PROPAGATION OF CERTAIN TROPICAL FRUITS

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The far north coast produces over half of Australia's bananas, from a now relatively stable area of about 7000ha. However, there has been rapid expansion in a wide range of other tropical fruits such as avocados, macadamias, custard apple, litchi, guava, papaw, mango and low-chill stone fruits.

MACADAMIA

The macadamia (*Macadamia integrifolia* and *M. tetraphylla*) is the only Australian native tree ever developed as a commercial food crop It (*M. tetraphylla*) is indigenous to the coastal areas of northern New South Wales and southern Queensland between the latitudes 25° and 32° South. Lismore, N S.W. has a latitude of 28° South.

Macadamia is one of the best edible nuts in the world and is the richest oil-yielding nut known, producing about 76 per cent of very high quality oil. It may be eaten raw, is delicious when roasted and salted, makes a nice nut paste and can be used in cakes, confectionery, and ice cream. It can also be used as a cosmetic base.

The shell is used in plastics manufacture. The husks (green coverings of the nuts) contain about 14 per cent of substances suitable for tanning leather, but as yet have not been used commercially for this purpose in Australia. Husks are used extensively as undertree mulch and trials indicate they are excellent in potting mixes.

Selecting from several trees introduced from Australia in the 1870's, Hawaii has established an industry with 2,000 hectares of trees annually producing 10,000 tons of nuts in shell. There are also plantings in South Africa, Rhodesia, Kenya, California, and Central America.

Since 1970, the area under macadamias in New South Wales has expanded rapidly to 1,900 hectares at present. The macadamia offers long-term economic potential, but is most suited to investors with large capital resources. Currently 10 to 12 hectares appears to be the minimum viable area.

The macadamia is a rainforest tree of the sub-tropics and requires high moisture. Rain in early spring and summer is necessary for a good set of nuts and to ensure the crop reaches maturity. With the dry spring/summer of the far north coast, irrigation in commercial orchards is essential. Without it, the crop can be halved in dry seasons.

Propagation. Using basic nursery techniques, propagation of the macadamia is not difficult. Shade houses are necessary but need not be as elaborate as for crops such as avocados.

Seedbeds should be made of coarse river sand and be at least 20 cm deep. Use them only for germination of the seed and not for growing seedlings through to stock size. To avoid the possibility of disease build-up, do not re-use the sand once seedlings have been transplanted.

Seed for propagation should be fresh and selected from trees that are vigorous, and produce well-filled round nuts of average size. Plant the seed soon after harvesting as it deteriorates quickly. Seed allowed to dry out will be slow to germinate. Late summer (February-March) plantings of mature new season seed should result in good germination. High temperatures experienced then, and the freshness of the seed, assist in speeding seedling growth.

If the seed cannot be used immediately, it may be stored in moist sand at a temperature of 5 to 10°C in a shaded site. It can also be kept in airtight plastic bags under refrigeration.

Nuts are planted in their shell with the suture or crease underneath. They are sown thickly but not touching and should be covered by about 2 cm of sand. If buried too deeply, losses may occur from rots and lack of air. Keep seedbeds moist at all times. This is important during the first week after sowing as the shells must absorb moisture to open freely at germination. Under warm seedbed conditions (soil temperatures of 30 to 35°C), germination should commence in three to four weeks. However, germination of the whole crop may extend over a period of six to eight weeks, especially if air temperatures fall below 24°C.

Where glasshouses are not available for germinating seeds in the colder months, use the sunny sides of buildings and fences, with a clear plastic or glass covering to provide extra heat.

For artificially heating seedbeds in the winter, some nurseries use a waterproofed electric blanket under the seedbed.

Transfer seedlings from the seedbed to nine litre plastic bags in the shade house as soon as the first two sets of leaves have hardened. If planted too soon, or when flushing, heavy losses may occur. Weak or off-type and albino seedlings should be discarded.

Potting mixtures should be free-draining. Nurseries use various mixtures of sand, loam, peat moss, and well-rotted sawdust. As mentioned, macadamia husks are also proving to be an excellent component of potting mixes. Although mixtures benefit from the addition of dolomite lime, nitrogen,

superphosphate, and potash, excessive use of these can be detrimental Too much or poorly mixed dolomite lime will cause chlorosis in young trees. The pH should be in the range 5.5 to 6.5

Do not allow seedbeds to dry out, otherwise germination will be affected. On the other hand, too much moisture and lack of aeration tends to promote fungal activity, and losses may occur through infections, which either penetrate the seed as it becomes exposed during germination or attack the developing shoot. Trained potted seedlings to a single stem. When seedlings are 12 to 15 months old they are ready for grafting.

