

# Cashew information kit

Reprint – information current in 1999



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For updated information please call 13 25 23 or visit the website [www.deedi.qld.gov.au](http://www.deedi.qld.gov.au)

This publication has been reprinted as a digital book without any changes to the content published in 1999. We advise readers to take particular note of the areas most likely to be out-of-date and so requiring further research:

- Chemical recommendations—check with an agronomist or Infopest [www.infopest.qld.gov.au](http://www.infopest.qld.gov.au)
- Financial information—costs and returns listed in this publication are out of date. Please contact an adviser or industry body to assist with identifying more current figures.
- Varieties—new varieties are likely to be available and some older varieties may no longer be recommended. Check with an agronomist, call the Business Information Centre on 13 25 23, visit our website [www.deedi.qld.gov.au](http://www.deedi.qld.gov.au) or contact the industry body.
- Contacts—many of the contact details may have changed and there could be several new contacts available. The industry organisation may be able to assist you to find the information or services you require.
- Organisation names—most government agencies referred to in this publication have had name changes. Contact the Business Information Centre on 13 25 23 or the industry organisation to find out the current name and contact details for these agencies.
- Additional information—many other sources of information are now available for each crop. Contact an agronomist, Business Information Centre on 13 25 23 or the industry organisation for other suggested reading.

Even with these limitations we believe this information kit provides important and valuable information for intending and existing growers.

**This publication was last revised in 1999. The information is not current and the accuracy of the information cannot be guaranteed by the State of Queensland.**

This information has been made available to assist users to identify issues involved in cashew production. This information is not to be used or relied upon by users for any purpose which may expose the user or any other person to loss or damage. Users should conduct their own inquiries and rely on their own independent professional advice.

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Queensland Government



# *Growing* **THE CROP**

*This section is our recipe for growing and marketing a commercial crop of cashews. To keep this section as brief as possible and easy to follow, we provide little explanation with the recommendations. Where more information may help, we refer you to other sections of the kit. Symbols on the left of the page will help you make these links.*

*Our recipe is based on the research results and experience from the two major cashew plantations in Australia. Cashew production is still in its infancy in this country and, as a relatively new industry, changes in growing practices will occur.*



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# Important cashew terms

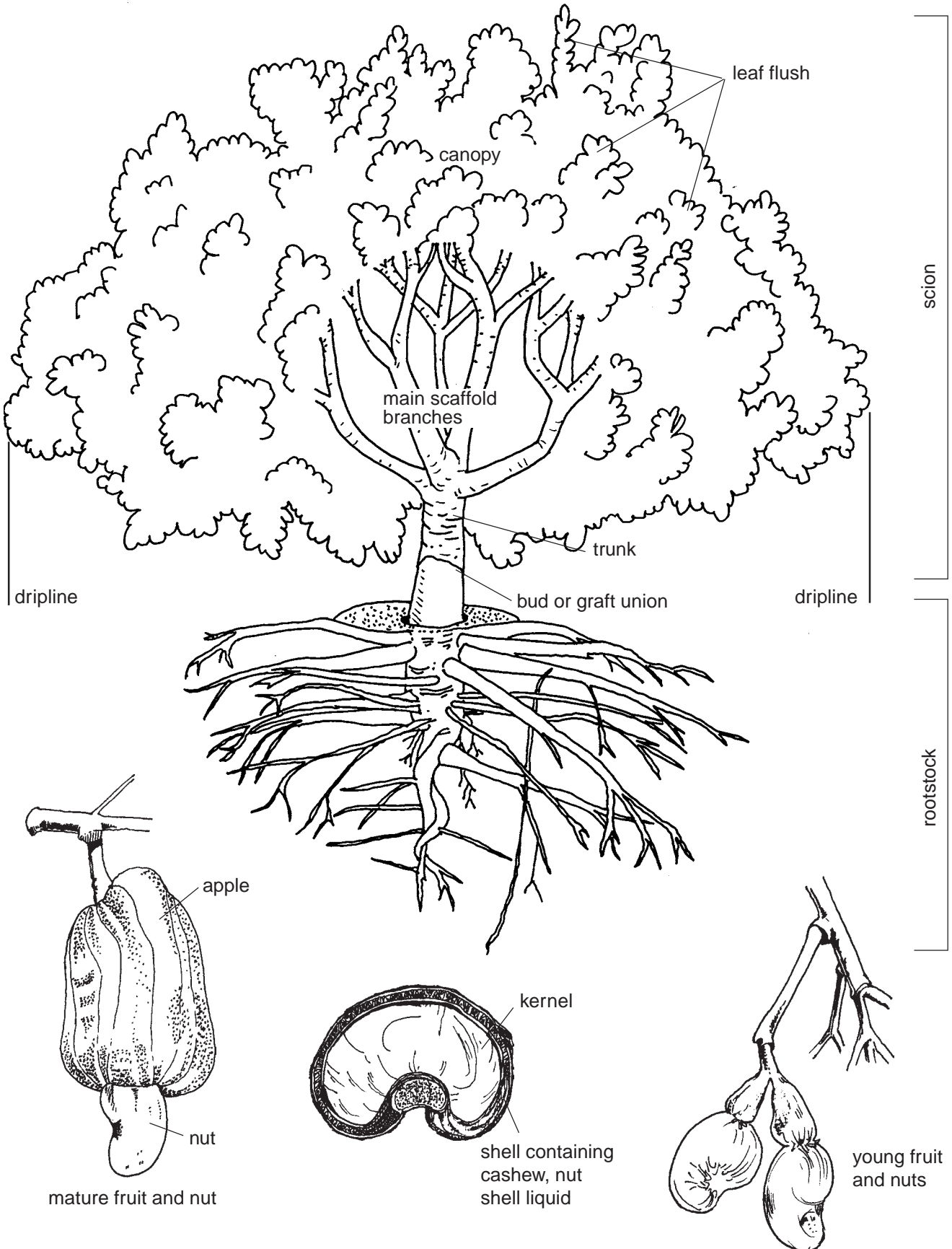


Figure 1. Parts of the cashew tree, and the cashew apple and nut



## Getting the plantation started

*Setting up a plantation that will be profitable in the long term requires careful planning because mistakes made at this stage are difficult and costly to correct. There are 15 important steps. The time taken to complete these steps will be different for each site, but you should allow 18 months between ordering the trees and the planned date of transplanting, and at least 1 month between applying pre-plant fertilisers and transplanting.*

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### Choose the site

The location of the plantation should be chosen with care. The soil type and climate must suit the growth requirements of the crop, there should be adequate good quality water for irrigation, and there should be year-round accessibility for marketing the crop, for employees and for on-farm services.

## Soil

Cashew prefers a free draining, light textured, deep soil. Sands and sandy loams to loamy sands that have no compacted horizons to restrict root growth for at least 2 m are ideal. Avoid locations with rocky soils, steep slopes, poor drainage or swampy sites, and areas where the watertable is closer than 1 m to the surface. Machinery access to the plantation is required throughout the year.

Although cashew can tolerate soils of low fertility, such soils will require more fertilisers for optimum growth and yield than soils of moderate to high fertility. Get a soil test done. The ideal soil is moderately acidic to neutral with a pH between 5.5 and 7.5. Avoid soils with a pH above 8.0.

## Climate

Cashew prefers a frost-free, tropical climate where the mean monthly minimum temperature does not drop below 10°C. Temperatures in excess of 40°C can be tolerated, but irrigation will be needed for optimum yield in climates with prolonged high temperatures. Locations in Australia north of 17°S latitude are the most suitable.

Prolonged rain periods will spoil the quality of the kernel because the nut germinates readily in continuously wet conditions. For ease of harvesting and to ensure good quality of nuts, cashew should be grown in a seasonally wet/dry climate where the dry season coincides with nut fall.

## Water

Cashews can be grown without irrigation but yields will be poor. An adequate supply of good water during the dry season is essential for economically viable yields in Australia. The average water requirement is 16 000 L/tree/year, which is the equivalent of 3.5 ML/ha/year. Mature trees will need between 250 and 500 L/tree/week throughout flowering and fruit setting. Plan for sufficient on-farm storage capacity as dams or as licensed pumping rights from rivers or underground sources.

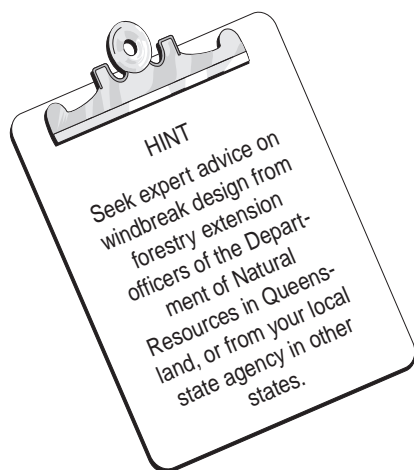
Get the water quality tested. Ideally, the electrical conductivity of the irrigation water should not exceed 0.8 deciSiemens per metre (dS/m).



## Plan the plantation layout

Planning the plantation is a complex procedure and we recommend that you get some expert assistance. In Queensland, this is available free from land conservation extension officers of the Department of Natural Resources. In other states, consult your local agricultural agency.





