good growth. Some small orchards of quandongs have been developed on this host-free, simplified plan. Under this system quandong plants usually only attain shrub-like proportions. The pre-attachment phase can be minimised by direct seeding of quandong onto 1-year-old, dripper-fed host plants (usually acacia) when soil temperatures permit significant root growth of the quandong.

After attachment of quandongs to significant host plants, management of the orchard should be based on the requirements of the host plant.
Most propagation of selected quandong varieties has been achieved using nursery techniques. Field grafting onto established seedling rootstocks is possible but the technique needs improvement to obtain a commercially satisfactory success rate. This technique offers much potential: for example, sandalwood rootstocks (other Santalum species) are compatible with quandong scions, allowing conversion of seedling orchards of Santalum to specified varieties of quandongs, thus combining high-value sandalwood and quandong fruit production.

Weeds should be removed manually and frequently from around the plant, with cautious use of herbicides because of the potential for transfer of toxic compounds through the roots of the host plant to the semiparasitic quandong. Check that annual weed roots have not been parasitised by examining a selection of hand-pulled roots before application of herbicides.

Training and pruning of quandong trees should be early and light to improve tree structure. Where shading by the host plant could be significant this should also be addressed early in the life of the orchard.

Quandong trees are predominantly cross-pollinated, so planting of at least two varieties of trees in close proximity to each other is recommended.

**Pest control and disease**

The major pest affecting quandong fruit is the quandong moth (Paraparmenia santiella), a native species common in the natural range of the quandong. Quandong moth can be controlled by spraying with a dimethoate-based insecticide when eggs are detected in the fruit calyx or if there is obvious fruit damage. Although there can be highly conspicuous damage from leaf-feeding insects, this will not greatly affect fruit yield. Scale insects can be damaging to trees and are usually controlled by natural enemies or, for heavy infestation, oil-based sprays have been found to be useful. Gall-forming insects and bud mites (Family Eriophyidae) have been reported to cause damage to some trees.

Root-rot diseases such as Phytophthora have been implicated in poor establishment rates from nursery-derived plants and in inhibiting growth on poorly drained sites.

**Harvest and post-harvest**

All quandongs are currently harvested by hand. The current scale of production does not yet warrant "cool chain" procedures to be developed. Residual pest infestations can be eliminated by heating the harvested quandong fruit at 60°C for 30 minutes. Most quandong varieties are free-stone and fruit are de-stoned and halved on manual or automatic cutting machines based on technology developed for the apricot industry. The fruit is either fresh vacuumed packed and frozen or more commonly sun dried. Quandong fruit has a low moisture content relative to other fruits, so drying is a relatively simple process.

**Financial information**

An economic analysis for new crops should be treated with caution due to uncertainties in production and prices of quandong and host plant products. It is recommended that the host plant be established at least one year prior to planting of quandong trees and therefore establishment costs should be based on that of the host plant, plus the additional cost of quandong plants and protection from desiccation.

Most quandong orchards are currently based on seedlings for which yield data are highly variable. For improved grafted varieties, production is predicted to begin in year 4, with increasing yields of 0.5 kg dried fruit per annum to year 15 (dried equivalents, equals approximately 25% of fresh whole weight). Assuming 300 quandong trees/ha, a farm-gate price of $40/kg (first quality) of 1.5 kg dried fruit per tree gives an estimate...
of $24,800/ha (gross) at year 6. This is comparable to returns from other new horticultural pursuits. There exist opportunities to include quandongs in farm revegetation programs. The indirect economic benefits of improved environmental status and seasonally dependent, manufacturing-grade quandongs and host plant products (such as wattle seed) are difficult to calculate.

Key messages

- The economics of this new industry are uncertain but an industry infrastructure is developing according to well-formulated plans.
- Research into a better understanding of the semiparasitic nature and production of quandong is occurring. *Acacia victoriae* is showing much promise as a host in orchard situations.

Key statistics (estimates)

- In 2001 25 t of quandong were harvested, 33% cultivated and the remainder wild harvested.
- $0.7–$1.3 million was the farm-gate gross estimate for 2001.
- There are 26,000 orchard trees in various stages of production, predominantly in South Australia.

About the author

Dr Ben Lethbridge BAgSc. (Hons) PhD is a private consultant and has been a member of the Australian Quandong Industry Association since its inception and committee member since 1994. He has contributed to RIRDC-funded research projects on the quandong.

