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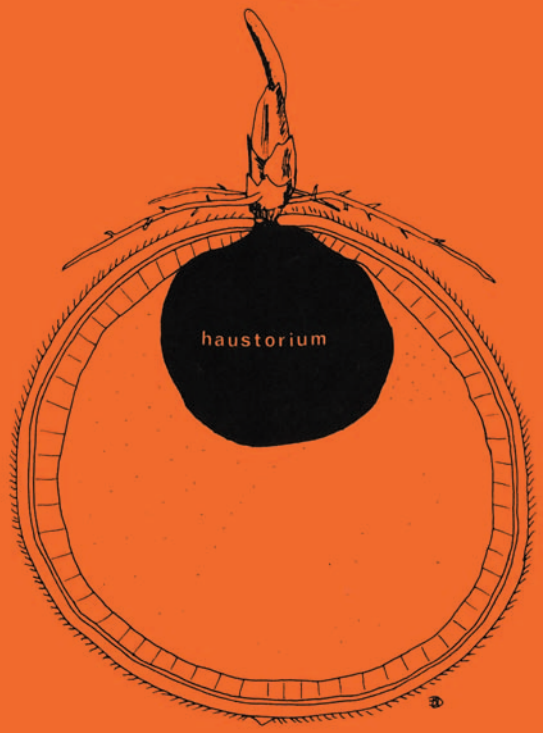
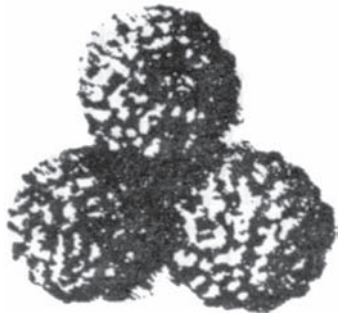


West Australian Nutgrowing Society Yearbook

Vol. 4 1978

WEST AUSTRALIAN NUTGROWING SOCIETY • YEARBOOK -- 4 --1978

West Australian Nutgrowing Society



Yearbook

Volume 4 1978

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

WANS

West Australian Nutgrowing Society

This Yearbook published 1979 by the West Australian Nutgrowing Society, P.O. Box 27, Subiaco, W.A. 6008, Australia
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* * *

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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 1978 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.

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. Members wishing to acquire WANSCO shares should write to WANSCO Secretary at P.O. Box 27, Subiaco,WA. 6008. WANSCO operates a retail and wholesale store (Squirrel Nutkin) at 225 Onslow Road, Shenton Park (Tel. [09] 381 8656).

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Editorial

During the past year there has been a surge in public interest in nuts in Australia. Along with the publicity on the milky sap from euphorbia stems as an alternative source of hydrocarbons potentially useful as a petroleum substitute, has been news items on the jojoba. With concern by whale conservationists, it can be expected that serious considerations will be given to the utilization of the liquid wax from the fruits of jojoba as a substitute for whale oil as well as other industrial uses.

Considerable research encompassing propagation, nutritional requirements and harvesting, both on this species and other recognized profitable nut species, needs to be carried out. It is good to see the beginning of local experimentation in *Juglans* and *Carya*.

There is still potential for the successful cultivation in Australia of nut trees other than the traditional ones such as almonds, macadamias and pecans. For example, little known species such as the tung tree have grown well at Donnybrook. It is hoped that WANS members will continue to experiment and increase the range of edible nuts available to the public.

ORNAMENTAL NUT TREES - SLEEPING BEAUTIES

HOMER L. JACOBS
The Holden Arboretum, Mentor, Ohio

Members of the Northern Nut Growers Association are of course interested mostly in trees which bear edible nuts. However, some of them have features that are ornamental or that are otherwise interesting. (Growing some of these adds to interest in our collections and to our show and tell" discussions.

In our promotion of nut trees at Holden -- articles in *Leaves* and classes in northern nut culture-we have, of course, emphasized them as trees which bear edible nuts. But, since most of our collections have to do with woody plants for ornament and shade, Let's take a look at our nut-bearing trees from that viewpoint.

Several species of nut trees rank with maples and many of the oaks as shade trees for the country estate or large urban property. Although the bitternut hickory, *Carya cordiformis*, bears inedible nuts, it is the most beautiful of the hickories and certainly specimens native to a property that is being developed should be preserved if at all possible. Several cultivars (varieties) of black walnut, *Juglans nigra*, which are grown for the quality of nuts, have excellent foliage which remains green and free from leaf diseases until normal leaf fall. Hickories, other than the bitternut, reach majestic sizes, are sturdy and resistant to wind and ice damage. Among these there are the shagbark, *C. ovata*, and the big shellbark, *C. laciniosa* (Figure 1).

Perhaps the hazels, or filberts, (*Corylus* species, are best represented by ornamentals in our collection of nut trees at Holden Arboretum. Most striking is the contorted hazel, *C. avellana* Contorta' (Figure 2). Its twisted and curled branches justify the other common name of 'Harry Lauder's walking stick''. Grandpa, tell the children who Harry Lauder was, back in the good old days.

The golden-leaved filbert, *C. avellana* 'Aurea', bears leaves which ordinarily are tinged with yellow throughout the summer. This genus is rich also in varieties with purple or wine-coloured leaves. We have two of these, derived from the European filbert, the species that

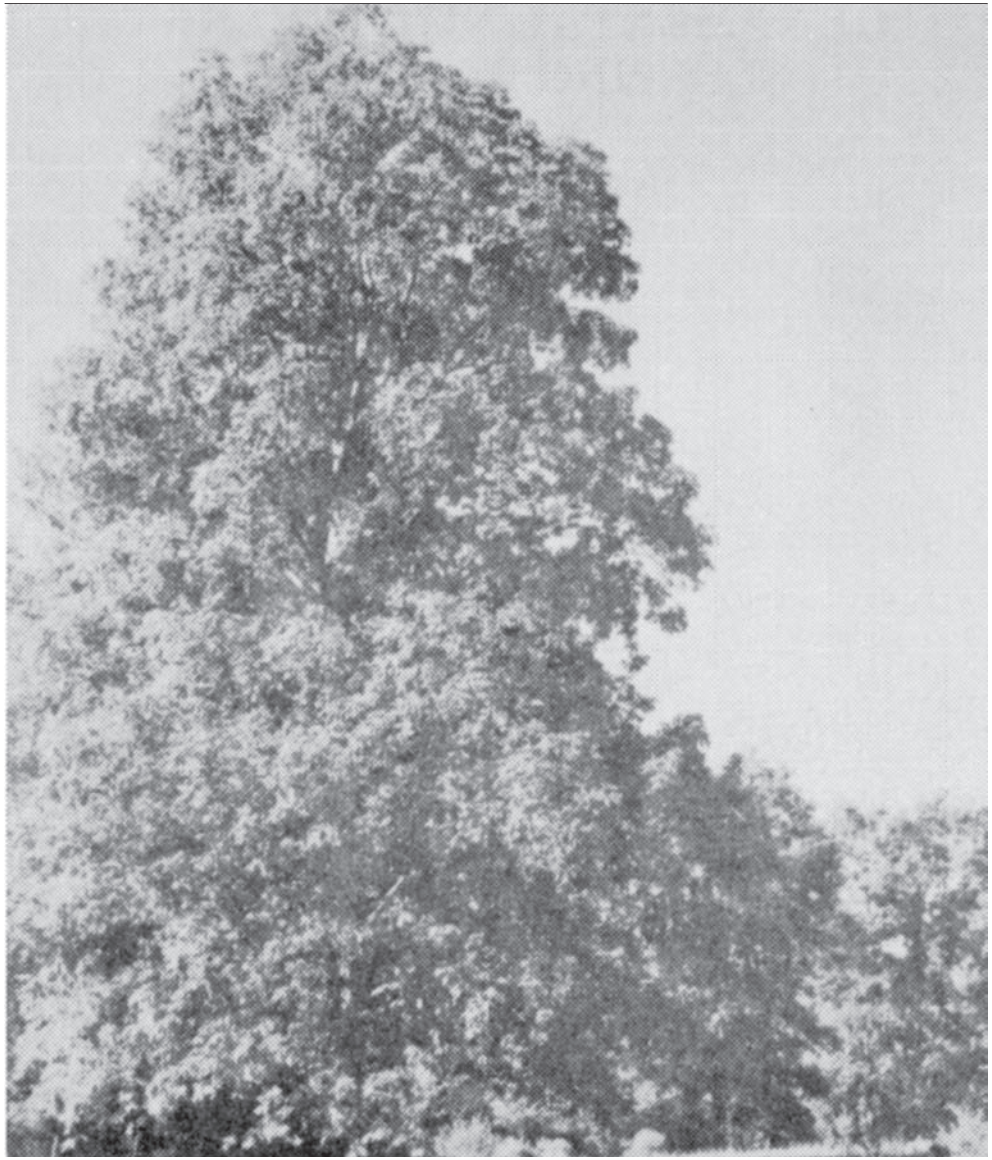

Figure 1 -- A mature shagbark hickory

produces the filbert found in produce markets. These are (*C. avellana* 'Superba', and *C. avellana*, 'Rotblaettrige Zellernuss', which my German friends tell me means simply "red leaved filbert". This latter variety bears nuts of good size and flavour. *C. maxima* 'Purpurea' bears small nuts with thin red skins and which have excellent flavour.