Get a map of the intended plantation site and mark on it existing features (roadways, standing timber, gullies, slope, direction, etc). Then develop on it a plan showing access roads, buildings, windbreaks, tree rows, surface drains to control runoff, dam sites and so on. The aim is to achieve maximum productivity with minimal environmental impact. There are 9 important things to consider:

**Provision for windbreaks.** Windbreaks are vital because strong winds can cause structural damage to the tree. Plan to plant the windbreaks on at least the sides from which the most damaging winds come. Use existing stands of timber where possible, otherwise plant windbreaks well before the plantation is established. Windbreaks are also useful as roosts for flying foxes, for erosion control and as insecticide spray filters.

Flying foxes can remove significant amounts of fruit from the plantation. The presence of tall trees around the plantation provides landing sites for flying foxes and large numbers of nuts are found under these trees. Flying foxes take the cashew apples and fly with them to the nearest roosting site. After they have eaten the apple, the nut will fall to the ground below the roost site. These nuts can then be harvested. Temporary windbreaks such as bana grass are a good idea when the trees are young.

**Provision of firebreaks** Cashews are prone to damage from fires as they accumulate a considerable quantity of dry leaves under the canopy. Fires that are common in northern Australia during the dry season can sweep through a plantation and damage flowers and young fruit that are on the tree. Even if the trees are not killed, you will probably lose a full year's crop. Firebreaks, which can double as roads, are essential on all borders and headlands. A 10 to 15 m wide strip around a plantation should be kept free of vegetation.

**Surface drains.** Uncontrolled water runoff removes valuable topsoil and exposes roots to desiccation. It may also pool within the plantation, causing waterlogging and root rot. Drains are necessary to safely carry water through the plantation. A drainage system normally consists of a diversion drain at the top of the plantation, contour drains or v-drains within the plantation, and stable waterways to carry the water to a dam or watercourse.

**Slopes.** Slopes of up to 10% are preferred, as these are less susceptible to soil erosion, allow flexibility with row layout, and enable tractors and machinery to be operated safely across the slope. Slopes greater than 10% should be avoided, but if used, require specialised design advice.

**Row direction and length.** Try to run rows in a north-south direction where possible. Row direction, however, should suit the design needs for erosion control and of the irrigation system. On slopes of up to 10%, rows can be run across the slope or up and down the slope. On slopes



above 10%, rows must be run up and down the slope to allow safe machinery operation. Try to get long rows as these are preferred for machinery efficiency but some breaks in the rows help for efficient harvesting.

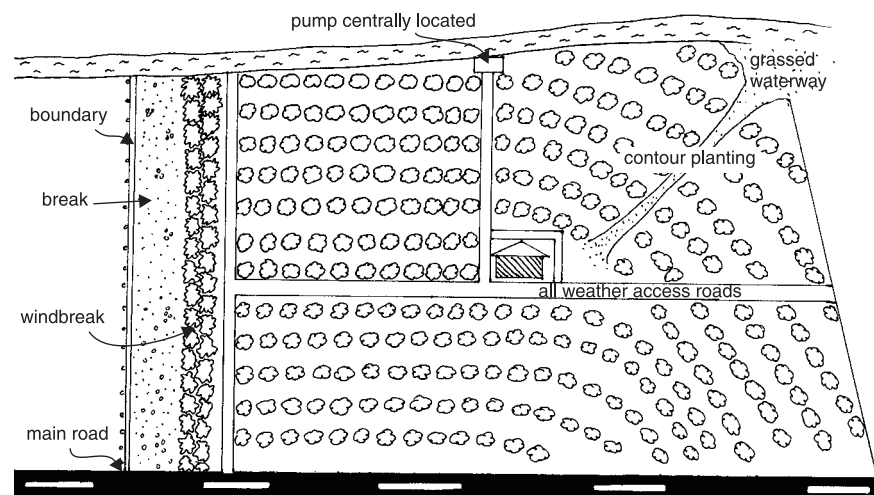
**Watercourses.** Gullies, creeks and depressions should be disturbed as little as possible. Leave a buffer of trees along gullies and creek banks to keep them stable. Do not plant trees where runoff naturally concentrates in gullies or depressions.

**Roadways.** It is important to have all-weather access to the plantation for spraying, harvesting and other operations. Locate access roads on ridgelines wherever possible.

**Irrigation layout and location of dams and mainlines.** Irrigation is required for economically viable yields. Plan the water supply and storage locations. Professional advice on dam location and construction should be sought from water field officers of the Department of Natural Resources in Queensland, or from your local state agency in other states. A qualified irrigation designer should be consulted to draw up an irrigation design showing the best location and sizes of pumps, filtration systems, mainlines, and in-field irrigation lines.

**Machinery buildings and processing plant.** The machinery buildings and processing plant should be centrally located to minimise travelling time during farm operations.

An example of how these important elements are integrated into a plantation design plan is shown in Figure 2.



**Figure 2.** An example of a plantation design plan showing windbreaks, firebreaks, surface drains, watercourses, buildings and roadways



## Choose varieties and tree spacing

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### Varieties

A large number of selections and hybrids have shown potential under test by the Department of Primary Industries in Queensland (DPI), the Northern Territory Department of Primary Industries and Fisheries (NTDPIF), CSIRO in Darwin and commercial growers (Cashews Australia and Cashews NT). While these varieties are not commercially available, it is anticipated that superior varieties adapted to Australian conditions will be released in coming years.

Suitable varieties have an upright intensive branching habit, high nut-in-shell (NIS) yield capacity, large nut (5 g or more) and a high kernel recovery percent (30% or more).

Promising varieties can be obtained either as budwood for on-farm propagation or as grafted trees. They include KAM 6, KAM 2, 9/14, and Guntur, all of which are available through DPI, Queensland and NTDPIF. Hybrids from the hybrid breeding program are available from CSIRO, Darwin under a testing agreement.

### Row and tree spacing

Trees are usually planted in large, single variety blocks. Although new work indicates interplanting of varieties may increase fruit set and size, firm recommendations cannot be made at this stage.

The most common spacing is 8 m between rows, with 6 m between the trees within the row, giving just over 200 trees/ha. The tree canopy will start to touch along the rows by the time trees are 4 to 6 years old. You will need to start your canopy management program, which will include regular pruning, by the fourth or fifth year if you choose this spacing.

Alternatively, you can use a wider spacing such as 8 m x 10 m or 12 m x 12 m. The advantage of these wider spacings is that you delay the need for major canopy pruning for several years. You would also have slightly lower establishment costs, but you would sacrifice early yields.

A system of closer spacings, 3 m x 8 m with subsequent tree thinning, has been used overseas and has some advantages in developing the bearing canopy more quickly. The cost benefits of this system have not been tested in Australia but it has the potential to increase yields and cash flow in the early years of the plantation. However, if you use closer spacings, it is essential that you remove trees from the fourth year or when required. If you are unsure about this, plant at the wider spacings.



## Order trees

Once you have chosen your varieties and worked out your row and tree spacing, calculate your tree requirements. Cashews can be propagated from seed or by grafting. The latter is preferred because seedlings do not come true-to-type.

Order your grafted trees. If you are propagating your trees, order the budwood and rootstock seeds at least 18 months before the planned date of planting.

Nursery production of trees is a specialist job so you should carefully plan the nursery facilities you will need to propagate your trees.

## Nursery propagation

Rootstocks are grown from seed planted individually in a sand/soil/peat potting mix in a 3 L poly bag. Grow the seedlings under 50% shade. It is important that rootstocks are growing vigorously. Keep the pots adequately watered and apply slow release fertilisers at prescribed rates.

Rootstocks can be grafted when they are 4 to 10 weeks old and growing vigorously. The scion wood should be semi-mature shoots that have swollen apical buds. The best time to graft is when night temperatures do not fall below 20°C. Wedge and side grafting techniques are used successfully. A plastic bag is placed over the scion and graft union and plants placed in a humidity tent until the graft takes.

Harden the trees to full sun before you plant them in the field.

## Clear the land, leaving appropriate windbreaks

Start any clearing at least 12 months before the planned date of planting. Identify and mark strategically placed existing stands of timber to act as windbreaks. Before clearing, get professional advice from forestry extension officers of the Department of Natural Resources in Queensland, or from your local state agency in other states.

Clear and stick rake the land where necessary. It is important that stumps and all timber residues are completely removed or broken down to minimise infestations of termites, a major pest of cashew. Stack the timber into windrows for burning. Don't push it into gullies and depressions. Leave gaps in the windrows every 30 m to allow safe removal of runoff water.

## Control termites

Termites can be a major problem, particularly in the Northern Territory. Destroy existing termite colonies and any subsequent evidence of termite activity. Deep ripping will disturb termite colonies and baiting with Mirex® (WA only) or Mirant® (NT only) at this time will control termites. While there are several promising alternative bait



toxins to Mirex® and Mirant®, none is registered for use at this time on plantation crops; it is up to the chemical companies concerned to complete the processes involved for registration.

## Install infrastructure

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### Major roadways and buildings

Construct the major access roadways to the plantation and those within the plantation. The main machinery buildings and staff accommodation should be constructed at this time. For stand-alone operations, a processing plant will be needed where postharvest cleaning, deappling, drying, bagging and storage of nuts is completed. The location of the processing plant should be marked on the plan of the plantation, but its construction will not be needed until the trees start to produce marketable quantities of nuts about 3 years after transplanting.

