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Volume 3 1977

COVER PHOTO: Cashew nut and cashew 'apple', *Photo by Charlie Woods*

WANS

West Australian Nutgrowing Society

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* * *

SOCIETY PUBLICATIONS

WANS publishes a newsletter QUANDONG 3-4 times a year, devoted to news of meetings and events, details of tree and seed sources, notes on books and leaflets about nuts, reprinted short articles about nuts, and other items of interest The major publication is the annual WANS YEARBOOK, which contains articles drawn from Australia and overseas, covering any aspect of nut horticulture and production, and is regarded as an important research journal in this area.

Members subscribe for the Calendar Year, and receive one copy of all Society publications issued in that year as a subscription benefit.

The current subscription rate is $8.00 per year.

BACK NUMBERS

WANS began publishing in 1975. Back sets of 1975 publications are available to members at a cost of $6.00 per Yearbook and $2.00 per set of Quandong. Contact the Secretary for back numbers. The cost of a set of 1977 publications (same as subscription) is $8.00.

MEMBERSHIP DETAILS

Any person or organization interested in the growing or production of nuts may apply for membership. Members are welcomed from outside Western Australia and overseas, as well as in W.A. Write to P.O. Box 27, Subiaco, W.A. 6008, Australia, or to the Secretary as above.

WANSCO

Members of the Society own a co-operative, West Australian Nut Supplies Cooperative Limited, a legally registered Co-operative Company set up to buy and sell nuts and nut products. Shares in the WANSCO co-operative are available to WANS members at par, i.e. $1.00 each. Memberw wishing to acquire WANSCO shares should write to WANSCO Secretary and Director, Edmund Czechowski, at P.O. Box 12, Wanneroo, W.A. 6065. WANSCO operates a retail and wholesale store (Squirrel Nutkin) at 225 Onslow Road, Shenton Park (Tel. [09] 381 8656.

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Editorial

Welcome to the third issue of the West Australian Nutgrowing Society Yearbook. With the production of the present volume, the Editor feels that the WANS YEARBOOK has come of age and is now firmly established. The YEARBOOK is now indexed by both the Biological Abstracts Service and by Horticultural Abstracts, the World's two premier abstracting journals in our field; there could be no better compliment paid to the worth of our publication.

As far as the Editor is aware, the WANS YEARBOOK remains the only publication with an avowed interest in tropical nuts in general. The reasons for this are not hard to find; Australia is the only advanced Western-style country with extensive tropical areas, and so has a unique chance to apply the production techniques developed in temperate nut production to its tropical areas, thus realising the potential of a vast and undeveloped source of protein-rich foods. Australian sugar-cane techniques and machinery have been used and copied all over the world, now is the time to apply our expertise to tropical nuts.

Admittedly, tropical nut production on a large scale is still in the future for us, and so the bulk of the present volume is concerned with nuts more suited to our temperate areas.

Society membership continues to increase apace, and has now reached and exceeded the 450 mark, a 50% increase in the year. The present volume contains a notably higher proportion of articles written by the members themselves, although articles from outside sources will continue to appear. But Australia is in many respects a unique country, a unique continent, and the local information contained in members' contributions is therefore especially irreplaceable.

It is nice to have a sense of accomplishment in what we do, and with this YEARBOOK, our principal publication, members can feel that they are contributing towards a solution of some of the world's major problems, and in particular, working towards production of improved food supplies in an improved, rather than degraded, environment.

WALNUT GROWING IN VICTORIA*

ANTHONY D. ALLEN**

In 1973/74, Australia imported more than 1000 tonnes of walnuts worth $1.2 million.(3) They came mainly from India, People's Republic of China and USA. In the same year, Australia produced only 75 tonnes, of which 46 tonnes came from Victoria(2), figures that seem to indicate a considerable potential for growing walnuts here.

Many walnut trees are grown as shade trees in Victoria and their nuts are used mainly for home consumption. Commercial groves can be found in the fertile river valleys of east Gippsland and north-eastern Victoria(6).

Success in walnut growing depends largely on the production of economic yields of high quality nuts overs a long period. Yields are affected by soil type, weather and the incidence of pests and disease (17).

CLIMATE AND SOIL

Walnuts need a deep, rich, soil containing high amounts of organic matter. Good drainage is essential to a depth of at least three metres (6, 15).

The area to be planted must be free from frosts (particularly late spring frosts) and extreme heat, both of which will adversely affect production. Rainfall above 760mm is desirable, unless supplementary irrigation is available.

VARIETIES

As the ideal walnut has yet to be found, work on variety selection and improvement is still being carried out.

The four principal varieties grown in Victoria are Franquette, Treyve Mayette, Eureka and Wilson's Wonder.

Franquette is a French variety, said to be nearly two hundred years old (14). The nuts are medium to large, decidely elongated and pointed with a base much broader than the apex. The shells are light yellowish-brown. The kernels are plump, filling the shell very well. Flavor is sweet. The nuts are well sealed, but with a rather thin shell which is cracked easily.

Franquette trees bear consistently but not heavily. They have the additional advantages of freedom from blight and injury from spring frosts because they come out into leaf very late. However this variety is slow to bear, and its late maturity period puts harvest time into late autumn.

Treyve Mayette is another French variety imported into America by Felix Gillet. It is our second most important variety (14).

It produces nuts that are medium to large, oval when viewed from the side and round and slightly symmetrical when looked at from the ends. They have a bright yellow-tan kernel with a mild flavor. The nuts are generally poorly sealed with a thin shell that can be opened with the fingers. The trees are late in leafing out, but not as late as Franquette. The variety is harvested earlier than Franquette but it grows more slowly and produces a relatively light

* Published by permission of the Department of Agriculture, Victoria.
** District Horticultural Adviser, P.O. Box 69, Wangaratta, Vic 3677; Member, West Australian Nutgrowing Society.

crop.

Eureka originated from a seedling at Fullerton, California (14). Nuts are generally decidely elongated with blunt ends. They are dull light brown, but more attractive when bleached or well washed. Nuts are generally very uniform.

The light-straw-colored kernels, of excellent flavor, usually fill the shell well. The shell is normally very well sealed and hard to crack with the hand. This variety is known to have some resistance to blight, and so it has some importance.

Wilson's Wonder was propagated originally by F.C. Wilson in Sunnyvale, California (14). This variety produces very large nuts which are decidedly smooth and symmetrical for one so large, being somewhat broader at the apex than at the base and nearly square in end view.

The flavor of the kernel is mild and sweet, but generally for a nut so large the kernel is small and light.

The trees grow large and bear well, but this variety is not as important now as it was in the past because of the light weight of the nuts and their poor sealing qualities.

Other varieties grown in small numbers include Myrteford Jewel, Placentia, Perfection, Concord, Gate, Wybaleena, Freshford Gem, and the newer American varieties Payne and Shubert. The Department of Agriculture, Victoria has imported further varieties but they will not be released for several years. Three varieties from Germany are hoped to be blight resistant. It is anticipated that Californian varieties will also be imported to widen the range of areas where walnuts can be grown in Victoria.

FLOWERING AND POLLINATION

Walnut trees are self-fertile and wind-pollinated. The male catkin develops on the previous season's growth, while the female pistillate flowers are borne on the tips of the first flush of growth in spring. Although walnuts are self-fertile, most varieties have a degree of unfruitfulness due to dichogamy (the male and female components do not mature at the same time, and the pollen is shed before the female flowers are ready) (7).

Weather plays an important part in pollination. Warm spring weather hastens catkin maturity, and pollen is released quickly. Cool weather has the opposite effect. The pistillate flower is not affected by weather to any great degree. Strong winds around blossoming time can cause catkins to fall before the pistilate flowers mature.

Although the walnut is self-fertile, the normal practice is to plant more than one variety so that the time of pollen shedding is extended to cover maturation period of the pistilate flowers.

PROPAGATION

Because of their growth habits, seedlings of Northern California Black walnut (*Juglans hindsii* Jeps) and Paradox Hybrid seedlings (*Juglans hindsii* x *Juglans regia*) (English walnut) or *Juglans nigra* L (Eastern Black) x *Juglans regia*) are used as rootstocks for walnuts (13, 15).

Northern California Black walnut seedlings have shown some resistance to Armillaria, but when used as rootstocks in replanting situations, they do not do as well as the Paradox Hybrid stocks.

Seedlings are easy to raise. The seed is collected when mature in the autumn and placed in beds of sand over the winter. Seedlings are removed as they appear (at intervals) and planted out in the nursery rows.

Walnuts varieties are propagated by budding (patch) or by whip and tongue grafting of the required scions onto one to two year-old seedling rootstocks.

Fig. 1. Young walnut growing in cultivated situation

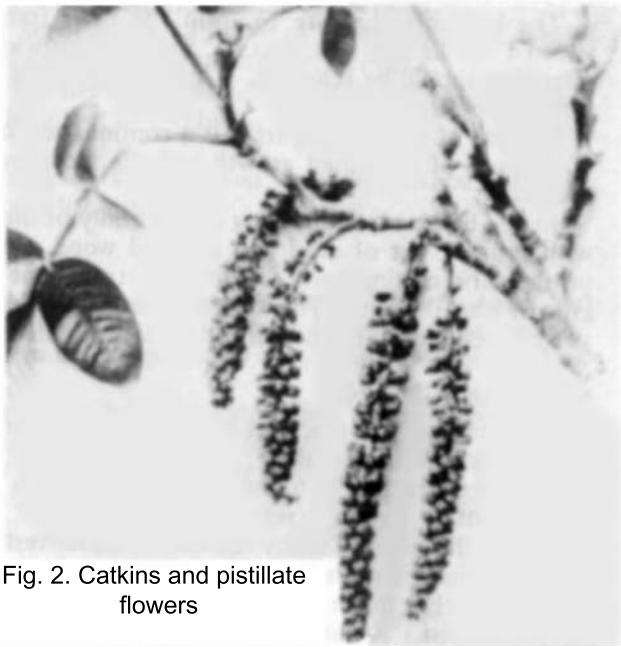

Fig. 2. Catkins and pistillate flowers

Propagation is still one of the more difficult tasks in growing walnuts and a high percentage of takes is uncommon. Research in many countries is attempting to make propagation easier.

PLANTING

Mature walnut trees will occupy a space of 15m to 18m (50 to 6Oft), but they usually take 20 to 25years to attain such a spread. Since they do take so long to reach their full cropping potential, young walnut trees can be interplanted with other crops or temporary walnut trees. The use of interplanted walnut trees is common practice in USA.

Experimental work at Davis, California (9) has shown that, at a closer planting of 15m x 9m (50 x 30ft) and 15m x 12m (50 x 40ft), yields per tree were similar to 15m x 15m (50 x 50ft), but the larger number of trees per hectare gave a proportionate increase in unit area yields. As the number of trees per hectare increased, so also were the long term returns above fixed costs.

In Australia, plantings in the past were on 15m (50ft) spacings, but recently some plantings on 12m (40ft) spacings have been tried.

PRUNING AND TRAINING

Trees are normally planted as rods and should be headed back 1.5 - 1.8m (5-6ft) from the ground. If too short at planting, they should be left to grow until they reach this height before heading.

However, heading is not necessary as some growers prefer to grow their trees on a central leader.

The branches that are to form the basic framework of the tree should be selected during the first, second, and third growing seasons and excess branches after that should be removed. Three to five main branches should be enough to form a good tree (11).

Pruning of non-bearing trees is a continuation of basic training. This consists of removal of unwanted growth and the incorporation of new branches where needed.

In the bearing trees, pruning consists only of the removal of low limbs togethe with pruning out of dead and diseased wood. Pruning to rejuvenate old trees involves the cutting back of limbs to strong side limbs. This action stimulates growth near the cuts. This type of pruning should be repeated every three to five years depending on the health and vigour of the trees.

SOIL MANAGEMENT

Soil management practices in walnut groves vary considerably. There are two major practices in Australia.

The first practice is to suppress weed growth and it involves three or more cultivations to have a “clean” surface at harvest. The major drawback of this system is that if there is any rainfall during harvest, the nuts tend to become dirty and they must be washed before grading and drying.

In the other major practice, the groves are sown down to pasture and grazed before harvest. Around harvest time the areas around and under the trees are slashed. This leaves a relatively clean surface from which the nuts can be picked up.

In the USA, the use of herbicides is practised in walnut groves which are sown down to pasture (5). Diuron and simazine are sprayed either under trees or as strip and their use in these situations gives the areas under the trees a hard surface which make harvesting with “sweepers” practical. The practice of chemical weed control is not used widely in Australia yet, but it is becoming part of the normal routine.

FERTILISERS

Generally fertilisers applied in walnut groves are in the form of complete N:P:K fertilisers. These are normally applied at the rate of 10 to 15kg per mature tree and proportionately less for younger trees.

Nitrogen is needed by most mature trees to maintain growth and productivity. This must be applied carefully. If too much nitrogen is applied, especially in the early years of the tree’s life, growth tends to become weak and “leggy”; on the other hand, too little nitrogen tends to make trees decline in health, with pale leaves and sparse growth (12).

Applications of fertilisers should be made in late winter to early spring, and should be broadcast under the tree canopy.

Boron is one of the elements most needed in walnut growing. Boron deficiency in walnuts is often described as “snake heading” (15). This refers to the growth of long leafless shoots with flattened terminals, twisted at right angles. The shoot dies back the following winter. Boron applications are seldom needed before the tree comes into bearing but are essential for mature trees. Boron can be applied as a soil dressing or as a spray application of Borax.

IRRIGATION

Walnuts need an annual rainfall of above 760mm. Even if this figure is reached, walnuts will respond to supplementary irrigation during dry periods.

Experience has shown that between 100-150mm of water should be applied per irrigation, to wet the soil to a depth of one to two metres (10).

Irrigation tends to increase the size of the walnut shells and the plumpness of the kernels. Water also has the effect of producing vigorous wood for the next season’s crop.

Irrigation is carried out mainly by the pipe and sprinkler method, although furrow and trickle, on young trees, are also used.

HARVESTING

Walnut harvest in Victoria usually begins in late March to early April, and continues to May. The time taken to harvest the crop depends on the weather. If wet, the harvest will be over in a short period; if dry, it may be prolonged for up to six weeks.

Rain around harvest time is both a help and a hindrance. Once the hull of the nut has cracked, rain is a help as moisture will collect inside the hull, increasing the weight and causing the nut to fall. But rain does harm as well. The longer the nuts are left on the ground, the more susceptible they, become to moulds and stains. This is especially so in groves under pasture or cultivation. Rain also makes picking up the nuts a slow unpleasant process. The ideal situation is short heavy showers overnight, followed by fine days.

Mechanical shakers and harvesting machines are used to harvest the entire crop in the USA, but in Australia the crop is still picked up by hand, although large growers are showing some interest in machines (1).

The use of ethephon (ethrel) (8) as an aid in harvesting is being investigated in Victoria. This chemical controls the fall of the nuts, thus saving much time. Results so far look most promising.

First grade nuts must be collected as soon as possible after they fall from the tree, and put through a brushing machine to remove any husks and foreign matter. They are washed and sorted to remove badly stained or diseased nuts, before being dried in a dehydrator or kiln for 24 to 36 hours at a temperature of about 40°C. Time in the drier depends on the moisture content of the nuts.

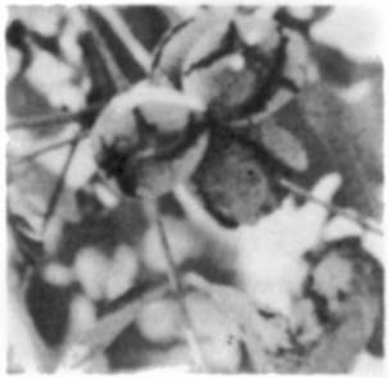

Fig. 3:
Walnuts ready to fall from husk as a result of ethephon spray.

Fig. 4:
Bacterial blight of fruit and leaves

Fig. 5:
Walnut varieties

Eureka

Treyve Mayette

Franquette

Wilson's Wonder

If the nuts are badly stained or dirty, they are usually bleached with a 2 per cent solution of sodium hypochlorite. The nuts are dipped in the solution and washed before drying (4). Sun drying of small quantities of nuts is still carried out. Once dried, the nuts are graded by size and bagged for market.

PESTS AND DISEASE

Bacterial Blight. Blight is the major disease which affects walnuts in Victoria. It is caused by the bacterium *Xanthomonas juglandis* and is often referred to as walnut black spot. The bacteria overwinter on infected buds and twigs. During the spring growth period, bacteria are spread by rain from these sources of new growth. Frequent and prolonged rain just before and after blossoming results in severe blight outbreaks. It is then that the nuts are most susceptible.

Symptoms of the disease are small black spots which first appear on twigs, buds and catkins and later on the leaves and nuts. Early infection of nuts occurs on the tip of the husk which is at the base of the former stigma. On young nuts, infection can extend through the husk into the nuts causing the kernel to shrivel and even rot. Severe infection will cause the nuts to fall off. Infection of nuts in the later part of the season results in the husk adhering to the shell, or discoloration of the shell.

Control of the disease can be obtained by the use of cover sprays or Bordeaux 500g:500g: 100 1 at budburst followed by sprays at 10 to 14 day intervals. If weather is bad, sprays should be no more than 10 days apart. Complete coverage of the tree is essential in controlling this disease, as reinfection following rain is almost a certainty if the tops are missed (16). In most districts in an average year, three to five sprays will be required.

Crown and Roots Rots. Crown and root rots caused by fungi *Phytophthora* spp. and *Armillaria* are difficult to control (16). Good drainage is essential and usually prevents these problems from developing. Once established, there is very little that can be done to save the trees. If applied early enough, soil drenches of Fenarninosulf will help to some degree. Exposing the crown to allow it to dry out will also be of benefit.

Codlin Moth. Codlin moth, the same pest which attacks apples and pears, can cause trouble in some varieties. This pest can be controlled with a November spray of arsenate of lead at the rate of 300g in 100 litres.

Erinose. Erinose mites often attack walnuts and give the leaves a blistered appearance. In severe cases, lime sulphur at 0.1 per cent can be applied just before budburst.

Birds and Vermin: Parrots, cockatoos, currawongs, crows, choughs and gang gangs can cause heavy losses. The use of scare guns will sometimes help to keep these birds away.

Rabbits and hares can attack young walnuts. Wire guards and wraps can helpto prevent losses from this source.

Vegetable Weevil: Weevils have caused severe damage to young trees planted in old vegetable areas. The adults climb the trees in September-January, chewing leaves and young bark which goes black. Bad infestation can stunt trees severely or even kill them.

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NOTES ON GERMINATING QUANDONGS

M.S. BUTTROSE*

We have recently submitted a short article(l) to “Australian Plants” about our work on the quandong. I am therefore just sending you the following notes on germination, which you may care to pass on to your members and which will, I hope, be useful.

We crack dry seeds carefully in a steel vice, remove the parchment-like cover to the actual kernel, then immerse kernels for 30 minutes in household chlorinated bleach, (e.g. White King) diluted to one-tenth strength. We then wash three times in cool boiled water and dust the damp kernels with a general purpose fungicide (e.g. Captan, Thiram or Zineb). We then place the kernels in clean plastic bags containing moist vermiculite or wood shavings which have been pasteurised in a moist state in the bags by heating to 60°C for 30 minutes in an oven.

The vermiculite or shavings must be damp but not wet. We clip the plastic bags shut with peg or paper clip and store in the dark. Temperature is important - seeds germinate best between 16°C and 20°C, and at 25° germination is poor and at higher temperatures almost nil - therefore a cool place is needed. Many people may not be able to germinate the seeds in summer. Normally the first seeds can be seen, through the plastic, to have germinated by three weeks, and we have achieved up to 80% germination by this method.

Please contact me if I can be of any further help.

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* CSIRO Division of Horticultural Research, G.P.O. Box 350, , S.A. 5001.