The cut-leaved filbert, *C. avellana* 'Heterophylla' has the most beautiful foliage of any variety of this species. The leaves have acutely serrated lobes. The weeping filbert, *C. avellana* 'Pendula', grown from grafts on Turkish tree hazel understocks, begins to "weep" as soon as the grafts start to grow. As the tree enlarges, the top branches grow upward and

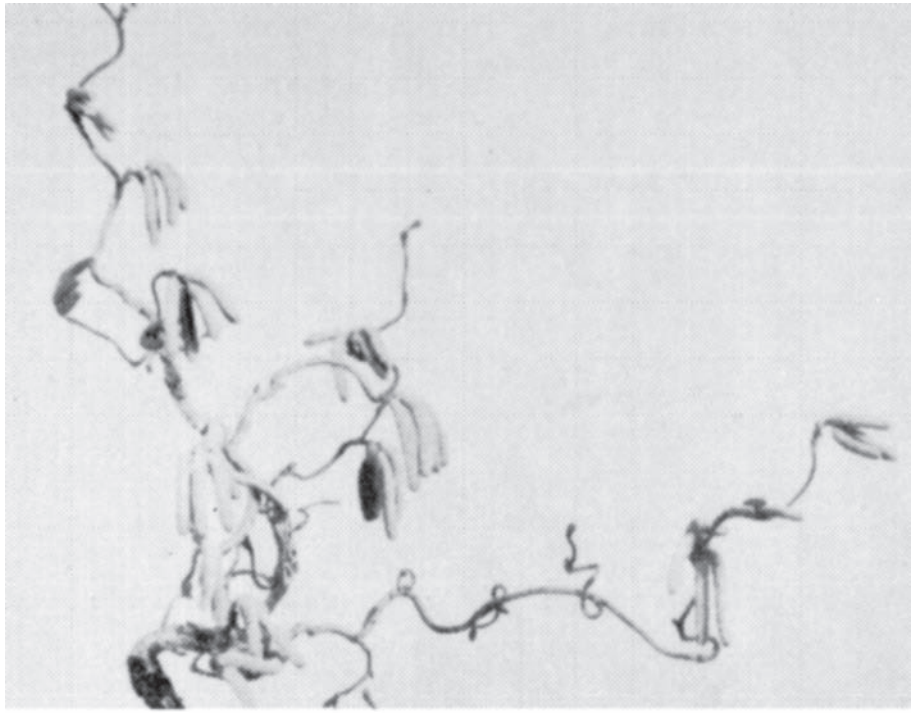

Fig. 2 -- Winter twigs of the contorted hazel

Fig. 3 --Long catkins of the Japanese heartnut add to its ornamental value

outward in a cascade like form. Before leaving the hazels, we must not forget the Turkish tree hazel, *C. colurna*. It is an attractive shade or ornamental tree which sometimes reaches a height of 75 feet. It can be grown as a multiple stemmed tree, but naturally tends to form a straight central leader with branches coming out at a strong wide angle (Figure 4). The soft, almost corky, gray bark adds to its beauty.

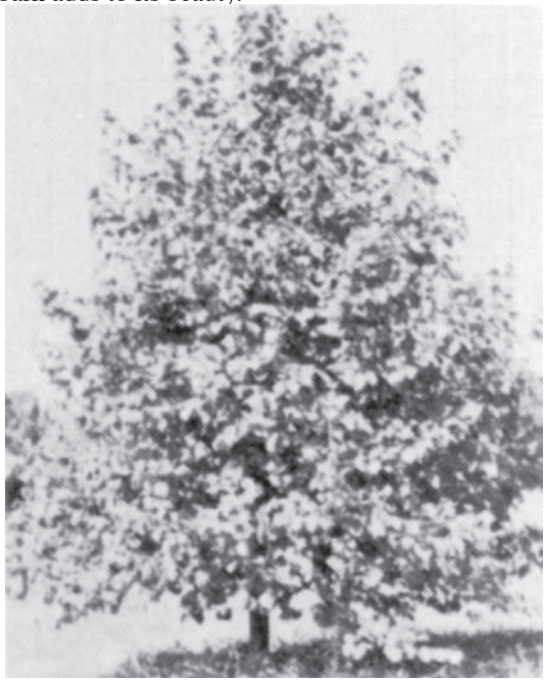

Fig. 4 -- A young Turkish tree hazel

A variety of our beloved black walnut, J. *nigra* 'Deming Purple' was called to nut grower's attention more than 50 years ago. The parent tree grew in Connecticut. It was 15 feet in trunk circumference and "bore very fair nuts". The purplish-red foliage on the young trees we have at Holden has not been especially bright, but the colour is noticeable in the cambium, and in the bark of small twigs. The husks of unripe nuts, and pellicles of the kernels, show the purplish colour. Dr. Deming, who introduced the variety, believed the wood might be valuable for cabinet work because every part of the wood carried the tint.

The cut-leaved black walnut, *J. nigra* 'Laciniata' is well established at Holden. Its deeply cut leaflets of the compound leaves form a delicate pattern, as beautiful as the pattern of the fern-leaved beech. On the young trees we have, the closely spaced leaves on rapidly growing twigs droop to give a plume-like appearance to the terminals of the branches.

Heartnuts are novel and attractive. The tree, *Juglans sieboldiana* f. *cordiformis,* is a form of Japanese walnut, which bears heart-shaped nuts that produce heart-shaped kernels. But, become acquainted with the beauty of the tree. The large compound leaves, some more than two feet long, give it an exotic, almost tropical, appearance. The delicately coloured catkins, as much as 12 inches long, draw attention to the tree at blossoming time (Figure 3). Less conspicuous, but equally fascinating, are the tiny two-plumed, pink-tipped female flowers which appear at the ends of the current year's shoots.

The only ornamental hickory we know is the Holden shagbark hickory, *Carya ovata* 'Holden'. This tree was introduced by Holden seven or eight years ago. The parent tree has a narrow crown, about fifteen feet wide at the base. The branches start upward from the trunk, droop, and then curve upward at the ends. Grafted trees five or six years old are beginning to show the branch pattern of the parent tree.

Among the pines are several that bear small but edible nuts. One is also an attractive ornamental. This is the lacebark pine, *Pinus bungeana*. Its beauty is in the trunk, the old bark of which peels off leaving chalky white patches of new bark (Figure 5). Other pine trees, which bear seeds of edible size, and which are doing well at Holden are the Jeffrey's or bull pine, *P. jeffreyi*, and the Korean pine, *P. koraiensis*. The bull pine is a distinctly ornamental species remarkable for its long pale bluish leaves. The Korean pine is hardy and handsome, of slow growth and dense habit. These three species might well be used more freely, as ornamentals in place of some of the pines which are planted more often.

Fig. 5 -- Bark pattern of the lace-bark pine

We Northern Nut Growers do not often grow the maiden-hair tree or ginkgo, *Ginkgo biloba*. However, in China, and perhaps elsewhere, the seeds of this tree are roasted and the kernels eaten as a digestive aid, perhaps where we might reach for the bottle of Tums or Alkaseltzer. The leaves and habit of growth of the trees justify including it among our Sleeping Beauties".

The individual flower of the Chinese chestnut, *Castanea mollissima* is not impressive but a tree in full bloom is quite striking; especially as the flowers appear in late spring or early summer after most trees and shrubs have bloomed.

Reprinted from the '68th Annual Report' of the Northern Nut Growers Association Incorporated, August 14-17, 1977.

METHODS OF PREDICTING THE NUTRIENT NEEDS OF NUT TREES

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The purpose of this paper is to discuss methods of predicting the nutrient needs of nut crops. The pecan is used as an example, but the principles discussed apply to most nut and fruit tree crops.

The methods are a) guess, b) nutrient removal by the harvested crop, c) nutrient deficiency symptoms, d) soil analysis, and e) leaf analysis. The objective of any method is to prevent or minimize losses in yield due to nutrient imbalances. Preventing nutrient disorders is easier than correcting them. For instance, two or more years may be required in some groves to correct zinc, potassium, and magnesium deficiencies. During this period losses in growth and yield continue to accumulate.

Guess

Guessing may appear to work for a while, especially with large trees. If the initial nutrient status of a large tree is high, several years may be required to detrimentally alter the nutrient level by improper fertilization. However, with young trees, guessing can induce drastic disorders within one growing season. In addition, this method frequently results in fertilizer applications which are not needed and, with current prices of fertilizers, guessing can be an expensive and nonprofitable method.

Nutrient Removal

Nutrient removal by the harvested crop has been suggested as an indicator of the nutrient needs (4). This method assumes a complete recycling of nutrients; in other words, there is little or no loss in drainage water nor fixation of nutrients by the soil. The method also assumes nutrient incorporation into the permanent structure of the tree is not a significant factor. Neither assumption is valid.

The amount of nutrients removed with the harvest of one acre of pecan nuts is small (Table I). Tree growth and nut production obviously cannot be maintained by fertilizing with these levels of essential nutrients.

TABLE 1 -Quantity of nutrients removed from the soil by 1000 pounds of nuts per acre, Farley variety, dry weight basis.

Nutrient	Pounds of nutrients removed per 1000 pounds of nuts
Nitrogen	8.53
Phosphorus	1.93
Potassium	3.60
Calcium	3.26
Magnesium	.49
Manganese	.069
Iron	.027
Boron	.010
Copper	.008
Zinc	.028
Molybdenum	.0018

From Sparks (8)

Nutrient Deficiency Symptoms

The use of nutrient deficiency symptoms to predict the nutrient status is an expensive method because suppressions in tree growth and yield have already occurred. The nut grower hopes he will never have to use this method. Nevertheless, nutrient deficiency symptoms do sometimes occur even with the best grower. Consequently, the grower should be able to recognize at least the more common deficiencies. Colour photographs of leaf deficiency symptoms of nitrogen, potassium, magnesium, iron, and zinc and of nitrogen scorch have been published (9).[1] These are the most frequently occurring nutrient disorders in pecan.

With some deficiencies, for example potassium and magnesium, the symptoms can change drastically as the deficiencies progress from incipient to severe. In advance cases, in which the leaf scorches, deficiency symptoms of several nutrients can be easily confused. Herbicide injury can also be difficult to distinguish from nutrient deficiencies. As a consequence, considerable expertise is often required to positively identify nutrient deficiency symptoms. As a general rule, visual deficiency symptoms should only be used as a guide and should be confirmed by leaf mineral analysis.

Soil Analysis

In the Southeastern U. S. the major advantage of soil analysis is pH determination. The importance of soil pH in relation to the nutrition of the grove has been recently reviewed (11). Among other effects, soil pH influences the availability of many nutrients in the soil solution.

