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NSW DEPARTMENT OF  
PRIMARY INDUSTRIES

## Mango growing

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### INTRODUCTION

The mango (*Mangifera indica*) is native to Asia, occurring from northern India to the Malay Peninsula. It has been cultivated in India, where it thrives and is considered the 'king of fruits', for over 4000 years. It is a major fruit crop in many countries such as Mexico, Philippines, Brazil, Pakistan, Thailand and China.

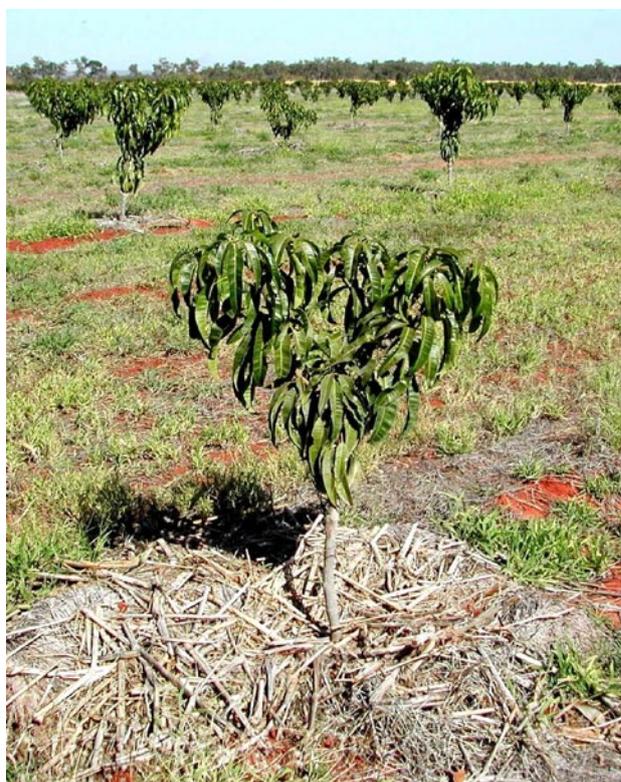
Australia produces around 46 000 tonnes of mangoes annually. There are 1.7 million trees planted on an estimated 11 250 hectares.

Mangoes are grown commercially in many areas, including Darwin and Katherine in the Northern Territory, Kununurra and Carnarvon in Western Australia and Mareeba, Burdekin, Bowen, Rockhampton, Bundaberg and in south-east Queensland.

In NSW the growing areas are spread over a wide range of soil types and micro-climates and extend from the Tweed Valley down the coast and hinterland areas to Stuarts Point and inland to the drier areas of Kyogle and Hogarth Range. The NSW plantings are small on a national scale and represent around 3% of the industry.

According to the Australian Bureau of Statistics (2001), NSW has 54 000 trees, of which 26% are less than six years old, compared with 10 000 trees in the late 1980s. There is much interest in the recently released patented varieties. Production is around 400 tonnes (although this fluctuates greatly), with a small tonnage going to processing. The industry has 160 growers.

The NSW industry is based on one variety, Kensington Pride, estimated to be 90% of plantings.



A well-mulched one-year-old tree. Shaping and limb selection is a priority during the tree's early years.

Tree yields fluctuate significantly from year to year. This variety is most susceptible to fungal diseases in wet growing season, low temperatures in the spring during flowering and alternate bearing characteristics.

### ECONOMIC ANALYSIS

It is beyond the scope of this Agfact to discuss this subject in any detail since there are so many variables

and assumptions to be made in preparing a case study and presenting a gross margin.

An economic analysis detailing variable, fixed and capital costs, including a gross margin sensitivity analysis is presented in the *Mango Agrilink Kit*. Even though this analysis is for the Mareeba area in north Queensland it provides an example on how to complete a gross margin study. Figures and practices appropriate for NSW growing conditions should be used.

## SITE SELECTION

Mangoes grow on a wide range of soil types, from the deep and fertile red krasnozems to the shallower and less fertile podsollic and dermosol soils. It is a good practice to dig soil pits to check the profile for depth and drainage.

Growers should consider ways to protect trees from winds. A windbreak around boundaries and along crests is encouraged and, if possible, should be planted up to three years before the orchard itself.

The provision of roadways and surface drains should be planned. Drain runoff water into grassed waterways to reduce soil erosion on sloping land.