NUT GROWING IN RHODESIA TODAY

GORDON NICOL*

Our Association was pleased to hear from yours, and put the question of exchanging information to the executive committee. It is very difficult to co-ordinate the members these days when so many, in fact all, are doing three or four jobs. Security forces have virtually no age limit, and we are all committed to doing some form of patrol plus our own job plus the job of the chap who is away on his stint.

Our committee feel it would serve us both best if we form a cordial relationship with your society exchanging views and information. On our part, exchange control restricts transfers of money quite severely, and we believe there may be an embarrassing situation in the offing for yourselves, should your government now or in the future turn the screw of sanctions, as you are probably aware, communications sanctions have already been proposed in the U.N. However enough of that.

I will begin with a general background of this part of Rhodesia and T.N.P.A.R.

The Eastern border of this country is quite mountainous at 1000 to 2000 metres altitude, with rainfall from 750 to 2500mm (30-100 inches) per year, generally between November and March. This is the area of macadamias, and in lesser degree pecans. Pecans have a larger following further West, on higher ground with lower rainfall and colder winter temperatures, around the town of Marandellas. Umtali is described as the Eastern Gateway to Rhodesia and is right on the border, being more in the nature of a market town, but without a market, very picturesque, no heavy industry except timber. The surrounding area grows a wide variety of crops, maize, tobacco, wheat, bananas, coffee, tea, wattle, pine, apples etc. and of course gum. You name it, it grows here.

As you have probably gathered, our association started as macadamias only, but with p were a few growers with pecan plantations and the name was subsequently changed to as at present. Pecans are now coming on fast. There is no other nut grown here commercially, although there is one local enthusiast developing an almond orchard, and there are many who have some oyster nut vines, but there is little interest in them, the latter, as the nuts are not very popular and the vines are troublesome when they climb into the indigenous trees then pull them down in high winds. There are a few native fruits, but nothing that could be marketed, or more correctly, have been marketed. The marula fruit is considered only as food for game animals, though some sections of the African population produce an intoxicating drink from it. Another fruit favoured by children is the wild loquat (Uapaca Kirkiana) local name, mushanje or mushuku or umhobohobo, but this again has never been marketed. The baobab tree produces a fairly popular fruit containing a form of pip which is pleasant to the taste and very refreshing, being creme of tartar. These again are not a commercial proposition, so do not enjoy much popularity with growers. You mention ximenia nuts, I enquired of these with out local horticulturalist, but to date have had no reply, he completed a tour of duty on the border and is now in England on leave, so that information will be a little late in coming forward.

The association was formed in 1972, and in 1975 we managed to convince the government that we represent nut growers and were declared a levying authority, which gives us an

* Secretary, Tree Nut Producers' Association of Rhodesia, P.O. Box 696, Umtali, Rhodesia.

official status and an income from compulsory levies. $10 per year plus 21/2 cents per tree. Most growers have less than 4000 trees, farmers with spare land, or part time growers with say 20 hectares (50 acres). A couple of the larger companies have 10,000 or more trees, but have been restricted in further planting as they intended by the terrorists activities. Membership at present is about 55, but should increase this year to about 70 when we round up all the wayward growers.

Total crop of macadamias this year will be about eight tonnes, pecans about five. The members of the association got together and 22 of them formed a private company to process and market our crop, after a trial year in '76 with 3 tonnes of in shell nuts, they are now ready to roast and can this years crop of macadamias. The grower receives 50 cents per kg. and a secondary payment should this be available after marketing. Pecans sell so well in shell at this time that they are marketed direct from grower to retailer or distributor at $2.50 per kg. Demand far exceeding supply.

One of the biggest troubles to date in marketing/processing has been insect damaged nuts. Our information from Hawaii indicates a 35% crackout, whether this means initial crackout or saleable crackout we have yet to establish, but the latter interests us more. We know and accept the fact that due to the altitude of our growing areas, 500-600 metres above their normal maximum, our shells would tend to be thicker, but in the trial year of macadamia processing we only sold 15% as kernels of in shell nuts purchased.

Growers here have followed the Hawaiian line very closely, very few tetraphyllas are planted and generally the H.A.E.S. named integrifolias have pride of place, with the exception of the macadamia hybrid 695 Beaumont. This seems to do very well here, very high early production volume, thin shell and high percentage No. 1 kernels, of course time will tell if it stays the distance. There are no mature trees in this country, the first one was only grafted in 1965, so we have much to learn.

THE pH OF NUTS AND EFFECTS ON DIGESTION

A.T. SAS*

Nuts with a pH lower than 7 (with acid ash)

Brazil nuts
Cob nuts (filberts)
Peanuts
Peanut paste
Walnuts

Nuts with a pH above 7 (with alkaline ash)

Almonds
Barcelona nuts (Hazel nuts)
Chestnuts
Coconuts, fresh
Coconut milk
Coconut, desicated

The pH of nuts or other foods has not much bearing on digestion. Very few foods are ever as acid as gastric juice.

A food is considered acid or alkaline after a chemical determination is made of the excess of acid or base-forming elements.

Foods that are predominantly protein usually yield an acid ash (a noncombustible residue). Most fruits and vegetables leave an alkaline ash.

It might be supposed that foods containing organic acids (e.g., citric acid in citrus fruits, tartaric acid in grapes, and malic acid in apples) would increase body acidity. On the contrary, these organic acids are oxidized to form carbon dioxide which is partly eliminated through the lungs and partly as sodium carbonate or sodium bicarbonate by the kidneys.

There are a few fruits that are exceptions to this. They are prunes, plums and cranberries. These contain appreciable amounts of organic acids (e.g. benzoic and quinic) which the body cannot oxidize to carbon dioxide and in turn to carbonic acid. They are eliminated by the kidney as acids.

A food that is sour or "acid" to taste is no indication that it will have an acid effect on the body. Rather, its alkalinity or acidity depends on its mineral elements or noncombustible residue.

Digestive disturbances may occur from large consumption of nuts in some individuals, because nuts contain large amounts of indigestible cellulose, but not because of their acidity or alkalinity.

There are only two organic acids produced within the body, which can cause acidosis of the blood. Large quantities of lactic acid may accumulate in the blood after severe muscular exercise. Acetoacetic acid is produced in excess in diabetes which has been inadequately treated and in other conditions in which fat metabolism predominates.

* Superintendent Dietician, Royal Perth Hospital, GPO Box X2213, Perth, W.A. 6001; Member, West Australian Nutgrowing Society.

GUIDE FOR COMMERCIAL PROPAGATION OF SOME NUT SPECIES IN WESTERN AUSTRALIA

B. DELL*

Introduction

The purpose of this paper is to provide the beginner with the minimum amount of information necessary to commence propagation of suitable commercial varieties of six species of nuts. It is important to realize that, as with most fruits grown in Western Australia, a large amount of effort has been put into the selection and breeding of varieties for commercial exploitation. Whilst most species of nuts will readily regenerate from seed, the resulting trees may not necessarily have the fruiting qualities of the parents. For this reason it is essential that easy and effective ways of vegetative propagation, suitable to particular climates, be researched. The accompanying figure provides a self explanatory guide to grafting and budding methods and Table 1 summarizes proven methods of propagation for the six species. Information, additional to that given below, is available for the east coast of Australia and overseas, particularly South Africa and U.S.A. (see Bibliography).

Anyone attempting budding and grafting for the first time should become familiar with the function and position of the vascular cambium in woody plants. The vascular cambium is a meristematic tissue lying between the xylem vessels (wood) and phloem (bark includes cork). When sap is running in the tree or growth is about to begin (deciduous trees) the bark can be readily removed from the wood. This process ruptures the vascular cambium, some remaining on the outside of the sap wood, other on the inside of the bark. The success of any budding or grafting operation depends on the careful juxtaposition of the vascular cambium of the bud or scion to that of the stock. This is especially important in top wedge grafts. Proliferation of cambial cells results in the union of the two tissues. The process is essentially one of callus formation (as occurs on the ends of cuttings) and cell division must begin within hours of budding or grafting otherwise the bud or graft will not "take".

During this critical period the bud and scion union should be carefully protected from drying out. Any of the standard techniques are applicable e.g. wax, plastic tape, aluminium foil, plastic bag etc.

Grafting and budding terminology can be confusing. In this paper the following are considered to be synonymous: chip-bud = patch-bud; whip graft = splice graft; top wedge graft = cleft graft = kerf graft = notch graft; seed graft = nut graft. The former terminology is used throughout.

Macadamia (*Macadamia tetraphylla, M. integrifolia*)

Only current season's fruits should be planted as rootstocks because seed viability rapidly decreases to less than 50% after 6 months. Best results can be obtained by grafting stocks, 1 - 1.5cm in diameter, in the early flush stage of growth (April/May or August/September). It is essential for the scion wood to be cinctured 4-6 weeks before use to allow sufficient time for the build up of starch food reserves. Select mature wood, 0.8 - 1.0cm in diameter, and remove bark and all traces of the vascular cambium for about 3cm in length below the scion branch. The scion should have two bud whorls with long internodes and the leaves should be removed when grafting. Success rate is improved when there is good contact between stock and scion and the area of contact is as large as possible. Macadamia wood is very hard and

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Fig. 1

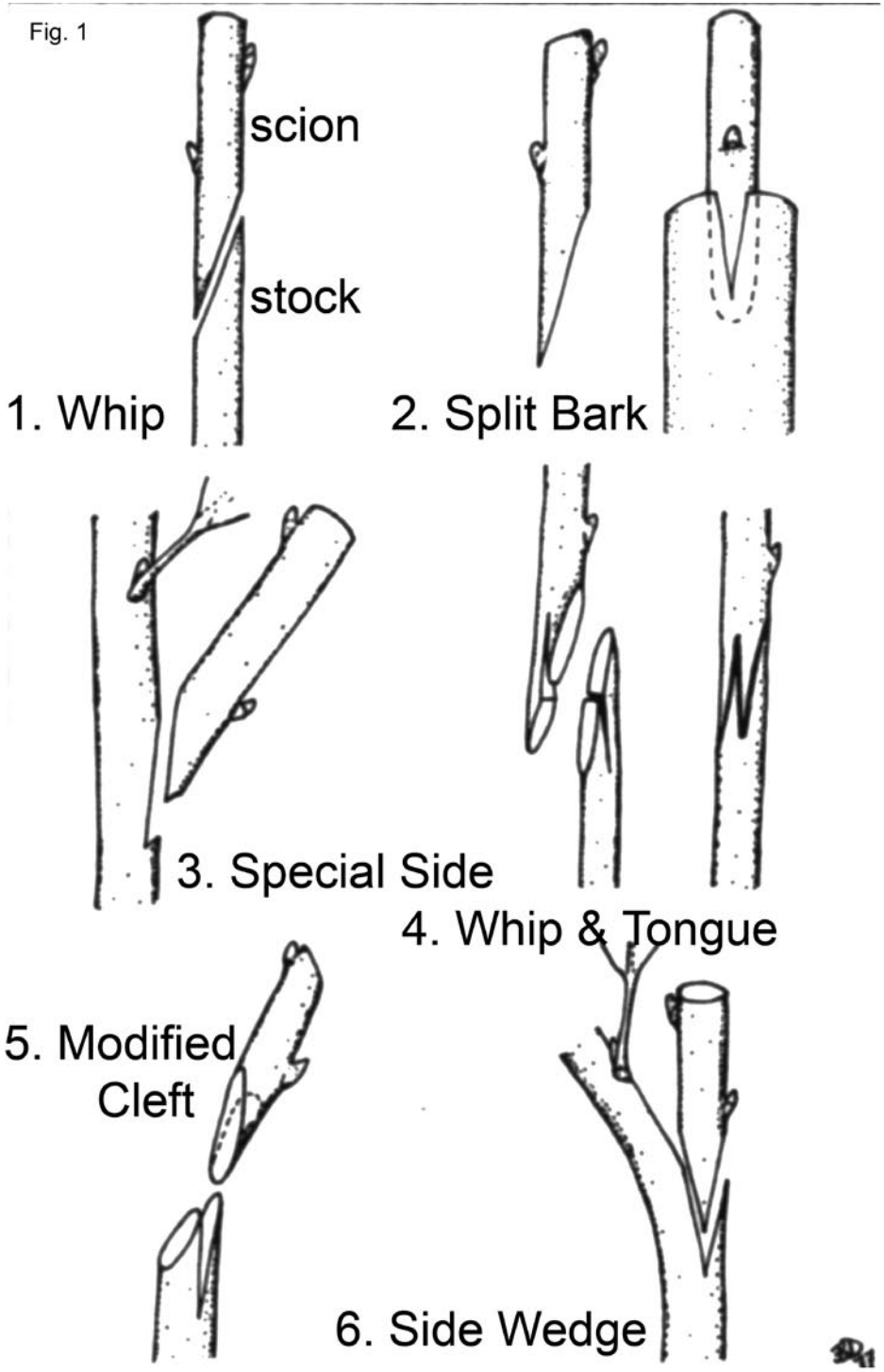
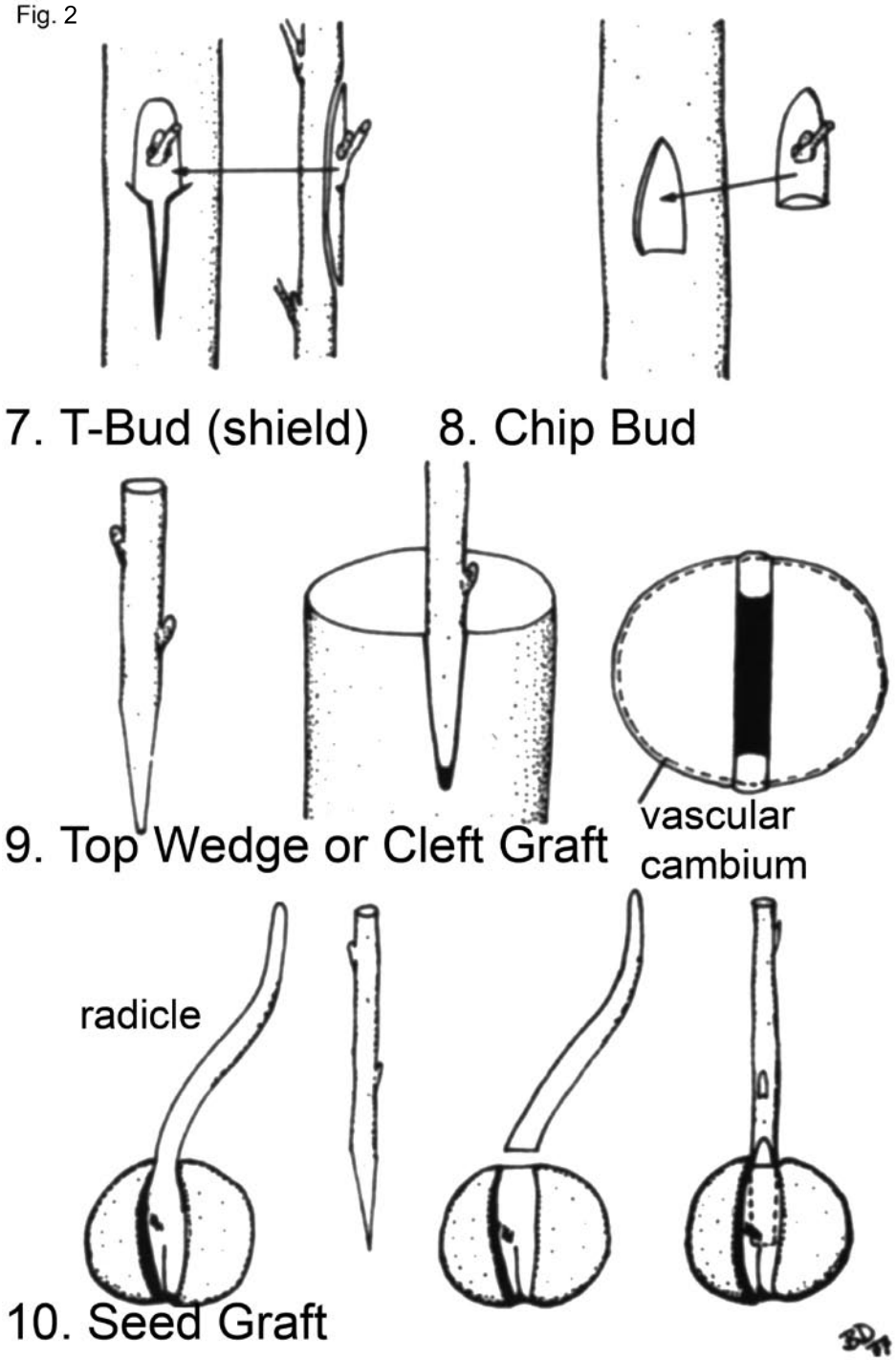

scion
stock
1. Whip
2. Split Bark
3. Special Side
4. Whip & Tongue
5. Modified Cleft
6. Side Wedge

Fig. 2


7. T-Bud (shield)
8. Chip Bud
9. Top Wedge or Cleft Graft
vascular cambium
radicle
10. Seed Graft

brittle and therefore difficult to graft. Problems with wood splitting may be encountered with top and side grafting.

Chip-budding, especially of larger trees in the field, provides an alternative to grafting e.g. top wedge or bark grafts. Buds from previously cintured wood of recently matured growth should be used from August to October in the first instance.

The method of seed-grafting works well where good temperature and fungicidal control can be achieved. Seeds (greater than 2.5cm in diameter) should be germinated (May - November) and the radicle severed close to the cotyledons when 5 to 7cm in length. A cinctured scion, 0.6 to 1.0cm in diameter and cut to form a wedge, is forced into the cotyledons at right angles to the fissure between cotyledons. As with all grafts, cut surfaces should be covered with a suitable mastic.

Macadamias can also be propagated by cuttings or air layers. However, these methods are not recommended because the resulting plants are usually shallow rooted.

Pecan (*Carya illinoensis*)

Pecan seeds usually require stratification, a period of moist cold, before germination. The seeds, are non dormant and will germinate at any time after harvest. Sometimes the shell can mechanically restrict elongation of the radicle under cool conditions. Difficulty in grafting may be encountered due to bleeding of the sap. Seedlings should be grafted shortly before and during the period of new growth (August/September). Alternatively, seedlings may be chip-budded in late summer (March/April). Top graft mature trees in the field with bark grafts (inlay or slot).

Pistachio (*Pistacia vera*)

Fresh seed of *Pistacia atlantica* should be germinated for rootstocks. The husks, which contain germination inhibitors, should be removed before planting. Although *P. terebinthus* has been used as a rootstock it is not recommended because it has a short growing season. *P. chinensis* is unsatisfactory as a rootstock. Stocks should be budded in the field in late February or March. The T-bud is probably the most satisfactory though some nurseries use an improvised chip-bud. The pistachio is dioecious and both male and female trees are required for fruit-set.

Walnut (*Juglans regia*)

The walnut is probably the most difficult nut tree to propagate vegetatively because the young stems have a central pith, and bleeding often occurs from cut surfaces. Scion wood should be selected from last season's growth. It should be solid, with little pith, and the buds should be from 8 to 10cm apart. Grafting can be carried out before (e.g. bench graft) or after the seedlings have shot out in spring. Scion wood for the latter must be cut in July, the ends waxed, and then refrigerated. *J. regia* is not a suitable rootstock in areas where *Armillariella mellea* is a problem.

Almond (*Prunus amygdalus*)

The almond is easily propagated by T-buds in late summer. Almond, peach and plum may be used as rootstocks, though cherry plum is preferable.

Hazelnut (*Corylus avellana*)

The hazelnut (filbert) is easily raised from seed. Tip-layering is a very successful method of vegetative propagation. Grafting should be restricted to special cases of top working, and budding is not recommended.

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MACADAMIA CULTIVAR YIELDS IN QUEENSLAND

R.M. O'MARA*

This report concerns ten cultivars which were planted at Glasshouse Mountain On May 16, 1963. The trees were on seedling rootstock and planted on a deep red sandy loam soil. The orchard is unirrigated, but rainfall is about 1300mm per year.