The analysis of the nutrient content of the soil has restricted value. In other words, tree

[1] 'Deficiency symptoms of black walnut illustrated in colour also appear in an article by Phares and Finn. 1971, 62nd Ann. Rept. NNGA pp. 98-104.

performance is neither consistently nor highly correlated with soil analysis (15). Likewise, soil analysis is not highly correlated with leaf analysis (3, 14, 15). There are several reasons for these poor correlations. With soil analysis there is a potential error in sampling because the root distribution of a given tree or nut species is generally unknown and, in addition, it can vary considerably with soil type. Once the soil is sampled, the nutrients are extracted chemically. The extraction power of the chemicals is assumed to be equivalent to that of the root regardless of species. The universality of this assumption is questionable. Also, the uptake of a given nutrient by a tree can be a function of multiple factors. For example, the amount of potassium taken up from a given supply is influenced drastically by soil type and by the amount of nitrogen applied. Another disadvantage of soil analysis is that soils are not generally analysed for nitrogen. This is a serious disadvantage because nitrogen is often the most limiting nutrient in nut production.

Regardless of the limitations of soil analysis, employment of this method is necessary if the nutrient status of the nut grove is to be fully understood. For instance, if a soil test from a grove with zinc deficient trees indicates soil zinc is adequate, the zinc is probably unavailable to the tree and correction will most likely have to be by foliar application of zinc. If, on the other hand, the test indicates zinc is low in the soil, there is a greater possibility of the deficiency being corrected by soil application. In short, while the levels of nutrients in the tree are of much greater immediate concern, soil levels can also be essential information in correcting imbalances and ascertaining possible future problems. Also, soil analysis is the most reliable method in a preplant situation.

Leaf Analysis

Leaf analysis works especially well in pecan. Leaf analysis can be used to measure uptake following an application of a given nutrient; in other words, did the tree take it up. Leaf analysis can also be used to identify deficiency and toxicity symptoms, distinguish between herbicide injury and nutrient disorders, but most important the tree can be monitored and fertilizer applied before a deficiency occurs. The major disadvantage of leaf analysis is that it supplies little information about the soil. Thus, leaf and soil analysis should be used in combination to predict the nutrient needs of nut crops. Because leaf analysis is the single most reliable method for predicting nutrient needs, the principles involved are discussed in detail.

Principles of Leaf Analysis

Tissue analysed One may ask why is the leaf the tissue selected for analysis rather than the root or other tissues. The reason is that the leaf is more sensitive than other tissues to changes in nutrient supply. This is illustrated by the data in Figure 1. The increase of potassium in the leaf, in response to increasing potassium supply, was much greater than in stem and root tissue. Similar results were found for nitrogen (12). These results are not surprising because the leaf is the food producing organ of the plant and is a site of intense metabolic activity.

Sampling procedure The concentration of nutrients varies with the position of the leaf on the shoot and in the case of compound leaves with the position of the leaflet on the leaf. For instance, calcium concentration in the pecan decreases from basal to apical leaves on a shoot and from basal to apical leaflets on the leaf. Consequently, the sampling procedure for any plant must be standardized if leaf analysis results are to be meaningful. In pecan the sampling procedure consists of sampling the middle pair of leaflets from the leaf on the mid-portion of the shoot (2). For example, if a pecan shoot had 11 leaves the sixth leaf would be the one selected. If this leaf had pairs of leaflets the sixth pair would be sampled.

Time of leaf sampling Once the sampling procedure has been selected, the time to sam-

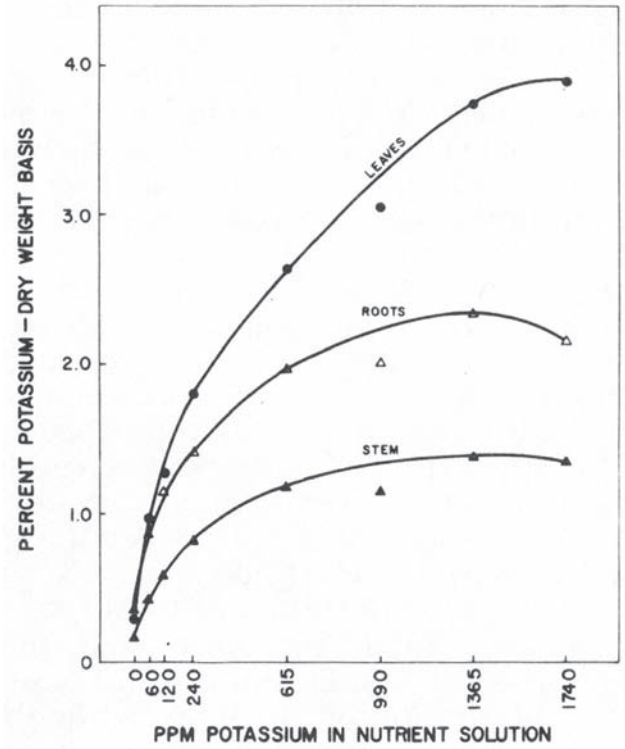

Figure 1. -- Percentage potassium in the roots, stem, and leaves of one-year-old pecan seedling as a function of potassium in the nutrient solution. From Upson and Sparks (13)

ple must be determined. This is necessary because the concentration of nutrients in a given leaf changes as the season progresses or as the leaf grows. The change in phosphorous concentration of pecan leaflets with time is depicted in Figure 2. The data were from the same group of trees sampled at four week intervals throughout the growing season. Early in the season, during the period of rapid leaflet growth, the phosphorous concentration decreased sharply with time. As indicated on the curve, sampling during this interval gives different phosphorous values although the phosphorous concentration in the soil may remain constant with time. As a result, if leaf analysis values are to be repeatable and thus comparable with standards, sampling must be during the period in which the nutrient concentration is stable with time. For most of the nutrients in pecan leaflets, this interval is 56 to 84 days after catkin fall or in Georgia from July 7 through August 7 (7). This is a month interval. A long interval is important because it is unreasonable to expect growers to sample within a few days, for example one week. Sometimes it is necessary to collect samples at times other than the recommended time. On such occasions, two samples should be collected. One sample should be taken from the tree that has a suspected nutritional disorder and one from a healthy tree. In these cases, the healthy tree serves as the standard.

Establishing leaf composition standards The final step in a leaf analysis program is to determine the leaf composition values associated with deficiency, optimum, and toxicity. Two approaches, the survey method and experimental studies, can be used. In the survey method, leaf samples are taken from groves that have records of high yields. The assumption

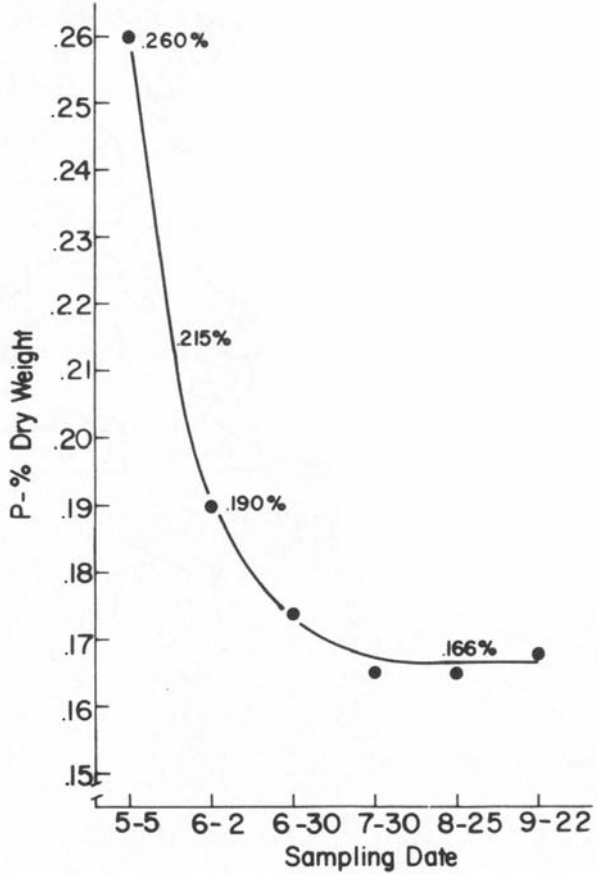

Figure 2. -- change in phosphorus concentration in pecan leaflets as a function of time.

is made that the nutrition of these groves is optimum and, thus, the leaf composition values of these groves can be used as standards for adequacy. The survey method is quick and works reasonably well when no other nutritional data are available.

However, values established by the survey method are tentative, and unequivocal values require experimental studies in either the field, greenhouse, or both. Greenhouse studies are quick and values for deficiency appear to be easily transferred to the field. However, values for optimum growth may be more difficult to transpose to the field. Field studies can be long term and expensive but a field approach is the ideal method.

Tentative leaf composition values for pecan are presented in Table 2. These values are from various sources (1, 2, 5, 6, 10, 12, 13) and unpublished data. Corresponding values for Mn, S, Mo, and Cu are unknown.

In summary, among the methods employed in predicting the nutrient status of nut trees, leaf analysis is superior followed by soil analysis. The nutrient status of the nut orchard can best be predicted by using both methods in combination.

TABLE 2 -- Tentative leaf composition standards for pecan, dry weight basis.

Nutrient	Deficiency symptoms	Optimum growth	Toxicity symptoms
Nitrogen -- %	2.3	2.7 - 3.0	3.0 [+1]
Phosphorus -- %	.10	.14 - .30	?
Potassium -- %	.60	1.25 - 1.50	3.50+
Calcium -- %	.40	1.00 - 2.50	t ?
Magnesium -- %	.20	.40 - .60	?
Iron -- ppm	50	65+	?
Zinc -- ppm	20	50 - 100	?
Boron -- ppm	6	15 - 50	?

[1]The toxicity value varies depending on the potassium concentration in the leaflet.

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PECANS FOR SOUTH AUSTRALIA

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Given a favourable market outlook, successful pecan culture in South Australia will depend on selecting the right growing site and variety mix for planting.