Plant tree rows north-south if possible as this maximises sunlight inception.

Prior to applying fertilisers take a representative soil sample for chemical analysis and then apply the recommended nutrients. It may take longer than one year to correct a soil nutrient imbalance.

Supplementary irrigation is not considered to be a requirement in NSW. However, it will assist with young tree establishment and early fruit development during dry spring months.

## VARIETIES

There are hundreds of varieties world-wide. They vary in colour, shape and flavour. Some are eaten green.

Kensington Pride (KP) is the most widely grown variety in Australia. It is also known as Bowen or Browns. Australians prefer the flavour and eating qualities of KP.

In NSW they mature from late January through to April depending on location. The fruit has a low fibre content and ripens to a bright yellow skin colour with varying degrees of red blush on the shoulders.

KP is a polyembryonic variety—the seed has multiple embryos and produces several seedlings true to type so grafting of trees is not essential.

KP can perform poorly in cool subtropical areas due to poor flowering and fruit set. The fruit is also susceptible to sap burn and skin browning at harvest.

Varieties maturing earlier than KP are not considered viable in NSW as they compete with good quality, and often cheap, KPs from Queensland.

NSW has the advantage that our harvest follows on from Queensland at a time when there is considerably less fruit on the market, so higher prices are achieved.

Other varieties are grown in NSW primarily to extend the harvesting period. These include:

- **R2E2**, a large highly coloured fruit that matures a couple of weeks after KP. A selection of Queensland Department of Primary Industries, it was released in 1991.
- **Nam Doc Mai**, a Thai variety with elongated fruit. It is often used in Australia as a hard green fruit in Asian cooking. Fruit when ripe can exhibit the jelly-seed disorder. There may be scope for additional plantings of green-eating mango varieties on account of the increasing Asian population in Australia and interest in Asian cuisine.
- **Keitt, Palmer and Brooks**.

In recent years patented varieties (PVR) have been released under different licensing arrangements that include royalties paid per tree/graft, tree quotas in growing areas and specific marketing controls on domestic and export fruit.

Two PVR varieties, **Calypso** and **HoneyGold**, have been planted in NSW. No cropping information is available at this time. A number of South African varieties are also being trialled in northern NSW.

## FLOWERING

The unreliability of KP mangoes to crop in NSW can be in many cases traced to the flowering period.

Low temperature is the most common cause of poor flowering and fruit set. Other factors include tree vigour, insect and disease damage, carbohydrate reserves, tree nutrition and hormone balance.

Night temperatures during winter of 10 to 12°C promote flower development. When temperatures fall below 10°C during flowering pollen viability is affected and young fruitlets may be damaged.

Mango trees flower profusely. Each flowering panicle bears both male and hermaphrodite (bisexual) flowers. Most mango varieties can be fertilised by their own pollen.



**Kensington Pride panicles at the 'asparagus stage' just prior to flowering.**

Wind and activity by insects, such as flies and bees, pollinate flowers. Panicles often set a number of fruit but most of these are shed by the tree, leaving one or two fruits per terminal.

Fruit set may be improved by the use of a growth regulator (paclobutrazol) or a foliar application of potassium nitrate. Trials in NSW have shown inconsistent results using these products.

## **PLANTING YOUNG TREES**

Buy trees from a reputable source. Although not essential, it is recommended that grafted KP be planted. Such trees are earlier bearing and have more consistent growth and yield patterns than seedling trees.

Take care when planting. Dig holes large enough to take the root system comfortably, although very large holes are unnecessary. If post-hole borers are used ensure that the glazed side of the hole is broken in so that roots do not spiral in the tree hole.

Potted trees can usually be planted without disturbing their root systems. Where a tree has become rootbound through having been in the pot too long, gently loosen and straighten the roots before planting. Some light root pruning may be necessary.

Do not place fertiliser in the planting hole as this can burn sensitive roots.

Place the tree in the hole so that the potting mix mark is slightly higher than ground level, to allow for some

sinkage. Half fill the hole with soil and press it gently towards the root ball. Fill the hole with water and allow it to drain before completely filling the hole with soil. Make a basin around the tree so hand watering can be carried out if irrigation is not installed.

On windy sites staking of trees is encouraged.