Yields (kg nut-in-shell)
Age (years)

Cultivars	7	8	9	10	11	12	13
Keauhou - 246	6.6	15.5	9.8	17.9	8.2	30.0	8.9
Kakea- 508	4.0	11.4	9.8	17.5	8.8	17.9	5.9
Hinde- 112	8.6	10.8	3.4	17.5	5.1	12.2	3.5
Own Choice	11.9	14.0	8.7	25.9	14.3	41.2	12.9
Nutty Glen	4.9	10.8	5.3	18.2	10.9	31.1	10.2
D4	8.9	6.9	5.8	7.6	2.4	26.6	11.7
Rickard-B5	3.6	6.5	4.7	4.2	3.7	13.8	1.1
Tinana-B6	3.7	11.1	7.8	14.1	11.3	25.3	1.6
Don 7.5	7.5	12.9	6.2	19.8	7.9	35.3	17.5
Schimke 7.9	7.9	10.0	11.7	17.2	13.6	31.3	17.1

We believe that the apparent alternate bearing habit is only apparent, and that the variations in production are due mainly to inadequate insect control by the co-operating grower. Certainly this was so in year 13 (1976), when the mild winter allowed an unexpectedly early attack of flower caterpillar.

In general, production in the good years from all cultivars except Kakea, Hinde and Rickard are comparable with reports from overseas. The highest yielding cultivar, Own Choice, has the disadvantage that its nuts will not drop from the tree. As much as 80 per cent of the crop must be hand-picked. At the present time, this renders it unacceptable as a commercial cultivar.

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ROOTS II, OR, MURRAY RAYNES' NUTS

MURRAY RAYNES*

Editor's Note:

When the Editor asked Murray to describe his Harvey planting, he suggested that Murray put his plane on autopilot while he got to work. However, the Editor suspects that Murray stayed at the controls and got the autopilot to write the following article.

1. THE BEGINNING: Murray Raynes, born and bred in Western Australia, was transplanted by love of flying and greed for money to Hong Kong. Both these vehicles having been destroyed, he then looked back to the West in search of tranquility, fulfillment, and a closeness to his land.

2. THEN CAME WANS: Our hero at once saw an opening, a possibility of great things in the future, a heaven on the horizon of his life (all this on one bloody mary and one white wine!). Reading (?) deeply, he said "NUTS". But which?? Macadamia? Have I enough water? How do I crack them? They're a tough nut. Almonds? No - parrots!! Eventually, by elimination, pecans seemed to be the answer.

Pecans - very weather tolerant, easy to open, producing indefinitely - appeared to be the most suitable.

3. BUY LAND! Still living in Hong Kong and able to get to the West for brief periods only, the search took the form of infrequent frantic rushes into the hinterland - roughly after the fashion of a lizard drinking water. North is too dry, south too cold, east too salty, west is owned by the Rottnest Board of Control and not for sale. Eventually found in the Harvey hills, between the Harvey Weir and Stirling Dam - the absolute dream block. One hundred acres

(40ha) crossed by a perennially flowing stream. After a few problems with Cyril Rushton (Minister for Planning) and others - eventually signs purchase agreement.

4. TREES IN: Six hundred pecan trees were ordered in January, 1977 from Fitzroy Nurseries in Rockhampton, for delivery by air freight on July 5th and 12th (300 each week).

5. At this stage, our intrepid birdman is still in Hong Kong. He has the "Handbook of North American Nut Trees", an Agreement to Purchase Land signed by both parties, a confirmed order with Fitzroy for 600 trees (arriving in four months) and five weeks leave (10th June - 25th July) in which to pull the entire operation into order. On April 18th he breaks his collarbone in a motor cycle accident, which ultimately turns out to be the best day's work he ever did. Unable to fly aeroplanes, our intrepid ex-aviator finds himself on the agricultural scene five weeks early.

6. Ex-aviator arrives in Perth and in one day he visits -

(a) Lawyer, and finds he owns the land;

(b) Public Works Department, and finds authority to construct a gully dam on the property is not necessary;

(c) Agriculture Department, who advise that indole-3-butyric acid for root nourishment is unwarranted.

So he proceeds to Harvey.

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7. Aviator becomes carpenter, thus reversing the more widely-known precedents, and constructs bridge and resurrects old tin shed as working and living area. Consults earth-moving contractor for quote on dam to be constructed later in year. The word from Joe (Godfather of Junction Mafia) "If you don't get it in this week, you'll be b---- d until the creek dries out next summer, and it's going to cost plenty!!!!" Four days later the carpenter has a (5 metre) wall across the creek, and in another five days has 21/2 million gallons of water.

8. PLANTING PLAN: 35' x 35'? 50' x 50'? Closer and chop early? The most recent trend appeared to be along the lines of closer trees, with periodical pruning to keep the trees smaller so that the growing goes into the fruit and not the wood. After lots of thought, it was decided by aviator that trees would be spaced six metres apart, in rows 12 metres apart.

9. MARKING AND DIGGING HOLES: Here evolved a method of marking out an orchard, the results of which bear testimony to the tremendous inaccuracy of the method and the inadvisability of detailing same. However, in the event of the plantation not producing nuts in commercial quantities, there may be a possibility of using the area as a maze. The holes were dug using an 18" (45cm) tractor-mounted post-hole digger. Advice from a long-time friend, ex-rubber planter from Malaysia, indicated that the holes should be as big as possible as, with mechanical diggers, there was a danger of almost "polishing" the inside of the hole, making it very difficult for the young roots to find an egress point, with the result that the roots run themselves round and round in the hole and eventually choke themselves. This problem, however, was negated by heavy rains which filled the holes with water. The subsequent cave-ins obviated the need to roughen-up the inside surfaces.

10. A half pound of superphosphate (potato E) was thrown into each hole. Slow release pills were advised against by the Ag. Department as being unnecessary expenditure due to ground temperatures releasing pills quicker than planned. Superman used potato E because it was readily available, and Wesfarmers dealer showed that the only difference between that and superphosphate was in ?nitrogen?? content.

11. Off to Perth Airport for 300 trees- arrived on schedule. Well packed. Dept. Ag. fumigation centre - Charlie Woods - very co-operative' No problems.

12. **TREES INTO GROUND**: After very slow, uncertain start (Aviator once grew cress in Wettex cloth) and some help from friends, 300 trees were in the ground in three days. With water readily on hand, one man could efficiently plant 70-80 trees per day.

13. One week after first shipment airline freight department says "No trees - maybe tomorrow". TOMORROW!!! Tomorrow is 14th July - impending Transport Workers' strike - possibility of airlines closing down their operations - Aviator sees trees dying in some corner of a foreign hangar which is forever ridiculous. However, trees arrive next day on the other airline. Telephone call confirms shipment ex Rockhampt on - one day late - wrong airline. Rocks thrown at Fitzroy.

14. Second 300 trees were planted without further incident, as per 12.

15. Electric fence was constructed to keep out pigs (indigenous) and cattle (domestic).

16. A microtube irrigation system is being installed to gravity feed water from an elevated tank fed from the dam.

SUMMARY: Without exception, nothing was done without reference to the written word, be it WANS periodicals, Handbook of North American Nut Trees, or S. African Ag. Bulletin, as Aviator had no experience in any field of agriculture whatsoever.

The doubts Aviator has concerns the Ag. Department advice not to treat roots with indole-3-butyric acid. During second 300 treeplant (400 in the ground by now), Ag. Department field rep. from Bunbury called by, and was surprised that indole-3-butyric acid was not being used to treat roots before planting. After some muttered expletives from Aviator, Bunbury field rep. offered to mix same for remaining 200 trees - accepted and used. Result - - 400 clean and 200 with indole-3.butyric.

The planting consisted of:-

200 Success
100 Western Schley
170 Texas Prolific
100 Williamson
30 Vanderman

and covered approximately 16 acres (7ha).

Five weeks would not have been enough time to complete the job. In the circumstances it was necessary to break the clavicle.

JOJOBA IN AUSTRALIA

JOHN E. BEGG*

Jojoba (*Simmondsia chinensis* [Link] Schneider) or the liquid wax plant, is a large leafed evergreen shrub of the Sonoran Desert of southern California and Arizona, and north-western Mexico. Since it was first described as *Buxus chinensis* by Link in 1822, who mistakenly believed it was collected in China, it has been assigned to four different families, the Buxaceae, Garryaceae, Euphorbiaceae and is currently the only member of a new family, the Simmondsiaceae. A comprehensive article dealing with its natural distribution, propagation, and progress towards domestication in America, was published in the 1975 yearbook by Paul H. Thomson (l).

The introduction of Jojoba into Australia dates back to the mid 'thirties, when the late Albert Morris introduced seed from Arizona as part of a programme evaluating the suitability of native and introduced species for the revegetation of denuded areas around Broken Hill. Since then, experimental plantings have been established in all of the mainland states and the Northern Territory, by State Departments of Agriculture or Forestry, and CSIRO. Generally only a few plants were established at each site, and with one exception no seed has been harvested in the field, due either to a lack of male bushes in one case, ineffective pollination due to low temperature during flowering, or immaturity of the plants.

Preliminary observations on these plantings indicate that growth rates in the field can be quite low during the establishment period, i.e. 10 to 20cm per year, and that frost is likely to be a major climatic constraint on the survival and/or production of new plantings, particularly in inland Australia. While mature bushes will recover from frosts of -5 to -9°C, seedlings are more sensitive, and the most sensitive stage of all is during flowering and pollination. One unusually heavy frost can wipe out years of work in the establishment of a new planting - a recent case was the loss of the Barona plantation of 30 acres in California during the winter of 1975. This area was not replanted and is now considered unsuitable for the cultivation of Jojoba.

Flowering occurs in response to autumn/winter rains and if the flowers are exposed to light frosts (screen temperatures of 0 to -1°C) during pollination, little or no seed may be produced that year. The preferred sites for Jojoba are light textured, well drained soils where long term extreme values for screen minima do not fall below -5°C, and for stability of production the minima should not go below zero during flowering.

It is only this year that attempts have been made to establish plantings of an acre or more in Australia. Nursery grown seedlings have been planted out this winter on at least two properties in the Victorian Wimmera, and further plantings have been planned for southern New South Wales and Western Australia. Because of the long lead time between sowing and full production, effective site evaluation in terms of production will not be known before 1990. Plantings on sites which are unsuitable or marginal because of soil and/or climatic factors will generally become apparent before then, so that by the mid 1980's we will have a better understanding of the sites on which it will not grow and persist. However the critical question re production, and the stability of that production, under Australian climatic conditions will not be known before the 1990's.

Studies of the natural distribution of Jojoba when used to indicate suitable areas for its cultivation in other countries can be misleading. In its native habitat the criterion for success

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is survival. Thus for a species with a life span well in excess of 100 years, favourable rains and benign winter temperatures are necessary only once in every 25 to 50 years, to ensure adequate seed production and seedling establishment for survival of the species. In contrast, the criterion for success as a domesticated crop is continuity of annual seed production. Thus its ecological range of habitats will exceed its commercial range. Also the mechanisms enabling it to survive under stress in its native habitat are generally not compatible with those necessary for sustained commercial production. Hence its domestication as a successful commercial crop will require considerable modification of the native wild types.

Controlled Environment Studies

Results from the phytotron in Canberra have clearly shown that Jojoba will grow and flower over a wide range of temperatures (18/13 to 36/31°C - day/night temperatures) and that it is not "summer dormant" at high temperatures when water and nutrients are freely available.

A major problem in the field is the slow establishment and the delay of at least three years, before you can identify the females and adjust the ratio of male to female plants for effective pollination. Thus it is of interest that under phytotron conditions, males have flowered in five months and females in nine months.

Also, once superior male and female plant types have been identified, e.g. males with a long blooming period, these can be readily propagated from vegetative cuttings. In this way cuttings of known sex and plant type can be transplanted into the field, thus providing control over the ratio and planting arrangement of selected male and female bushes.

When sown directly into moist soil at 80°F (27°C) the seed germinates within a week. The thick fleshy tap root then elongates at over 2cm per day, and can reach a depth of 50 to 60cm before the shoot appears above ground. Root growth following transplanting is, however, not so active and methods for stimulating the root growth of transplants need to be developed. While the optimum temperature for germination, early root and shoot development, and photosynthesis is around 80°F (27°C), photosynthesis is maintained over a very wide temperature range and does not fall below 30% of the peak rate until the temperature exceeds 40°C (104°F) or drops below 10°C (50°F).

Jojoba has received considerable publicity as a substitute for sperm whale oil, however the recent recognition of the economically more attractive low volume markets in the cosmetics, pharmaceutical and hard wax industries, indicates that they may provide a more viable base for its domestication as an industrial crop.

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Author's Annotation

In the above article, I have included an outline of the controlled environment work here in Canberra, and also included some which is relevant for those contemplating growing it. Thus the state of play at the moment, is that we are at an interesting stage experimentally, it will require a lot of work to successfully domesticate it, and any attempts at larger scale plantations should be considered as pilot experiments at best, and certainly as very high-risk investments.

I was interested in the article and map showing the nut growing zones in W.A. - 1975 Yearbook p. 71 - and the request for further information. Jojoba is now growing in the coastal region of zone 3. The growth rate of seedlings which were raised from seed I sent to Dampier last year of 15cm/yr was quite good, considering they had been transplanted during that period. Also, if Parana pine and/or Almond require frost protection in zones 9-10-11 and 12, then while Jojoba may grow in those zones, it is likely to show marked seasonal variation in

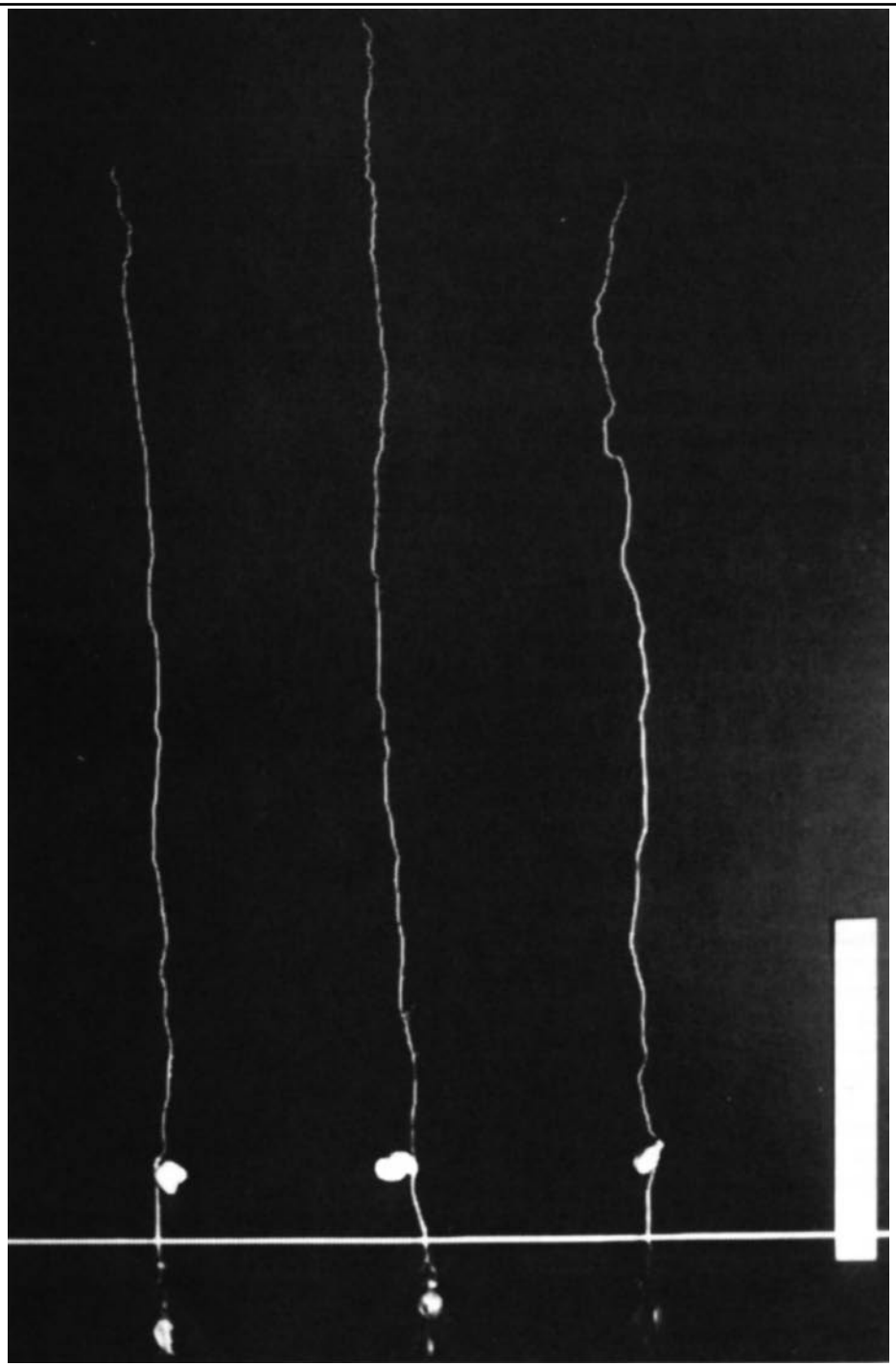

Fig. 1: Root and shoot development in jojoba

yield associated with frosts during flowering.

The photograph supplied shows active tap root development, slow shoot development, and almost complete absence of lateral root development during the first seven weeks. The tap root had then reached a depth of 70-80cm, and the shoot a height of 8cm. Plants were grown in a temperature-controlled glass-house at 27/20°C.

USE OF ETHEPHON TO INDUCE MACADAMIA NUT DROP

R.M. O'MARA*

With the increasing cost and scarcity of rural labour, the traditional method of harvesting macadamia nuts (picking them up by hand as they fall) has become uneconomic. With the advent of mechanical sweeper-pickers, the problem of getting the nuts on the ground when required has come to the fore.

Ten-year-old trees of the variety Kakea (508) were sprayed with ethephon, and 2 weeks later 70-80 per cent of the nuts had fallen, where the concentration used was 400 to 600 ppm. A 200 ppm spray was not adequate at this time.

It is evident from this trial and from personal and grower observation that this chemical can be used safely to drop nuts from macadamia trees. However, the concentrations required vary markedly with cultivar, and even on the one cultivar change through the season.

The effects of these factors are yet to be tested adequately.

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PROSPECTS FOR NUT PRODUCTION IN TASMANIA

ANTONY JOYCE*

I have some land near New Norfolk in the Derwent valley of Tasmania. I am planting as many species of fruit and nut trees on it as I can find. So far these include Walnut, Chestnut, Hazel, Stone Pine, Almond and a couple of Oaks (Quercus robur and Q. palustris). All these have done well in their first season in spite of minimal site preparation, but helped by an unusually wet spring.

The main problem has been possums. To overcome it I have put a 44 gallon drum with the ends removed over each young tree. If one end of the drum is cut with a cold chisel into four "petals", which are then folded outwards, this protects the growing tree from sheep.

One omission that I note from your publications is mention of some of the rarer types of temperate nuts that would suit properties like mine in Tasmania and the cool western corner of W.A. My knowledge of these is very limited, but to start things off here is a list of possibilities taken from "Sturtevant's Edible Plants of the World" (1)

Carya alba	-	Hickory
Carya sulcata	-	King nut
Castanea dentata		American chestnut
Castanea pumila	-	Chinquapin
Corylus colurna	-	Cobnut
Juglans cinerea	-	Butternut
Juglans nigra		Black walnut
Juglans sieboldiana	-	Japanese walnut
Pinus lambertiana	-	Sugar Pine
Pinus sabiniana	-	Digger Pine

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QUANDONG OR WOLGOL?

