

water. Definitely not a "dollar plant" under our conditions. Not impossible to grow, but highly unprofitable.

However, on the other hand, we grow a number of banksia's, approximately 25 species, and we can manage to do them very well. Our soil mix is made up of 6 parts sand and 4 parts Jarrah sawdust, making sure that the resulting mix is well drained and on the sandy side.

To the basic mix we add:

- 3lb per cubic yard — 9 mth Osmocote.
- 2lb per cubic yard — I.B.D.U. 31% N.
- 1lb per cubic yard — ferrous sulphate
- 3lb per cubic yard — dried blood.
- 2lb per cubic yard — fine ground limestone.

The whole lot is mixed in a concrete mixer for 5 to 10 minutes, and then the pots are filled by machine. Currently we are doing about 25,000 banksias per year. The filled trays of pots are placed outside under sprinklers on a 3" layer of 1/2" slag. The seeds are then pressed into the surface soil and covered about twice their own thickness. Timing of the planting is when the winter rains are around — in Perth you have to be quick or you can miss them. May until September we find is OK; the plants reached a saleable size by February or March. Supplementary feeding is by I.B.D.U. as a top dressing if they need it and, once a month, with liquid feed through the sprinklers using N150-P30-K70-Mg20.

PROPAGATION OF AVOCADOS IN SUB-TROPICAL COASTAL REGIONS OF QUEENSLAND AND NEW SOUTH WALES

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The avocado (*Persea americana* Mill.), family Lauraceae, is a native of Central America and the West Indies. The avocado industry commenced in America about 1910. Prior to this it was only known as a backyard fruit. There are records in Queensland of two trees being planted at Buderim Mountain in 1908. Both trees bore fruit. A few Queensland growers planted trees around 1920 and attempted to market the fruit. I say attempted, because fruit had to be given away to get people to eat them. These early plantings consisted of seedling trees and were established in North Queensland and in the coastal regions of South Queensland.

There are three horticultural races of avocados, namely

Mexican, Guatemalan, and West Indian. There are also hybrids derived from crosses between these races.

Avocado trees can be propagated either by seed or vegetatively by grafting, budding, cuttings or marcottage. The avocado, in common with many other species of plants, is cross pollinated and seedlings rarely, if ever, come true to type. Yields and fruit quality from seedling trees are usually inferior to that of proven commercial cultivars such as Hass and Fuerte. Some years ago a Mr. Sheppard from California planted 1500 seedling trees in his search for improved cultivars. Finally, after some years, he selected only two as having some market potential. This shows the futility of planting an orchard with seedling trees.

Avocados are normally grafted onto selected seedling or marcotted rootstocks. Great care must be taken when selecting a rootstock as the rootstock will undoubtedly affect the performance of the grafted tree. Various aspects to consider when selecting rootstocks are vigour, susceptibility to frost, resistance to *Phytophthora cinnamomi*, and salt tolerance. Little information is available on the suitability of the various rootstocks for subtropical conditions, but in California preference is given to Mexican strains, mainly because of their frost resistance. Guatemalan stocks are also compatible with most scions and produce vigorous trees. However vigour isn't the only consideration, for smaller trees have many advantages in a commercial orchard.

The following is a list of the most commonly used rootstock types with a brief description of their main features.

Mexican. Californians claim that this rootstock is the most suitable as it produces the most lateral roots and is hardier. Trees grown on this rootstock are small, and it is somewhat resistant to frost, surviving temperatures of -5° to -7°C (20° to 24°F) for short periods.

Guatemalan. Trees on this stock are more vigorous and a little more salt tolerant than those on Mexican roots but are less resistant to frost.

West Indian. Trees on these roots can only be expected to do well in frost-free areas and are not used commercially in Australia at this time. However, they may be used at some future date because of their salt tolerance. The Israelis have a highly salt tolerant cultivar named Maoz. Perhaps this is worth trying where salt is a problem.

Duke 6 & 7 (Mexican). Roots of these trees have some resistance to *Phytophthora cinnamomi*. Marcotted plants are being used as a rootstock by some nurserymen.