GROWING SITE

One area of uncertainty in pecan culture is the environment limits to growth under Australian conditions. The length of growing period (bud burst to shuck splitting) is an important factor in selecting varieties for planting. Cool areas require varieties with a short growing period, while warm areas may be planted with varieties with a longer growing period.

What is the shortest growing period required? How cool may a district be before it is unsuitable for pecan culture? U.S. experience does indicate the answer.

Table 1 gives the number of degree-days/year above 10°C for important pecan producing centres in the U.S. The units "degree-days above 10°C" are an index of the length of the growing season at a particular site. Centres having a large number of units have long/warm growing seasons and centres with a low number of units have short/cool growing seasons.

Most of the popular varieties of pecan require a high number of heat units during the growing season to mature their nuts.

From Table I it is seen that the coolest of the centres for which data is available is about 2500 degree days above 10°C. In fact pecans are grown in cooler areas of the U.S., but special (short growing season) varieties are adapted to the areas - most of which are not available in Australia at present.

Pecan experts consider that short-growing season varieties can be grown at 1500-2000 heat units.

Diagrams 1 & 2 show the distribution of degree-days/year above 10°C for South Australia as calculated from meteorology data. Comparing the data displayed in the diagrams with Table 1 and adopting, say, 2000 degree-days/year above 10°C as the absolute minimum for pecan culture in South Australia, then most of the South East and Mount Lofty Ranges are seen as unsuitable areas for pecan culture. Climatically suitable areas include the northern Adelaide Plains/Port Pine area, Upper Murray, Eyre Peninsula and Far North.

Generally, for the conventional southern U.S. varieties, growing season heat units below about 2500 are associated with small nuts and low yields, e.g. where night temperatures are relatively low, as at Davis in California, it was found that there are insufficient heat units (about 1950) to mature a pecan crop, in spite of high day temperature, and the shucks stay green right into winter and do not dehisce.

Table 1: Degree days/year in excess of 10°C for some pecan growing centres in the U.S.A.

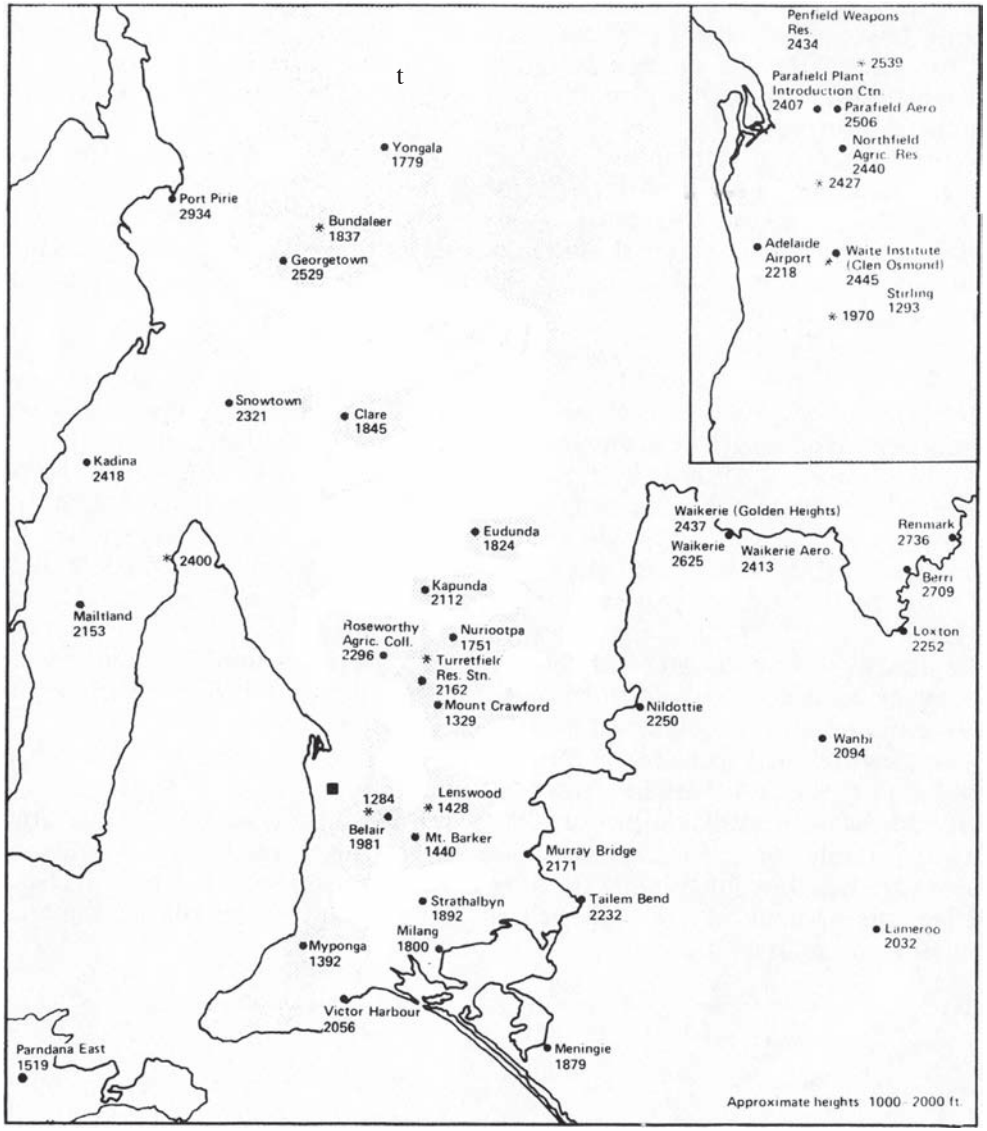
City	State	Degree days	%Total* U.S. Crop 1967-1957	Mean Temp.(°C) coldest 3 months
Atlanta	Georgia	2757	32.5	7.8
Dallas	Texas	3515	19.7	9.1
Birmingham	Alabama	2790	12.6	8.2
Schrevepont	Louisiana	3497	10.4	10.0
Phoenix	Arizona	4004	-(young trees)	11.5
Tulsa	Oklahoma	2691	8.4	4.3
Meridan	Mississippi	3081	5.3	9.5
Roswell	New Mexico	2489	3.9	3.4
Little Rock	Arkansas	2885	2.4	5.8
Tallahassee	Florida	3682	2.2	12.4
Sportanburg	South Carolina	2630	1.0	5.9
Raleigh	North Carolina	2479	1.0	5.9
	Mean	3043		

* 49% of the U.S. crop is harvested from native (seedling trees)

Diagram 1
The number of degree days per year above 10°C for a range of meteorology recording sites in South Australia*

*** Source: Australian Bureau of Meteorology**
"Climate Averages: Australia" Metric edition 1975

Diagram 2
The number of degree days per year above 10°C for meteorology recording sites in the central distracts of South Australia.*



*** Source: Australian Bureau of Meteorology**
"Climate Averages: Australia" Metric edition 1975

As a guide, a large commercial (U.S. sponsored) pecan planting has been made at Moree, N.S.W., where the number of degree-days/year above 10°C is 3394. Tree yield and nut quality would be higher in areas with a larger number of degree-days/year above 10°C.

Availability of irrigation water arid suitable soils are further constraints to be imposed within the climatically suitable areas before a final selection of site is made.

Long term success has been associated with growing pecans on well aerated soils to a depth of 3-5 metres. Good soil drainage is needed, and in the drier areas with a potential salinity problem, the water table should be about 3 metres from the soil surface.

Alluvial soils of moderate-low clay content are considered excellent for pecans and a pH value in the range of 6-7.5 is ideal.

The pecan is sensitive to chloride levels (toxicity) in arid areas and the soil structure and irrigation water should allow for occasional deep flushing (leaching) irrigations in such areas. Also zinc deficiency problems would be more acute in neutral to alkaline soils.

VARIETIES

Selection of the right mix of pecan varieties for planting is important in terms of pollination and length of growing season or adaption to local climate.

Although pecan trees bear both male and female inflorescenses (parts) the parts may not function at the same time. This is illustrated by Diagram 3 which shows the timings of "activity" by male and female parts for some pecan varieties. (The timings are for U.S. -Northern Hemisphere!). These timings would change slightly according to the district and season although the basic sequence is likely to be the same.

To ensure pollination and nut set a mix of varieties is needed where the male and female parts complement one another in their activity. U.S. experience is that nut size and quality are improved by cross pollination.

Varieties presently available in Australia and suitable for so called "high density" plantings (e.g. 9 m x 4.5 m) are shown in Table 2.

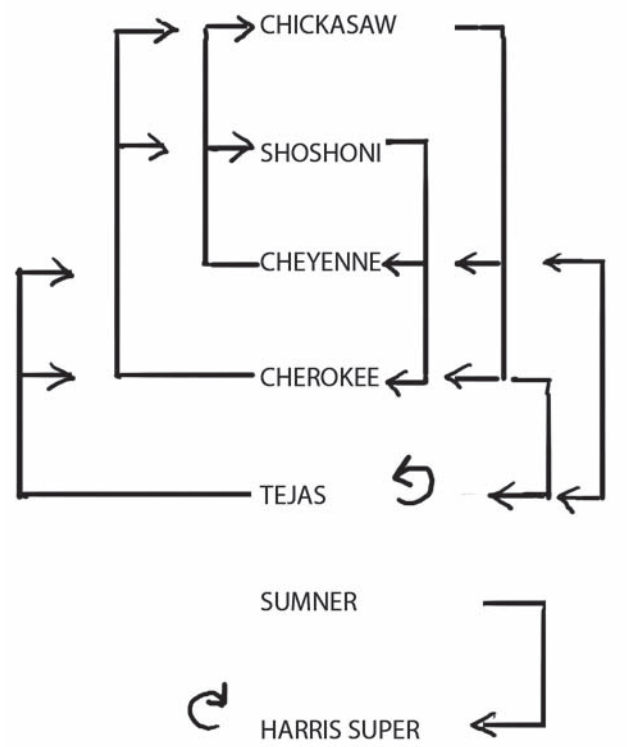
On the basis of available information (U.S. literature), a selection of varieties thought suitable for short growing season areas is shown in Diagram 4 and a selection of varieties thought suitable for long growing season areas is shown in Diagram 5. Diagrams 4A and 5A are suggested layouts or planting designs for the recommended varieties in an orchard.