Key contacts

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It is recommended that all prospective quandong growers contact the association for up-to-date information on the status of the industry.

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The Davidson plum

Anthony Hotson

Introduction

The Davidson plum (Davidsonia spp.) is an “undomesticated” Australian native rainforest fruit well suited to commercial production. It offers new ingredient value to the global food industry and its versatility of use gives it opportunities in many food market niches. The fruit, whilst versatile, is constrained by market unfamiliarity and thus greater market risk. Present production outweighs demand. There is a need for improved production efficiencies and technologies, as well as improved post-harvest processing techniques. Overall, the greatest challenge is better marketing and greater adoption of the fruit in the food-manufacturing sector. Being very sharply acid, Davidsonia does not have access to a fresh food market. The fruit is a processing fruit and must compete on price with processing-grade fruits of other species. These other fruits can be cross-subsidised by fresh produce sales to an extent and hence come onto the processing market at or below the cost of production.

Australian production of the Davidsonia is very limited but, as long as the market identity of the fruit continues to be “Australian native”, production will benefit. At present overseas production seems entirely limited to enthusiasts and researchers. Market demand is perhaps the most significant limitation at present, with many growers over the past four years having difficulty selling their crops.

The Davidson plum is a sour, plum-like fruit used in jams, sauces and preserves, cordials, dairy products, confectionery, wines and liqueurs. Its tart flavour and intense burgundy...
The Davidson plum

Markets and marketing

At present the principal markets are specialty jam and sauce manufacturers, dairy foods, the hospitality and food-service industry, and wine and liqueur makers. Only a very limited amount of the crop has been exported raw, although value-added products made with *Davidsonia* are exported.

The fruit is sold fresh or frozen as whole fruit or frozen as deseeded pulp or deseeded puree. Many growers deseed their crop by hand and freeze to sell as fruit pulp, though the majority prefer to sell whole fruit.

There is a clear need for market brokerage and/or a grower organisation to ensure quantity and quality of supply in order to access higher volume markets.

Accurate industry estimates are difficult in a dispersed and unorganised industry. Production has been estimated at between 6,000 and 10,000 kg/yr, with many producers not harvesting their crop due to lack of market demand.

Some growers have pulled out their orchards in recent years because of marketing or management problems. Many small orchards (100–1,000 trees, with some to 6,000) were planted in the mid to late 1990s, with very few operating profitably at present. Total plantings can have reached 30,000 trees.

Prices range from $2 to $6/kg for whole fruit, $5 to $13/kg for hand deseeded pulp, and around $9 to $10/kg for puree.

Organically certified produce attracts a premium in certain markets.

Production requirements

The commercial range of the *Davidsonia* is as yet untested. The tree’s natural range for New South Wales species is from Tintenbar near Ballina to the Tweed Valley in far northern New South Wales, and around 30 km inland from the coast. This suggests the optimum growing area. Young trees do not tolerate frost, but trees more than about 3 years old can tolerate mild frost to −2° or −3°C. The natural range of the Queensland species is in rainforest of coastal north-east Queensland; however, the species is grown commercially in mid-north coastal areas of New South Wales.

No data have been ascertained for *Davidsonia* requirements for optimal photo-period, chilling hours or diurnal variation, and more research in this area would be useful. Good rainfall distribution and volume of around 1,200–2,500 mm/yr seems appropriate.

*Davidsonia* do best in deeper, friable soils high in organic matter but naturally occur across a range of soil types. Soil moisture, and...
The Davidson plum, therefore water-holding capacity, are important during flowering and fruit set, although the tree can tolerate seasonal dry periods once established. Irrigation is generally thought to be essential for good productivity, particularly at flowering and fruit set during dry springs. During dry periods, competition for water from other tree crops or nurse crops in polycultural orchard plantings has resulted in poor fruit set and size.

*Davidsonia* are able to produce in semi-shaded conditions and can be appropriate to south-facing slopes. However, the most productive orchards appear to be those grown in full sun or east-facing slopes with adequate soil fertility and irrigation. There are problems with losses occurring due to sunburnt fruit, which has led to suggestions that south-facing slopes and/or shade tree inter-plantings are appropriate. Some observations suggest that fruit will burn even in relatively shaded situations and that fruit burn seems more dependent on how abruptly high temperatures and sunny conditions follow on from cooler, overcast periods. Orchards should be protected from wind to reduce tree stress.