'Topa Topa' and 'Mexicola' are other Mexican cultivars currently being used in Queensland.

In the past we have been mainly concerned with resistance to *Phytophthora*; now, however, steps have been taken to control sunblotch virus or viroid. Sunblotch is transmitted in infected budwood and seed, or by naturally occurring root grafts between trees in an orchard. Apparently some researchers have succeeded in transmitting the viroid in pollen and mechanically; however, I have not seen this literature personally.

The Australian Avocado Growers Federation, in association with the Department of Primary Industries in Queensland and the Agriculture Department in New South Wales, have imported a nucleus of seed and budwood which is free from sunblotch virus. As a result, approximately 5% of all plantings in Queensland this year (1980), will be produced from indexed stock. Indexed cultivars currently being produced are Hass and Fuerte (and Sharwill by the end of 1980).

PROPAGATION AND GROWING HOUSES FOR AVOCADOS

Glass, or fiberglass houses, are not essential, and are not normally used, in sub-tropical coastal regions of Queensland and Northern New South Wales. However, they are advantageous in maintaining high humidity, particularly in winter; in sub-coastal regions they are a necessity for establishing new grafts.

In coastal regions a shade house with a galvanised pipe frame and covered with 32 to 50% Sarlon shade cloth is quite adequate. It may, however, be necessary to erect a fiberglass wall on the western and southern side to provide some protection from cold winds in winter. Sub-surface drainage must be installed in the ground and the whole floor area covered with several centimetres of crushed blue metal, or washed 19ml ($\frac{3}{4}$ in) gravel. Alternatively the floor can be concrete. Naturally, a concrete floor must have sufficient slope for water to drain away quickly following rain or irrigation.

The trees are grown on either wooden or preferably galvanised wire benches about 75 cm above the floor.

There is good evidence to suggest that the root-rot fungi, *Phytophthora cinnamomi*, was first introduced to many orchards in Queensland and Northern New South Wales on nursery trees. Today in order to control this disease a procedure called the Avocado Nursery Voluntary Accreditation Scheme has been introduced and nurserymen wishing to join (and consequently have their name added to an approved list of nurserymen) must comply with the hygiene standards set out.

Rootstock seed. Seed is gathered from March to July (fall to mid-winter), or perhaps a little later. The seed, where possible, should be taken from fruit which has been harvested from the tree and handled under hygienic conditions, e.g. kept off the

ground and placed on treated benches. If the seed has been taken out of fruit from the ground, the seed must be hot-water-treated at a temperature of 49° to 50°C for 30 minutes. Rinse seed immediately after treatment in clean, cool chlorinated water (town water) then spread out in the shade to dry (but not on the ground). The seed is then dusted with a fungicide if thought necessary, then planted. Very small and shrivelled seed should be rejected.

Seed should not be taken from immature fruit as this may reduce germination percentage and produce some albino seedlings. Such seedlings do not produce chlorophyll; they live and grow on the food reserves in the seed but if not grafted quickly (soon after emergence) they will die.

If seed is in short supply each seed can be cut in half to give two growing points. This is possible because the avocado seed is polyembryonic. There is more than one bud initial in the seed. The most obvious way to cut the seed in two would be to separate the cotyledons; however when this is done, more often than not the whole embryo stays attached to one of the two cotyledons so you still end up with only one plant.

The correct way is to turn the seed upside down (the flat base uppermost) and to cut the seed across at right angles to the division between the cotyledons. It is important to cut through the centre of the embryo, otherwise you will only have an embryo in one half of the seed and none in the other.

Seed should be planted as soon as possible after extraction from the fruit as the germination will be reduced if the seed is allowed to dry out. If the seed has to be kept for sometime before planting it should be packed in slightly moist peat or sawdust and kept at a temperature of about 43°F (6°C).

Sowing Rootstock Seed. The seed is normally planted in polystyrene or wooden flats filled with either composted or leached sawdust or a pasteurised potting mixture. The seed should be planted with the point either just above, at, or below ground level. The medium must be kept moist, but not too wet, until the shoots emerge.