Diagram 3: Stigma receptivity and pollen shedding of pecan varieties at Brownwood, Texas, 1972

Variety	APRIL																									MAY				
	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5
Cape Fear							X	X	X	X	X	X	X	X		O	O	O	O	O	O	O	O	O	O					
Cherokee						X	X	X	X	X	X	O	O	O	O	O	O	O	O	O	O	O								
Cheyenne																				O	O	O	O	O	O	O	O			
							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Chickasaw				O	O	O	O	O	O																					
							X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
Witchita				O	O	O	O	O	O																					
											X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Shoshoni				O	O	O	O	O	O	O	O	O																		
												X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Tejas					O	O	O	O	O	O	O	O	O	O																
						X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		

O Stigma receptivity
X Pollen shedding

Diagram 4:
A pecan variety mix likely to be suited to short growing season* areas showing pollen donation and reception between varieties.



	Variety Growing Period (Days)
CHICKASAW	176
SHOSHONI	179
CHEYENNE	191
CHEROKEE	187
TEJAS	192
SUMNER	*
HARRIS SUPER	*

* Growing season data is unavailable for these varieties, but their precocity and availability commends their consideration.

≠ Less than 2500 degree days above 10°C/year.

Pollen donated from → Pollen received by

Diagram 4A:
A layout of pecan variety* mix suited to short growing season areas.

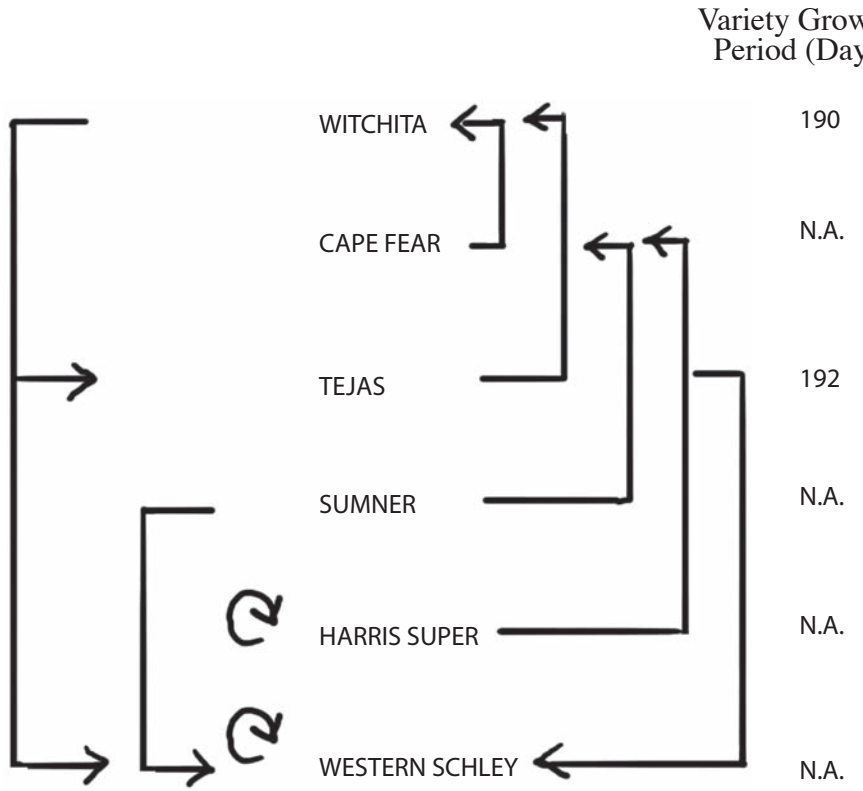
BOUNDARY FENCE

TEJAS	X X X X X X X X X X X X X	Row 1
CHEYENNE	X X X X X X X X X X X X X	Row 2
SHOSHONI	X X X X X X X X X X X X X	Row 3
CHEROKEE	X X X X X X X X X X X X X	Row 4
CHICKASAW	X X X X X X X X X X X X X	Row 5
SUMNER	X X X X X X X X X X X X X	Row 6
HARRIS SUPER	X X X X X X X X X X X X X	Row 7
CHICKASAW	X X X X X X X X X X X X X	Row 8
CHEROKEE	X X X X X X X X X X X X X	Row 9
SHOSHONI	X X X X X X X X X X X X X	Row 10
CHEYENNE	X X X X X X X X X X X X X	Row 11
TEJAS	X X X X X X X X X X X X X	Row 12

* Pollen transfer reportedly effective over 9 tree rows

X = Pecan tree

Diagram 5:
A pecan variety mix suitable for long growing season* areas showing pollen donation and reception between varieties.



≠ Greater than 2500 degree days above 10°C/year.

Pollen donated from → Pollen received by

Diagram 5A:
A layout of pecan variety* mix suited to long growing season areas.

BOUNDARY FENCE

TEJAS	X X X X X X X X X X X X X X	Row 1
WITCHITA	X X X X X X X X X X X X X X	Row 2
CAPE FEAR	X X X X X X X X X X X X X X	Row 3
W. SCHLEY	X X X X X X X X X X X X X X	Row 4
SUMNER	X X X X X X X X X X X X X X	Row 5
HARRIS SUPER	X X X X X X X X X X X X X X	Row 6
W. SCHLEY	X X X X X X X X X X X X X X	Row 7
CAPE FEAR	X X X X X X X X X X X X X X	Row 8
WITCHITA	X X X X X X X X X X X X X X	Row 9
TEJAS	X X X X X X X X X X X X X X	Row 10

* Pollen transfer reportedly effective over 9 tree rows

X = Pecan tree

Table 2: The characteristics of some pecan varieties available in Australia

Variety	Year released	Tree Efficiency Ratings (kg. nuts/sq.cm)	No. nuts/kg	Quality/Flavour	%Kernel Yield (shelling)	Tree Vigour	Length Growing Season (days)	Maiden Live (years)	Pollination Type*	U.S.§ Maturity Dates	Precocity Ratings*	Cropping	Comments
Tejas	1973	N.A.	143	Good	53	Very vigorous	192		II	10 Oct.	1.3		Long pollen sheeding. Easy cracking. Strong crotch angles
Cheyenne	1970	1.35, 2.05	150	Good	58	"Dwarf"	191	3.4	I	26 Sept, 9 Oct.	1	Regular Light	Good shelling. Wrinkled kernel. Medium size nuts.
Shoshoni	1972	1.64, 2.35	108	Fair	53	Very vigorous	179	Short	II	26 Sept, 9 Oct.	1	Heavy	Strong crotch angles. Large nuts.
Cherokee	1971	1.38, 2.64	139	Poor storing	55	Very vigorous	187	3-4	I	26 Sept, 2 Oct., 12 Oct	1	Irregular	Profuse branching. Good shelling. Small nuts.
Chickasaw	1972	1.58, 4.4, 3.52	156	Average	54	Vigorous	176	Short?	II	26 Sept, 2 Oct.	1	Alternate, Heavy	Profuse branching. Good shelling, upright growth. Premature defoliation at maturity.
Sumner		N.A.	143	N.A.	54	N.A,	N.A.	4-5	I	N.A.	N.A.	N.A,	-
Harris Super		N.A.	99	N.A.	53	N.A.	N.A.	Short	I	N.A.	N.A.	N.A.	-
Witchita	1959	1.47, 3.5	114	N.A.	61	N.A.	190	3-4	II	3 Oct., 7 Oct.	2	Medium/ heavy, regular	Late season. Nut splitting. Poor shelling. Needs detailed training.
Cape Fear		1.06, 1.17	90, 108	Good	57	N.A.	N.A.	3-4	I	17 Oct., 24 Oct.	4	Poor	Subject to scorch and leaf drop.
Western Schley		1.47	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	3 Oct.	N.A.	N.A.	-

* 1 = Excellent; 3 = Good; 5 = Fair; 7 = Poor.

*1 = Protandrous variety; pollen is shed before the stigma is receptive.
II = Protogynous variety; pollen is shed after the stigma is receptive.
N.A. = Not available.
§ Different dates are associated with different seasons and/or districts.

GROWING WALNUTS

TOM SPEER
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INTRODUCTION

The first things to be considered when growing walnuts are climate, soil and availability of fresh water. If too hot in summer, the nuts are prone to sunburn, but irrigation helps to reduce sunburn, as dehydration is a contributing factor. Walnuts are sensitive to salinity, so avoid high salt levels in irrigation water. Walnuts naturally thrive in good rich loamy soil such as is found in the Karri country, where salinity is not a problem. However, I have grown walnuts quite well in Bridgetown on light gravelly soil with a clay subsoil. They will not survive excessive waterlogging, so avoid areas that are under water for long periods in winter.

NUTRITION

Walnut trees are gross feeders and respond to generous application of fertilisers. One I recommend is N.P.K. "Blue Special" (12-12-20 plus trace elements), especially when growing seedlings and for the first four or five years of the young tree's life. Older trees respond to liberal applications of nitrogen (urea), and are partial to calcium. A soil reading of pH 6-8 is suitable.

DISEASE

Walnuts are subject to only one serious disease - Black Spot. This fungus attacks the fruit in late spring, causing ugly spotted misshapen nuts which have no kernel, and disfiguring others, making them less saleable. Treatment for this disease is to spray at leaf-fall, and again at bud-burst, with Bordeaux Mixture, using 6lbs Copper Sulphate, 4lbs Lime to 40 gallons of Water. Other fungicides can be used. Franquette seems to be the most resistant, mainly because it comes into leaf late in spring (mid-November), when conditions are generally drier. A very resistant variety has been found at Balingup, and this could provide a welcome breakthrough in the control of this disease. I have a trial planting of seeds of this variety.