JOHN SAGGERS*

"Often in our walks we would gather the *Wolgol* nuts (in the eastern States they are called quandongs and the name has gradually spread over here)". This is what Ethel Hassell has to say in her book "*My Dusky Friends* "(1) which is about Aboriginal life and legends, and station life at Jarramungup in the 1880's (now Jerramungup).

She goes on to say:- "These trees grew very plentifully everywhere and could be seen a long distance off, for they are as tall as, and not unlike, a cherry tree, with pale green almost yellow leaves, shaped like a narrow pear leaf, and red berries resembling a large deep red cherry. The skin is thick and there is not much flesh over the stone, which is deeply crinkled. The fruit has a slightly tart flavour and the kernels taste like a Brazilian nut. I tried to make jam from the fruit, and my effort was most successful. It was very like damson (plum) and after my trial I was just as keen to collect the *wolgol* nuts as any of my dusky friends, though I used to give them the kernels, and there used to be a good deal of nut cracking by the children around the wood heap.

The stones are a pretty pale brown colour, and I made some beautiful necklaces for they vary in size from a small marble to as big as my two thumbs. In the winter I often used to bring out some *wolgol* stones to amuse the children, and the cracking would keep them quiet while I got their mothers to do small jobs for me."

Further on in the same chapter Ethel Hassell says about the sandalwood:-

"The *poilyenum* or sandal wood also has a pretty red seed, but the skin was very thin over the nut, was tough, and tasted like alum. The nut was a smooth pretty brown colour, about the size of a large marble. The kernels were very oily and had a bitter flavour and though they were occasionally eaten, the women preferred to pound them up and rub their lords with the oil extracted from them. The smell is not unpleasant but soon becomes rank, and while these nuts were plentiful I preferred to get well to the lee side of the men.

The sandal wood tree I think is about the ugliest tree I have ever seen, with fleshy leaves about the size and colour of sage; they only looked rather pretty when covered with their red berries, but nothing like as beautiful as the *wolgol*. There were a great many about and I loved to burn small pieces of it on a summer's night, not only on account of its fragrant smell, but because it kept the mosquitoes away."

These quotations from the book suggest that *wolgol* is the local name and that quandong is from "over east". The Oxford dictionary gives two spellings, i.e. quandong and quantong - a semi-parasitic nut tree native to Australia.

As children in the Tambellup district, we used the name quongdong as I always thought it was spelt that way until I learned better. Or did I? Our father, who came from Victoria and was a land guide in the early settlement days of Tambellup, always called them wild peaches.

I have had some success in growing quandongs from seed and have five trees producing now, with more coming on. The largest would be almost fifteen feet tall, and last season it produced well over 501b (23kg) of ripe fruit or nuts, weighed as picked, with the skin on. As

* Member, West Australian Nutgrowing Society

we picked quite a few for visitors and casually for our own use, the total weight would have been over 601b (27kg). We dry the peel or fruit for use as stewed fruit throughout the year, and the nuts find various uses as ornaments, etc. being very popular with craft workers for necklaces and so on. I eat a few, but not everyone likes the flavour of the kernel, although, like the peel, it is an acquired taste and after a while one becomes a connoisseur, both of the fruit and the kernel. The fruit or peel is delicious.

To germinate the seeds, I crack them carefully either in a vice or with a soft blow from a heavy hammer while holding the nut against the end grain of a solid block of wood, removing all the shell, without bruising the kernel. Some nuts which I simply cracked and planted in the bush, shell and all, have germinated and are growing. These were planted two to three inches (50-70mm) deep near a suitable host plant.

Last season I used a plastic ice-cream container with a few holes in the bottom, about 21/2 to 31/2 inches (65 to 90mm) of damp sand, and just put the kernels in shallow depressions in the sand about an inch (25mm) apart. I bedded the seeds down about half their depth and covered them with a layer of cotton wool, or two or three layers of old towel, etc. The covering was moistened, the plastic lid put on, with about six small knife slits in it for ventilation. This arrangement will not dry out rapidly, can be watered easily when required, and any kernels that should mould or rot can be removed.

Some germinate easily and some take a long time - Autumn seems a good time, but I have also started them in December as well as in Spring. When they develop a root I make a hole in the sand with a thin stick and put the root loosely in it or the nuts will be pushed around as the root grows. As soon as the root is about two inches (50mm) long and the leaves begin to withdraw from the kernel, transfer to separate pots and cover lightly with sand and keep damp or the young plant may get trapped in the drying kernel and break off below the first leaves. If that happens it cannot grow.

As soon as possible select a suitable site and plant without disturbing the roots. Don't dig a big hole, but only enough for the contents of the pot, as the small plant must find the roots of a suitable host. Apparently the wattles, jam trees, eucalypts, and others are suitable, although mine seem to prefer scrub sheoak, and the biggest quandong has killed an almond tree about six feet (2m) away.

In this district the fruit is ripe in October and into November, and the new buds are on the trees almost immediately, with flowers in December.

Young trees prefer partial shade for a year or two, and need water in the first summer at least. They respond well to small regular applications of trace elements and superphosphate (super, copper, zinc, and molybdenum), but I killed some seedlings in the bush with sulphate of ammonia. Possibly one of the new slow release fertilizers would be suitable, although I haven't used these yet.

For anyone interested in sandalwood, the Forestry Department have quite a bit of useful information, although all attempts to grow sandalwood as a plantation crop have been unsuccessful, due mainly to its parasitic habit and also its slow growth and damage from rabbits, bush fires and domestic stock.

Anyone interested in quandongs is welcome to call and see my trees at any time. I usually have seed nuts on hand, and, at the time of writing, half a dozen young plants in pots.

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NOTE: *Wolgol* and *Poilyenum* are native names from the Wheelman tribe in the Jarramungup area.

NOTES FROM BRITAIN

L.T. SWAIN*

I am a plantsman/gardener and I take a great interest in the type of work you are doing. If there is anything I can do for WANS members from the U.K. end, they should feel free to ask.

Some years ago I had some contact with a group of people who were setting up a conservation farming society in the Nelson area of New Zealand to utilise sheep range which was going back to scrub. My contribution was the suggestion that the original tree cover should be restored, but to select nut-bearing trees from the temperate world. Although 1 have lost touch with this group, I have continued to research this idea in my reading and tree propagation, and to discover techniques of acquiring plant material from overseas. I assume that it was my advertisement in the RHS. "Garden" for scions of dwarf walnuts which caused us to come into contact.

I have an interesting North American tree book(1) which describes, among others, *Quercus arizonica, Q. emory; Q. virginiana,* and *Q. oblongifolia.*

These four oaks, from arid regions of North America, lie in the same latitude as Perth, so should provide a suitable provenance for you. The State of New Mexico seems central for them all and I note in Jayne's 'North American Nut Trees'(2) that there is a Pecan Growers Association at La Mesa. Perhaps they can help in getting you the acorns.

I note in 'Quandong' that some growers are having trouble with weeds. A tip which works in our high rainfall, but may not in sunnier and drier climates, is to use four plastic fertiliser bags, weighted with stones or logs, as a mulch and weed smotherer. This at least saves competition within the root area of a young tree. The alleyways, if they are not clean cultivated, could then at least be rough-cut with a mower (hand or tractor) and the coarse lay used for compost or mulching.

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* Member. West Australian Nutgrowing Society.

THE BALL NUT, MACADAMIA PRAEALTA

NOEL THIES*

The rain-forest area of northern New South Wales - southern Queensland is the home of a surprisingly large number of native Australian nut-bearing species. These include the coniferous Bunya Pine (*Araucaria bidwillii*) and a number of species from the Proteacea family, of which the best known are *Macadamia integrifolia* and *Macadamia tetraphylla*, both grown and sold commercially as macadamia nuts. Much less well known, and probably now quite rare, are *Hicksbeachia pinnatifolia* (1) (Red Nuts) and a number of other Macadamia species.

Of the several other species known, only *Macadamia ternifolia*, the Gympie or Maroochy nut, is especially closely related to the two commercial species. Storey and Frolich(2) carried out graft-compatibility trials with different Macadamia species, and concluded that these fell into three groups, with grafts between species from different groups having a very low degree of compatibility. The first group contained the three species already mentioned. The second included *Macadamia whelani* and *M hildebrandii*; and the third included the two species *M. heyana* and *M. praealta*. Relationships between the different Macadamia species are by no means settled, and there are other species not mentioned here, which may fall in the above three groups, or in other groups altogether.

Francis(3) gives one of the few detailed descriptions of Macadamia praealta, although it is also mentioned in Rumsey(4) and Anderson(5). According to Francis, the Ball Nut tree reaches a height of about 20m (making it probably the tallest macadamia), and a stem diameter of about 30cm. The trunk does not become prominently buttressed. The bark is brown and fairly rough, but not fissured. The leaf stalks are 0.5-1.2cm long. The leaves are alternate, usually wavy, and net veins are visible on both leaf surfaces.

The narrow flower racemes, of typical macadamia appearance, are 5-12cm long, with individual flowers about 2cm long. The racemes form at the leaf forks or at leaf scars.

The large fruit is globular, up to 5cm or more across, almost as large as a tennis ball (Fig. 1, 4). The shell is up to 0.5cm thick, and is much softer than that of the common macadamia or Queensland nut. Within the shell there is usually only one seed, but occasionally two may be found. Seeds are covered by two separable, papery seed coats. As well as Ball nut, the fruit is sometimes also called an Opossum nut.

The flowering period is January and February, and the fruit is ripe around June. The tree is found in and around scrubs of the coastal areas from the Clarence River, New South Wales, and north to Gympie in Queensland. The timber is fairly durable, resembling Silky Oak in appearance, and could be used in cabinet work.

The tree now appears to be very rare, especially where the north coast of New South Wales is concerned; I have only come across two trees. One is a very poor specimen near the banks of Wilson Creek, the other is a beautiful shade tree on private property. In recent years this has deteriorated also, but does have a few poorish nuts on it (Fig. 2, 3).

In their book 'Wild Food in Australia'(6), the Cribbs note that the nuts were known to be

* Lismore Naturalists Club; 14 Compton Avenue, Goonellabah, N.S.W., 2480.

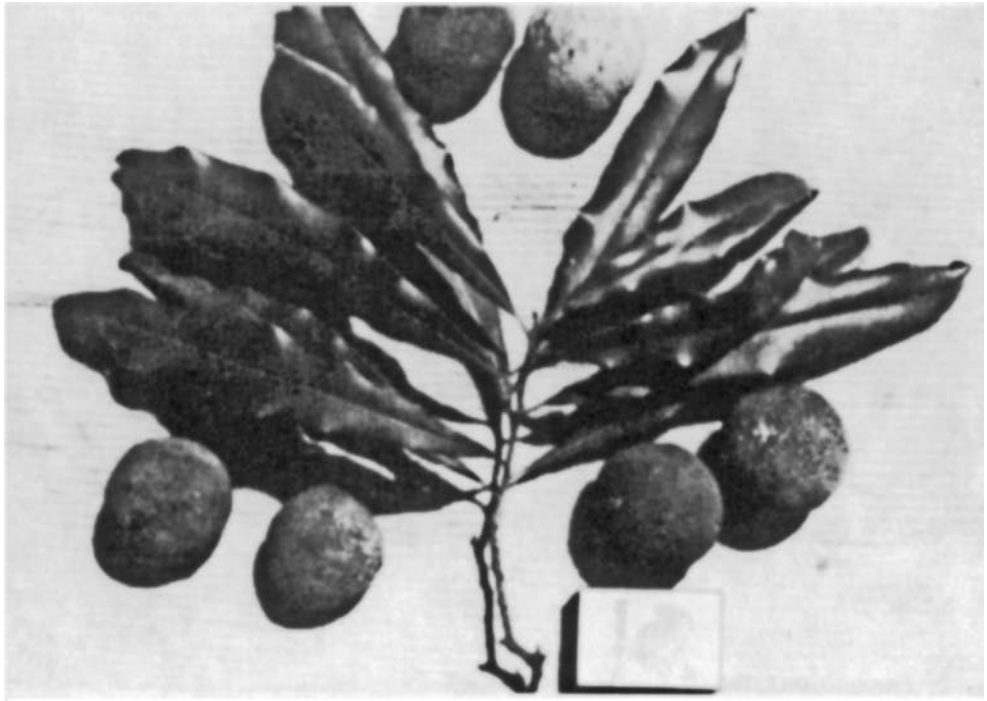

Fig. 1: Leaves and nuts of Macadamia praealta

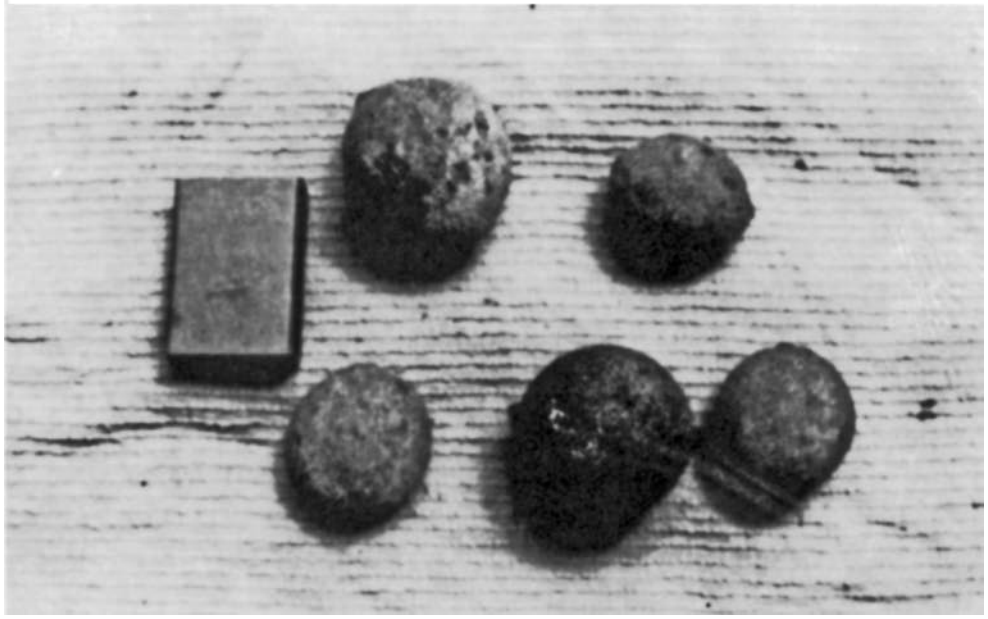

Fig. 2: The ball nut tree or beefwood.

Fig. 3: Macadamia praealta tree about 8m high.

a popular food with the Aborigines, although they had not tasted the kernels themselves. But when I tried the taste, I found them worse than liquid quinine (which I had to take for a long time), and it took me about half an hour to get rid of the taste from my mouth. I would have to assume that the Aborigines had some way of treating the nuts before eating them.

For the nut breeder, hybridising with the ball nut seems a possible way of greatly increasing the size of the commercial macadamia nut. However, if the graft incompatibility is due to a basic genetic difference between the species, hybridising may not be possible.

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NOTES ON PECAN CULTURE

L.C. McMASTER*

1. CLIMATE AND WEATHER

Winter chilling requirement for 400-800 hours, below 7°C.
When dormant the pecan can withstand -32°C without injury.
Temperatures <0°C during growth cause nut and foliage damage.
1200-1700 heat units needed during the 7 month growth period depending on variety.
Nut size and yield reduced below 1400 heat units.
Low humidity (<80%) preferred for pollination and preventing nuts from sprouting.
Require irrigation in summer - beneficial even in rainfalls of 1400mm p.a.
Climate range in North America extends from Florida to Canada.
Heat tolerant of 110°-120°F but best at 80°F average.
Trees need 180-200 days to fill shell, hence northern limit of cropping is New Jersey in U.S.A.

2. SOILS

Adapted to a wide range of soils. Best growth on deep alluvial soils; sandy soils have the disadvantage of poor moisture retention. Soil pH of 6-6.5 is thought optimum, although various sources cite from pH 5.7-7.6 with an upper limit at pH 8.3.

Impervious clay subsoils or soils with a shallow water table are considered unsuitable for pecan growth.

Ideal soils are sandy loams(18-24") with a sandy clay subsoil.

3. PROPAGATION METHODS

Budding or grafting on seedling rootstocks. Leafy softwood cutting will root under mist. Plants have also been started by root cuttings and by trench and air layering (with the aid of IBA).

Seeds lose their viability in warm, dry air storage and should be kept at 0°C after harvest or at 10°C in moist sand.

Crown grafting in late winter or early spring by the whip or tongue method may be, used to work seedlings. Skin and Patch budding may be used.

Success depends on the timing of operations and knowledge of the scion material requirements.

viz. Budding - Mid February and autumn)
Grafting - Mid August)
Narara, N.S.W.

4. ROOTSTOCKS

Seedlings of cvs 'Moore' and 'Mahan' are used. U.S. workers have yet to select a suitable dwarfing rootstock.

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5. VARIETIES

Numerous selections have been made and active breeding programs are underway in the U.S.A.

"Paper shell" varieties are not well suited to the cooler areas, having a growing period of 205-215 days. Pecan varieties suited to cooler areas have thick shells and a growing period of 180-200 days. Thick shelled varieties are also more suited to mechanical harvesting.

Varieties which have cropped satisfactorily over 40 years at Narara are (in descending order of yield) - Moore, Western Schley, Caspiana, Halbert, Pabst, Stuart, Burkett, Delinas, Van Deman. However, the influence of variety layout upon pollination in these records is not known to me.

However, several newer varieties such as Wichita and Sioux show promise for Australia and particularly for the trend toward "high density" orchards. 31 varieties are listed presently in Australia in the variety list of R. Ikin (1974) and this is known to be incomplete.

6. POLLINATION AND PLANTING DENSITY

The pecan carries male and female flowers separately on the same tree. In some varieties the female flowers become receptive to the pollen when it is shed from the male flowers, and self pollination occurs. In other varieties, the female flowers mature and the stigmatic surfaces dry out before pollen shedding takes place; here other varieties are needed for cross pollination.

Fortunately all the self pollinating varieties shed their pollen during the receptive period of those varieties needing cross pollination - fertilising themselves and the cross pollinated varieties.

Nut size is reported to be larger as a result of cross c.f. self pollination.

Traditionally pecans have been planted at densities between 17 trees (50' x 50') to 4 trees (100' x 100')/acre, resulting in a 'break-even' productive stage at year 11 or 12. Recent interest in, and employment of, so called "high density" plantings and new varieties has reduced this stage to year 5 or 6 in some cases.

Close plantings currently employed in the U.S.A. are 30' x 15' and 40' x 40'.