### Main diversion drain above plantation

On sloping land, construct a major contour diversion drain above the plantation to divert water into a stable waterway or dam. The drain should have a gradient of 1 to 5% and be large enough to handle the peak water flows from the catchment above. Keep the steeper sections of the drain furthest from the waterway or dam unless you have very stable clay soils. Establish a creeping grass such as carpet grass, couch or African star grass in the drain channel to prevent scouring.

### Plant windbreak trees

Cashew trees develop a large canopy relative to their roots, and are easily blown over in strong winds, particularly when the soil is wet from heavy rains. Plant windbreaks to:

- minimise wind damage to the plantation
- reduce chemical drift
- provide a better environment for pollinators
- improve irrigation efficiency (less evaporation), drift losses and placement of irrigation water.

Windbreak trees throughout the plantation also act also as roosts for flying foxes, which can otherwise remove significant amounts of fruit from the plantation.

Where it is necessary to plant windbreak trees to supplement natural timber, plant trees at least 10 m from the cashew tree rows to allow machinery access and to reduce competition for water and nutrients. Temporary windbreaks such as bana grass can be used while the trees are young. Seek advice from forestry extension officers from the Department of Natural Resources in Queensland or from your local state agency in other states.



When planting windbreak trees, deep rip rows to a depth of at least 60 cm before planting. If ripping downhill, lift the toolbar every 30 m to prevent water scouring down the rip lines. Plant the trees 4 m apart. Mulch well with coarse straw if it is readily available. Install a separate irrigation line to keep the trees well watered. Regular applications of small quantities of a mixed tree fertiliser will promote rapid growth. Maintain a weed-free area around the trees.

### Install major irrigation structures

Install the major irrigation structures, such as dams, mainlines and sub-mains of the irrigation system, on the basis of the irrigation design plan prepared by a qualified irrigation designer.

## Level the land and mark out the rows

### Level the land

For efficient mechanical harvesting, the area between the rows needs to be free from major hollows, sticks and stones. Now is a convenient time to remove remaining sticks and stones, and to fill in hollows that may have been produced during land clearing, planting the windbreaks, building the roadways and diversion drains, and installing the irrigation mainlines and sub-mains.

### Mark out the rows

On slopes, rows across the slope are marked parallel to a surveyed key line. Wire is tightly stretched between two people at right angles to the key line and points marked every 20 m along the row (Figure 3). Rows up and down the slope are usually marked at right angles to the contour or parallel to the longest row.

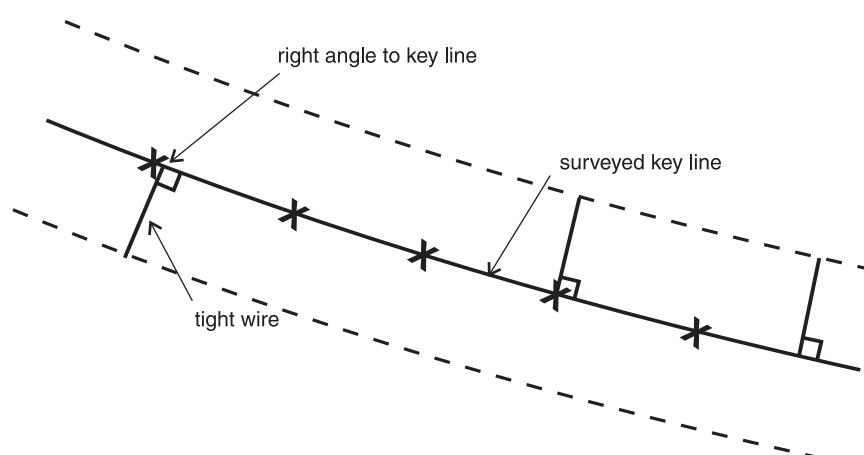


Figure 3. Marking out parallel rows across a slope

## Deep rip along the rows

For land that has been cultivated or grazed, deep rip to a depth of at least 60 cm along the rows. Ripping will also assist with the drainage of wet areas. If ripping downhill, lift the toolbar every 30 to 40 m to avoid subsequent water scouring down the rip lines.

## Build contour drains to control runoff within the plantation

Uncontrolled overland runoff of water can result in loss of topsoil, exposure and drying of surface roots, and washing away or burying of nuts. Poor drainage can cause waterlogging and result in poor growth or death of trees. Trees should not be planted in areas where runoff concentrates or in natural drainage lines or depressions.

Within the plantation, contour drains are used to control overland flow of water and to provide drainage. Build major contour drains at least every 50 m or so down the slope. These are built to similar specifications to the main diversion drain above the plantation.

Immediately after building the contour drains, grass all disturbed areas to minimise erosion.

## Do a soil analysis and order pre-plant fertilisers

Soil samples should be collected and analysed at least 6 months before the planned date of transplanting. The laboratory analysing your sample will interpret the results. As a guide, the optimum soil nutrient levels to aim for are shown in Table 1.

**Table 1.** Suggested nutrient levels in the soil

Parameter	Level	Notes
pH (1:5 water)	6.0 – 6.5	satisfactory
Electrical conductivity (dS/m)	<0.15	low (good)
	>0.30	medium (undesirable)
Phosphorus (bicarbonate) (mg/kg)	<30	low
	30 – 50	adequate
	>50	high
Potassium (cmol <sup>+</sup> /kg) *	<0.1	low
	0.2 – 0.4	adequate
Calcium (cmol <sup>+</sup> /kg)	1.6 – 1.8	adequate
Magnesium (cmol <sup>+</sup> /kg)	0.2 – 0.3	adequate
Zinc (mg/kg)	<0.5	low
	0.5 – 1.0	marginal
	>1	adequate
Copper (mg/kg)	<0.3	low

\*centimole/kg

Based on the result of the soil test, fertilisers may need to be applied to overcome problems associated with soil pH and nutrient deficiencies. Discuss the results of your soil analysis with your farm supply agent and work out what fertilisers are required for at least the first 12 months growth of the young tree.

Fertilisers with low solubility, such as lime, dolomite, gypsum, superphosphate, copper and zinc, must be applied pre-plant, about 1 month before transplanting, and must be well incorporated into the topsoil. In most soils, these pre-plant fertilisers would usually supply all nutrients except nitrogen and potassium, which can be supplied by more soluble fertilisers with the irrigation water (fertigation) in the weeks after transplanting.

### **Apply pre-plant fertiliser, cultivate strips along tree rows**

About 1 month before transplanting apply the less soluble fertilisers such as dolomite and superphosphate as a strip down the planting row. Cultivate a 2 m wide strip along the tree rows. As well as incorporating the fertiliser, cultivation along the tree row aids tree establishment and reduces initial weed competition. Tined implements or a rotary hoe are preferred for cultivation. Do not overuse a rotary hoe as it can lead to soil compaction and soil structural problems, as well as causing later settling of the tree row below ground level. This settling may cause subsequent soil erosion from water movement along the row.

### **Mark out the tree plant sites**

Mark out the tree plant sites with a peg.

### **Install the in-field irrigation system**

For the first year, the lateral irrigation lines should be left on the ground. Before starting mechanical harvesting, the laterals can be lifted and placed in the crotch of the trees to facilitate access under the tree for harvesting and weed control.

Install the in-field irrigation system on the basis of an irrigation design plan prepared by a qualified irrigation designer. Soil type needs to be considered in relation to the discharge rates of various emitters and sprinklers, the infiltration rates of the soil, and the design rooting depth. There are several irrigation options:

**Under-tree minisprinklers fitted with a micro-spray feature.** The micro-spray feature is used to limit water throw to a diameter of about 2 m for young trees, but allows the throw to be increased as plants grow towards maturity when the wetted area should be about 5 m in diameter. Use sprinklers with an output of 50 to 80 L/hour, to give a precipitation rate of about 5 mm/hour. When designing the irrigation system, remember to allow capacity for the extra sprinklers to water your windbreak trees.

**Drip and drip tape** irrigation systems will apply less water, will cost less to install but require more careful management and monitoring of soil water status.



**Trickle irrigation** using pressure compensated dripper emitters. A single 8 L/hour dripper installed at each tree is adequate for young trees. As the trees approach maturity, additional drippers — up to 4 drippers per tree — may be required. The 4 drippers should be equally spaced from the tree, the spacing depending on soil type and the lateral spread of water from the drippers.

**T-tape trickle systems.** The tape may be buried or left on the soil surface, but buried tape may present problems from root intrusion. For young trees, use one row of tape. When trees are about 3 to 4 years old, a second row of tape is installed on the other side of the tree row. Trickle systems need to be very well designed to operate effectively and must be properly maintained to prevent blockages. High level filtration with sand filters is essential.

## Plant the trees

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Trees ready for planting should have good leaf colour, be free from pests and diseases, and be hardened to full sunlight. If trees are not sun-hardened, gradually condition them to full sunlight over a 2-week period. Avoid trees that are stunted, root bound or yellow.

Nursery hardening off should include:

- reduced fertiliser and water
- reduced nursery shading
- reduce nursery density by spreading pots out.