To reduce the risk of hare and wallaby damage, sunburn, frost and herbicide spray drift, place a protector sleeve or staple a strip of sisalation around the tree stem. An application of white plastic paint will help to prevent sunburn damage.

Apply a mulch layer under young trees. Slightly 'hayed off' and coarsely cut crops such as oats, sorghum, setaria or mixtures of these with a legume such as lablab, soybean or lupins provide open mulch that decomposes gradually. Coarsely cut barner grass is excellent. Finely cut softer material, such as sawdust and bagasse, is undesirable as it may pack down and become soggy, inducing root rot.

Mulch provides organic matter (a valuable source of tree nutrients and food for beneficial soil micro-organisms), improves physical characteristics such as soil moisture and temperature levels and checks weed growth.

Mulch crops can be grown in the interrow and directed onto the tree row with a side-throw slasher during mowing.

## **Tree spacing**

Planting density is a much debated subject. Mangoes generally grow into a large tree, making management difficult. To facilitate spraying and harvesting, tree size is controlled by regular pruning. This means trees can be planted much closer—200 to 350 per hectare depending on variety.

Access between tree rows is required for spray machinery and harvesting aids. Trees within the row can grow into a hedge row.

## **TREE TRAINING AND PRUNING**

Aim to produce an open centred tree with about 8 main supporting limbs to a height of 3 to 4 metres.

Limbs causing overcrowding and shoots arising from below the graft union should be removed. It is important to avoid a weak crotch or a divided trunk.

Remember that mangoes are tip or terminal bearers; the more laterals that are present the greater the bearing potential of the tree.



Many Kensington Pride (KP) trees are being reworked to the new PVR varieties. Here a ‘nurse branch’ keeps the tree functioning while the young grafts are established. White plastic paint is used on exposed limbs to reduce sunburn. The heavy layer of mulch is from tree prunings.

Pruning of bearing trees shapes and regulates tree height and assists with opening up the tree for spray penetration, wind movement and light inception for fruit colouring.

The preferred time to prune mangoes in NSW is in winter prior to flowering, not following fruit harvesting as is done in Queensland. From February to May rainfall averages in excess of 200 mm per month and any vegetative flush following pruning is very susceptible to anthracnose disease.

It is recommended to prune a little every year so the tree maintains a balance between vegetative and reproductive growth.

To detail prune a mature eight-year-old tree takes 15 to 20 minutes. To remove larger growth only using a small chain saw and large loppers takes 5 to 10 minutes per tree.

All pruning cuts should be made flush against the branch. Remove dead wood and any stubs as these are a source of disease infection and die-back. Paint

the surface of large internal limbs that are exposed to sunlight with white plastic paint to avoid bark damage.

## NUTRITION

Since mangoes grow on a wide range of soil types, tree nutrition must be monitored regularly using soil and leaf analysis. Building up the soil organic matter by mulching and cover cropping within rows is beneficial in sandy and gravelly soils.

With young trees apply a small amount of fertiliser, but apply it often. For example, an N:P:K mix of 14:6:12 could be applied a rate of 50 grams per tree every 2 months to 1-year-old trees, increasing to 100 grams in year 2 and 130 grams in year 3.

A luxury level of nitrogen in mangoes is undesirable as it leads to excessive vegetative growth and internal fruit disorders. Many growers prefer their trees to show a slightly yellow leaf colour. Potassium is often foliar-applied at flowering to increase fruit yields and then pre-harvest to enhance fruit colouring. Calcium

is required for fruit cell development and to improve internal fruit quality. Boron is important at flowering and fruit setting.

In the past NSW fertiliser recommendations for bearing trees were based on Queensland research and field observations. Since their growing conditions, tree management practices and soil types are quite different to those in northern NSW, a study was carried out to determine what nutrients are removed by a fruit crop.

The resultant concept of crop nutrient replacement aims at replacing the nutrients removed by fruit, vegetative growth and roots. Other losses from leaching, erosion and phosphorus fixation are estimated. It was calculated that for every one tonne per hectare of fruit yield, the total nutrient replacement figure under normal growing conditions is approximately: nitrogen 3 kg, phosphorus 1 kg, potassium 4 kg, calcium 1 kg and magnesium 0.5 kg.

In acid soils apply lime during the winter. Use dolomite if magnesium is lacking.

## IRRIGATION

Unlike many other tropical fruit crops mangoes do not require supplementary irrigation in northern NSW, although watering of young trees during their establishment phase can be beneficial.

