



Australian native citrus – wild species, cultivars and hybrids

Introduction

Australia has six species of true native citrus¹. Previously they were classified as being in two genera (*Eremocitrus* and *Microcitrus*). However, recent taxonomic work has led to their reclassification and they are now included in the genus *Citrus* (along with oranges, lemons, limes, etc), emphasising their close relationship with 'conventional' citrus².

Native species are able to hybridise with a range of other citrus species, have been trialed as rootstocks and successfully grafted onto conventional citrus rootstocks. These abilities, along with attributes such as drought and salinity tolerance and disease resistance, have long attracted the interest of citrus researchers and breeders, including the CSIRO. Improved selections and hybrids of native citrus also have potential in their own right for commercial production of fruit for both the fresh and high-value processing markets.

Fruit is used in a range of sweet and savoury processed products, such as marmalades and sauces, and is in demand by chefs producing 'Australian Native Cuisine' dishes. To-date, most fruit has been harvested from the wild. Commercial orchard production has also commenced and, because of quality and reliability of supply factors as well as environmental concerns, may eventually replace wild harvested fruit.

Three cultivars of wholly or partly Australian native citrus parentage have been developed by the CSIRO at their Merbein research facility and released to commercial growers through a licensing agreement with Australian Native Produce Industries Pty Ltd (ANPI) – the Australian Outback Lime ^ϕ³, the Australian Blood Lime ^ϕ and the Australian Sunrise Lime ^ϕ.

A further cultivar, called Rainforest Pearl ^ϕ, has been selected and is available from Byron Bay Native Produce.

- ¹ There are also several native plants known as 'wild oranges' that are not members of the citrus family.
- ² While the new classification of these plants as belonging to the genus *Citrus* is used in this publication, the names *Eremocitrus* and *Microcitrus* are retained as an informal 'group' designation (like 'mandarins'), since they help distinguish between rainforest and arid environment members of the native citrus family.
- ³ The symbol ^ϕ signifies a variety protected under Plant Breeders Rights legislation.

Wild species

Microcitrus

The *Microcitrus* group contains seven species, five of which are native to Australia with the other two found in New Guinea. The Australian species occur in rainforests and their margins from Cape Yorke Peninsula south to the Northern Rivers of New South Wales. They produce small, round or finger-shaped fruit, with a pleasant but very acid juice.

Citrus australasica (previously *Microcitrus australasica*), commonly known as the Australian finger lime, occurs as an understory shrub or tree in rainforests in southern Queensland and northern New South Wales. It produces finger-shaped fruit, up to 10cm long, with thin green or yellow skin and green-yellow compressed juice vesicles that tend to burst out when the skin is cut. A pink to red-fleshed form with red to purple or even black skin (known as *Citrus australasica* var. *sanguinea*) also occurs in the wild. Fruit from wild harvest and limited plantings are used by the native food industry, with recent farm gate prices ranging from \$8 to 12 per kilogram.



Fig 1. Australian finger limes

Citrus australis (previously *Microcitrus australis*), commonly known as the Australian round lime or occurs as a shrub or tall narrow tree on the open and drier rainforest margins of southeast Queensland, from Brisbane northwards. It produces round fruit with a thick, green to lemon-coloured skin and pale green pulp, very similar to a small commercial lime in appearance. Fruit from wild harvest and limited plantings are used by the native food industry, with recent farm gate prices ranging from \$8 to 9 per kilogram.

A hybrid between *Citrus australasica* and *Citrus australis*, commonly called the 'Sydney hybrid', is known and was provisionally given the scientific name of *Microcitrus virgata* before its hybrid nature was established. It is notable for its extreme vigour, exceeding that of all other known citrus in the length of twigs produced. More than 200 metres of twigs were borne on a single branch, 3 cm in diameter, of a Sydney hybrid growing near Riverside, California, which survived for several decades on land no longer irrigated and where conventional citrus trees made little or no growth.

Citrus inodora (previously *Microcitrus inodora*), commonly known as the Russel River lime or Large-leaf Australian wild lime, is now rare in the wild, being native to the high-rainfall lowland rainforest between Cairns and Innisfail, much of which has now been cleared to grow sugar cane or bananas. It is a shrub or small tree and produces a lemon-shaped fruit. Fruit is not traded commercially.