## When to plant

In coastal areas where mean monthly temperatures rarely fall to less than 20°C, transplanting can begin as soon as the major wet season has passed. In inland areas where minimum temperatures are lower during the winter dry season, begin transplanting in spring or towards the end of the wet season before minimum temperatures prevent rapid establishment and growth.

## Planting procedure

One to two days before planting, water to thoroughly wet tree sites to a depth of 30 cm. Do not plant trees during the hottest part of the day. Follow these steps for planting:

1. Water pots well 1 or 2 days before planting.
2. Dig a hole slightly deeper and wider than the bag. Do not use posthole diggers or augers. Do not place fertilisers or organic materials in the hole.
3. Remove tree from bag. Examine the root ball and straighten or trim any large roots sticking out at the bottom. Gently tease out the roots at the bottom of the root ball and shake away a little of the potting mix from the fibrous roots at the top of the root ball.



4. Place tree in hole so that the graft union is as high as possible without having any roots exposed.
5. Backfill the hole with soil, ensuring good contact between backfill and the root ball and firm it down. Do not use your feet. Water thoroughly to soak the root ball and surrounding soil. This helps to bring the soil into close contact with the root ball.
6. Where mulch is available, apply coarse mulch such as sorghum stubble, straw, cotton gin waste or similar to a depth of 15 cm. Keep the mulch 10 cm away from the trunk.
7. Water the trees twice a week for the next four weeks.

### **Staking**

Good growing conditions in the field can lead to rapid shoot growth relative to root growth. This may result in poor anchorage that may cause the plant to tilt or fall over in wet, windy weather. Young plants may need to be staked for about 12 months until they are well established. Considering the high costs of staking, selective staking is an option. Try just staking those trees that are already leaning over.

Trees need staking when:

- the planting site is exposed to strong winds;
- the stem is not strong enough to remain upright; (The stem is lanky because, in the nursery, it was left for too long, was growing in over-crowded conditions or it was over-fertilised.)
- there is excessive canopy growth after planting. (The roots provide insufficient anchorage, particular in wet windy conditions, because the soil is moist and the canopy carries additional weight of rainwater. Over-fertilising with nitrogen can promote excessive canopy growth.)



## Managing young trees

*Cashew is a very precocious tree and will often come into bearing during the first year after transplanting. However, the pattern of producing new vegetative growth (flushing) and flowering and fruit set is irregular until about 2 or 3 years after transplanting. During this time, the tree is classed as being in a juvenile phase of growth.*

*The aim, during this phase, is to grow a strong, healthy canopy of branches and leaves that will be able to produce well into the future. Of the 5 important operations that must be attended to, controlling insect pests, fertilisers, and water are of major importance.*

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Control weeds .....	24

### **Pest and disease management**

#### **Vertebrate pests**

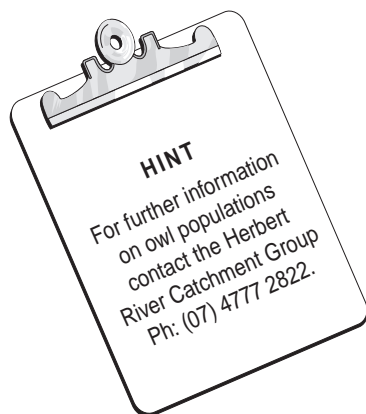
Vertebrate pests such as pigs and rats can be a problem. While pigs can cause localised destruction, rats can cause widespread damage to poly-irrigation pipes and fittings, resulting in high labour and material repair costs.

#### **Rats**

Rat control is best achieved by a combination of:

- grass/weed control
- strategic baiting
- encouraging owl populations.

Grass and weeds provide habitats for rats and shelter from predators. Grass control is the most important strategy to deter rat activity within the plantation because high rat populations usually exist in habitats outside the plantation. Headlands adjacent to the plantation should



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be maintained as 'low grass' buffer areas 10 to 15 m wide. Rats moving across these areas will be exposed to predators. Grass and weed growth within the plantation should also be regularly controlled.

Baits strategically placed where repeated damage occurs (hot spots) can be a more economical and effective way of baiting. Baits are best placed in short lengths of 100 mm PVC pipe fixed horizontally in a tree at hot spots. This will prevent feeding by other animals.

Encouraging owl populations (in combination with grass control and strategic baiting) has been effective for controlling rats in some crops. This can be achieved by placing nesting boxes and perches in the plantation.

## Insects

To ensure that commercial production is achieved early, it is important to establish a bearing canopy as soon as possible. There are many insect pests that attack cashews and can delay the establishment of a bearing canopy. The major insect pests in Australia are:

- termites
- sap-sucking insects
- leaf-eating caterpillars
- leaf-chewing beetles.

Heavy infestations of some insects can kill trees (for example, termites), cause defoliation (red-banded thrips) or kill the new shoots (sap-sucking bugs). If insect pests are not adequately controlled, the development of a strong bearing canopy will be delayed.

**Termites** can be a major problem, particularly in the Northern Territory. Destroy existing termite colonies and any subsequent evidence of termite activity. Deep ripping will disturb termite colonies and baiting with Mirex® (WA only) or Mirant® (NT only) during land preparations will control them. While there are several promising alternative bait toxins to Mirex® or Mirant®, none is registered for use at this time on plantation crops; it is up to the chemical companies concerned to complete the processes involved for registration.

**Caterpillars and sap-sucking bugs.** These pests can be controlled effectively by several beneficial insects as well as biological and natural insecticides (for example, green ants, meat ants, spiders, beneficial bugs, mantis and lacewing larvae). Chemical sprays will still be needed at some time during the year to obtain full or adequate control.

The old approach to pest control was to apply routine calendar sprays. This approach had three main problems:

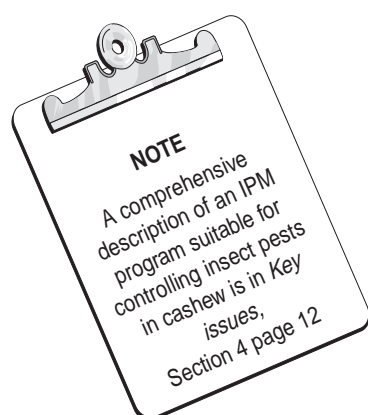
- It was a waste of money if the pests were absent.
- Even if pests were present, it disregarded the fact that plants can tolerate small numbers of pests without significantly affecting yield

and quality. In this case, the cost of spraying is greater than the benefit gained by controlling the pest.

- It increased the amount of chemical residue in both the fruit and the environment.

The modern approach to insect pest management involves checking the crop regularly to determine when pests are present. Only when they are present and at damaging levels, are chemicals or other control measures applied. This process of checking the crop to determine the need for control measures is called monitoring.

The system works around pre-determined pest action levels. The action level can be thought of as the point at which the damage is roughly equivalent to the cost of control. Monitoring enables pest levels to be measured and compared with the action levels. Control measures are applied only when the pest population approaches or reaches this action level. Monitoring then continues to allow pest populations to be managed at or below this action level. As well as the pests, the beneficial insects and mites that naturally attack the pests are also monitored because, in some cases, they alone will be sufficient to keep the pest populations under control.



Monitoring is a complex procedure and the use of professional pest monitoring services is recommended. Monitoring is an integral part of a strategy known as integrated pest management (IPM). IPM aims to reduce the reliance on chemicals by using a range of complementary pest management techniques such as biological control (beneficial parasites and predators of the pests) and cultural control (crop hygiene, etc). Chemicals can still be used within an IPM program, however, they are only used when necessary and preference is given to chemicals that are compatible with beneficial insects and 'softer' on the environment.

## Diseases

While there are several serious diseases of cashew that can cause loss of yield and even death of trees, none occurs in Australia. Some minor damage to leaves, shoots and apples caused by fungal organisms has been noted, but they do not cause serious problems and no control measures are required.

Anthraxnose is the only problem in Australia, and then only in wet areas.

## Fertilise the trees

Most soils suited for cashew in Australia are relatively infertile, and fertilisers will be needed for good growth and nut production. Cashew responds readily to fertilisers so apply too little rather than too much. Over-fertilisation causes excessive vegetative growth that produces a



Nutrition  
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weak framework and top-heavy trees that will lodge or be uprooted in wet, windy conditions. The types and rates of fertilisers will depend on soil fertility. Also, the rates will generally increase with tree age until the optimum canopy size is reached.

- Most soils will require nitrogen (N), phosphorus (P) and potassium (K), and if sensitive varieties are planted, zinc (Zn) also. Use soil and leaf analyses as a guide for developing and modifying a fertiliser program that will overcome any problems associated with pH of the soil and nutrient deficiencies. Your local farm supply agent can assist in designing a suitable fertiliser program based on the results of your soil and leaf analyses.

If soil and leaf analyses are not available, use the following recommendations as a guide.

### Year 1

The fertilisers you applied about a month before transplanting should supply sufficient nutrients other than nitrogen and potassium for the needs of the establishing tree for at least the first year. To provide adequate nitrogen and potassium, apply soluble fertilisers with the irrigation water (fertigation) in the weeks after transplanting.

To provide adequate nitrogen, apply up to 50 g nitrogen/tree by fertigation in two applications, the first within 1 month of transplanting and the second 6 months after transplanting. Forms of nitrogen that are suitable for fertigation include urea, ammonium nitrate, and mono-ammonium phosphate (MAP).