The root system of the macadamia consists of bunches of lateral rootlets forming mats just below the soil surface As a result, plants are sensitive to soil moisture fluctuations, particularly in the seedling stage and an adequate water supply is essential.

Grafting. Conventional methods of grafting are suitable for shade house or field grafting of macadamias in late summer (February-March) and late winter (July-September). In the field, avoid the cold midwinter and hot summer periods

Experience has shown that macadamias can be whip grafted in commercial quantities if stock and scion are well matched. Because the wood is so hard, the cut surfaces are prepared with a small wood plane. This results in a very even surface and the necessary close contact between the cambium layers of stock and scion. Other types of grafts are used less.

Health, vigor and stage of growth of both the stock and scion are important in obtaining successful grafts. The most suitable stocks are vigorous, in an early flush stage of growth, and from 1 cm to 1.3 cm in diameter.

Mature, vigorous scionwood, cinctured (girdled) on the parent tree four to eight weeks before use, gives best results. This technique increases the starch content and, as the starch content in the scion increases, so does the degree of success with the operation.

To check the starch content, dip the cross-section of budstick in a saturated solution of potassium iodide. The deeper the purple colour produced, the higher the starch content.

Scions with two bud whorls are best. Tie grafts with plastic tape to hold the cut surfaces in firm contact and seal the graft with a suitable mastic. White flat plastic paint reflects sunlight and helps keep scions cool in field grafting. In nursery situations, shade can be increased during and shortly after grafting.

Seed grafting. Germinated seed with the radicle removed

and a scion inserted has been used in the past by some propagators. However, field experience has proven they develop weak root systems. Even bearing trees are easily uprooted or snapped off at ground level under windy conditions.

Mini-Grafting or cleft grafting of seedlings 1 or 2 weeks after germination gives a good result and is very quick and simple. Seedlings are lifted out of germinating seed boxes with sand still adhering to the matt of roots, headed, scion inserted, tied, turned upside down and dipped in watered down Colgraft and planted in 2″ tubes and placed under mist.

Budding. Punch, patch and chip-budding have all been used successfully and economically. The operation is much quicker and requires less budwood than grafting. A strong union results with vigorous upright growth. Buds may be taken from large wood, which would be too bulky for use in grafting. Plump buds are taken from mature uncinctured growth.

In patch budding, oval shaped punches can be used to remove the bark from the rootstock and then collect the bud from the scionwood, ensuring perfect matching. Grafting tape is then used to bind over the bud. The bud is best inserted on the side of the rootstock away from the sun.

The tape is removed after six weeks and, if the bud is alive, the rootstock is severed with a sloping cut 1 cm above the bud. Use grafting mastic around the perimeter of the patch to prevent desiccation and lifting of the edge.

Chip-budding is done in the conventional manner, ensuring that the bud chip matches the portion removed from the stock. Good contact between the cambium layers is essential for satisfactory bud union. Chip-budding is used when the bark is not lifting readily, otherwise patch or punch-budding is preferred.

After budding, stocks are cut back to within 15 cm of the bud insertion, or at a point leaving two whorls of leaves above it. New growth from the bud may be tied to this stem stub for protection against snapping off in the early stages of development.

Cuttings. Cuttings have been used widely in S. Africa to propagate macadamia but not in Hawaii or Australia. Use a hardened young flush of growth. Make cuttings about 15 to 18 cm long, with 2 whorls of leaves. Remove leaves on 1 whorl and treat the basal end with a hormone rooting powder. Place in hot beds (30°C) under mist and 80% success can be achieved.

Because macadamias have weak root systems, every at-

tempt must be taken to avoid operations that restrict the roots. Germinate seeds in very deep boxes (30 cms) and do not bend roots in repotting.

Research into improved nursery techniques have led to better growth of seedlings and quicker outturn from nurseries. The use of husks in potting mixes gives a quicker growth — 9 months to grafting size rather than 14 to 18 months. Open-earth trees are used only rarely when necessitated by restrictions in potting operations.

LITCHI

The litchi (*Litchi chinensis*) is a native of southern China, where it has been grown for over 2,000 years. The fruit has a delicious subacid flavour and is regarded as a delicacy by the Chinese Besides beıng eaten fresh, the fruit may be dried, frozen or canned without loss of flavour.

Litchi trees are evergreen, compact in shape, and very attractive in appearance. Slow growing, but long lived and very sturdy, the tree grows to a height of about 12 metres. To encourage regular cropping only one growth flush must be allowed — in early autumn.