### Varieties

No recognised varieties or cultivars are available to date. Some selections have been made by various nurseries for improved performance and manageability, but no formal breeding has been carried out on the fruit. Seed-bearing *Davidsonia* spp. are reasonably true to type when grown from seed and are relatively easy to propagate. There are currently three species of *Davidsonia*: *D. pruriens*, the Queensland Davidson plum; *D. jerseyana*, the New South Wales Davidson plum; and *D. johnsonii*, the smooth leaved Davidson plum. A reported hybrid cross of *D. jerseyana* and *D. pruriens* fruited for the first time in the last year.

The predominant species grown is *D. jerseyana*, the New South Wales Davidson plum. This species is the smallest growing, with trunk-bearing (cauliflorous) characteristics, which lend themselves well to hand-harvesting from ground level. The fruit are born in early to mid-summer. Selections have been made for larger fruit, a leaf-free trunk and longer flower panicles.

*D. pruriens* is the predominant crop in Queensland, with much production in the past coming from the harvesting of naturally occurring trees. This species bears fruit in winter in its natural range; the fruiting period seems less clear in New South Wales. The crop has minimal fruit fly pressure. Fruit is borne on long flower panicles, generally from upper branches, but often from the tree trunk. The fruit is larger and paler than that of *D. jerseyana*.

*D. johnsonii* is rarely cultivated and is extremely rare in the wild but has been reported to have very high yields. Grafted specimens have been known to bear fruit at year 4 in optimum conditions. This species has significant pest problems from fruit fly (*Dacus* spp.) and caterpillars (*Lepidoptera* spp.). *D. johnsonii* fruit, although known as “seedless” (seeds are infertile), still have a persistent pericarp or seedcoat, which needs to be removed for most processed...
The Davidson plum products and the flesh of the fruit is paler when compared with D. jerseyana. In the wild, *Davidsonia* are classified by New South Wales National Parks and Wildlife Service as ‘endangered’ under the New South Wales Threatened Species and Conservation Act 1995 and as such a permit is required to pick and/or sell material from these plants. Genetic pollution of wild tree populations can be an issue in selecting appropriate planting sites. There are specialist native food nurseries in northern New South Wales selling selected-provenance material for fruit production, and many rainforest nurseries in both New South Wales and Queensland stock the species or grow to order. One specialist nursery in northern New South Wales offers grafted selections.

**Agronomy**

Site selection should enable adequate safe machinery operation and the ability to irrigate (around 100 L/tree per week during dry periods throughout the flowering and fruiting season is as a rough guide). Orchard sward should be established prior to planting if possible, and care should be exercised to avoid any chance of erosion occurring when ripping or exposing soil.

Deep ripping will improve the permeability of soil to tree roots, liming materials, fertilisers and water. Liming materials should be applied as early before planting as possible. Soil pH of around 5.2–5.5 (CaCl₂) is appropriate for *Davidsonia*. Planting of young trees (less than 300 mm high) will need great attention to weed control, irrigation, sun and frost protection to avoid tree losses and setbacks. Planting of older stock (at least 600 mm high) will improve successful establishment rates, although adequate care will still be needed. Trees from selected seed source or clonally produced will maximise orchard productivity and manageability.

Pelleted poultry manure or compost applied at or prior to planting will improve soil organic matter and microbiological health.

Planting models are numerous, ranging from highly diverse plantings to monocultures. Monocultures will provide management efficiencies, though can entail greater pest and disease management inputs. Planting in rows 2.5–3.5 m apart will allow for machinery access and plants can be spaced at 1.0–1.5 m centres within rows.

Basic equipment relevant to *Davidsonia* production is as follows:

- irrigation plant—water storage, licence, pump, controller, mains, laterals and emitters
- tractor with ripper/auger
- mower/offset slasher
- trailer
- brushcutter or other weed control equipment
- chainsaw/loppers/machine pruner
- picking bags/boxes
- wash and brush system, sorting table or machine
- ripening trays
- ripening room, cool storage, packing room, cold storage (optional)
- commercial-grade certified food handling kitchen if value-adding
- dispatch, office and warehousing if value-adding.

During establishment of young orchards, adequate weed control is essential. As orchards mature, a permanent groundcover should be encouraged. Inter-row sward should be mown or slashed when long and directed under trees as a mulch.