If potassium is required, apply up to 50 g potassium/tree by fertigation at the same time as the nitrogen is applied (that is in 2 applications, the first within 1 month of transplanting and the second 6 months after transplanting). Potassium chloride (muriate of potash) is a suitable form of potassium for fertigation.

If foliar symptoms of micro-nutrient deficiencies should appear during the first year, foliar application with insecticides is a satisfactory method of applying zinc (Zn), copper (Cu), boron (B), manganese (Mn) and molybdenum (Mb). Zinc may be needed more than once a year, but an annual application should be sufficient for the others. If applied separately, rates of application are shown in Table 2.

**Table 2.** Separate application rates for some micro-nutrients

Micronutrient product	Application rate
Zinc sulphate heptahydrate	0.50%
Copper sulphate	0.50%
Solubor	0.10%
Sodium molybdate	0.05%

If zinc and copper foliar sprays are being applied separately (not with insecticides), add 3 g calcium hydroxide/L to the copper sulphate and zinc sulphate heptahydrate sprays to prevent leaf burn.

An alternative method of correcting for deficiencies of boron and molybdenum is to apply Solubor and sodium molybdate through the irrigation water (every second year apply 2.5 kg Solubor/ha and 1 kg sodium molybdate/ha).

### Years 2 and 3

Juvenile trees have an irregular pattern of vegetative flushing, and the aim is to use the timing of fertiliser applications, particularly of nitrogen fertilisers, to encourage them towards a regular pattern of vegetative and reproductive growth. As a general rule, the less soluble fertilisers should be applied as a surface dressing spread evenly around the tree within the dripline, while the more soluble fertilisers can be applied by fertigation. The less soluble fertilisers (Table 3) should be applied at the beginning of the wet season. This means as much of the nutrients as possible can be moved into the soil during the wet season.

**Table 3.** Less soluble fertilisers for use on cashew

Fertiliser product	Element/s supplied
Lime	Calcium
Dolomite	Calcium and magnesium
Gypsum	Calcium and sulphur
Magnesium oxide	Magnesium
Single or triple superphosphate	Phosphorus, calcium and sulphur

A high analysis NPK fertiliser, (for example, 14% nitrogen : 14% phosphorus : 12% potassium boosted for sulphur and trace elements) can also be applied during the wet season to provide the tree's requirements for nitrogen, phosphorus, potassium, sulphur and trace elements. Supply additional nitrogen and potassium, if required, during the dry season by fertigation to encourage the trees towards a definite growth cycle. One fertigation in April/May, and again in August/September should be adequate.

If foliar symptoms of micro-nutrient deficiencies should appear, foliar application with insecticides can be made as listed in the previous section under year 1.

If soil and leaf analyses are not available, use the rates in Table 4 as a guide only. They are based on experience from two cashew plantations in Australia and data from responses to fertilisers in overseas countries. You should modify them according to how your trees respond and to your own experience; this will be made easier if you keep good records of your fertiliser applications.

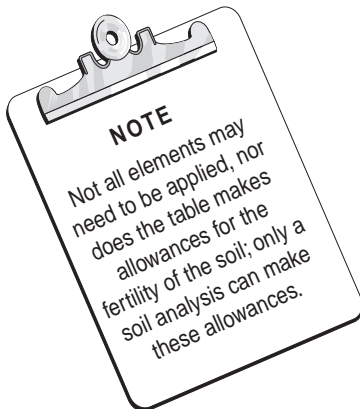


Foliar applications  
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**Table 4.** Recommended rates of elements for healthy growth of juvenile cashew trees

Element	Year 2 (g/tree/year)	Year 3 (g/tree/year)
Nitrogen	200	400
Phosphorus	30	80
Potassium	150	400
Calcium	100	100
Magnesium	100	100
Sulphur	5	10
Iron	1	2
Manganese	0.2	0.4
Zinc	0.2	0.4
Copper	0.1	0.2
Boron	0.1	0.2
Molybdenum	0.001	0.001



## Water the trees

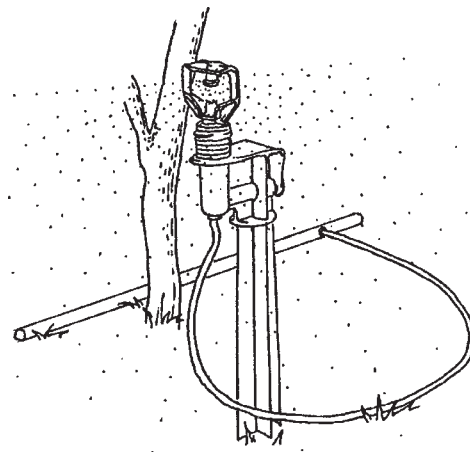
### Year 1

For the first dry season, apply about 20 L of water per tree twice a week for at least 4 weeks immediately after transplanting, and then once a week thereafter until the start of the wet season. If you are using minisprinklers, use the micro-spray mode to limit the spread of water. As the trees become established and start to grow vigorously, convert the sprinkler back to the mini-sprinkler mode to increase the wetted area and encourage rapid root spread. The set up for a minisprinkler watering system is shown in Figure 4 for young trees and in Figure 5 for larger trees.

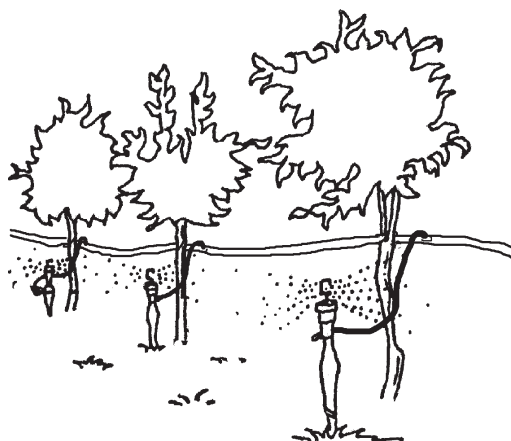
a key issue



Irrigation  
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**Figure 4.** Setup for mini-sprinkler watering system for young trees



**Figure 5.** Trees showing the lateral lines lifted in to the tree crotch. Make sure that piping is long enough to allow the lines to be lifted

### Years 2 and 3

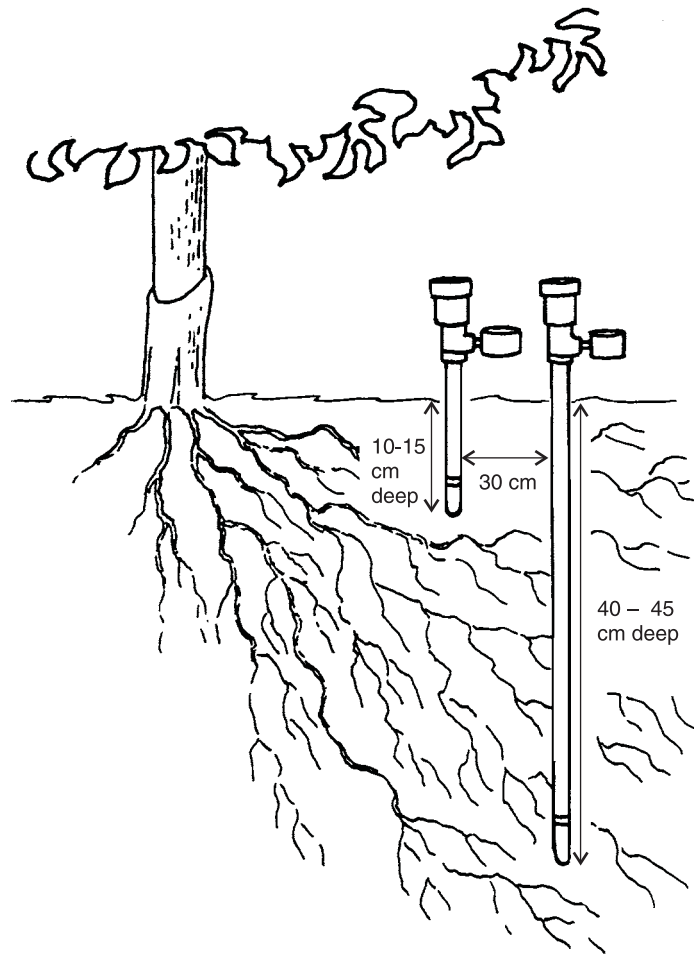
Once the trees are established and have grown large enough to support the lateral irrigation lines, it is best to lift these lines in to the crotch of the trees to allow access under the trees for harvesting machinery and for weed control.

During the second and third years, it is difficult to recommend a standard rate of watering because the amount of water required will depend on tree size, soil type and climatic conditions. Common sense is required, and irrigation management can be improved greatly by basing watering rates and frequency on a soil moisture monitoring system. There are three main monitoring systems, each with its pros and cons. The choice will depend on the degree of accuracy required and the available budget.

### Tensiometers

Tensiometers are positioned in the tree row about 1 month after planting (Figure 6). They are relatively inexpensive and can be installed and read by growers. However, they are inaccurate, particularly in dry soil conditions, and they do not effectively monitor the top 10 cm of soil. The value of tensiometers is also only as good as the grower's ability to regularly make the readings and to maintain the devices in good working order.