Citrus garrowayi (previously *Microcitrus garrowayi*), commonly known as the Mount White lime, occurs in rainforest on Cape Yorke Peninsula. It produces a finger-shaped fruit, similar to *Citrus australasica* though shorter and thicker, with a pale lemon skin and light green pulp. The species is considered rare in the wild and fruit is not traded commercially.

Citrus maideniana (previously *Microcitrus maideniana*), commonly known as Maiden's Australian wild lime, is reported to have the same distribution as *Citrus inodora* and is very similar to in appearance, with a sunken apex its main distinguishing feature. It may in fact be a variation of *Citrus inodora*, rather than a separate species.

Eremocitrus

The Eremocitrus group contains one species, *Citrus glauca* (previously *Eremocitrus glauca*), known commonly as the Australian desert lime. A similar species, *Citrus gracilis*, the Humpty Doo or Kakadu Lime, has recently been described.

Citrus glauca grows wild in Queensland and New South Wales, west of a line running from Rockhampton to Dubbo, with some isolated occurrences in central South Australia. It is the only known member of the citrus family which is a xerophyte (i.e. adapted to withstand drought). Seedlings develop a large root system before making vigorous aerial growth and under extreme

drought the leaves fall and the leafless twigs carry on photosynthesis. The plant tolerates high temperatures (up to 45°C) and when dormant in late winter is able to withstand temperatures of –24°C, or lower, without injury. The roots are able to endure high salt concentrations. It has the shortest flowering to fruit maturity period (about 8 weeks) of any member of the citrus family.

It is likely that the desert lime shared a common ancestor with the more coastal *Microcitrus* types and has been spreading slowly westward over a long period of time, during which it has become adapted to a semiarid climate and saline soils.

Trees vary from short shrubs, only 2 to 3m high and often forming thickets, to tall upright trees up to 12m high. The fruit resembles a small, thin-skinned, yellow-green lime. It is juicy, pleasantly acid and often seedless. Fruit from wild harvest and limited plantings are used by the native food industry, with recent farm gate prices ranging from \$5 to 7 per kilogram.

Citrus 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 *Citrus glauca* and produces round fruit up to 8cm in diameter. Fruit is not traded commercially.

Cultivars and hybrids

As far as is known, four cultivars (cultivated varieties) of native citrus are currently available, although others may be under development. Rainforest Pearl ^ϕ is a selection of *Citrus australasica* var. *sanguinea* made by Erika Birmingham from Byron Bay Native Produce in Northern NSW, while Australian Outback Lime ^ϕ is a selection of *Citrus glauca* made by Dr Steve Sykes of the CSIRO, Merbein, Victoria. Two cultivars of partly Australian native citrus parentage have also been developed by Dr Sykes, the Australian Blood Lime ^ϕ and the Australian Sunrise Lime ^ϕ.

CSIRO cultivars

These cultivars have been released to commercial growers through a licensing agreement with Australian Native Produce Industries Pty Ltd (ANPI). ANPI believes that the fruit of these cultivars is highly suited to manufacturing a broad range of sweet and savoury products, including beverages, preserves, marmalades, chutneys, sauces, syrups, garnishes and confectioneries; and that the Blood and Sunrise Limes may also have fresh market potential.

To-date around 15,000 trees of these three cultivars have been planted in mainland States and ANPI have forecast that further plantings may be required to meet likely market demand.

Experimental and early commercial plantings of these cultivars have generally responded satisfactorily to routine citrus management practices. Some field and postharvest problems have been evident and are discussed below, and there is a need for on-going applied research to improve our understanding and refine aspects of crop management. Assuming appropriate crop management and suitable site conditions, ANPI believes trees should bear reliably each year. Small quantities of fruit can be expected in the second or third year after planting, with ultimate yields in excess of 10 kg per tree per year likely.

Troyer Citrange is commonly and successfully used as a rootstock for these three cultivars and to-date has shown no incompatibility problems. Troyer Citrange is resistant to *Phytophthora* root and collar rot, is cold hardy and suited to a wide range of soil types, except highly calcareous soils where it is prone to micronutrient deficiencies.

The Australian Outback Lime (b): The Australian Outback Lime (b) is a variety of desert lime (*Citrus glauca*), selected by the CSIRO for its large, flavoursome fruit, high yield, lack of thorns, upright habit, uniform ripening time, and potential suitability for mechanical harvesting. The variety was selected in 1990 at CSIRO, Merbein.