ROOT STOCK

I have tried several varieties, viz. Black Walnut, and seedlings of Wilson's Wonder, Freshford Gem, Franquette, Trêve-Mayette and a vigorous local variety. To date, I find Franquette definitely the best - Black Walnut the worst (it has the same problem as the Pecan, all taproot and no feeder roots). I have also some promising seedlings selected from my seedbeds which are at least twice as vigorous as Franquette.

RAISING SEEDLINGS

Do not buy nuts from your corner shop. They are most likely to have been fumigated with gas for 24 hours, and most probably are not viable. If you wish to try your hand at growing your own seedlings it is better to purchase from a local grower.

Nuts should be planted point-down, 2-5 cm deep, 25-30 cm apart, in rows about 75 cm apart. It is important to plant the seed with the point down, as the tap root emerges at this point, and grows straight down. If the point is reversed, the root starts skyward, then reverses direction, causing an ugly club-footed seedling which never thrives. The success of your endeavours will be in direct ratio to the amount of food and water you can give them during the first summer.

I have found that seedling trees average 5 to 7 years before bearing fruit. It has also been established that good commercial varieties breed reasonably true to type.

GRAFTING

Some success has been had with two methods.

Whip and Tongue. The Whip and Tongue method is suitable for seedlings about the size of a pencil. I find the addition of an extra tongue has the effect of locking the scion and the stock very firmly (Fig. 1).

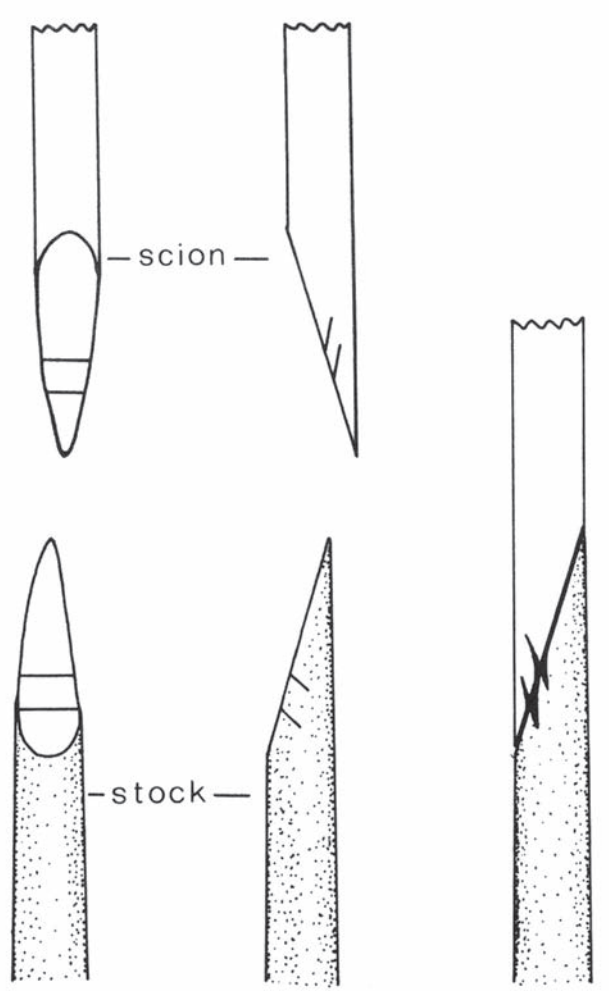


Fig.1 Whip and tongue

Cleft Graft. The ideal tool to use for this graft is the Rolcut secateur. With this it is possible to make a perfectly clean straight cut, whether the grain of the wood is wavy or straight. If a knife is used, it will follow the grain. With a good cut in the stock, half your problems are over. Now take the scion, and using a sharp knife, cut to a tapering point the same length as the cut in the stock. Tie with budding tape (plastic), and finally, cover the graft with a piece of plastic about 7 - 10cm (Fig. 2). This patch eliminates using grafting wax or paint.

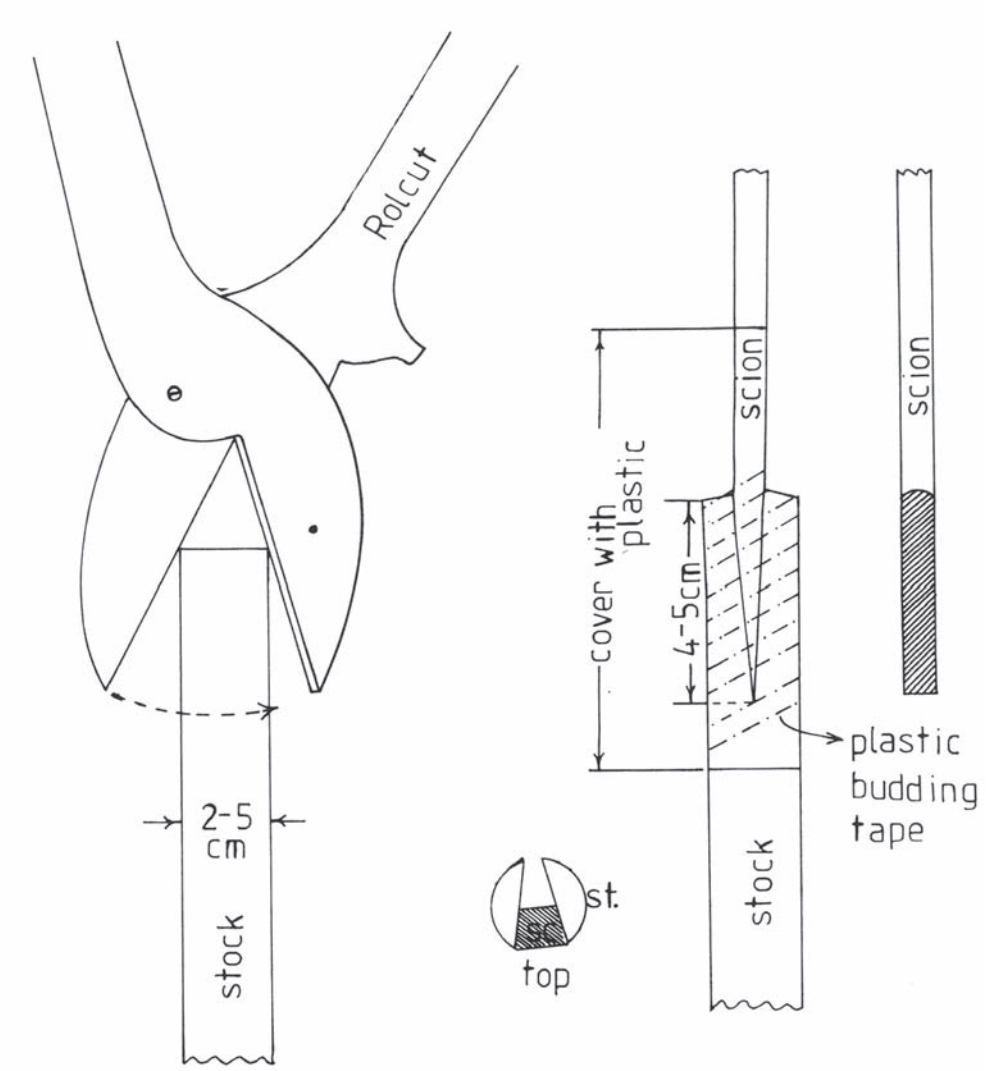


Fig. 2 Cleft graft

On August 22nd, 1978 1 grafted 18 walnut seedlings using this method and by November most are growing well. I recommend anyone wishing to raise named varieties to try this method. I would like to emphasise that the tools used should be very sharp.

PLANTING OUT

It is possible to transplant to the permanent site any time after leaf-fall, but if the ground gets too wet in winter, it is better to delay planting until the spring. I recommend a spacing of 9 to 10 m between trees.

When planting young trees, avoid using any artificial or animal manure in the hole. Use good top-soil to plant the tree then apply the manure in a circle about 1 m in diameter round the, tree. If this is thoroughly mixed into the soil to a depth of about 15 cm, there is little likelihood of the roots being damaged. One pound of N.P.K. or a generous dressing of rotted animal manure should supply the needs of the tree for the first summer. A good mulch of sawdust, law clippings, etc., will help to reduce losses in hot weather and cut down on irrigation requirements. When planting, try not to cut the tap root. After you have dug the hole sufficient to accommodate the root-spread, use a crowbar to make a hole for the tap root.

CONCLUSIONS

I consider there is a good future in nut-growing in W.A., especially in the forest areas of the Southwest. I would recommend aspiring nut-growers to grow their own trees from seed of a good commercial variety, such as Franquette, Trêve-Mayette, Freshford Gem or Wilson's Wonder. Should you then have trouble with the grafting, I feel sure that 80-90% of these trees will produce good saleable nuts. I have found this to be so from my own experience.

TRIALS WITH NUT CROPS IN CARNARVON

J.R. BURT, Tropical Adviser and D.W. THOMAS, Manager,
Gascoyne Research Station

INTRODUCTION

Nut crops have not been produced commercially in the Carnarvon area. The three main reasons for this are as follows:

a) The climate is unsuitable for most nut crops.

b) Economic production of nut crops would involve large land areas and there is a shortage of irrigation water in Carnarvon for this type of enterprise.

c) There is a lengthy time to commence full bearing with some nut crops and these would not compete economically with the existing range of horticultural crops produced at Carnarvon.

A wide variety of nut crops have been investigated at Gascoyne Research Station and trials on these crops are summarised as follows.

CASHEW NUTS

The cashew nut is a tropical tree. Despite low winter temperature in Carnarvon (monthly minimum in July is 10.6°C), this tree grows well in Carnarvon. At Gascoyne Research Station, initial bearing commenced only three years after planting. Four-year-old trees produced 0.4 kg nuts per tree.

The trees in Carnarvon produce a nut which is small (2.5 cm long by 1.5 cm wide). This may be an inferior varietal characteristic.

A large number of varieties have been collected in Queensland. Seeds of these improved strains will be sent to WA. for testing in Carnarvon and areas further north.