7. PRUNING AND TRAINING

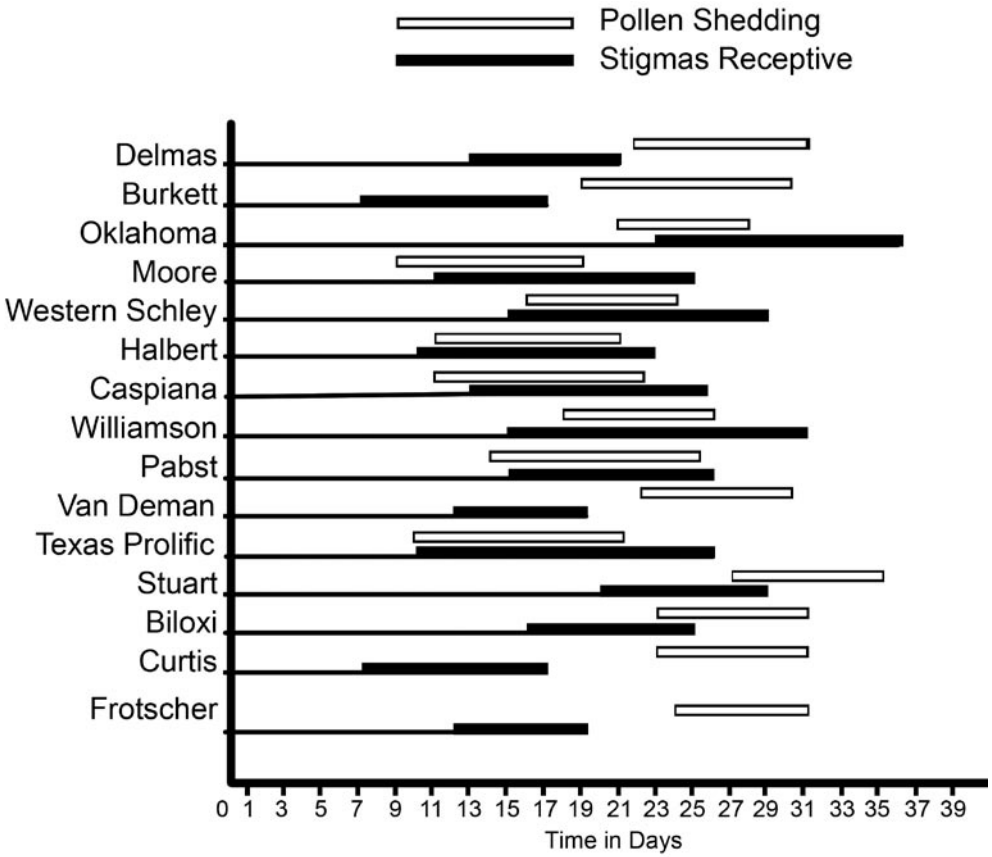
Young trees are pruned annually to develop a permanent framework and strong scaffold limbs. Trees are trained over the first 4 years to produce side shoots or scaffold branches that grow off the main trunk (central leader) at wide scaffold crotch angles. The scaffold branches should radiate the central leader for a space of 8-10'.

Varieties differ in their natural branching characteristics, the strength or texture of wood.

e.g. Varieties producing narrow/weak crotch angles include - 'Witchita', 'Desirable', 'Cape Fear'.

Varieties producing wide or strong crotch angles include - 'Western Schley', 'Summer', 'Sioux'.

Mechanical hedging and pruning is employed. Annual pruning helps contain tree size. Yield/tree appears to be increased by removing terminal shoots each year. (The number of fruiting shoots is increased). Excessive pruning may cause sun scalding of the main tree framework.



The diagram above shows relative dates of pollen shedding and stigmatic receptivity of pecan varieties at the Horticultural Research Station, Narara.

Day 0 varied from 17th October to 28th October in the seasons 1951, 1953, 1954, 1955 from Horticultural Research Record, **3**, 1959.

8. FERTILIZER AND SOIL MANAGEMENT

Pecans do not respond to large quantities of fertiliser and any response may be staggered over 2 or more seasons.

In the U.S.A. leguminous cover crops are recommended and once established they should be able to provide sufficient nitrogen. For mature trees on cultivated ground, maintenance dressings of 2.25kg nitrogen, 2kg phosphorus and 1kg of potash/year are recommended. Nutrient deficiency symptoms are well documented.

Clean cultivation, mulching (particularly young trees) herbicide sprays for weed control and over cropping are common practices. At low planting densities, interplanting and cash cropping are practised in the early years before the trees start cropping.

9. PEST AND DISEASE MANAGEMENT

Little information is available on this aspect under Australian conditions.

10. IRRIGATION

Dry periods during the growing season cause nuts to drop - hence irrigation would be needed.

11. CROPPING HABIT

11.1 Maiden Life

In N.S.W., 4 year old 'Western Schley' pecans yield 4Ibs of nuts/tree. Other varieties appear to produce token crops by years 5-6 with good management and pollination etc.

11.2 Cropping Life

Pecan trees are long lived. Native trees in the U.S.A. are known to be 1000 years old and some plantings are over 100 years old.

11.3 Maturity Indices and Harvest Dates

Nuts ripen in late autumn (April-June). When ripe, the husk enveloping the nuts separates into four sections thus releasing the nut, which falls to the ground.

11.4 Production x Time Schedule

Yields are influenced by climate, variety, site and management. Recorded yields range from 25-80lbs./tree.

The variety 'Cape Fear' is recorded to begin cropping the second season after planting, and the variety Mahan in the third season.

Depending on variety production for 6 year old trees at Melrose, Louisiana, U.S.A. ranged from 0-30.2lbs/tree.

Discussing the theory of high density pecan plantings, a U.S. pecan specialist produced the following tables to illustrate theoretical production, adding that results have been reported which would approach the figures included in the tables during the early years of tree production.

viz. **Table 1: Number of trees and production potential/tree for various tree spacings**

		Production Per Tree Per Year At Age				
Spacing (ft.)	Trees/acre	**4**	**5**	**6**	**7**	**8-10 (Ave.)**
30 x 15	96.8	10	20	25	30	40
30 x 30	48.4	10	20	25	30	40
40 x 30	27.2	10	20	25	30	40
80 x 80	6.8	10	20	25	30	40
100 x 100	4.4	10	20	25	30	40

Table 2: Production lbs/acre at various spacings and tree ages

Spacing (ft.)	**4th Yr.**	**5th Yr.**	**6th Yr.**	**7th Yr.**	**8-10 Yrs. (Ave.)**
30 x 15	968	1936	2420	2904	3872
30 x 30	484	968	1210	1452	1936
40 x 40	272	544	680	816	1088
80 x 80	68	136	170	204	272
100 x 100	44	88	110	132	176

11.5 Biennial Tendency/Thinning Weeds

Alternate bearing of light and heavy crops is a problem in some Western areas of U.S.A. Thinning techniques to correct this problem are still to be perfected.

As with the apple, there are 3 waves of dropping of flowers and young fruits -

1st Drop = Pistillate flowers

2nd Drop = Young fruit (poor fertilisation)

3rd Drop = Nuts (about March - embryo and abortion)

Alternate cropping interferes with nuts supplies to processors' shelling plants.

12. HARVESTING

12.1 Pre-harvest Treatment

Ethrel sprays show promise in getting uniform and quick husk dehiscence.

12.2 Harvest Method

Nuts are knocked or shaken to the ground for collection. Pre-laid sheets may be used to collect the fallen nuts.

12.3 Mechanical Harvesting Potential or Aids

Numerous aids have been developed viz. - Tree shakers, Sweep-Type harvesters, vacuum-type harvesters.

- Stick remover, pop and shrivel remover, grading table, sizing machines.

13. STORAGE

13.1 Methods Available

Low temperature (37°- 40°F) at 70-80% R.H. or 32°F or 50°F.

13.2 Shelf Life

3-4 months (37-40°F); 12 months (32°F); 2 years (50°F).

13.3 Miscellaneous

Pecans need to be dried to a kernel moisture level of about 4.5% as soon as practical after harvesting. This prevents moulding, discolouration and oil breakdown and it shrinks the kernel to prevent "sticktight" shells during subsequent shelling.

14. PACKING

Sold in shell in bags and various containers.

Shelled kernels also 'gift wrapped' and canned.

Mechanised shelling - about 94% of U.S. crop.

15. PROCESSING POTENTIAL

(Post shelling events)

Good - confectioners, bakers, ice-cream, salting, oil extraction (low grade kernels), canning.

16. CULINARY USES

Fresh, fruit cakes, pies, desserts.

17. MACHINERY AND EQUIPMENT

Mechanical shakers and harvesters.

Shelling machines.

Grading and sorting machines.

Cool storage facilities.

18. CULTURAL PECULIARITIES

Soil pH range of 6-8.3.

Selection of compatible (self or cross pollinating varieties).

Scion vigour.

19. MISCELLANEOUS

Daminozide (S.A.D.H.) is reported to reduce shoot growth in pecans. Weares Nursery at Griffith, N.S.W. is the only known commercial supplier of pecan nut trees;

Western Schley nuts fetched $ 1/lb on open market in 1976 in N.S.W.

Oldest pecan planting in Australia is at Dagun, Qld., some 20-30 years old. (Includes the variety Mohawk).

CROP MERITS	CROP DEMERITS
High prices	Vigorous
Off season maturity	May biennially crop
Good storage processing potential	Need for careful selection of varieties (pollination)
Mechanised harvesting and processing aids	Extent of local demand (Domestic market) unknown
Early production (precocious 'new' varieties)	

NOTES ON NUT GROWING IN EASTERN AUSTRALIA*

TIM LYNN ROBINSON**

Having thought about nuts, read about nuts, and talked about nuts, we decided that if we were going to become growers of nuts it would be wise for us to go and look, see, and discuss prospects with the people who are active growers already.

We wrote to numerous people requesting visits, following leads read about in the rural press, and finally, with note book full, we set off just before Christmas 1975.

The three main nut tree crops we chose to look at in detail were: *walnuts; pecans;* and *macadamias*, as we felt that these looked to be fairly suitable to the Chittering Valley area of Western Australia where our property lies. We have since added *pistachios* to our list as worthy of attention. Of course there are many others, but with time in short supply we were determined not to be too side-tracked.

So, we gave South Australia a miss even with the realization that there are large almond groves there, and some walnuts are grown. We had been told that the main area for walnuts in Australia was the Ovens Valley of Victoria, and that's where we headed. Soon we were on our way down the relatively flat Ovens Valley, of rich red and chocolate soil. Tobacco and maize were in evidence, and then as the ground started to become more hilly, we turned off at a small place called Gapsted to visit our first commercial grove of *walnuts*, owned by the Shlapp family.

The late Mr. Shlapp and his brother planted their first trees in 1922, and built up to a grove of 50ha (120 acres) a few years ago, when a fire unfortunately destroyed some 50 acres of trees. Over a period, by removing non-productive trees etc. most of the grove had been replanted and the trees on average are only 25 years old. It is truly a magnificent sight to see a large area of these majestic 11-12.5m (35-40ft) trees standing in their rich, cultivated, red friable loam. Walnuts definitely require good drainage for good production. Even young trees, 10-15 years old, were 6-8m (20-25ft) high here and producing well under good management.

Fertilizer, even in this rich valley soil, is applied twice a year, and irrigation is done in the drier months of January and February, although the area receives some summer rain.

The Shlapps have fully integrated their business - they grow their own seedlings (black and persian walnut trees supply seed), do their own budding (September and February), carry out their own hulling and drying (fairly tricky work but apparently most necessary) and hand and machine grading and bleaching. They also have their own marketing outlet, Valley Nut Groves (Sterling Brand), in Melbourne.

At the corner of this magnificent grove of walnuts they had an old pecan tree which we showed a desire to see. As we came out of the shade, there, towering above us, was this 52-year-old seedling tree, which all agreed must be at least 30m (l00ft) tall, with a 1.5m (5ft) diameter trunk. What a sight!

Now to the problems, which do exist, and which tend to be glossed over in magazine articles. Black Spot disease has to be controlled as it can decimate the crop; root and crown

* A condensed version of 'Travels with Tim', which appeared in Quandong Vol. 2, No. 1, 1976, and in the five succeeding issues.

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rots caused by *Phytophthora* species of fungus (like Jarrah die-back in WA.) are hard to control. Codling Moth (Victoria only), Erinose (leaf mite), and bird and vermin damage all have to be watched, and last but not least, cheap and nasty rancid imports which turn people off walnut eating altogether. One more thing which I have omitted to mention is that after many years they have now established their plantings of the FRANQUETTE variety, which is a late flowerer.

Walnut Reading Musts: "Walnut Investors Must Wait For Dividends", by J.E. Kenez (reprinted Quandong 1[3]); "How To Grow Walnuts If You Really Want To", by M. Ellwood and others (Victorian Dept. Agriculture).

There are other walnut groves in the Oven Valley, but most apparently got a lot of their stock and know-how from the Shlapps, so we decided to give them a miss.

Next on our list was the Department of Agriculture at Macksville, on the northern New South Wales coast. But in getting there, we first negotiated the Alpine Way through Kosciusko National Park, then Cooma, Canberra, and the Goulburn valley to Sydney, arriving their at peak hour!

My sister-in-law in Sydney works at CSR (Colonial Sugar Refining Company), and she produced one of CSR's newer products, a tin of roasted, salted macadamia nuts processed from CSR's plantings in Queensland. The nuts were certainly very well-presented and tasty products, but our correspondence with CSR had not been very fruitful. Apparently they feel a lot of time is wasted taking visitors 'on tour', so they do not make a practice of it. I can appreciate their problem, when you see the numbers of people touring in Northern N.S.W. and southern Queensland.

We made our way northwards to Macksville, where we met up with a Mr. Arthur Akehurst, who led us out along the Bellingen River area (fruit growing and dairying) to a new planting of pecans 35ha (90 acres) in all on an old dairy property. The climate here of course is becoming more tropical, with the major portion of the rain falling in the summer.

This property is owned by a dentist who lives in Coffs Harbour, a large seaside resort. The property lies on the banks of the Bellingen River, and has 12m (40 ft) of friable soil. Unfortunately the owner was away in New Zealand, but as soon as we stepped onto the property we could see the problems encountered by trying to do too much too quickly.

This owner was unlucky in that he was suddenly landed with thousands of seedling trees from Stahmann Farms, Moree, and tried to organize them into the field in one hit. This meant that on the old kikuyu grass based dairy pastures the weed control was poor, and possibly getting away from him. The young trees were showing signs of stress, and many of his budding attempts had not taken, so that in the future great unevenness would appear in this grove. I was told, at a later stage in our tour, of the vital importance of never allowing any competition to occur with young pecan trees.

I encountered this inability to control weeds with other, smaller groves, and the problem really lies in the fact that they are not full-time operations, because of the long interval between planting and the first commercial cropping. This growth of weeds would not be quite the same problem here in W.A. as it is in Queensland and northern N.S.W., where they seem to grow overnight and need mowing every week.

This owner was apparently trying to find a way to import some of the newer varieties from America, but the regulations here, we were told, made this virtually impossible. This might be a vital issue in Western Australia, because I believe that the newer varieties developed in America for climates such as California and Texas might be more suited to the West, where we have a hotter, drier climate.

Disease and insect problems are immense in sub-tropical and tropical climates, and there is no knowing how many of these would apply to us, even under irrigation. Phytophthora comes up time and time again as a rather disastrous disease as far as tree crops are concerned. My opinion now is that the 3 W's are the major things to watch for Wogs, Weeds, and Water. There is no doubt that nut trees are reasonably hardy, but to produce high quality, marketable, full kernels, the 3 W's are vital.

Because of time interval between planting and commercial crop, the owner of the Bellinger Grove did try to grow a cash crop of maize in between rows, but to be successful here some extra machinery and expertise was required, which one way or another was lacking, and the cash crop wasn't as rewarding as envisaged.

There seems to be no real criteria on tree spacing. With pecans, some plantings have been 10m x 20m (30' x 60'), with the intention to remove alternate trees later (who wants to remove a tree after ten years growing!!?), others 15- 16m (45' x 50'), and also in 20m (60') squares with an extra tree in the middle of each square.

The Agriculture Department itself was doing nothing in the nut tree crops, except observing.

One point worth noting is that the chilling requirement which pecans have doesn't necessarily mean that frosts are needed --cold mountain winds can do a good enough job

* * *

Our next appointment was with the Department of Agriculture in Lismore, where we met Mr. Ross Loebell, who was a veritable fount of information on *macadamias* (which are natives of that part of Australia, and are still called by some people the 'Queensland Bush Nut'). Ross does a lot of the technical work such as soil and leaf analyses for the growers in the area. He is also personally very interested in Macadamias.

I usually start out by being positive about a tree, but there a few definite **don'ts** with macadamias as they **are** a rain-forest tree.

Macadamias don't like: frosts, cold winds, soggy ground, water stress, or high winds. Frosts and cold winds decimate young tender shoots, soggy ground encourages Phytophthora infestation, water stress stops fruit set. The macadamia actually has a high water requirement due to the nature of its root system. High winds will just blow trees down due to lack of tap roots. The cyclones that we hear about occurring in Queensland have taken their toll.

The 'Alamo' grove that we were first taken to was in the higher plateau country that Lismore itself sits on, but it undulates, and the trees were planted on a more sheltered hillside of volcanic origin, which of course is well-drained. Even with the high rainfall received in this coastal region, irrigation is carried out in the spring months with a trickle system. This grove, being one of the earliest commercial plantings, had good sized trees 3-5m (10-15ft) high bearing well, with many clusters of nuts visible.

We soon learnt that there were two basic types of macadamia, the *Tetraphylla* and the *Integrifolia*. The tetraphyllas have the wilder characteristics - prickly leaf margins, and rough-shelled nuts. The integrifolias are more domesticated, these are the ones the Hawaiians are working on and prefer. When I posed the question on which of these we should use in W.A., opinion was divided, with the technical types like Ross Loebell saying base your plantings on tetraphyllas, and the processors (Nutta Products - a subsidiary of Meadow-Lea Margarine) saying that the integrifolias were 20 years ahead, and produced a more acceptable product. I guess we will have to do some of our own evaluation.

One note of caution which I did receive from Nutta Products was that if both types were grown, they should not be mixed together, as in the roasting one stays a very acceptable

cream colour, while the other turns a grey colour which when mixed with the creamy ones looks 'off' and quite unacceptable.

At 'Alamo', the manager, 'Ned', told us that they had 14 varieties, among which several seem to crop up again and again: **Hawaiian** - 246, 508, 660, 333 (all with Hawaiian names difficult to remember); **Others** - Own Choice, Renown, H2, B6.

Talking to Ross and Ned, each appeared to have its own advantages and disadvantages. 'Own Choice' was by far the heaviest producer of nuts, but the fruit doesn't fall, it hangs on for months. Varieties that were highly praised in Hawaii didn't fare as well when they had been tried in Australia. Four or five varieties are apparently necessary for good cross-pollination.

Now we come to the sad part of the operation - weed and grass control and insect pests. Because it's a native of Queensland, some insects have developed life cycles on the macadamia (and we in Western Australia must realize that we might not be exempt because the macadamia is a member of the banksia family). Some of these are as follows:

1. The flower caterpillar
2. The fruit spotting bug
3. The nut borer
4. The twig girdler
5. The leaf miner

All of these we saw evidence of, even under Ned's good management.

Not in the insect field, but still a big headache, is the fungal disease *Phytophthora cinnamomi*, which causes trunk canker and root rot.

Tetraphyllas, we were told, seemed to be less susceptible than the Integrifolias, so they use them as rootstocks. Higher incidence of *Phytophthora* occurs in wet soggy ground and where the bark of trees is injured by mowing machinery or by weedicides. Phytophthora can be controlled by good management, careful tree husbandry, and of course careful site choice. NOTE - Pineapples are a natural host to Phytophthora.

Because of the surface-feeding nature of the macadamia, sod culture (the practice of non-cultivation and the growing of grass) is carried out, and hence in Queensland mowing is an essential routine, and I venture to say a rather tiresome one, due to the rapidity of growth. This mowing procedure is very vital to young macadamias, as we saw on our visit to the next plantation.

Ned does his own propagation on tetraphylla root stocks. Grafting can be done at any time, but I will mention more of this later. Ned was the only one, I found, who did seed grafting.

Down the road from the 'Alamo' grove is a property known as the 'Macadamia Plantation', owned by two Sydney businessmen. Some l90ha (600 acres) of macadamias have been planted on old dairy pastures (kikuyu etc.), and trees range in age from one to five years old. Without fully knowing the circumstances here, we were a little sad to see many acres of young trees under stress from weed and grass competition, and could only say that it seemed an example of the dangers of trying to do too much too quickly, with an incomplete knowledge of what is entailed. Inflation was also playing its part here, as the cost of labour to effect good management would be enormous.

The 'Macadamia Plantation' had installed trickle irrigation to every tree, and had three huge (1.4Mz or 30-million gallon) dams to supply the water, which tends to bring home the water needs of the macadamia. There was a large, well-run nursery, propagating several va-

rieties (again mainly Hawaiian), for their own use and for sale.

We were shown evidence on some older trees of the decimation of young shoots, caused by sudden infestation with the red-shouldered beetle, which apparently can happen overnight. They arrive in millions, and can soon dampen the enthusiasm of a 'budding' grower!