Position two tensiometers (one 30 cm long and the other 60 to 90 cm long) in each irrigated block to the depths shown in Figure 6. Place on the north-eastern side of a healthy tree, inside the dripline and where they will receive water from sprinklers. Read tensiometers in the morning before 8 a.m. Start watering when the shallow tensiometer reads 20 centibars (on sandy soils) and 30 to 40 centibars (on loam and clay loam soils). Stop watering when the reading on the deep tensiometer falls to 10 centibars. Reposition tensiometers every second year in winter to the new dripline position. Once a week, remove any accumulated air and check that gauges are working using a vacuum pump. Refill tensiometers with clean water.



**Figure 6.** Installing tensiometers under trees

### **Neutron probe**

The neutron probe is a sophisticated device generally used by consultants to monitor and provide recommendations for watering. The consultant will set up several access holes in the plantation and bring the probe to these sites during the season. The neutron probe is more accurate than tensiometers but its value depends on how regularly the consultant visits and makes readings. It also has difficulty in accurately monitoring moisture in the top 10 cm of soil.

### **Enviroscan probe**

The Enviroscan is a continuous moisture-monitoring device based on capacitance sensors. The sensors are mounted on probes installed in PVC tubes, which are put in after the trees have been established. The sensors are connected by cable to a data logger with measurements being made automatically at regular intervals. The data from the logger is downloaded to a computer every few days to provide recommendations for watering. Although Enviroscan units are relatively expensive, they are more accurate than tensiometers and neutron probes because they allow continuous and regular monitoring of soil moisture. They also accurately monitor the top 10 cm of soil. We

recommend that you engage a consultant to help develop and fine-tune this system.

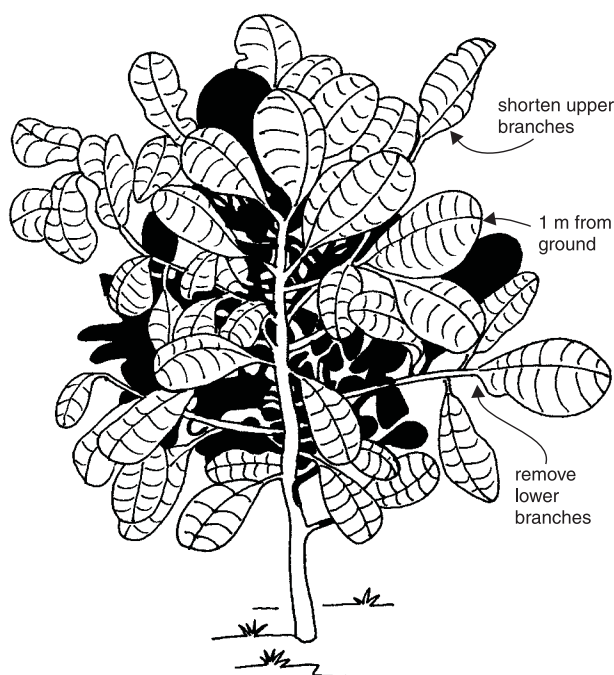
Remember that monitoring systems may not actually reduce water use but they will make watering more accurate to suit the seasonal needs of the trees. If these systems are not being used, Table 5 is a rough guide to the watering needs of trees during the second and third years. The table makes no allowance for rainfall or very dry weather; only the moisture monitoring devices can make this allowance.

**Table 5.** *Irrigating juvenile trees*

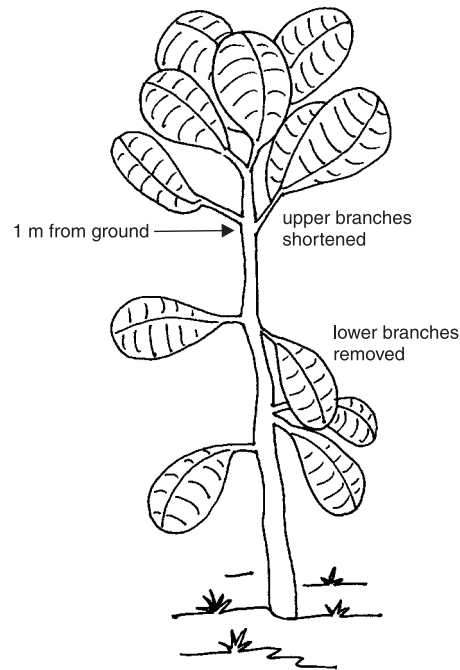
Tree age	March/April every 7 – 14 days	May/July every 10 – 14 days	August/December every 7 – 10 days
Year 2 (L/tree)	150 – 400	100 – 400	200 – 400
Year 3 (L/tree)	200 – 500	200 – 400	250 – 500

### Prune and shape

The type of pruning and shaping that occurs during the juvenile phase determines the type of tree for the remainder of the life of the plantation. Harvesting and other machinery requires easy access under the tree. Juvenile trees are pruned to promote a strong balanced framework of three or four primary branches developing at 1 m above the ground. This encourages numerous side branches. Select three or at the most four upright side branches spread evenly around the trunk to become the main branches. Shorten these branches to 45 cm and remove all other shoots (Figures 7 and 8).



**Figure 7.** *Unpruned tree*



**Figure 8.** Correctly pruned tree

After planting trees should be pruned every 2 to 3 months to remove lateral shoots. Trees often produce lateral branches at 1 m and if this does not occur they should be tip pruned at 1 m.

## Control weeds

Weeds compete for water and nutrients and may harbour pests, for example, rats. Even under very favourable soil and climatic conditions, young cashew trees develop much faster if weeds are controlled from the time of field planting. Good weed management considers the weeds in two zones:

- within the expanding rooting zone of the developing young tree
- outside the developing root zone.

### **Weeds within the root zone**

It is important to kill weeds within the root zone of the young tree. If mulch is available, mulching to about 15 cm deep in a ring about 1.5 m from the trunk will prevent weed growth and reduce evaporation of soil water. Keep the mulch 10 cm away from the trunk. If mulch is not available, chemical sprays or mechanical weeding will maintain a weed-free ring close to the trunk. If chemical weeding is used, apply only chemical weedicides that are registered for use on plantation crops.

**Weeds outside the root zone, between the rows**

Control weed growth in areas outside the developing root zone of the young tree by regular slashing to prevent tall weeds shading the young trees. Leave the stubble on the soil to prevent erosion or use it to mulch the young trees.

Alternatively, a non-climbing, low-growing perennial legume, such as *Arachis pintoii*, can be grown in the interrow to fix nitrogen for the benefit of the trees, and to control the growth of tall weeds.





## Managing bearing trees

*Between the third and fourth year after transplanting, trees develop a definite seasonal pattern of vegetative growth, flowering and fruit development. The focus of management now changes. Between the third and sixth year, the object is to increase the fruit-bearing surface rapidly while at the same time producing quality fruit. By the sixth year, when trees should have reached the optimum canopy size for the tree spacing, the main objective is to maintain maximum production of quality fruit.*

*Of the six important operations, controlling pests, fertilising and watering are of such importance that failure to complete any one of them can undo all the benefits of the others.*

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Water the trees .....	29
Control weeds .....	30
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### **Pest and disease management**

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#### **Insect pests**

Pest management of bearing trees is similar to that used for young trees. Although pest management was important during the years before the production of marketable crops, to maximise the yield potential of the tree from about the third or fourth year onwards, pests must be controlled. Cashew bears its fruit on current season's wood. The more new shoots that are produced, the greater the potential yield of the tree in that season. Any thing that damages new shoots, developing flowers and fruit will decrease the yield.

Heavy infestations of some sap-sucking bugs can kill new shoots and developing flower panicles. Control is most important from mid to late vegetative growth through to flowering and nut development. Likewise, heavy infestations of some beetles and leaf-eating caterpillars can defoliate new shoots. To protect the potential yield of your tree it is essential to control insect pests.



Insect pest  
management  
Section 4 page 12

## Diseases

While there are several serious diseases of cashew that can cause yield loss and even death of trees, none is in Australia. Some minor fungal damage to leaves, shoots and apples has been noted, but they do not cause serious problems and no control measures are required. Anthracnose is the only problem in Australia, and then only in wet areas.

## Fertilise the trees

Fertilisers required for the bearing tree will increase with tree age until about the sixth year when the canopy reaches the optimum size for the tree spacing. The rates and types of fertilisers depend on the level of soil fertility, nut yields, and the rate of growth of the trees. The monitoring program of soil and leaf analyses begun with the young trees should continue on an annual basis, or at least every two years.



## Time of application

The objective is to manipulate the time of application of nitrogen fertiliser to control the pattern of vegetative flushing, flowering and fruiting and so maintain the bearing tree in a definite growth cycle pattern.

Small amounts of nitrogen applied after nut drop has ceased, and before the onset of the main wet season rains, will promote an early vegetative flush, and begin the development of the shoots where next year's flowers and nuts will form. Be careful not to add too much nitrogen fertiliser at this time because heavy wet season storms can leach nitrogen beyond the root zone of the tree. Over-fertilisation with nitrogen also causes the development of long, weak growths that may break under the load of nuts later in the year or will need to be pruned to maintain a strong framework of branches.