As trees grow taller, canopy must be managed to keep to a harvestable height. Trees beyond this will not be harvested regularly and will become a pest haven. Trees respond to topping at harvestable height by

![Topped D. jerseyana orchard](image)
chainsaw every two to three years. Alternatively, training the trees to a multiple trunk structure and then periodically trunk stump%ng on a rotational basis will achieve a similar result.

Harvesting during bearing must be done every one to three days, depending on temperature and cloud cover. Fruit picked just as it is beginning to develop its purple blush will ripen off the tree readily, and this will minimise pest build-up. Other pest control practices should be maintained from flowering to final harvest.

Fertiliser requirements for *Davidsonia* spp. are not well understood or well researched. Current practices are based on individual site observations. Broadly, from year 1 to 3, nutrition aimed at vegetative growth should ensure good tree establishment and bearing structure. Pelleted poultry manure at rates of around 300 g for each site twice a year or 4 L of composted broiler litter can be applied after harvest, along with 10 g per site of K₂SO₄.

For bearing orchards, at year 4 onwards pelleted poultry manure broadcast or banded at rates of around 2,000 kg/ha after harvest or composted broiler litter at 6 m³/ha and 150 kg/ha of K₂SO₄ is advised.

*D. jerseyana* will bear in year 3, with commercial production by year 4 or 5. *D. pruriens* will bear in year 5 or 6.

**Pest and disease control**
The following common pests have the potential to cause large losses:

- **native budworm** (*Heliothis* sp.)—high populations can occur rapidly and are particularly destructive of flowers and fruit at all stages to maturity
- **light brown apple moth** (*Epiphyas postvittana*)—larvae graze on fruit skins and bore into fruit, often grazing on seed. Can cause significant and extensive damage
- **orange fruit borer moth** (*Isotenes mierana*)—larvae will eat into fruit and graze on fruit skins
- **fruit fly** (*Dacus* spp.)—in heavy fruit fly seasons, with poor orchard hygiene, the larvae of this common pest can cause heavy crop losses. Adults can lay eggs in green

Occasional pests causing minor losses:

- **Variegated hairy caterpillar** (*Anthela varia*)—can cause damage to flowers and fruit.
- **Brown loopers** (*Lophodes sinistraria*)—can cause damage to leaves.
- **Leaf hoppers and grasshoppers** (unknown spp.) can cause damage to leaves and fruit. Heavy, deep grazing is often found at all stages of fruit development.
- **Red-shouldered leaf beetle** (*Monolepta australis*)—often heavily defoliates young leaves of the tree, particularly *D. pruriens*.
- **Fruit spotting bug** (*Amblypelta nitida*)—uses its piercing and sucking mouthparts to superficially damage fruit but do not cause observable losses.
- **Larvae of longicorn beetle**—a stem borer, have been known to ringbark and kill off branches and trunks of trees.
- **Rodents** (*Rattus* spp. and *Mus* spp.)—relish the seed of *Davidsonia* spp. but will generally only use fallen or over-ripe fruit. However, it has been noted that rodents will forage on fruits in the tree, with the potential to cause substantial damage. Isolated orchards have also lost significant numbers of trees due to rodents chewing the tree bark and root system. Seed-beds in nursery production must be protected from rodents with wire mesh.
- **King parrots** (*Alisterus scapularis*)—will forage on the seed of the fruit and will

Cauliflorous fruit on trunk of *D. jerseyana*
damage much of the fruit in the process.

- Flying foxes, *Pteropus spp.*—have been reported to damage some crops recently. Generally these native animals have posed a minor problem to *Davidsonia* crops to date.

There are currently no registered preparations for pest control in *Davidsonia*. Good orchard practice such as maintaining high organic matter, fertile, healthy soils, appropriate canopy management, regular harvest and orchard hygiene, and so on are the best measures to minimise the impacts of pest problems.

Integrated pest and disease management practices such as designing orchards to include refuges and corridors for beneficial insects and insectivorous birds, will assist in buffering orchards against severe pest problems.

Bait spray or paint yeast autolysate and insecticides (organic or otherwise) subject to compliance with the Pesticides Act and label indications can be a means of controlling fruit fly.

Observations show that where ants are present, generally associated with mealy bug (*Planococcus citri*) on fruit stems or calxes, incidence of caterpillar is minimal. Mealy bug does not observably affect the development or quality of the fruit.