Under commercial cultivation it is an open, upright shrub to small tree, usually 2 to 4 m high and 1.5 to 2 m wide. Foliage is grey-green, comprising long narrow leaves, to 80 mm long by 15 mm wide, with slightly serrated edges and rounded ends. Mature trees are completely thornless, although long slender spines may be present on juvenile stages of growth.

Small, white flowers occur in spring. The crop is carried on the previous season's growth, towards the outside of the canopy. The flowering to harvest time is extremely short, in the order of 2 to 3 months.

The spherical fruits (to 20 mm) have a thin skin and turn from green to yellow as they ripen in early summer. The attractive fruit can be eaten whole, although the strength of flavour and an 'oily' characteristic are unappealing to some. Juice squeezed from the fruit is sharp and refreshing, with a Brix:Acid ratio of approximately 2 and a pH of 3.3.



Fig 2. Outback lime fruit

Due to compressed ripening time and the ease with which the fruit is removed from the tree when ripe, mechanical harvesting has been proposed, but not proven, for this crop. At Merbein, the fruit ripens in December to January. In the Riverland fruit often ripens around the Christmas-New Year period. Fruit drop near harvest has been a problem, which may be related to stress factors, such as soil water deficits or high temperatures during this period.



Fig 3. Outback lime tree

While it is difficult to estimate the ultimate farm gate price that will be received for this cultivar, the current price paid for wild-harvested native limes, which ranges from \$5 to 7 per kilogram, can be used as an indication. Naturally, prices can be expected to vary according to supply and demand in future years.

Australian Blood Lime ^ϕ The Australian Blood Lime ^ϕ is a hybrid between *Citrus australasica* var. *sanguinea* (the red finger lime) and the Rangpur lime (*Citrus x limonia*). The original parent tree has selected in 1990 at CSIRO, Merbein.

Under the right conditions the tree produces striking, blood-red coloured fruit, which greatly enhances the appeal of the fresh and processed product. The variety also has potential as an ornamental tree.

Fruit is produced on an attractive, dense, upright shrub to small tree, usually 2 to 3 m high and 2 m wide with dark, glossy-green foliage and red growth flushes. The oval-shaped leaves are approximately 25 to 35 mm long by 15 mm wide, with slightly serrated edges. Short, stiff, slender spines are present in the leaf axils. These spines pose a continual damage threat to fruit, are a hindrance to hand picking and are a significant contributing factor to postharvest problems with this cultivar.

Fruits ripen in winter, are oval in shape and are usually 30 to 50 mm long, by 20 to 30 mm wide. The skin colour may range from a gold, with red flecking, to a uniform intense blood red, while flesh and juice may show red tinges or may occasionally be more intensely red. Seasonal, geographic and harvest timing practices appear to influence the intensity of colour development. Seeds are small and plump. Juice squeezed from the fruit has a sharp, crisp/clean flavour with pH (approx 3.4) and Brix:Acid Ratio (approx 1.0 to 1.5) similar to the West Indian Lime.

The crop is carried on the previous season's growth, often on long weeping shoots, which may be covered by later dense canopy growth. Pruning and nutrition management may be necessary to reduce this growth and present the fruit in a less damage prone and easier to harvest position.



Fig 4. Blood lime fruit

At Merbein, experimental planting fruit ripens in June to August with the fruit remaining on the tree with colour until October. In commercial cultivation a high incidence of fruit drop has often stimulating harvest in June, with little fruit held on the tree.

While it is early days for this cultivar, postharvest problems have been an issue. In the 2001 harvest, fruit soundness problems were encountered due to Sour Rot, with thorn damage, tree habit, management and seasonal issues involved. Physiological breakdown of packed fruit also contributed to losses. While it is difficult to estimate the ultimate price for this crop, fruit harvested in the 2001 season received \$5/kg for processing grade fruit. Naturally, prices can be expected to vary in future years.



Fig 5. Blood lime tree

Australian Sunrise Lime [Ⓢ] The Australian Sunrise Lime [Ⓢ] is an open-pollinated seedling selected from a 'faustrimedon', a hybrid of *Citrus australasica* (the finger lime) and a calamondin, itself a hybrid between mandarin and cumquat. The original faustrimedon was bred in California in 1911 and the parent tree of the Sunrise Lime was selected in 1990 at CSIRO, Merbein.