Throughout the dry season, continue applying small amounts of nitrogen by fertigation to maintain and realise the yield potential of the tree. Australian experience suggests that optimum yields are obtained if nitrogen is applied once or twice at the beginning of flowering, and again, once or twice during fruit set. Stop applying nitrogen about midway through the main nut drop period to 'turn off' the reproductive process and ensure that spasmodic flowering and nut production does not continue into the next wet season.

As a general rule, the less soluble fertilisers should be applied as a surface dressing, spread evenly around the tree within the dripline, while the more soluble fertilisers can be applied by fertigation. Even spreading of fertilisers is important so as not to compromise soil analysis results.

The less soluble fertilisers (Table 6) should be applied at the beginning of the wet season. This means that as much of the nutrients as possible can be moved into the soil during the wet season.

**Table 6.** Less soluble fertilisers for use on cashew

Product	Element/s supplied
Lime	Calcium
Dolomite	Calcium and magnesium
Gypsum	Calcium and sulphur
Magnesium oxide	Magnesium
Single or triple superphosphate	Phosphorus, calcium and sulphur

A high analysis NPK fertiliser, (for example, 14% nitrogen : 14% phosphorus : 12% potassium boosted for sulphur and trace elements) can be applied also during the wet season to provide the tree's requirements for nitrogen, phosphorus, potassium, sulphur and trace elements. Supply additional nitrogen, and if required, potassium, during the dry season by fertigation.

If foliar symptoms of trace element deficiencies should appear, foliar sprays should be applied as soon as possible. An effective method is foliar application with insecticides.

### Rates

The rates of fertilisers required would depend on the fertility of your soil, tree size and health, and the amounts of nuts produced. Since nuts remove nutrients from the plantation, as a minimum, you should aim to replace the nutrients taken off in the nuts.

Use soil and leaf analyses to develop and modify your fertiliser management program. If soil and leaf analyses are not available, use the rates in Table 7 as a guide only. They are based on experience from two cashew plantations in Australia and data from responses to fertilisers in overseas countries. You should modify them according to how your trees respond and to your own experience; this will be made easier if you keep good records of your fertiliser applications. Note that:

- not all elements may need to be applied
- the table does not make allowances for the fertility of the soil or for local environmental conditions such as excessive leaching.

Only a soil analysis can make these allowances.



Fertilising young trees  
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**Table 7.** Recommended rates of elements for healthy growth and optimum yield of seasonally bearing cashew trees

Element	Year 4 (g/tree/year)	Year 5 (g/tree/year)	Year 6 & 6+ (g/tree/year)
Nitrogen	600	800	1200
Phosphorus	100	140	170
Potassium	600	800	1200
Calcium	200	300	400
Magnesium	200	250	300
Sulphur	20	30	45
Iron	4	6	8
Manganese	0.5	0.7	1
Zinc	0.6	0.8	1.2
Copper	0.2	0.3	0.4
Boron	0.3	0.4	0.5
Molybdenum	0.001	0.001	0.001

## Water the trees

Continue using the soil moisture monitoring devices (tensiometers, neutron probe or Enviroscan) recommended earlier for young trees as a guide to watering rates and timing.

If you are using tensiometers, use similar positions to those recommended there but place them deeper in the soil. Place the first tensiometer at a depth of about 25 cm and the second at a depth of about 60 cm.

Remember to read tensiometers before 8 a.m. each morning. Start watering when the shallow tensiometer reads 10 centibars on sandy soils or 35 centibars on heavy soils. Stop irrigating when the deep tensiometer reads zero. It is essential to maintain tensiometers in correct working order.

Alternatively, a cheap evaporation pan can be made from a cut-off, empty 44-gallon drum. Position the drum on level ground in an open location. Fill it with water to a marked position, and read the amount of evaporation that occurs every 7 days. As a first estimate, aim to apply 100% of the evaporation loss every 7 days.

If moisture-monitoring systems are not being used, Table 8, based on experience in Australian cashew plantations, can be used as a guide to watering. Remember that the figures in the table make no allowance for rainfall or very dry weather. Only the moisture monitoring devices can make this allowance.



Watering young trees  
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**Table 8.** Irrigating bearing trees from the fourth year onwards

Time of year by location		Growth stage	L/tree/application	Frequency (days)
Coastal (e.g. Darwin, Cairns)	Inland (e.g. Katherine, Dimbulah)			
April/May	April/July	pre-flowering and floral flush	minisprinklers: 400 – 500 drippers: 250	every 7 – 14 every 7 – 10
May/August	August/September	flowering and early fruit set	minisprinklers: 400 – 500 drippers: 250	every 10 – 14 every 7 – 10
September/ November	October/December	main fruit set and nut drop	minisprinklers: 500 drippers: 250	every 7 every 3 – 7

### Control weeds

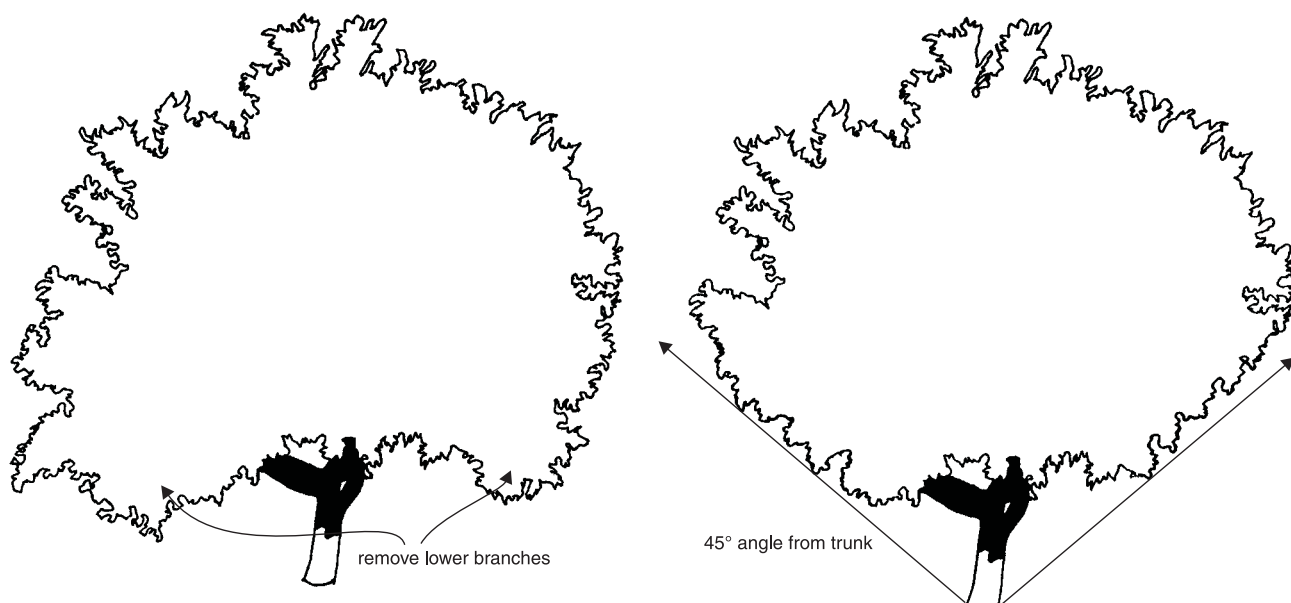
Weeds compete for water and nutrients and can impede harvesting. When fruiting starts, weed control should be extended to include the areas between the trees to provide a trash-free area along the row to facilitate mechanical harvesting. At this stage, boom sprayers applying chemical weedicides close to the ground surface to reduce spray drift are an economical method of controlling weeds. If chemical weeding is used, apply only chemical weedicides that are registered for use on plantation crops or fruit trees.

In the interrow areas, regular slashing should be used to control growth of grasses and weeds. Leave the stubble on the surface of the soil to assist in soil conservation by controlling overland movement of water.

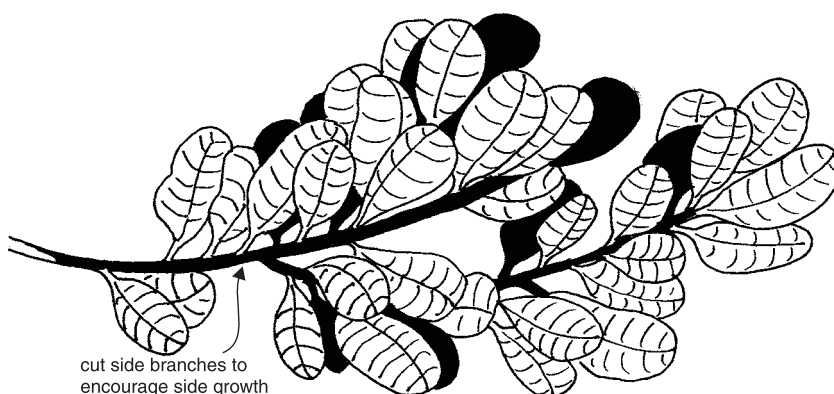
### Prune and shape the canopy

Prune seasonally bearing trees immediately after the last harvest of nuts and before the start of the first vegetative flush. The aim is to maintain a conical-shaped canopy that was developed during the young phase. Remove any shoots that grow on the trunk below the crotch and any lower branches that will hinder mechanical harvesting of the nuts or weed control. Unproductive inward-growing or dead branches should be removed. Prune overlapping branches from adjacent trees to allow better light interception and management of pests.