At this time, Ross Loebell gave us his opinion of training a young macadamia. The macadamia's natural habit is one of vertical branching, which renders it vulnerable to winds and liable to limb breakage due to weak crotches. At the base of the leaf stem are 3 buds, one above the other. If the top two buds are removed, the bottom one will tend to come out at 90 degrees, and I stress tend, because on mentioning this to other growers later, they said that they had had mixed results because of varietal differences. Very long leaders, which some varieties have, can be 'headed off'.

It was suggested that as it was obvious that we would have to irrigate in Western Australia, we should have a talk with a Tim Trochoulis at the Alstonville Tropical Fruit Research Station. Tim had done some work on trickle irrigation of macadamias and he said that it was better to give two good waterings a week (he used a rate of 9 litres/hour) rather than water on a daily basis. The number of drippers should be increased with the age of the tree.

From here we headed for Brisbane, and through to the north side of the city to visit the 'Daffodil' and Meadowlea' margarine people, whose subsidiary NUTTA PRODUCTS was being run in the same complex. I had to ring the day before for an appointment.

It seemed to me that our industry, in which I was intending to be a producer, should have good liaison with the processor and the marketer. I had a talk with a Mr. Bill Ruddell who explained in general terms the processing procedure for macadamias. He made me realize that one thing I had not fully appreciated was the importance of the right **drying** technique for nuts, as these go towards enhancing flavour and storage life. Perhaps this is the reason that a lot of imported nuts turn out to be unpalatable and rancid (walnuts in particular).

Bill answered my question about sun-drying of nuts on racks as "all right, but somewhat haphazard", as temperatures from day to day vary so much. If we are to compete with the cheaper imports, which on most occasions are well presented (in looks if not in taste), we must offer the consumer, and make him aware of, a superior product. This means hulling, drying correctly, grading, polishing, and attractive packaging, and this means **good liaison** with the processors.

Bill said that if I cared to come back the following week I could have a yarn with Ian McConachie (who is Nutta Products industrial chemist, but a ball of fire on macadamias). Bill rang Ian and he said that I must come back through Brisbane to see him. In the meantime, I should visit the President and the Secretary of the Australian Macadamia Society, who both resided in the Glass House Mountains area.

One phone call later we were on our way to the fascinating volcanic area of the Glass House Mountains, where we eventually found our way to a delightful little property at the base of these ragged, steep-sided mountains.

The Secretary of the Australian Macadamia Society is a Mr. Norm Richards, a retired structural engineer who took up this old pineapple property some 10 years ago. He used to run it part time from Brisbane, but now lives on the 10 acres of macadamias, pecans, custard apples, and oranges. This place was a credit to Mr. Richards and his wife, and they very obviously enjoyed it.

Mr. and Mrs. Richards did us proud with their marvellous hospitality, and we stayed with them overnight. His trees in appearance were the best I'd seen, and he did say that he used a considerable quantity of nitrogen fertiliser. Whether this in fact leads to better fruiting,

or just more leaf, is debatable. Norm adds copper oxychloride to latex paint and paints his macadamia trunks, which helps in obtaining good coverage against Phytophthora. Norm also trims the lower limbs of his trees for easier picking, which he and his wife do themselves. Picking in fact is quite an item of cost in nuts. I discovered later that this trimming of lower limbs is not such a good idea, as the macadamia top thickens up as a result, and trees blow over much more easily in a wind. Norm stuck mainly to two varieties, 'Own Choice', and the Hawaiian '246'.

The sod in between trees was just like a lawn here, and a credit to these people. Their pecans, however, although growing well were not fruiting so well, and this he put down both to lack of chilling time here and to lack of pollination. With some varieties of pecan, male flowers appear at a different time to female flowers, so that varieties have to be carefully chosen to cover these gaps, or poor fruiting will result.

Norm did say that macadamia pests were a constant worry, and even though with the best will in the world you don't want to spray around with chemicals, you have to, or no crop results. Admittedly not much is really known about the 'vicious circle' side of spraying chemicals - you kill one lot of bugs, which immediately imbalances another. It is possible, as the next grower we visited said, that it is best to spray as little as possible, which can be done by studying the optimum time to spray. Norm Richards mentioned again his observation that if weedicides are to be used for under-tree growth, great care must be taken not to let spray drift onto the trunk, as even minute injury could increase incidence of Phytophthora.

Our next port of call was the Maroochy Research Station at Nambour, where our guide was Robert O'Mara, who has been working with macadamia for some years; however, as he said, evaluation of nut trees is a slow process. Robert could see no reason why, with good management, we should not grow macadamia in the West, with careful choice of area and variety. He said perhaps we should seek out our own seedling trees and use them for our progagation.

At Nambour they were looking at fruiting character (e.g. 'Own Choice' had the characteristic of fruit 'hanging on'), shell thickness, evaluation of Hawaiian varieties under Australian conditions, tree training, cross-breeding, etc. We saw trees here that were 25 years old and bearing 50kg (100lbs) of nuts per tree fairly consistently. With phytophthora, Robert mentioned that there was an indication that if a good acid humus was put around the tree, less infestation occurred, but this needed further investigation.

I asked Robert whether, at a future time, I might be able to obtain scion wood from the trees there for grafting purposes, and he had little doubt that it could be arranged. I'm sure, also, that he would be only too pleased to help us with any information we required. This, in fact, was the story wherever we went - help and information was not held back.

He said that we should visit a Mr. Jim Rogers, who was over the mountains from Nambour and just south of Gympie at a small place called Dagun.

At Mr. Rogers' property was a tall Norfolk Island pine-looking tree, which of course offered the best shade. On the side of the gate was a notice: 'Watch out for large falling Bunya Nuts' - they could do some damage! This was my isolated and somewhat apprehensive first meeting with the Bunya Nut tree.

Mr. Rogers told me that he had bought the property only a few years ago, and that the pecan grove had been planted by an American, the late Mr. Doyle, some 20-30 years previously. It was the first commercial pecan grove in Australia, and one seedling pecan near the house was some 20m (60ft) high.

The property is a fairly steep one, in an old pineapple area. Some terracing had been done

for ease of handling, and 14 varieties of pecans had been planted; the only one that really wasn't producing too well was Frotcher. The planting had been made fairly close - l0-15m (39' x 50') - with a view to pulling out every other tree at a later stage, but as Mr. Rogers said, no man in his right mind can cut down a producing tree which he had been caring for and watching grow for 15-20 years. This is quite a consideration, and a point against initial close planting, which I heard advocated quite often. It would be a hard decision for a tree lover to make, to suddenly pull out half his trees. Jim Rogers said that a planting space of 14-18m (45'-60') was ideal in good soil and moisture conditions.

I noticed all around the house and grove, pecan seedlings, and commented on these. "Oh", he said, "They grow like weeds around here, and are a damn nuisance!" Jim does do his own propagating, and sells grafted trees, using old mallee fowl nests (a mixture of just about everything) for his potting mixture.

Again I posed the question of the chilling requirements of pecans, and again it was said that the chilly gully winds are sufficient. Jim sells all his crop, mixed graded varieties in shell, to an outlet in Melbourne. He does a little de-shelling himself, which he demonstrated, for local consumption.

He told me a lot about varietal characteristics as far as the nuts themselves were and the problems of in-shell pecans, which, unless stored correctly 'go off' very quickly.

Inside the outer shell of the pecan and walnut are some woody, thin pieces holding a tannin-like substance, which breaks down and goes back into the oil of the nut under heat. This causes the nut to taste bitter or rancid, although in many cases this is the flavour one is used to in imported nuts, and perhaps has turned Australians away from walnuts and pecans. Looking at nuts in shell, you can tell the pecans that have 'broken down' by their darker, oilier appearance.

I got the distinct impression from Jim, that there is far too much written which in his opinion is too technical and too far removed from the natural logical way of growing plants, of whatever sort. This might be all right for the large grower, but puts the beginner off, and the beginner is important.

One point that Jim noticed was that a tree that had severe wind damage one year, with loss of limbs, bore a tremendous crop the following year. With this in mind he decided to give one of his 'poor croppers' a shock. He did this by bruising it around the trunk with the back of an axe. Presto - fruit everywhere the following year.

There is a problem in combating disease in these large trees, in that a fair pressure is needed in your spray unit to get a good coverage. These trees didn't look as if they were suffering from very much. Mohawk and Western Schley seemed to be favoured varieties. The Queensland Department of Primary Industry have taken over the lower part of the grove for experimental work, I couldn't find out what.

While at the property of the Australian Macadamia Society secretary (Mr. Richards) earlier, we contacted the President, Mr. Cohn Heselwood, who is also editor of a local paper. He resides at Beerwah, south of Brisbane, and south of the Glass House Mountains. But first we visited Nutta Products again and I spent a couple of hours talking to Ian McConachie about varieties and the industry as a whole. I believe that the processors, such as Nutta Products, are very interested in future growers, for obvious reasons, and offer all the help they can. Ian had recently been for a trip to America and Hawaii and was very impressed with what the Hawaiians had done about the macadamia. Nutta Products had just acquired a macadamia sheller from America, very expensive and kept behind locked doors, so they, for one, see a future in nuts.

On now to Cohn Heselwood's grove of mixed-age macadamias and avocados. His trees looked well too, but he was having some wind problems after the State Forestry authorities had cleared all of the natural shelter belt which was next to him. Some of the young trees were showing signs of being pushed about by the wind. Cohn believes that trees do a lot better if seedlings are planted in the field, and grafting is done in the field in cooler weather. The seedling develops a much better root system. He also believes in spraying as little as possible, and an observation he made after the elimination of the forest trees next door was that there was a definite increase in insect problems, which he puts down to the fact that the insect-eating birds etc. had gone with the forest.

Colin received top grading and price for his nuts the year before, which speaks well for his management, even though he works on the property only part time. He has tried training young trees, with mixed success. His main macadamia variety was 246, with a sprinkling of others. He carried out regular spraying of weeds around his young trees and all trunks were painted. Phytophthora was in evidence and again was a headache.

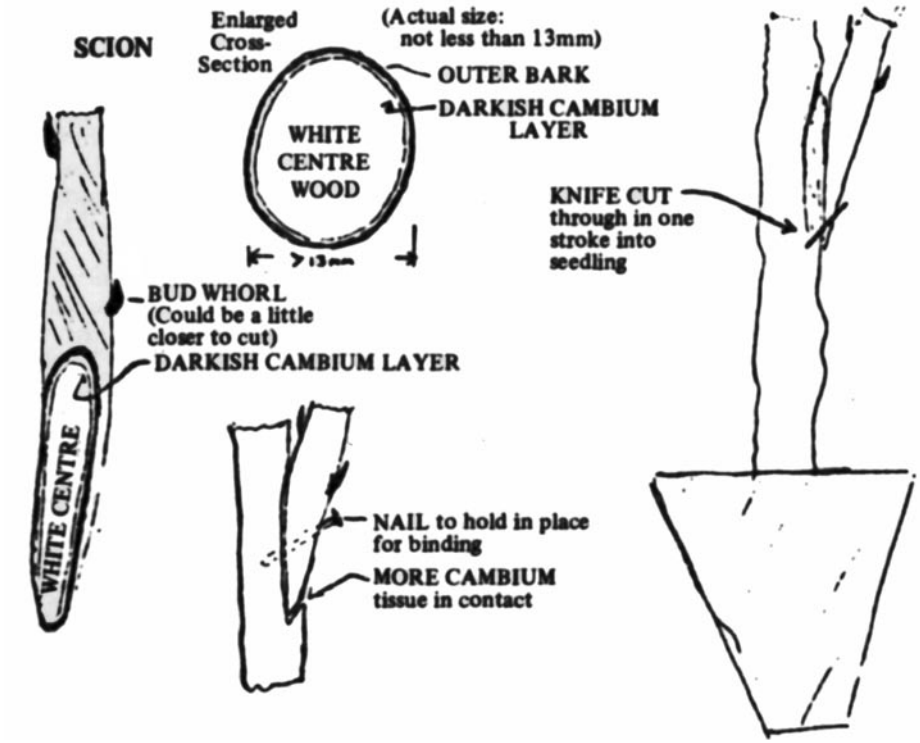
Colin did feel that communication between WANS and AMS should be beneficial to all concerned.

Our next visit was a very fitting end to our macadamia research, and I felt personally very privileged to have had the opportunity to meet and talk with Mr Norm Greber, who was the man in Australia responsible for developing simple grafting techniques for macadamia. Before his time, it was believed either to be impossible or to have a very low take percentage. Norm Greber did all the work as CSR's large plantation at Maleny (which unfortunately we didn't see), and is still working for CSR trying to find new varieties. He has a small grove of macadamias at his Beerwah property, and he spends his time grafting seedlings, top-working old trees of varieties he doesn't like, and talking to visitors or interested people.

As you walk through his grove you notice trees with what look like extra rooted trunks. When I asked about it he told me that he believed that natural ways were always the best to use where possible, and he had let seedlings grow around his trees, and then when a good 2m (6') high he had grafted them back onto the main trunk so that the tree had good natural support against strong winds. A great idea if you can graft. He actually showed me his technique of grafting, which can be done at any time of year, but preferably in the cool weather. The scion wood (the piece grafted on the seedling) is cut six weeks after cincturing the bark below where the scion is to be taken; the cincturing or ring barking is done simply with an ordinary pair of fencing pliers, but not too hard down. You try to choose 2-3 year old wood which is reasonably straight, has 2 bud whorls, and is growing vigorously and healthily. The bud whorls should preferably be widely separated, so that in the actual join as much as possible of the cambium layers are in contact, as shown in the drawing.

A very sharp knife is used to cut the scion wood, and then a plane (again honed very sharp) is used to plane the scion cut flat. You then hold the scion up against where the graft is going to be made on your seedling (remembering that this is a side graft), and cut through the bottom of the scion into the trunk of the seedling as shown. Scribe on your seedling bark with the knife the shape of the scion cut, and in one clean stroke cut this piece out, not too deep. You are left with a small wedge on the bottom of your scion wood which matches the one on your seedling, as shown.

Now try the fit and adjust accordingly; the object is to have as much as possible of the two lots of cambium layer in contact when the scion is in place. The wedge is important, because it holds the scion wood in place while it is being tied with tape and grafting mastic (e.g. Shell Colgraft) is being applied.



Norm Greber suggested that for beginners, a nail tapped through the scion into the seedling is a good idea. Also, don't cut your seedling top off straight away because if the graft doesn't take, the seedling keeps on growing and another chance may be had later. Don't bind grafts too tightly, and use grafting tape.

After leaving Norm, we then headed over the mountains and through the Gwydir River area to our next visiting place, 'Trawalla', a pecan plantation owned by one of the biggest private growers of pecans in North America, the Stahmann family.

Mr. Dean Stahmann, who is rather hard to get hold of, and whose residence is in Toowoomba, has already planted some 650ha (1600 acres) of pecans, and these are truly a sight to see. These trees, stretching as far as the eye could see, ranged up to 5 years old, and were as even as you could wish. We could see that one or two already had clusters of nuts. The property lies on a long bend of the Gwydir River and has an average 12m (40ft) of friable chocolate soil. Apparently a lot of time and care went into the choice of property, searching all over Australia.

There was a street of clean white cottages on the property for the staff which was quite large. The manager was Graham Fails.

I learnt that Graham had graduated in Rural Economics at one of the New South Wales universities. The place was a credit to him. There wasn't a weed to be seen, and unlike macadamias, row crops can be grown in between pecan trees. At 'Trawalla' soya beans had been grown very profitably and, by the look of the plants, very professionally. There an was impressive amount of machinery everywhere inside and outside a huge machinery shed, where skilled mechanics were working on bulldozers and disc ploughs; you name it, and it was there. This was undoubtedly a highly professional operation, and the way the trees were

looked after, it would soon be grossing millions of dollars:

50 trees/ha, 25kg/tree = 1250kg nuts/ha (Conservative)

At $1.20/kg in shell = $1 500/ha.

650ha = $975,000/year, and increasing!

Expansion is continuing, but one must remember the costs involved and the years of accumulated expertise. There are numerous risks involved, too, as some of the areas could be hit by floods, which can play havoc with the levelling, irrigation channels, and the trees. Irrigation has come from the Gwydir River itself.

I was told that they would have liked to use some of the newer American varieties, but can't import them easily. The two main varieties used at 'Trawalla' are Wichita and Western Schley, as these are good cross-pollinators. They were trying to import some of the newer ones, which all have Indian tribe names like Sioux, Cherokee, etc.

It was very noticeable that cultivation was done right up close to the trees, and I asked Graham whether there wasn't a risk of root and trunk damage. Their root system consists of a large central tap root and a considerable surface feeder root system. On cultivation of the young tree, you chop up the feeder roots on the surface and make them go deeper, which later in its life makes it a hardier tree, less susceptible to stress. The pecan produces tremendous foliage and crops of nuts, which takes a good deep root system to feed properly to be able to produce a well-filled kernel, vital for a top quality product. Moreover, stresses of any kind tend to reduce the quantity of the crop.

Pecans will grow with little water once established, but Graham did stress that it needs a power of water (irrigation) to produce large quantities of good-quality nuts.

After somewhat regretfully leaving the expert lushness of 'Trawalla' with its chocolate soil, we had Narara Research Station (just out of Gosford, N.S.W.) on our list as having 40-year-old pecans of different varieties.

We were truly let down at Narara as, although the 40-year-old pecans were still there, they were regarded only as shade trees for the staff members' cars. We also found a total lack of interest in nut tree crops, and I was told the reason was that there was no commercial pressure to do any research into these crops. Some work had been done on seed grafting of macadamias at Narara, some years back, but that's all.

We did wonder whether it was going to be the same story at Orange Research Station, but were pleasantly surprised to find a great interest being shown in nuts; they had a small walnut arboretum, but this was still only recently established. This collection included a walnut variety sent by a Mr. Scrivener of Manjimup, Western Australia. John Salvestrin, who took us on our tour, gave us his opinion of how the varieties were shaping up (but saying it was too early for anything conclusive). The Franquette variety that the Schlapps were using in the Ovens Valley didn't seem to be shaping up so well and seemed to suffer from Black

Spot, much more so than the others. A variety Concord was making very good growth, and at 2 years old already had fruit of a good size. Other varieties here were Tuwinga, Eureka, and Pinn I. None of these were receiving irrigation at this stage. John told us that black walnut rootstock was used, and that he found the double cleft graft the most successful providing both parent tree and rootstock were at peak sap flow.

Our final port of call as far as nuts were concerned was Merbein Research Station just out of Mildura in Victoria. Here we were introduced to Mr. Don Maggs, who told us the story of the pistachio, which, along with the walnut, is a very ancient nut tree crop.

Mr. Maggs published an article on the pistachio in the 1975 WANS Yearbook.

There is no doubt that it is one of the hardiest, droughtwise, of all the nut trees, and this was brought home to me when Don Maggs showed me where they were growing their seedlings. The patch of ground given over for this research was one that was not thought suitable for any other crop - hard, clayey rough stuff, but the little seedlings were doing fine. We tasted the salted roasted nuts from the previous year's crop, and I would say that it was next to, if not equivalent to, cashew in flavour. They are brined and roasted in the shells; these open naturally at harvest time and leave the kernel easily extracted. With kindness and good management, the pistachio is a very high-producing tree. Don Maggs offered us any assistance we needed, and the visit and the film shown to us were worth while.

Summary and Conclusions

Success of a nut enterprise in Western Australia will depend largely on: (1) careful assessment of growing conditions (soil, water, climate); (2) selection and evaluation of varieties best suited to Western Australia; (3) financial resources to cater for size of planting envisaged (don't overplant); (4) consistent management (rather than good one month and neglect the next); (5) Cater for size of planting envisaged (don't overplant); (6) grower ability to raise his own seedlings and do his own grafting.