The Sunrise Lime produces attractive golden-coloured fruit on an upright shrub to small tree, usually 2 to 3 m high and 1.5 to 2.5 m wide. Foliage is dark, glossy-green. The oval-shaped leaves are approximately 40 to 45 mm long by 20 to 30 mm wide. Short spines are located at leaf axils.

During spring 2000 a twig and limb dieback was observed in Sunrise Lime in several districts. In general, the first symptom noted was the wilting of leaves and death of branches, up to 1cm in diameter, although this symptom was actually preceded by the (often unnoticed) death of smaller twigs and shoot tips. While most Sunrise Lime trees in each affected block showed symptoms, only some branches on each tree were affected, with adjacent branches apparently healthy and often showing flush growth. The causal agent for the disease has been identified

as a *Phoma* sp. fungus and routine management and spray practices are likely to minimise its incidence.

The cream-coloured flowers occur in spring to early summer. Fruits ripen in winter, are pear-shaped and are usually 30 to 45 mm long by 20 to 40 mm wide. Second crops may occur, which can cause difficulties at harvest. The skin of mature fruit is a strong golden colour, while second crop fruit is paler, may have a green tinge and is generally thinner. Seeds are small and plump. Juice squeezed from the fruit has a sharp, clean flavour and a light 'floral' aroma. The balance of pH (approx 3.0) and Brix:Acid Ratio (approx 1.5) provides a refreshing 'acid-sweet' flavour. The fruit may be eaten whole and like a kumquat, has a sharpish flesh and a sweet albedo and skin.

A fruit lesion has been evident on some fruit. It is suspected to be of fungal origin and may be related to the dieback problem in this cultivar.

At Merbein, experimental block fruit ripens in August to September and is harvested in September. In cultivation, fruit has generally been harvested in August. Packout percentages and storage results from early commercial harvests have been good, with prices ranging from \$5 to 8/kg.

For further information on the availability of the Outback, Blood and Sunrise Limes contact:

Australian Native Produce Industries Pty Ltd
PO Box 163
Paringa SA 5340
Phone: 08 8595 8129
Fax: 08 8595 8099
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Website: www.anpi.com.au



Fig 6. Sunrise lime fruit



Fig 7. Pronounced dieback in Sunrise lime

Other cultivars

While other native citrus cultivars or hybrids may be waiting in the wings, and some orchards have been established using seedlings as planting material, the only other variety currently known to be available is Rainforest Pearl ^ϕ.

Rainforest Pearl ^ϕ An Australian finger lime (*C. australasica* var. *sanguinea*) selected for pink pulp, ease of propagation and ornamental properties as a garden subject, including vigour and openness of form. Trees are usually grafted onto Trifoliata or Troyer Citrange rootstocks, are thorny, and although slow to establish, ultimately produce vigorous upright trees 4 to 6m high. Fruit is harvested in late summer and autumn on the north coast of NSW.

For further information on the availability of Rainforest Pearl, contact –

Byron Bay Native Produce
PO Box 232
Bangalow NSW 2479

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E-mail: erikab@nor.com.au

Further information

Further information on native crops is contained in the other publications in this series:

Australian Native Citrus – Wild Species, Cultivars and Hybrids

Bush Tomato Production

Miscellaneous Native Food Crops – Davidson and Illawarra Plums

Miscellaneous Native Food Crops – East Coast Tree Species with Potential in SA

Miscellaneous Native Food Crops – Herbs and Vegetables with Potential in SA

Mountain Pepper Production

Native Food Background Notes

Native Food Crops – Frequently Asked Questions

Native Food Crops – Sources of Information

Quandong Production

Sunrise Lime Dieback

The Native Food Industry in SA

Wattleseed Production

These fact sheets are also available for download from the Australian Native Produce Industries website at www.anpi.com.au

Acknowledgements

The assistance and input of Dr Steve Sykes, Plant Breeder CSIRO and Andrew Beal, Managing Director and Graham McNaughton, Nursery Manager, Australian Native Produce Industries Pty Ltd, in the preparation and review of this publication is gratefully acknowledged.

Last update: November, 2001

Agdex: 350/30

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