## PESTS AND DISEASES

This subject is not covered in this Agfact due to constant changes in pesticide registration approvals. An Agnote 1/005 titled *Mango pest and disease guide: North Coast* is available.

## HARVESTING

Grafted trees may carry a few fruit in their second year. Full production may not be reached for 8 to 10 years.

Mangoes are clipped from the tree in an unripe but mature condition. Tree height and shape should be such that the majority of fruit is harvested from the ground. Picking ladders and poles are used on taller trees. Growers with large plantings may use various types of picking platforms.

KPs are ready for harvest when the background fruit colour changes from a bright green to a dull greenish yellow, the blush intensifies, the beak fills out and the flesh colour is almost all yellow. However, some growers 'colour pick' more mature fruit.

Harvest mangoes with long stems of at least 5 cm to stop fruit spurting sap and minimise the downgrading of otherwise good quality fruit due to sap burn.

Place harvested fruit in the shade to reduce the buildup of field heat. Do not overfill picking bags or field lugs and be careful not to break the long fruit stalks.

## GRADING AND PACKING

Growers use many systems to de-sap fruit, postharvest treat for pest and disease control, grade and pack. One example follows.

Prior to destalking, dip the field lugs in a solution of water and an approved detergent to minimise skin damage due to sap burn. Then place the destalked fruit stem-down on mesh sheeting to drain the sap for around 30 minutes. Wear gloves to protect your skin from sap burn. Some people are very sensitive to the caustic mango sap.

Before grading, spray fruit with a fungicide to control anthracnose disease as the fruit ripens. If fruit is being marketed in Victoria, dipping in an approved insecticide is required for fruit fly control. A drying tunnel or fans can be used to dry fruit. Do not pack wet fruit as skin browning may occur.

Brushes on the grader polish the skin and enhances the fruits bloom. Fruit are usually graded into 3 quality grades: first grade, second grade and processing fruit, depending on the type and size of blemish.

Fruit sizes for KP range from extra large 10–12s, large 14–16s, medium 18–20s and small 22–25s per single layer tray. Trays contain around 7 kg of fruit.

Mangoes are pattern packed in trays using plastic inserts with moulded cups. Packs should be firm to avoid fruit movement during transport. Pack fruit so the coloured cheek is showing. Fruit stickers are used to indicate variety, brand name and Price Look Up (PLU) number.

Following packing, pre-cool fruit to 10 to 12°C for no more than 3 days. The best transport temperature for a 1 to 2 day trip is 12 to 16°C.

Mangoes can be ripened either at the markets or on-farm using ethylene. Using the 'shot system' ethylene is injected at 200 ppm twice in 24 hours. Ventilate the room for 10 minutes between shots to remove the build-up of carbon dioxide. Keep the humidity above 85% to reduce moisture loss from fruit. The best ripening temperature is 18 to 22°C. Temperature control is important for full flavour and skin colour development, so avoid temperatures above 24°C. Mangoes will be ripe for eating in 5 to 9 days.

If you are selling your fruit through a market agent it is important that you communicate regularly and

visit the markets. In this way you know what your agent wants and you can supply him accordingly. Local grower markets and roadside stalls are gaining in popularity.

## QUALITY ASSURANCE SCHEMES

Quality Assurance (QA) is a term used to describe all the practices that give a business and its customers confidence that the product produced will consistently meet specified food safety and quality standards.

There are three levels of QA schemes in horticulture. Since most fresh horticultural produce is considered low risk an Approved Supplier Program such as FreshCare, which focuses on specified practice in production and handling, will in most cases suffice. However, some growers may prefer a higher level HACCP plan or a Certified QA System, for example, SQF 2000 or ISO 9002.

Growers of all horticultural produce are now obligated to have a QA system in place. For new growers training in QA is available.

## FURTHER INFORMATION

For further information contact the author or your district horticulturist. The *Mango Information Kit* is an excellent publication and is available from the Queensland Department of Primary Industries on 07 54449690.

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### ALWAYS READ THE LABEL

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

### DISCLAIMER

The information contained in this publication is based on knowledge and understanding at the time of writing in September 2004. However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up-to-date and to check the currency of the information with the appropriate officer of NSW Department of Primary Industries or the user's independent adviser.