The cashew nut grows excellently in the Kimberley area. In Kununurra, there are ample water supplies for irrigation. However, an area of 100-200 hectares would be required for the economic operation of a processing factory. The high cost of labour in Australia would be disadvantageous and it may not be possible to compete economically with India, Mozambique and Tanzania where labour costs are low.

COCONUT - PLANTINGS IN WESTERN AUSTRALIA

The coconut requires a well drained soil with regular water supplies. The plant is tolerant to high winds and has withstood cyclones fairly well. A fairly even climate, with temperatures ranging between 22° and 32°C and high humidities, is the most suitable for coconuts.

The closest to this ideal climate is at Kalumburu Mission in the north of Western Australia. However, due to high cost of labour and marginal climate, the coconut cannot be considered as a commercial crop in any part of Western Australia.

The coconut is highly valued as an ornamental palm for parks, gardens and beach areas, as it grows into a tall stately palm crowned by graceful spreading pinnate leaves.

In Western Australia, coconuts grow in the coastal regions from Carnarvon northwards to Kalumburu Mission, but will not grow well in areas further south than Kalbarri.

The oldest coconut trees at Gascoyne Research Station were planted in 1947. In Carnarvon, only a few nuts are produced each year and there is a lengthy period of up to 15 to 18 months between flowering and harvesting.

MACADAMIA NUTS

Some varieties of *Macadamia integrifolia* have yielded well at Carnarvon. With the best varieties, yields have been similar to average yields in California and Hawaii.

13-year-old trees of Hinde and Kakea produced 14 kg and 12 kg per tree respectively. The varieties Tinana, Rickard and Nutty Glen have produced low yields. Initial bearing commenced 6 years after planting.

Macadamias appear to tolerate the extreme climatic conditions in Carnarvon which has a temperature range between 5°C and 48°C, strong winds for half of the year and a relative humidity range of 5% to 80%.

However, a macadamia industry is unlikely to develop in Carnarvon for the following reasons:

a) Shortage of water for the development of a large industry.

b) Distance from the major confectionery firms in the Eastern States, and

c) Large scale plantings in the Eastern States.

In recent years, 1,000 hectares of macadamias have been planted in Northern N.S.W. and increasing amounts will be produced from this area in future.

PEANUTS

Blocks were initially opened in Carnarvon in the 1920's for the production of peanuts by ex-servicemen. However, an industry never became established in Carnarvon. In 1930, it is believed that the first commercial crop of peanuts in Western Australia was grown in Carnarvon. This venture failed as the crop was uneconomic to grow. Later attempts in the early 1950's also failed.

Yields of up to 5 tonnes per hectare have been obtained in trials. However, returns from peanuts are very low compared with horticultural crops and water supplies are insufficient for the development of a major industry.

PECAN NUTS

Winter temperatures are too warm for satisfactory production of pecan nuts, which require a degree of winter chilling to produce good flowering. 750 hours are required below 7 C, whereas in Carnarvon temperatures rarely drop below this level.

The best grafted variety at Gascoyne Research Station is Western Schley, but 9-year-old trees have produced only 2.5 kg nuts per tree. The varieties Nellis, Williamson and Success have produced lower yields.

725 hectares of pecan nuts are in production in Moree, Northern N.S.W. These have commenced bearing and increasing production can be expected from this area in future.

PISTACHIO NUTS

A few varieties of pistachio nuts will be planted at Gascoyne Research Station next year. Pistachio nuts originated in Western Asia where winter temperatures are considerably lower than Carnarvon. It is therefore doubtful that the pistachio will produce good crops, as it needs a degree of winter chilling for satisfactory production.

QUANDONG (NATIVE PEACH)

This native tree grows on the banks of the Gascoyne River and in most arid parts of Australia.

The Quandong has an edible fruit and nut. The wood may be used for furniture and the bark for tanning. Nuts may also be used for handicrafts. They are often used in games of Chinese Checkers.

C.S.I.R.O. are conducting research work and will attempt to develop improved strains by plant breeding. However, it may be difficult to bring this tree into cultivation as it is a root parasite and is affected by native pests.

SITES, LAYOUT AND IRRIGATION FOR NUT ORCHARDS

G. PARLEVLIET

Adviser, Department of Agriculture, Bridgetown, W.A., 6255.

Picking the site for a nut orchard is the first critical decision, assuming climate has already been decided on as being right.

Soils ideal for commercial nut production are deep, fertile, well-drained but with good moisture-holding capacity, and a static water table 3 to 7 metres deep. Unfortunately, such soils are scarce.

In the South-West of Western Australia the site should have deep permeable topsoil (75 to 100 cm deep of sandy loam), a sandy clay subsoil to be permeable to both air and water, and sub-surface moisture no closer than 2 metres to the surface. In most cases supplementary irrigation is necessary, and enough good quality water should be close to the site.

The potential site should allow free movement of air currents, as cold air settles into low spots and can be trapped by barriers - often causing both early and late frost damage. For pecans, walnuts, chestnuts, macadamia and almonds, avoid sites that are in a “hole” or that have hills, or timber lines that could reduce the movement of air currents. Topography should be reasonably level to help irrigation, cultivation, spacing and harvesting.

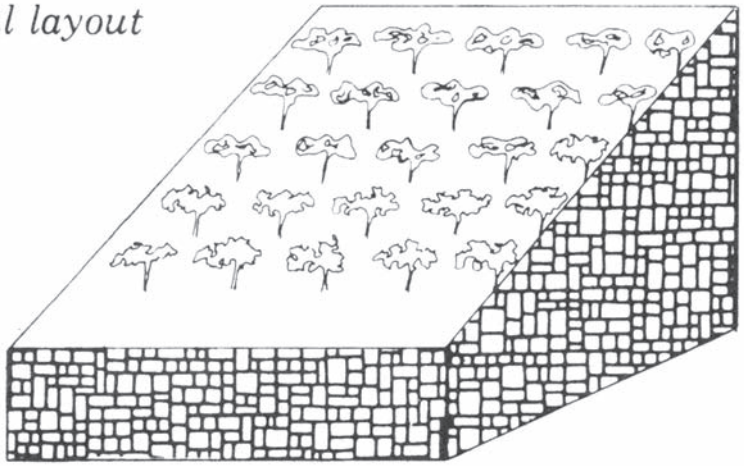
If a site is not ideal, it may still have to be used, with contour layout if too steep, tile drains if too wet and closer planting to allow for smaller-growing trees. Alternatively, a more suitable crop can be planted.

LAYOUT

Layout depends on the potential size of the tree, the shape of the paddock and the steepness of the land.

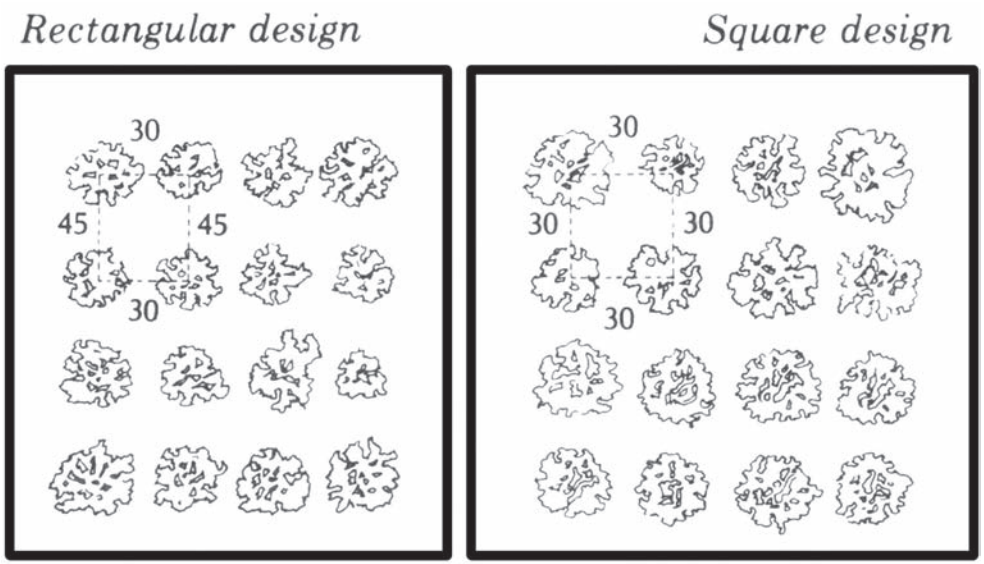
Conventional layout is satisfactory on flat sites, sites with gentle slopes, or sites with a uniform slope. There are four basic systems which can be used - square, rectangle, diagonal or triangle.

Conventional layout



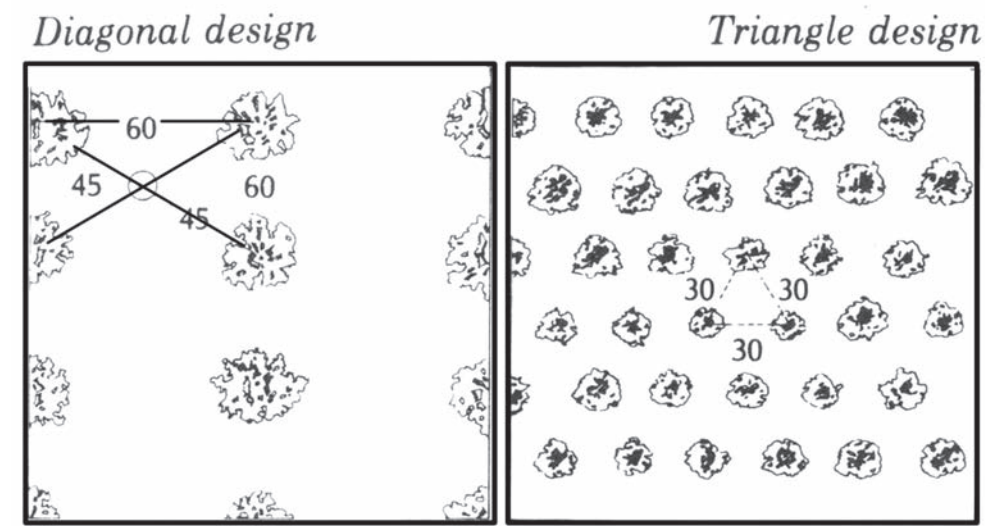
The *Square* is the one most likely to be used. The trees are planted equal distances apart in the row and between rows to form a square. As the trees begin to crowd, alternate rows can be removed, resulting in a rectangle.