Litchi fruits are round to oval, from 2.5 to 4 cm long, and are borne in loose clusters of between 3 and 20 fruits. The skin is red, thin and leathery, with small conical protuberances.

The edible flesh (aril) of the ripe fruit is white, translucent, succulent and high in sugar.

Fruits contain a single dark-brown seed about 1 cm long. Some cultivars have large seeds, whilst in others they may be shrivelled, allowing a higher proportion of aril.

Propagation. To obtain progeny with the same desirable characteristics as the parent tree, the litchi is propagated vegetatively by either grafting or air layering. Litchi trees grown from seed vary in tree characteristics and cropping ability and may take up to 20 years to crop.

Airlayering. Airlayering, or marcottage, is the most popular method for litchi propagation. In cooler months 12 weeks are required before marcotts can be removed. In summer months 6 to 8 weeks are sufficient.

Select branches 12 to 24 mm thick from the outside portion of the tree Remove a ring of bark about 2.5 cm wide and 50 to 60 cm from the growing point. Scrape off the cambium layer below it with a sharp knife or a strip of emery paper to ensure that there will be no overgrowing of the ringed area.

Wrap the girdled area with moist spahgnum or peat moss

enclosed in a piece of clear plastic sleeving about 25 cm wide. Squeeze the moss to remove excess water, before applying to the girdled areas.

Covering the sleeve with paper or hessian may be necessary to protect the developing roots against sunburn. Bind both ends of the sleeve enclosing the airlayer tightly around the branch and tie firmly. Pre-made bags of moss or peat can be used like a "split sausage" and save a lot of time.

Because of its brittleness, the airlayered branch may need supporting to prevent it snapping in the wind. Either tie it to a stronger branch or fasten it to a stake.

White roots can be seen growing from the airlayer, or marcot, about 8 weeks later. When enough have formed cut the marcot from the parent tree just below the sleeve.

Remember the following points before separating the airlayer from the parent tree;

* Remove 50 to 75 per cent of the foliage. The roots cannot support all the leaves at this stage. Remove excess side shoots and seal the cuts to prevent moisture loss.
* The young roots of the airlayer are very brittle and easily damaged by rough handling. Do not carry the marcots by their tops as this may wrench the young roots from the base of the plant.
* Take extreme care with newly potted marcots. Leave them in the shade house, water them well, and do not expose them to direct sunlight. Because the root system of a newly separated marcot is only partially functional, it is not capable of supporting the tree in the field.
* Marcots survive better if the potted plants are placed in a very humid atmosphere for several weeks or until the roots have made sufficient growth.

Harden marcotted plants gradually under less shaded conditions for about a month before planting out. This reduces the adverse effect of sudden exposure to full sunlight.

Grafting. Besides airlayering, a number of different grafting methods have been tried throughout the world with varying success. These include inarching, side veneer, and whip and tongue grafts. Budding (modified Forkert) can give about a 40% success rate.

When starting from seed make sure it is fresh, preferably straight from the fruit. Litchi seed dries out quickly and becomes non-viable if kept longer than a few days. If it is necessary to keep the seed longer before planting, stratify it in a mixture of damp sphagnum moss and ground charcoal and store in a cool place.

Sow the seed about 1 cm below the soil surface in deep seed boxes. Leaf mold is a good germination medium Transplant the seedlings singly into large containers (9 to 18 litre capacity) 2 weeks after germinating Seedlings grow quicker in large containers and establish a good root system. It takes between 12 and 18 months for the trees to reach a satisfactory size for grafting.

Before grafting, cincture the scion wood; remove a ring of bark about 1 cm wide from the branch, at least 21 days before use. Select new season's wood from the parent tree, to obtain a vigorous scion.

Litchi wood is hard and brittle and because of this, whip or slice grafting is regarded as the best and simplest means of grafting. Results of grafts made in various parts of the world show that an experienced operator achieves between 70 and 80 per cent success.

Cuttings. Though not widely used in New South Wales, litchis can be propagated by cuttings, with some success. Use hardwood or semi-hardwood cuttings, some 18 to 20 cms long and up to 15 mm in diameter, preferably with growth ring at butt. Place in coarse sand under mist with bottom heat at 24°C, in shaded greenhouse.

In some prelimilary trials a 3 sec. dip in 200 ppm IBA appear beneficial but this is not yet finalised.

BANANA

Banana (*Musa acuminata*) planting material is usually obtained from bits and suckers in established plantations. This material, while it is widely used, is variable and may transmit pests and diseases such as nematodes, weevil borer, and bunchy top. Its variability is related to its size (1 to 2 kg) and the status of the bud which forms the new plant.