There is no doubt in my mind that we can grow nuts in Western Australia and that processing will become available as crop size increases, provided we grow a high quality, well-graded product. This will enable us to compete with overseas imports from producers who at present have the advantage of years of experience, and in many cases, of cheaper labour.

PECAN NUTS - MARKET REPORT

L.C. McMASTER*

Some plantings of pecans exist in Australia (Table 1) but the crop is relatively unknown to both consumer and producer. Import figures are not available due to the pooling of pecan import figures with other nut import figures for statistical purposes.

Prices

Prices paid for pecan nuts to the few established producers in Australia are of the order of $4/kg in-shell. Pecan kernels have retailed for around $9/kg. While the high wholesale prices might be expected to continue in the short term, as production and market competition increases nut prices can be expected to fall and stabilise - perhaps around $2/kg in-shell.

Production

Modern precocious varieties start to bear in year 4 after grafting but under commercial conditions do not warrant machine harvesting (U.S.A.) until year 5-6; by year 10 these precocious varieties yield between 330-4500kg/ha (28-38 kg/tree) of in-shell nuts at a density of 118 trees/ha.

It is considered that the health, growth and yield potential of pecans in Australia is better (by up to 50%) than in the U.S.A. Tentative production statistics for Australia are shown in **Table 2**.

Economics

Given a suitable growing site, gross receipts/ha are mainly determined by planting density and variety. Precocious varieties suitable for "high density" plantings are available in Australia.

Adopting a pessimistic outlook in terms of production/ha and prices, the possible economics of pecan growing under local conditions are displayed in Tables 3A, 3B and 3C - each making different yield assumptions.

The influence of tree yield upon the economics of pecan production is shown in Diagram 1. All figures were derived (modified) from a similar exercise for walnuts undertaken by Mr. C. Pike, Agricultural Economist.

The initial capital outlay in development is probably the most debatable component of the cash flow data, and it is a component which will vary widely between one investor and another, according to individual circumstances. All figures are speculative.

Potential

"Guesstimates" of the Australian market for pecans range from 500-5,500 tonnes of kernels/year. One commercial source claims production from existing plantings could be 2,000 tonnes of nuts in-shell or 1,000 tonnes kernels. Some trade sources consider this is the limit for the Australian market, while others think this production would cater for only 1/3 of the local market.

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TABLE 1 - PLANTINGS OF PECAN TREES IN AUSTRALIA*

YEAR

TYPE	STATE	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76
Number of Bearing Trees	N.S.W.	291	212	192	319	338	46 114
	Queensland	2 580	N.A.	1 940	N.A.	9 570	7 790
	Sub-Total	2 871	?	1 952	?	9 908	53 904
Number of Non-Bearing Trees	N.S.W.	189	567	46 187	70 319	73 931	31 131
	Queensland	1 730	N.A.	16 840	N.A.	15 140	18 090
	Sub-Total	1 919	?	63 037	?	89 071	49 221
	GRAND TOTAL	**4 790**	?	**64 989**	?	**98 979**	**103 125**

* Source: Australian Bureau of Statistics - 160 non-bearing trees reported in S.A. in 1975-76.

N.A.: Not available

TABLE 2- PRODUCTION (TONNES) OF PECAN NUTS (IN-SHELL) IN AUSTRALIA

YEAR

STATE	1970-71	1971-72	1972-73	1973-74	1974-75	1975-76
N.S.W.	1.720	2.246	1.189	4.894	3.624	4.000
Queensland	7	N.A.	5	N.A.	8	25
TOTAL	**8.72**	**?**	**6.189**	**?**	**11.624**	**29.00**

I estimate mean per capita consumption in the U.S. (at about A$ 1.32/kg in-shell) for the years 1967-1975 to be 0.46kg of in-shell pecan nuts/year; this consumption appears to be less than "saturation point" i.e. there is a deficit of supply.

At a population of 14 million, at this U.S. consumption rate, Australian demand would equal 6,454 tonnes of in-shell pecan nuts/year; at a 55% shelling rate or kernel yield this is equivalent to 3,550 tonnes of kernels/year. On this basis, allowing a production potential of 20kg/tree, A.B.S. statistics of plantings in 1975/76 would eventually account for 2,063 tonnes of in-shell nuts/year, or (at 55% kernel yield) 1,134 tonnes of kernels/year, i.e. 32% of the potential Australian demand as gauged by U.S. consumption standards.

Conversely potential "demand" could be met by a total of 322,270 pecan trees, which allowing for existing plantings, leaves "room" for additional plantings of up to 219,140 trees. At a planting density of 119 trees/ha (30' x 30') this planting "deficit" is equivalent to 1,842ha.

Quality

Australian consumers are said to be confronted with a poor product, often 14-16 months old, imported from the U.S.A. Pecans should be eaten fresh or properly stored to maintain quality. Attention to nut quality will be important to the success of pecan culture and the continued expansion of this "embryo" industry.

DIAGRAM 1: Net cash flow for 1ha of Pecan nuts planted 9m x 4.5m over 10 years according to the yield assumptions.

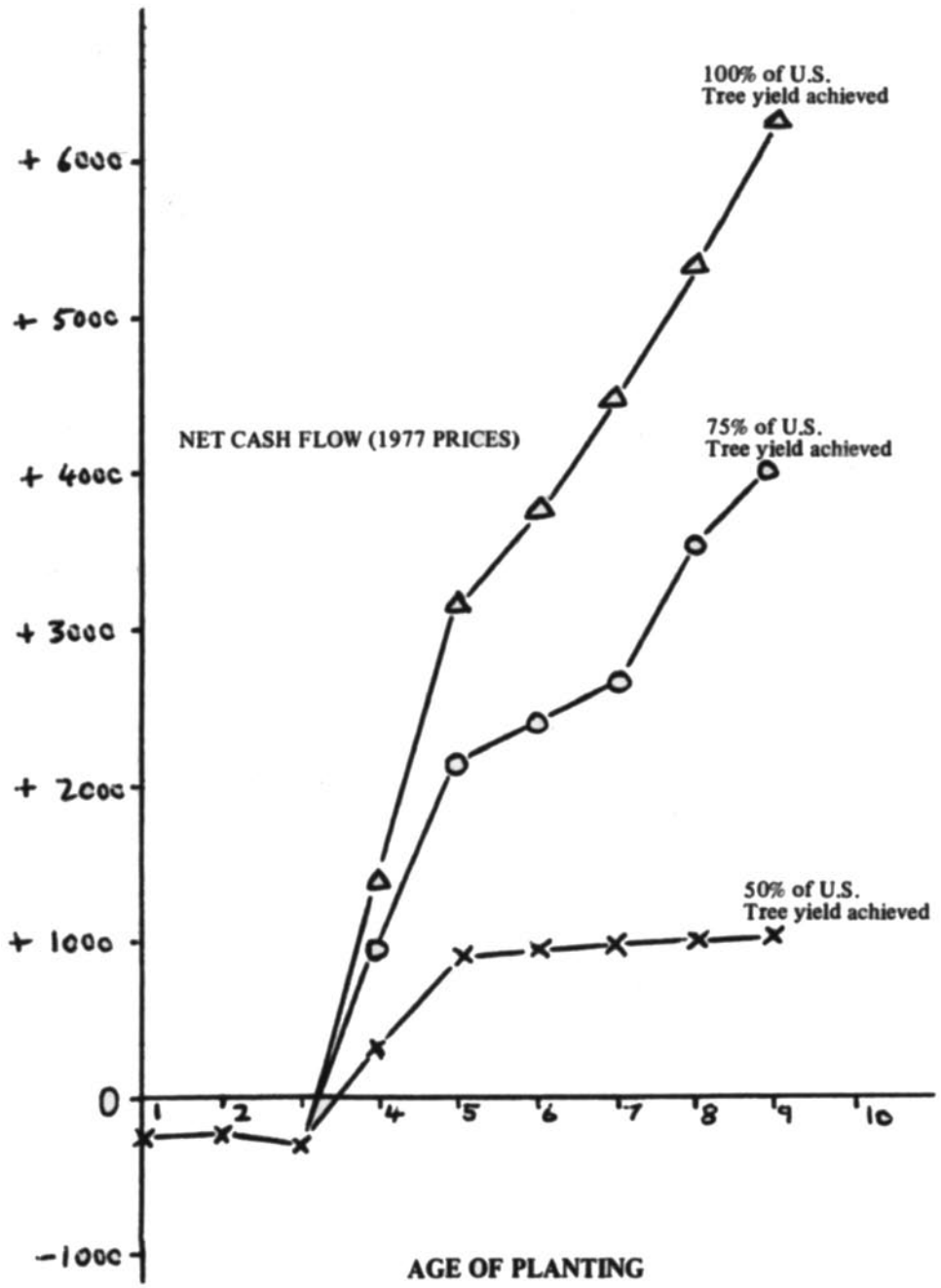

Table 3A: Cash flow data for 1ha of pecan nuts planted 9m x 4.5m which attain 50% of US tree yields (1977 prices)

		Yearst									
	$	1	2	3	4	5	6	7	8	9	10
INVESTMENT											
Land	2500										
Water, bore/dam	1000										
Trickle irrigation	1000										
Machinery implements	1200										
PLANTING COSTS											
Land preparation	150										
247 trees @ $5 each	1312										
Planting & stacking	175										
TOTAL	7337										
PRODUCTION COSTS											
Pruning		66	66	66	66	99	99	132	132	165	↑
Fertiliser		3	9	9	15	18	24	30	36	45	↑
5 Cultivations		30	30	30	30	30	30	30	30	30	↑
Irrigation, Power, Labour		45	45	45	54	54	60	66	69	69	↑
Spray materials		66	66	99	132	264	397	661	772	926	↑
Herbicides		-	-	9	9	12	12	15	15	15	↑
Spray operations		6	6	6	9	12	15	18	24	27	↑
Sundries		30	18	18	27	27	30	37.5	37.5	45	↑
Total Production Costs		246	234	282	342	576	667	990	1155	1322	
Harvest cost		-	-	-	397	666	931	1063	1195	1195	
Gross cost		246	234	282	739	1182	1694	2175	2350	2517	
Income $/ha					2200	4400	5500	6600	7700	8800	
Net Cash Flow		-246	-234	-282	+361	+1018	+1056	+1125	+1500	+1883	

Table 3A - continued

	1	2	3	4	5	6	7	8	9	10
Accumulative Cash Flow	-246	-480	-762	-401	+617	+1673	+2798	+4298	+6181	+8064
10% compound factor	1.1	1.21	1.331	1.4641	1.6105	1.7716	1.9487	2.1436	2.5937	2.8531
Net Cash Flow (compounded at 10%)	-270.6	-580.8	-1014.221	-587.10	+993.68	+2963.89	+5452.46	+9213.14	+16031.66	+23007.74
Interest @ 11% Simple for 10 years	1358	1358	1358	1358	1358	1358	1358	1358	1358	1358
Net Cash Flow (excluding Deprecn. & Capit.)	-1628.6	-1938.8	-2372.22	-1945.10	-364.32	+1605.90	+4094.50	+7855.19	+14673.70	+21649.40
Cumulative Cash Flow (including Capital Cost)	-9186	-9496	-9929	-9502	-7921	-5951	-3463	+298	+6083	+5408

Table 3B - CASH FLOW DATA FOR 1 ha. OF PECAN NUTS PLANTED 9m x 4.5m WHICH ATTAIN 75% OF U.S. TREE YIELDS (1977 PRICES)

ITEM	1	2	3	4	5	6	7	8	9	10
Income ($/ha)	0	0	0	1,650	330	4,125	4,950	5,775	6,600	6,600
Net Cash Flow $	-246	-234	-282	+911	+2,118	+2,431	+2,775	+3,425	+4,083	+4,083
Cumulative Cash Flow $	-246	-480	-762	+149	+2,267	+4,698	+7,473	+10,898	+14,981	+19.064
10% Compound Factor	1.1	1.21	1.331	1.4641	1.6105	1.7716	1.9487	2.1436	2.5937	2.8531
Cumulative Net Cash Flow (compounded @10%)	-271	-581	-1,014	+218	+3,651	+8,323	+14,563	+23,361	+38,856	+54,392
Interest on $8,000 @ 11% Simple/10 years.	1,358	1,358	1,358	1,358	1,358	1,358	1,358	1,358	1,358	1,358
Net Cash Flow (Excluding depreciation & Capital, but including Loan repayment)	-1,629	-1,939	-2,372	-1,140	+2,293	+6.965	+13,205	+22,002	+37,498	+53,033
Cumulative Cash Flow (Including Capital Cost)	-9,186	-9,496	-9,929	-8,697	-5,264	-592	+5,648	+14,446	+29,941	+45,477

Table 3C - CASH FLOW DATA FOR 1 ha. OF PECAN NUTS PLANTED 9m x 4.5m WHICH ATTAIN 100% OF U.S. TREE YIELDS (1977 PRICES)

ITEM	YEAR 1	2	3	4	5	6	7	8	9	10
Income ($/ha)	0	0	0	2,200	4,400	5,500	6,600	7,700	8,800	8,800
Net Cash Flow $	-246	-234	-282	+1,461	+3,218	+3,806	+4,425	+5,350	+6,283	+6,283
Cumulative Cash Flow $	-246	-480	-762	+699	+3,917	+7,723	+12,148	+17,498	+23,781	+30,064
10% Compound Factor	1.1	1.21	1.331	1.4641	1.6105	1.7716	1.9487	2.1436	2.5937	2.8531
Interest on $8,000 @ 11% Simple/10 years.	1,358	1,358	1,358	1,358	1,358	1,358	1,358	1,358	1,358	1,358
Net Cash Flow (Excluding depreciation & Capital, but including Loan repayment)	-1,629	-1,939	-2,372	-335	+4,950	+12,324	+22,315	+34,151	+60,323	+84,418
Cumulative Cash Flow (Including Capital Cost)	-9,186	-9,496	-9,929	-7,892	-2,601	+4,767	+14,758	+28,594	+52,766	+76,861

DEVELOPMENT OF MACADAMIA NUT CULTIVARS IN HAWAII*

R.A. HAMILTON and PHILIP J. ITO**

The macadamia nut, *M. integrifolia*, a relative newcomer among crop plants of the world, is the first and only native food plant of Australia which has achieved the status of a commercial crop. Most of the commercial development has taken place in Hawaii during the past 40 years.. This state presently grows and processes more than 95 percent of the world's production of this fine dessert nut. Macadamia nuts are now the most important tree crop in the state from the standpoint of acreage, production and value.

More than 100,000 seedling macadamia trees have been examined and evaluated to date in a continuing selection and testing program begun in 1934 by personnel of the Hawaii Agricultural Experiment Station. From this wide selection of seedling trees grown in private orchards and experiment station plantings, 863 preliminary selections were made and are being intensively tested and evaluated. Most of the early selections have already been discarded as a result of preliminary screening and evaluation procedures. About 50 of the most promising selections, which have survived preliminary testing, have been grafted and set out in several field plots on Hawaii, Maui and Oahu. They are now in the process of being tested in trial plots and experimental orchards throughout the state.

Since breeding and selection work was initiated by Hawaii Agricultural Experiment Station horticulturists in 1934, nine cultivars have been named. These are: 'Keauhou', 'Nuuanu', 'Kohala', Pahau' and 'Kakea' in 1948 (6); 'Ikaika' and 'Wailua' in 1952 (5); 'Keaau' in 1966 (3) and 'Kau' in 1971 (2). Two other cultivars, 'Chong 6' and 'Honakaa Special', although not officially named, have become known by these names and are still grown to a limited extent in the Kohala and Honakaa areas respectively. The nine University of Hawaii cultivars were named and introduced after yield trials, quality testing and objective evaluation of tree, nut and kernel characteristics over a long period of time. These clones were first grown commercially under the original HAES test numbers, but were officially released after being named and described in Hawaii Agricultural Experiment Station publications.

Five cultivars, all of which have been selected, tested and named by University of Hawaii horticulturists, are presently planted and grown in commercial orchards in Hawaii. This situation is considered to be somewhat unique among other tree crop cultivars, most of which have originated by chance as superior seedlings selected by nurserymen, growers and amateur horticulturists, or imported from other areas or countries. Macadamia cultivars in Hawaii, on the other hand, have originated almost entirely as a result of breeding efforts and rigorous testing activities by Experiment Station horticulturists and plant breeders. Exacting selection standards have been set up and are constantly being revised upward. A summary of present selection standards used in evaluating new cultivars from various sources, including 30 introduced clones from other areas and countries since 1949, follows:

* Originally published in: California Macadamia Society: Yearbook/22:94-100, 1976.
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Tree characteristics:

Vigorous trees with dark green foliage, strong crotches and ascending rather than spreading branch structure. Kakea' as well as Keaau' and 'Kau', the most recently introduced cultivars, have more upright growth habits than 'Keauhou' and lkaika' which have spreading growth habits. A more upright growth habit permits closer planting within the row and thus more trees per acre.

Nut and Kernel Characteristics:

Medium sized nuts with 10-20 nuts per cluster, 65-68 uniformly sized nuts per pound and 38-48 percent kernel. Uniform, round, white or cream coloured kernels without dark circles or off-colour tops. Few or no stick-tight nuts and at least 95 percent of grade 1 kernels having a specific gravity of less than 1.0 as determined by flotation testing in water.

Production:

A minimum annual production of 100 lbs. of in-shell nuts from well-grown eight year old trees in favourable locations and/or at least 75 lbs. from 10 year old trees in less favourable locations.

Named Hawaiian Macadamia Cultivars:

The first named macadamia cultivars in Hawaii were described in 1948 by. Storey (6). These were Keauhou', HAES 246, 'Nuuanu', HAES 336, 'Kohala', HAES 386, 'Pahau', HAES 425, and 'Kakea', HAES 508. 'Ikaika', HAES 333, and 'Wailua', HAES 475, were named by Hamilton, Storey and Fukunaga in 1952 (5). 'Keau', HAES 660, was named by Hamilton and Ooka in 1966 (3) and 'Kau', HAES 344, by Hamilton and Nakamura in 1971 (2). Two other cultivars previously mentioned, 'Chong 6' and 'Honakaa Special', although selected in the University of Hawaii selection program, were never officially named and described.

Recommended Cultivars:

Five cultivars are presently being planted and grown commercially in Hawaii. No one variety is outstanding enough to be recommended over all others. Choice of varieties is still made largely on the basis of adaptation to location and preference of individual growers.

Nut and kernel characteristics of the five main cultivars in Hawaii are listed in Table I.

Table 1. Comparison of nut and kernel characteristics in seven *Macadamia integrifolia* cultivars grown in Hawaii

Cultivars	Percent Kernel	Nut Wt. (g)	Kernel Wt. (g)	Nuts Per lb.	Percent No. 1 Kernels (floaters)	Kernel Appear-ance (cooked)
Keauhou	39	7.2	2.8	63	85	good
Ikaika	34	6.5	2.2	70	89	fair
Kakea	36	7.0	2.5	65	90	very good
Keaau	44	5.7	2.5	80	97	exc.
Kau	38	7.6	2.9	60	98	exc.
Mean of 5 Named Varieties	38.2	6.80	2.58	67	92	

Detailed descriptions of tree, nut and kernel characteristics of these cultivars have been published (1), (2), (3), (5), (6). The five varieties presently grown commercially in Hawaii are 'Keauhou', 'Kakea', 'Ikaika', 'Keaau' and 'Kau'. Brief descriptions of these cultivars follow:

'*Keauhou*', formerly known as HAES 246, is the oldest Hawaiian cultivar first selected in 1935 and named in 1948. The tree is broadly spreading in form with wide crotch angles and strong branch structure. It therefore requires wider spacing in the orchard than narrower more upright cultivars. It yields well and has attractive nut characteristics, but the kernel quality has proven somewhat marginal some years in certain locations (4). 'Keauhou' is not considered as hardy or wind resistant as 'Ikaika' and 'Kau'.