**Harvest and post-harvest**

Harvested fruit should be picked into picking bags or boxes and field heat removed as soon as possible. Food-grade approved ripening space at high humidity and low temperature (6–8°C) will be needed for ripening the fruit to full colour. High-humidity cool room (2–4°C) storage space for up to a week of harvest during peak bearing period should be planned (around 6m³/ha). Fruit are held in cool storage in shallow trays before processing or cold storage. Cold (~18°C) storage facilities can be necessary if fruit is not being sold or processed immediately, or whilst adequate fruit volume is accumulated for processing runs. Around 1 m³ will be needed for every 300 kg of whole fruit to be stored. This is often very costly if only seasonally used. Rental of such facilities close to the farm can be practical. Fruit pulp or puree will take less space to store than whole fruit per $ value, and sugar-stabilised puree is able to be stored at more economic temperatures than fresh frozen puree.

Post-harvest processing will vary depending on the degree to which a grower value-adds and buyer requirements. Small jam and sauce processors manufacturing boutique or cottage-style products generally prefer a hand-deseeded fruit pulp, which has a high ratio of larger fruit and skin pieces in it. There is reasonable demand for hand deseeded fruit pulp, but the process is very labour intensive and growers are often overstretched for labour. Often the hand processing is done in a domestic situation or by junior labour. At award rates and under commercial conditions, the costs are such that buyers are often not prepared to pay realistic amounts for the resulting pulp.
Machine pulping to remove the fruit seeds and calyx has been in development by some growers and processors for some years. Getting a balance between removal of the fruit calyx and keeping larger fruit and skin pieces has been difficult; however, the resulting puree is well suited to sauces, jams, syrups and beverages and offers commercial-scale volume and a more acceptable market price.

**Financial information**

*Davidsonia* is a high-risk crop. It can provide an alternative crop to diversify an existing enterprise but at this time does not offer a predictable or commercially profitable business opportunity. Enterprises with existing value-adding or tourism operations can be better placed to make a viable income from a *Davidsonia* growing enterprise through integration with these other businesses.

Broad figures here are based on a monocultural planting on relatively flat and clean, rock-free ground, with water supply, planted at 2,000 trees/ha.

General equipment and infrastructure costs, excluding land, will run to over $100,000. Establishment costs, including irrigation, set-out, preparation planting and planting stock will run to around $15,000/ha.

Maintenance costs run to around $3,500/ha/yr, including slashing, weed control, fertiliser, fuel and canopy management. Harvest, grading and packing costs can run to over $8,000/ha.

Given 2,000 trees/ha, a yield of between 1 and 3 kg of fruit/tree is likely—a total of 2,000 to 6,000 kg/ha.

Calculating a predicted value in an oversupplied market is fairly academic. Broadly, market prices of between $2 and $6/kg whole fruit give a value range of $4,000–$36,000/ha. After operating expenses of $11,500, this leaves a profit margin of between $(7,500 loss) and $24,500/ha.

Other costs, such as cool or cold storage and finance costs, need to be considered. The major risks to the grower lie in the small scale and vulnerability of the buyers’ sector. Only a limited market is established for the fruit, and the market is currently oversupplied. Any further plantings would need significant market development in order to be viable.

**Key references**


Anthony Hotson operates a wholesale nursery at Tuckombil, near Alstonville in northern New South Wales specialising in sub-tropical native food plants, rainforest re-afforestation and macadamia trees. He has been growing and researching *Davidsonia* since 1995 and runs a 1,500 tree commercial orchard.

### Key messages

- *Davidsonia* is a native rainforest species.
- It is a versatile processing fruit.
- There is a clear need for market development.
- Improved technologies are needed.

### Key statistics

- Estimated production is 6,000–10,000 t/yr.
- Estimated plantings are perhaps 30,000 trees.
- Estimated current market is 5,000 t/yr.

### Key contacts

**Research into genetic characteristics of Davidsonia**

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The Davidson plum
Native foods

This publication reports on R&D into the Australian native foods industry and is an extract of RIRDC’s *The New Crop Industries Handbook* which provides an introduction to new crop industries in Australia and is a guide for those who want to find out more about new crop opportunities.

The native food industry has grown slowly since the mid–1980s and operates within a variety of commercial structures. Commercial horticultural cultivation of native food species is expanding; however, managed wild harvest remains an important and integral part of the commercial supply. This report has specific agronomic information for selected species.

The species discussed in depth here are:- bush tomato; lemon myrtle; native citrus; native pepper; quandongs; and the Davidson plum.

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