Tissue culture offers a number of advantages to the New South Wales banana industry. These are. production of plants which are pathogen-free (no nematodes, weevil borer, or virus within the material) and which have good genetic potential.

Tissue-cultured bananas have been grown since the mid-1970's in Israel and Taiwan. They have been used on a small scale, especially for rapid multiplication of new cultivars.

Meristem tissue may be obtained from growing points in either the flower "bell," or young suckers. Bells are preferred because of: 1) ease of collection, 2) less chance of infection, and 3) allowing assessment of yielding ability. Up to 5000 new plants can be obtained from the one growing point.

Recently the Banana Growers Federation received money

from a Commonwealth Extension Services Grant to investigate the possibilities of using tissue culture methods to supply banana planting material in New South Wales. A nurseryman specialising in tissue culture was contracted to supply 10,000 plants over a period of 12 months. These plants are being supplied to the Department of Agriculture who will determine their suitability for planting in the field at various times of the year Some are being distributed to District Horticulturists who are arranging plantings in the Tweed, Richmond, Coffs Harbour, and Nambucca Districts.

Several unexpected problems have arisen in the production of these tissue cultured plants. 'Williams' is the most difficult Cavendish cultivar to grow by tissue culture. These problems have been overcome. From the bottles the plants are placed into 300 mm x 350 mm flats and grown to 10 cm in height. Problems are: nutrition, off types, initial variability, and competition among plants within the flats, and to virus contamination (CMV).

When these problems are overcome we need to determine the best type of plant for field planting. We think that plants with strong root systems, large corms, and small leaves will have the best chance of survival in the field. Top-root ratios can be manipulated by changing light, temperature, and nutrition.

AVOCADO

Because avocados (*Persea americana*) are extremely susceptible to *Phytophthora cinnamomi*, nursery standards for avocados must be exacting.

The Avocado Growers Association now operate a scheme whereby nurseries which comply with certain construction standards, maintain hygienic cultural operations, and are found to be free of *Phytophthora* and *Phythium* fungi, are granted accreditation. Such nurseries may advertise the fact that they have accredtation status.

The following conditions apply for obtaining accreditation:

TECHNICAL REPORT

1 Seed hot water treated or harvested directly off tree (specify) . . . . . .

2 Potting mix - well aerated, freely draining, holes in base of container (comment) . . . . . .
- at least 25 cm deep in container (state depth) . . . . . .
- disinfested with steam, methyl bromide, or not disinfested (specify) . . . . . .
- stored in sterile bins or on disinfested sealed floors (specify) . . . . . .

3 Water from deep well, or otherwise chlorinated (specify) . . . . . .

4 Hose nozzles kept off the nursery floor (yes or no)

5 Utensils, containers, trolleys and barrows confined to nursery area and regularly disinfested with chemicals (comments)

6 Floors of nursery and hardening-off area sealed (yes or no)

7 Nursery bench tops - at least 30 cm off floor level (yes or no)
- wire mesh or disinfested wooden slat (specify)

8 Waste soil and plant material regularly washed or taken away (yes or no)

9 Security - public and stray animals restricted entry (comment)
- loading area isolated from nursery (yes or no)
- foot baths at entrances properly maintained and installed (comment)

10 Plants from non-accredited nurseries excluded (yes or no)

11 Dust about nursery suppressed (comment)

12 Root systems (sample of a minimum of 10 containers) sound or otherwise (comment)

13 Assay for soil-borne pathogens
(bulk sample of a minimum of 30 containers).

14 General comments on nursery hygiene and/or plant health

Signed(Technical Officer)(date)

The avocado industry also aims to become established on virus-free lines. Conventional indexing takes 2 years, but is being supplemented by quicker D.N.A. methods. Grafting knives, secateurs etc. must be sterilised with hypochlorite.

Seed Division. As seed supply is restricted and expensive, seed may be divided. With care, eight plants may be gained from each seed, but simply halving of seeds is most common.

HIGH TEMPERATURE RELEASE CHARACTERISTICS OF RESIN-COATED SLOW RELEASE FERTILIZERS

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Abstract. Two types of slow-release resin-coated fertilizers, which control the release rate by coating thickness (Type A) or a release agent (Type B) were tested for their high temperature stability. Heating different formulations (various N-P-K ratios and/or release rates) to 25, 60 or 70°C in water for 30 minutes had little effect on their subsequent release characteristics in water at 25°C for 1 week followed by 45°C for 9 weeks Two different formulations of each fertilizer type were also held in water for 10 weeks at 25, 30, 35, 40 and 45°C The increase in release rate with increasing temperature was lower for type B fertilizers than type A fertilizers The per-