'*Kakea*' HAES 508, is an excellent commercial cultivar selected in 1936 and named in 1948. It has performed exceptionally well in long-time yield trials at the Poamoho, Waiakea and Kona experimental farms. It is reasonably hardy, producing kernels of excellent quality and has been a consistently productive, long-lived variety in all test locations. Its growth habit is more upright than Keauhou' and young trees often need to be topped. Nurserymen consider 'Kakea' harder to graft than other varieties but skilled propagators are able to get a high percentage of takes. 'Kakea' is one of the best and most reliable varieties for commercial planting in Hawaii.

'*Ikaika*', HAES 333, was selected in 1936 and named in 1953, largely because its early bearing tendencies, dark green foliage and vigorous tree characteristics. It has been widely planted in areas where wind problems are limiting factors in growth and production. The nuts are relatively thick-shelled so that recovery of grade 1 kernels is usually less than 30 percent. 'Ikaika' is hardy and productive but because its nut and kernel characteristics are not as desirable as those of other Hawaiian cultivars it is not being planted as extensively as before.

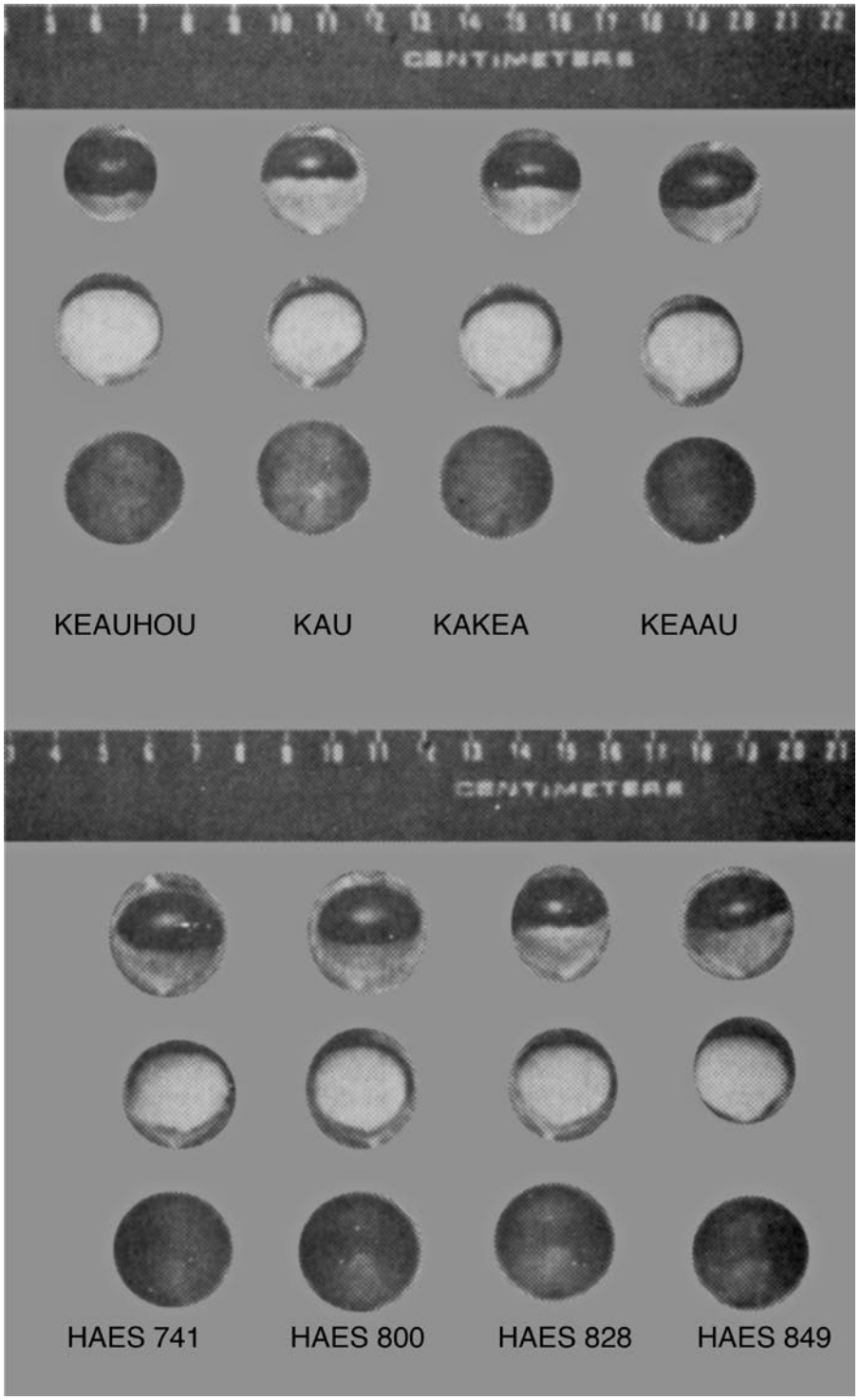
'*Keaau*' HAES 660, is a relatively new variety, first selected in 1948 and named in 1966. It has an upright growth habit permitting somewhat closer planting than most other cultivars without undue crowding. 'Keaau' has outstanding nut and kernel characteristics with 42 to 46 percent kernel and more than 95 percent of grade 1 kernels. The nuts are excellent for processing and the trees have performed well during the limited period that this variety has been tested.

'*Kau*' HAES 344, is the most recently introduced cultivar. Although first selected in 1935, it was not officially named until 1971. 'Kau' most resembles 'Keauhou' in nut characteristics and productivity but has appreciably better kernel quality in most locations. The tree form is more upright than Keauhou and it is also considered hardier and more wind resistant. 'Kau' is a relatively hardy, productive, wind resistant variety considered suitable for commercial planting in areas where it is adapted.

Compared to original seedling orchards in Hawaii, the five commercial cultivars listed in Table 2 have been found to produce approximately. 4 times as many nuts per tree which have about 10 percent more kernel and an additional 10 percent more of grade I kernels. This is calculated to be approximately 6 times greater yield of marketable kernels per acre than is produced on comparable seedling plantings of similar age. Nut and kernel characteristics of five promising new selections presently under advanced testing are also listed in Table 2 for comparison with those of five standard varieties. These new selections produce, on an average, nuts of about the same size as the standard varieties but the newer selections have higher percent kernel and a larger percentage of grade 1 kernels.

Table 2. Average nut and kernel characteristics of 10 *Macadamia integrifolia* cultivars grown in Hawaii

Standard Varieties	Percent Kernel	Nut Wt. (g)	Kernel Wt. (g)	Nuts Per lb.	Percent No. 1 Kernels (floaters)	Kernel Appearance (cooked)
Keauhou	39	7.2	2.8	63	85	good
Ikaika	34	6.5	2.2	70	89	fair
Kakea	36	7.0	2.5	65	90	very good
Keaau	44	5.7	2.5	80	97	exc.
Kau	38	7.6	2.9	60	98	exc.
HAES Selection Nos.						
741	43	6.5	2.8	70	98	exc.
790	38	7.0	2.7	65	99	exc.
800	40	8.0	3.2	57	97	exc.
828	44	6.6	2.9	69	96	exc.
849	52	5.8	3.0	78	98	exc.
Mean of 5 Standard Varieties	38.2	6.80	2.58	67	92	
Mean of 5 Promising Selections	43.4	6.78	2.92	68	98	



What predictions can be made about the future and improvement of commercial macadamia cultivars in Hawaii? On the basis of new selections already under test and genetic material under observation, production per tree can be increased by about 25 percent over present cultivars. Percent kernel recovery can be improved approximately 10 percent from about 35 up to 45 percent and percentage of Grade 1 kernels from about 90 to 95 percent. This potential increase in useable kernels would amount to an increase of about 70 percent in production of Grade 1 kernels per tree and per acre. A comparison of the shell and kernel characteristics of the standard Hawaiian cultivars with those of promising new Hawaii Agricultural Experiment Station selections is shown by Figure 1.

About 50 new cultivars are presently being tested and 2 of these, HAES Nos. 741 and 800, will be named and released as soon as adequate scion wood can be made available.

An active macadamia breeding project continues in Hawaii. Selection standards will remain high because excellent commercial cultivars are available and being used as checks in selecting superior new cultivars.

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PECAN TREE NURSERY OPERATIONS AND PROPAGATION*

OSCAR S. GRAY**

My papershell pecan nursery was begun when the first pecan nuts were planted about 1927 or 1928. It now consists of about 50 acres, originally on the outskirts of the small town of Arlington, population about 5,000, but now located in the very heart of today's Arlington with its 130,000 people

Our pecan growing operations are based on a three-year cycle. Our trees are grown for three years in the nursery field; then dug for market.

Seed nuts from selected sources used at this time are largely of the 'Riverside' or 'Apache' varieties. We like seed nuts that will produce uniform, stocky seedlings rather than tall and slender ones. We have tested over 1000 different seeds and are constantly testing for better rootstocks-faster growers-stockiness, disease resistance, etc. The possibilities of "better pecan rootstocks" have been neglected.

Seed nuts, in our operations, are stratified in ground pine bark, sacked in plastic bags, and placed in cold storage at 34 to 38° F for 10-12 weeks. They are then planted by hand about 4 inches apart in 8 foot wide rows in previously prepared ground. We throw up beds 4 feet apart with a "middle buster" leaving furrows 4 feet apart and about 6 or 8 inches deep. We drill about 200 pounds per acre of a mixed or balanced fertilizer into the bottom of every other furrow. Then we re-bed the field. Nuts are planted by hand only in the fertilized beds, resulting in rows spaced 8 feet apart.

As these seed nuts sprout and begin to emerge, they are cultivated or hand raked very carefully-sometimes stirring the soil 2 or 3 times weekly. The surface of our soil must be constantly stirred to break the reflection of the sun's heat or most of the little seedlings may be burned off at the surface of the ground as they emerge, resulting in a very poor stand of trees. This constant stirring of the, soil about the base of the young seedlings is important during the first season's growth.

Sometime during July-August of the second summer, the pecan seedlings are large enough to be "patch budded" with buds from desired varieties, but first they are rogued of small, runty trees by cutting off about an inch above the surface and carefully brushing a strong tree poison solution over the cut surface.

* Originally published in: Northern Nut Growers Association: Annual Report/67:53-55, 1976.

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We prefer that these buds remain dormant and not start growing until we "force" them the following spring. As soon as the bark slips freely next April, we peel the back upward, beginning just above the bud patch. This forces the bud into growth and leaves a stub above it to serve as a stake to which the growth from the bud is tied as it grows upward to a height of 4 to 10 feet by the end of the summer.

Very few stakes are used. We stretch a wire about 4 feet high down each row and tie the trees to it as they grow.

Bear in mind that the patch buds are inserted about 6 inches above the ground and that from that point downward, everything, including the entire root system has its origin in the seed that was planted and that from that point upward everything, including the entire trunk and tree top, comes from the growth of the tiny bud in the centre of the bud patch-the patch itself is about the size of a postage stamp. All bearing growth from this tiny bud will bear the same kind of pecans as the tree from which it was removed or taken. This is the origin of a "Papershell Pecan Tree."

After the end of the third summer, our trees are ready for market. All are "three-year old roots, with one-year old tops". Beginning this year, we are cutting off the tops of our trees when they reach a height of 7 feet in the nursery row, causing them to branch from about 6 feet up for yard tree planting. If trees of this size are to be planted in a commercial orchard, we recommend that they be cut off much more severely--but that is another story.

Our trees are dug with a blade on a powerful Caterpillar tractor. Tap roots are cut at a depth of about 30 to 42 inches. The digger blade is about 30 inches wide.

Almost all of our trees are given what we call our "chemical root treatment" for which we charge 15 cents per tree. Small round wooden sticks or round toothpicks are soaked in a solution of IBA (indole butyric acid). Two or three inch lengths are inserted into each tap root after the trees are dug from the nursery, rows, resulting in the stimulation of quite a mass of root growth at each point of insertion. This treatment originated at the U. S. Pecan Station in Brownwood, Texas, by Dr. C. L. Smith and Mr. L. D. Romberg.

After they are dug and root-treated, most of our trees are heeled in until orders (including several varieties) can be assembled. If properly heeled in, they, will keep in good condition for several weeks - sometimes in better condition than if planted earlier (especially in wet soil conditions).

In our experience, late planting (last half of February and first half of March) of pecan trees is fully equal to early planting (November and December). Our customers seldom are confronted with freezing soils during the winter season. Regardless of the time of transplanting, in our experience, new roots do not begin to grow on newly transplanted pecan trees until about the time top growth (leaves) begins in the spring. Therefore, we do not have the same advantages as with many fruit trees where new roots under our warm soil conditions will grow following an early or fall planting. On occasion, we have successfully, transplanted considerable numbers of pecan trees held in our cold storage (34-38° F) until July.

Most of our trees are packed in burlapped polyethylene bags for shipment. Very little moist packing material is necessary, and trees may be kept in the bags for several weeks if necessary. A shipment of several thousand trees went to Brazil a few years ago and was planted with a loss of only two trees.

While our trees are produced on a three-year cycle, some nurseries use a four-year cycle, usually producing a larger size tree. And while we use patch buds in the fall, many very large producers use the "whip graft" in the spring and are very successful. We have experimented with a few cleft grafts. We will probably make extensive use of a modified bark graft in spring propagation in the future. The scions are fastened in place with staples driven by a staple gun or by small nails. A shallow slice of bark is removed from the back or outer side of the scion. This gives a good contact between the underside of the bark flap and the outer-side of the scion.

NUTS IN TWO YEARS *

JOHN W. McKAY**

Nut trees are not widely planted because of the time required for nut production. Many of the older cultivars require five to ten years or longer before bearing crops of nuts. With modern procedures and varieties it is now possible to avoid this long waiting period, and this paper describes some of these methods.

Persian Walnut

One of the most promising opportunities for early nut production is the topworking of Hansen Persian walnut (Juglans regia) scions on black walnut (J nigra) stock. Hansen scions from mature trees grafted on vigorous J. nigra stock nearly always bear the second year, and frequently the first year. At Beltsville, Maryland, the author grafted Hansen scions on 24 six to eight foot high stocks, using methods developed by pecan workers in Texas (1,2,3). More than half of the trees produced clusters of nuts the first year, and a good crop the second year. Also, over a 20-year period several large black walnut trees top-worked to Hansen scions produced nuts the first and second years and annually after that.

The range of J. nigra covers most of the Eastern United States, and wild trees of medium to small size could be topworkecl to Hansen and made productive in two years. Moreover, Hansen bears heavy crops of nuts every year. It is also self-pollinating. When Hansen is grafted on black walnut nursery stock and the trees moved to the orchard, bearing may be delayed somewhat because of transplanting shock. To have early nut production, therefore, it is important to graft Hansen scions on established black walnut stock. The Persian cultivar Broadview is almost as precocious as Hansen, and produces a larger nut.

Pecan

In many parts of Texas native pecan trees have been topworkcd to precocious new varieties in order to hasten nut production. An example of this is the farm of Professor Fret! Brison, retired Horticulturist of Texas A. and M. University. He has topworked an excellent stand of native pecan trees along the Little River in central Texas to early-bearing, high-yielding cultivars, resulting in a productive orchard of high quality nuts.

The pecan breeding program at U. S. Pecan Field Station, Brownwood, Texas has resulted in several precocious selections, such asWichita, Cheyenne and Cherokee. Trees of these varieties usually bear nuts the second year in the orchard. Many growers are planting trees of these varieties with close spacing to produce heavy crops of high quality nuts beginning the second year after planting.

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* Originally published in: Northern Nut Growers Association: Annual Report/67:122-123, 1976.

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MEMBERSHIP REGISTER - 1977

This year the membership list is presented in alphabetical order. If you want to look up a member by his address, consult the 1976 membership list, which is in postcode order.

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254 Aquisitions State Library of NSW Macquarie St Sydney 2000
412 Mr A A Albuquerque 64 Victoria Ave Claremont 6010
337 Mr A D Allen Hortic. Advisor PO Box 69 Wangaratta VIC 3677
425 Dr J Allison 48 Hamersley Rd Subiaco 6008
39 Mrs J Ambrose 189 Reynolds Rd Mt Pleasantt 6153
153 Mr G Anderson PO Box 171 Esperance 6450
377 Mr T D Anthoine RMB 217A Mandurah Rd Medina 6167
432 J Argent 10 Tenaro Ct Greenwood 6024
395 Mr R Arthur P0 Box 38 Tom Price 6751
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427 Dr J E Begg 19 Colvin St Hughes ACT 2605
178 Mr A C Belford 59 Sulman Rd Wembley Downs 6019
10 Mr P Bell P0 Box 43 Harvey 6220
219 Mrs T L Bell P0 Box 71 Moora 6510
42 Mr J G Bennett 30 Hobbs Ave Dalkeith 6009
373 S Bennison Havacado Nursery Lot 24 Battersby Rd Mandogalup 6167
271 Mr F W Betts 10 Morago Cres Cloverdale 6105
263 Mr D F Biddles 93 Erie St Cottesloe 6011
354 Mr J Blacklock 11 Moat St Mandurah 6210
2 Mrs C Blaekwell Lot 9, Spring Road Roleystone 6111
332 Mrs E Blair 61 Helena St Guildford 6053
397 Botanica Nurseries 36 Belgrave Rd East Malvern Vic. 3144

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324 Ms E Bourne 590 Narrabula St Tom Price 6715
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331 P G Bradshaw 33 Parkfield Rd Kelmscott 6111
358 D K Brindley 23 Byrie Ave Como 6152
420 Mrs P F Brinsden 89 Victoria Ave Nedlands 6009
247 G H Brittain P0 Box 38 Greenbushes 6254
37 Mrs C Broadbent Willow Springs Albany Highway Bedfordale 6112
343 D H Brown 61 Charles St Northam 6401
385 M Brown 145 Barker Rd Subiaco 6008
38 Mrs E M Brown Bakers Hill 6562
301 Mr R H Brown-Cooper 42 Subiaco Rd Subiaco 6008
215 Mrs I Browning 11 Francis Rd Waikiki 6169
225 Mr D C Bruce 5 Minerva Bay Carine 6020
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256 Mr R M Buehrig Scarp Road North Dandalup 6207
86 Mr J Burns P0 Box 96 Harvey 6220
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163 N Burtenshaw 412 Nth Rocks Rd Carlingford NSW 2118
159 Mrs M A Butler P0 Box 23 Bruce Rock 6418
184 Mr P J Byles P0 Box 46 Busselton 6280
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141 R Edwards 10A Whitby Court Bentley 6102
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130 Mrs N F Foulkes-Taylor Attunga Bindoon 6502
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261 Mr K Gow 42 Gairloch St Applecross 6153
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340 M D Green 195 Keane St Cloverdale 6105
403 Mr J A Greive 90 Eglinton Cres Hamersley 6022
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165 Mr C M Hall PO Box 343 Wagin 6315
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160 Mr D C Mattinson Yungup Rd Napier Albany 6330
244 Mrs R Mattson Mirboo Kojoneerup East Rd Wellstead 6330
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11 Mr C Morgan Lot 35 Railway Crescent Herne Hill 6056
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284 Mrs M R Morton 3 Claud St Katanning 6317

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5 Mr A J Pearce Lot 20 Hawkins Rd Roleystone 6111
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439 Mr D Pearse PO Box 252 Denmark 6333
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168 Mr A Price Red Gully Nannup 6275
342 B Prideaux PO Box 94 Pemberton 6260
384 Mrs. M E Puckridge Coomahl Park Jurien 6516
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308 Mr G Rampant 29 Toowong St Bayswater 6053
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106 Mr D C Roberts PO Box 400 Fremantle 6160
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31 Mr C M Robinson 20 Bishopsgate St Lathlain 6100
194 Mrs C Robinson Post Office Forrest Grove 6287
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73 Mr R Salt Camms Rd Monbulk Vic. 3793
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32 Mr A T Sas 52 Croydon Rd Roleystone 6111
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