An alternative method of seed sowing is to sow directly into poly bags, in which the seedling will be grafted; however this results in an uneven stand of plants because the seed will not all germinate at the same time. After the seed sown in flats has a shoot about 7 cm high the seedling is then transplanted into finishing poly bags and transferred to the shade house. The poly finishing bags measure about 14 cm in diameter and 30 cm deep, providing ample space for the development of a tap root.

Marcot Rootstocks. These rootstocks are obtained by girdling

stems on the mother tree about 22 cm back from the shoot tip; the cut in the stem should be 2.5 to 3.5 cm long and the bark must be removed and the cambium scraped to prevent bark from redeveloping. Pack wet peat moss over the girdled area then wrap a square of plastic over the peat and tie at both ends around the stem. Keep the peat moist until the roots are well developed. The marcots can then be removed from the mother tree and planted in poly bags to be grafted when they have made sufficient growth.

The growing media must be open textured and well drained. Some nurserymen use 1 part pine sawdust and 1 part coarse sand; that is, sand to small gravel. Others use 1 part peat, 1 part sand and 1 part polystyrene. After adding nutrients the ingredients are thoroughly mixed and then pasteurised with aerated steam at a temperature of 140°F (60°C) for 30 minutes following which the steam pipe is turned off and the fan is left running until the mixture has cooled.

Rootstock Nutrition. The rootstock should not be starved for nutrients at any time but must be liquid-fed regularly to keep them growing vigorously so that the internodes are long and somewhat rounded. The rootstocks are ready for grafting when they are 35 to 60 cm high and the trunk is 8 to 10 mm in diameter.

Selection of Scionwood. All commercial cultivars now being grown are really clones because each one has been selected from one mother seedling tree. The three most popular ones grown in Queensland and Northern New South Wales are 'Fuerte', 'Sharwill' and 'Hass'.

Scionwood should be cut from tip-growth which has matured, that is, hardened off, and the buds in the leaf axils are plump — not thin, but are not bursting into growth. If possible round wood should be selected, not angular, pithy wood. The leaves are cut off immediately the scion is cut from the tree just leaving the stubs of the petioles attached to the scion. Place the prepared scions in a plastic bag and then into an esky. Frozen bricks are placed in the bottom of the esky before leaving home and these and the sides are lined with wet newspaper. The plastic bags are then placed inside with more wet paper over the top.

If absolutely necessary scions can be stored in a refrigerator for a few days at a temperature of 43°F (6°C). They can be stored for longer periods but this should be avoided wherever possible. Before using the scions they may be treated with 5% w/v calcium hypochlorite by dipping for 5 minutes then washing in clean water. Dry before using.

Grafting Gear & Maintenance During Grafting. A grafting

knife, flat on one side and bevelled on the other, should be made of good quality steel and be kept very sharp and clean at all times. The knife should be cleaned regularly during grafting with 70% metholated spirits and a water solution. After dipping the knife in the solution it should be rubbed dry on a clean, freshly laundered cloth. A 1 cm ($\frac{1}{2}$ ") wide strong, plastic grafting tape is used for tying. The one most commonly used is clear but coloured ones are satisfactory.

Although there are several different types of grafts, the two methods most commonly used on avocados are the cleft and whip.

Once the tree has been grafted it is then either placed in a glasshouse where no protection is required over the scion or it is placed in a protected position in a shade house. In this case the scion is sometimes covered with an inverted small plastic bag to retain humidity and consequently reduce transpiration from the scion.

If grafting is done in the field extra protection is advisable such as hessian for shade over the worked tree, and plastic water paint over the scion.

A close watch must be kept on the development of side shoots below the graft and the bulk of these should be removed when the graft has made several centimetres of growth; only the strongest of the buds on the scion should be left.

This remaining shoot is staked and tied with tape and allowed to branch further up away from the union where a stronger framework can be formed. All shoots below the graft must be removed at this stage. The plastic tape is normally cut about 4 weeks after grafting to avoid constriction at the union. Grafted trees should be hardened off in an open sunny position on benches before being sold.