Based on the dimensions of current harvesting equipment (which requires access under the tree), side branches within a zone defined by a 45° angle from the base of the tree (Figure 9) should be removed. This is achieved by undercutting (Figure 10), which encourages upright growth. Do not prune to leave a stump ('hat peg'), but prune to remove the branch to its point of emergence.



**Figure 9.** Remove side branches from the area defined by a 45° angle from the base of the tree to encourage upright growth and to facilitate access for harvesters



**Figure 10.** Undercutting of side branches to encourage upright growth

### Topworking to a new variety

Topworking consists of grafting a different variety onto existing trees to change to varieties with improved yield or growth habit. The technique has been used overseas with varying results, but has not been tried widely in Australia to date. Its advantage is that it reduces lost production time compared with replanting.

The main branches of the tree are cut down to the trunk. Paint the cut surfaces, the trunk and any branches that are exposed to sunlight with a water-based paint to prevent sunburn. Make the cuts slanting downwards, to prevent rain or dew collecting on the cut surfaces and causing rotting of the branches. After new shoots have grown from the branches, select 3 or 4 shoots spread evenly around the branch and patch-bud or wedge-graft the new variety to the new shoots.



## Harvesting, postharvest handling and shelling

*Harvesting and postharvest handling systems must be designed to maximise the take-off of top quality nuts.*

Preharvest clean-up .....	32
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Postharvest handling .....	33

### Preharvest clean-up

A pre-harvest clean-up will be necessary to prepare the plantation for harvest. This operation promotes harvesting and postharvest handling efficiency and maximises nut pick-up and quality. Obstructive foliage and extraneous materials (grass, stones, and leaf litter) may require removal.

Deteriorated nuts from the previous season must be removed because they are difficult to separate from current season's nuts during postharvest cleaning and they lower the quality of the current harvest. The interrow ground surface may also require levelling before the start of nut drop.

After removal of low foliage and levelling of the ground surface, harvesting equipment is used to sweep the rows and collect nuts and extraneous materials that are subsequently discarded.

### Harvesting nuts

When mature, the cashew fruit (apple with nut attached) falls to the ground. The apple is highly perishable and, depending on air temperature and humidity, will either rot or dry out after dropping. It may remain attached to the nut in various states (fresh, rotting or dried) throughout harvest.

Nuts are currently harvested using standard macadamia harvesting machinery. Harvesting is a two-stage operation in which a sweeper windrows fallen nuts together with loose trash in the interrow. A pick-up harvester that removes light extraneous material from the nuts



collects the windrowed material by screening and aspiration. The nuts are then deposited into a hopper that is used for transport to postharvest facilities.



**Figure 11.** The sweeper sweeps fallen nuts from under the trees into the centre of the row



**Figure 12.** The harvesting machinery used to pick up nuts from the centre of the rows after sweeping

## Postharvest handling

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Postharvest handling prepares the nuts for transport, either for sale as nut-in-shell or for shelling. While posthandling systems are being continually modified to improve efficiency, important steps include cleaning, deappling, drying, and storage.

### Cleaning

Further cleaning may be required to remove extraneous material (rocks, large wood prunings and previous season's nuts) that the harvester cannot remove. The preharvest clean-up is important to reduce this material, particularly previous season's nuts as they are difficult to separate from current season's nuts. They reduce the storage space available for good nuts, increase transport and shelling costs and reduce kernel quality.



**Figure 13.** Grading nuts after harvest

### Deappling

After harvest apples may remain attached to nuts in fresh, semi-decomposed or dried states. Nuts stored with fresh or semi-decomposed apples risk fouling from micro-organism infection as aeration is impaired and wet material will raise nut moisture above the maximum necessary for safe storage. Furthermore, apples, like previous season's nuts, occupy storage space. Overseas processors have been reluctant to accept nuts for shelling with apples attached and transport and shipping costs are higher.

Current deappling machines are capable of removing only dried apples. Prior drying of the apples is essential and this is expensive. In addition, apple fragments which suction fans cannot extract must be separated by hand from deappled nuts.

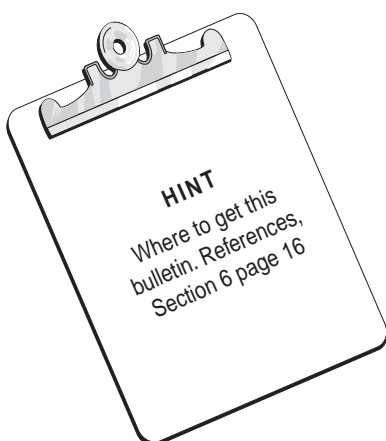
Opportunities for improving pre-deappling handling systems include separation of wet and dry apples and removal of excess fluid by presses and centrifuging.

### Drying and storage

The moisture content of the nut is important for its safe keeping during storage and transport. The maximum recommended moisture content to preserve quality is 9%. Nuts of higher moisture run the risk of developing internal mould growth that can make the kernel unsaleable.

If nuts are not dispatched for sale or shelling at the time of harvest, storage will be required. The size of the crop and the length of time nuts need to be stored will influence storage capacity. This will depend on available shipping, and sale or shelling arrangements. Nuts are currently bagged in 20 kg mesh bags for shipping to shelling factories in China.

Information on silo design, air velocity and volume, maximum depth of nuts, and heating for macadamia is a suitable guide for cashew. This information can be found in the Australian Macadamia Society News Bulletin article *On-farm drying of nuts in shell*.





## Marketing

*The way you choose to market your crop will have a large impact on the returns you receive. The more value you are able to add before sale, the higher the returns that can be achieved.*

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### Returns received

The returns received for the crop will be influenced by world prices, product quality, and the form in which the crop is sold, whether as nut-in-shell (NIS), kernel, or as kernel processed into value-added products (for example, roasted and salted, chocolate coated). Current farm gate price for NIS can range from \$1.50 to \$2.00/kg, whereas prices for whole kernel range from \$6.00 to \$10.00/kg, and for value-added products from \$20.00/kg upwards.

### Marketing options

#### Sell as nut-in-shell (NIS)

The crop can be sold as unshelled raw nut (NIS). The buyer will determine the price paid after assessing the quality of the nut. Quality aspects likely to be considered are:

- level of foreign matter
- level of void (empty nut)
- damaged, immature, and previous season’s nuts
- nut water content
- nut size (average nut weight)
- kernel recovery rate.

These factors affect processing costs and influence the potential kernel yield.

Growers should assess the potential kernel yield (total kernel weight and average kernel weight at 5% moisture content) of their raw nut before consignment. This will give you an indication of the value of the crop and is essential information for negotiations with buyers. If several consignments are sold separately, each should be assessed independently.

Sampling is important to accurately assess the quality of the consignment. The nut sample used for the assessment must be representative of the whole consignment. The procedure for assessing kernel is:

1. Weigh the raw nut sample.
2. Remove all extraneous material, undersized (less than 2.5 g), immature and previous season's nuts.
3. Soak the remaining sound nuts in water for 3 to 4 days to soften the shells.
4. Remove kernel with testa attached.
5. Count the number of kernels.
6. Dry kernel with testa at 65°C for 4 days.
7. Weigh kernel with testa (KT) and adjust weight to kernel weight at 5% using the formula:

$$[KT - (KT \times 0.066)] \times 1.05$$

8. Calculate the average kernel weight by dividing the kernel weight calculated in step 7 by the number of kernels counted in step 5.

Overseas processors are reluctant to accept small quantities (less than 100 tonnes) of raw nut. Growers with less than 100 tonnes can sell to a local large producer or combine with other producers.

Larger producers have the option of negotiating directly with overseas processors for the sale of their crop.

### Sell as kernel

Kernel sales are only a practical option for major producers who wish to enter the wholesale or retail markets. There are no shelling facilities in Australia. The process of kernel extraction is complicated and laborious and involves removal of the shell's caustic oil, shell cracking and testa removal. Growers must therefore make arrangements to have nuts shelled in India, China or elsewhere. In general, overseas processors in the past have not been in favour of contract shelling. Before consigning their raw nut to a processor, producers should assess the kernel yield using the procedure explained in 'Sell as nut-in-shell (NIS)' on the previous page.

In marketing kernel, Australian producers have the option of selling to overseas traders or to retailers in Australia. The major Australian retailers are Jorgenson Waring Foods, Michael Waring Trading and Salzo Food Industries. The price paid for kernel is influenced by the kernel's grade classification. About 25 individual grade categories exist as specified by the International Organisation for Standardisation (ISO) (reference number ISO 6477:1988 (E)). The criteria which classify kernel into the different grades include kernel size (individual kernel weight) and wholeness (whether whole or broken), discolouration, and insect damage. Large, whole, white kernels attract the highest prices.




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### **Sell as value-added products**

The current Australian cashew production is shelled overseas and the kernel returned to Australia where it is sold as raw kernel or processed and sold as value-added products. Value-added sales reap higher returns compared with NIS and kernel sales. In addition, broken kernel that would otherwise be downgraded under ISO standards and so draw a lower price can be marketed at the same price as premium grade kernel.

As the Australian industry expands it is likely that growers will benefit from pooling their production, value-adding and marketing with an Australian brand and name.