The *Rectangle* system is commonly used when inter-row cropping is intended or early fruiting varieties are used as fillers to be removed as they begin to crowd.

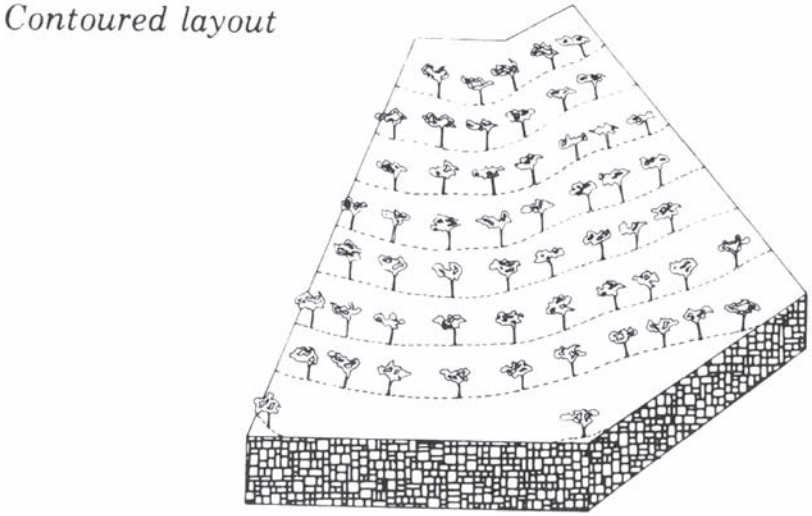


The *Diagonal* system is used to increase the number of trees per hectare and so increase early yields per unit area. A diagonal is formed by placing a filler tree in the centre space of trees planted on the square. The filler trees could be early fruiting varieties.

The *Triangle* system allows the orchard to be used to its maximum capacity and also allows cultivation in four directions, providing irrigation pipes are not in the way.



On steep slopes and other areas susceptible to erosion, it is often worthwhile to plant the orchard on the contour with trees evenly spaced at the same level along the slope. The result is that the trees follow a line around hills or gullies, and dis-tance between rows may vary due to the topography. To avoid unnecessary curves the contour system is often modified slightly to allow more straight or evenly curved sections of row.



SPACING

The spacing recommended for trees depends on tree size, and harvesting and cultural requirements. Larger trees such as pecans and walnuts require wider spacing than smaller trees such as almonds. Tree size is influenced by the variety, disease and vigour of growth.

Spacing in metres	Number of trees per hectare
30 x 30	11
20 x 20	25
18 x 18	31
15 x 15	44
12 x 12	44
10 x 10	69
9 x 9	123
6 x 12	139
7.5 x 7.5	178
5 x 10	200
4.5 x 9	247
6 x 6	278
5.5 x 5.5	330
5 x 5	400

Generally nut orchards are planted at a close spacing and eventually thinned out in two or three stages. For example, pecans can be planted at a 15m x 15m spacing with another tree at the intersection of the diagonal of the square, giving a 10m x 10m spacing. The closer spacing produces more nuts sooner from a given area, and this may be important if space is short or costs can be saved. Eventually such an orchard can be thinned. An alternative is to inter-plant an existing orchard.

There is relatively little local information available to help choose a suitable tree spacing, and it will be many years before the best spacing can be confirmed.

However, a common problem with close-spaced trees is that thinning is usually done too late. Growers with good production on their close-spaced trees are reluctant to perform the necessary pruning and ultimate removal of temporary trees, and once orchards become crowded, hedging (hard mechanical pruning along the row) is not effective in preventing production loss.

IRRIGATION

Irrigation is both beneficial and necessary for successful nut production. The amount of water needed will depend on the type of irrigation, weather, size of trees, the depth of the root system, soil type and type of tree. For planning purposes, for every hectare of mature orchard watered by sprinkler irrigation, about 11 million litres of water should be stored. This allows for evaporation from the dam. With trickle irrigation, normally the area watered can be nearly doubled with that amount of water.

Obviously a mature tree uses far more water than a one-year-old tree. Whereas in the first year the tree requires only 9 to 18 litres per day (or its equivalent) by year 10 it will probably need about 400 litres per day.

So with trickle irrigation, one outlet supplying 8 to 9 litres per hour will be enough for the first three or four years of a new orchard. At that time a second outlet will be needed for each tree. By the time the tree is 10 to 12 years old, it will need at least four outlets, the number depending on the size.

WATER QUALITY

With all irrigation, good quality water is necessary for optimum growth. Pistachios are a little more tolerant to salt than the other nut types, and more salt is tolerated using trickle irrigation than with under-tree sprinklers. Under-tree sprinklers can apply saltier water than over-head sprinklers.

TYPE OF IRRIGATION

Yield is little affected by different techniques of irrigation. What does influence choice of a system is the quality of water, the amount of water available (sprinklers use more than trickle) and cost (normally, sprinkler irrigation is more costly to install and operate).

If a sprinkler system is available and water quality is good enough, that system would be best. However, if a new orchard is being started, trickle irrigation should be used. It is wise to start the trees on the system to be ultimately used.

The trickle irrigation systems are basically the same, supplying small quantities of water on a daily basis. They operate at low pressures and apply the water directly to the roots. Outlets are either microtubes or drippers. Microtubes rely on varying lengths to ensure the same amount of water is applied to each tree.

Some drippers are pressure-compensating and supply a constant amount of water to each tree even if pressures are not equal. Other trickle systems use hydraulic design criteria to equalise pressures at each tree so that an ordinary outlet will give its normal flow. The Department of Agriculture or irrigation companies will help design such a system.

The relative costs of the trickle systems are roughly $550 to $600 a hectare about 60 per cent of this is in drippers and laterals and 40 percent in pump costs.

Some drippers have advantages over microtube outlets in terms of design and maintenance. The drippers are less prone to blockage and are easier to clean, but they cost more. This increased cost may not be significant on wide-spaced orchards.

Self-compensating drippers also allow friction losses in the submains downhill. The ordinary emitters need this friction loss to equalise the pressure throughout the system. This enables somewhat smaller submains and in some cases laterals - thereby resulting in a cost saving. In microtube design, the same could be done but the hydraulic design becomes more tedious and inaccuracies could occur.

WHEN TO WATER

With trickle irrigation, water is usually applied every day or every second day, the time depending on the weather. An evaporimeter should be used to help decide when and how much water to apply.

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BUDDING PERSIANS, BLACK WALNUTS, HEARTNUTS AND BUTTERNUTS ON BLACK ROOTSTOCKS

BILL and LOUIS DAVIE
Aliquippa, Pennsylvania

Many people have attempted greenwood budding of walnuts, heartnuts, and butternuts on black walnut rootstocks, but success has been only poor to fair, so few people even try it now.

Over a period of at least five years, we have studied budding on black walnut rootstocks and we now feel confident that we can achieve 90% success, unless weather conditions are very unfavourable.

To be successful, the budding must be done early in the season and the buds must be forced to grow immediately so that the shoots can harden off before winter. Buds that are not forced, even though they have calloused well, generally do not survive the winter and seldom can be forced out the next spring.

Listed below are the essential steps to insure a high success rate in greenwood budding. The finished bud will look much like the sketch given by Merle Latson in the NNGA 60th Annual Report, page 110, Figure 1E and reprinted here (Figure 1):

1) Bud before July 1. Budding can be done as early as new greenwood buds are available and daytime temperatures begin to reach above 80°F (27°C) for callusing.

2) Put the bud on the hot and light (south or west) side of the rootstock.

3) Use only immature buds (only about the tip four buds from a piece of budwood). The bud is cut from the bud stick with a bud shield of up to two inches in length. The cut is deep into the heart of the bud stick (at this time of the year, the heart of the bud stick is almost jelly-like). Since the leaf stem (petiole) attached to the bud chip is often quite wide, it is desirable to cut small notches out of both sides of the base of the petiole so that when the bud is put into the slit in the bark of the rootstock, the bark can close in well over the bud shield.

4) The budding cut is nut critical - apparently T-bud, change purse bud (single vertical slit), and chip bud are equally effective. We prefer the single vertical slit, since it holds the bud well while being wrapped and tied.

5) Leave at least a portion of the leaf attached to the bud. (We prefer 4 or more leaflets.)

6) Strip off all the leaves from the rootstock in the area where you want to bud and far enough above so the bud leaf gets light and can be wrapped.

7) After inserting the bud in the cut, tie the bud with a budding rubber, firmly but not tight.

8) Put the leaf up along the stem of the rootstock, gently wrapping the leaflets around the rootstock so that they get maximum exposure to light. Then wrap this whole area (bud, leaf, and rootstock trunk) with polyethylene, Saran Wrap, or similar plastic. Tie it top and bottom to keep in moisture. Now pray for hot weather for good callusing. (Latson used a long narrow plastic wrap 3 by 36 inches; we prefer a piece about 12 inches square.)

9) After 10 days to two weeks, unwrap it; remove the leaf if it has severed. Remove all dead, dying, or rotting leaflets, and rewrap with the plastic, tying only at the top. If the bud looks good, cut off the whole top of the rootstock about 4 inches above the bud. (The bud should be well callused in if the weather has been favourable.)

10) At the end of the third week, remove the plastic. If any leaflets remain, remove them. Remove any sprouts that have come out on the rootstock. At this point, the bud should be expanded and there may even be up to 1/2 inch of growth from the bud.

11) At the end of the fourth week, if the budding rubber has not deteriorated enough to release, remove it. Again remove any other sprouts that have come out from the rootstock and continue to remove other sprouts at about weekly intervals to force the bud.

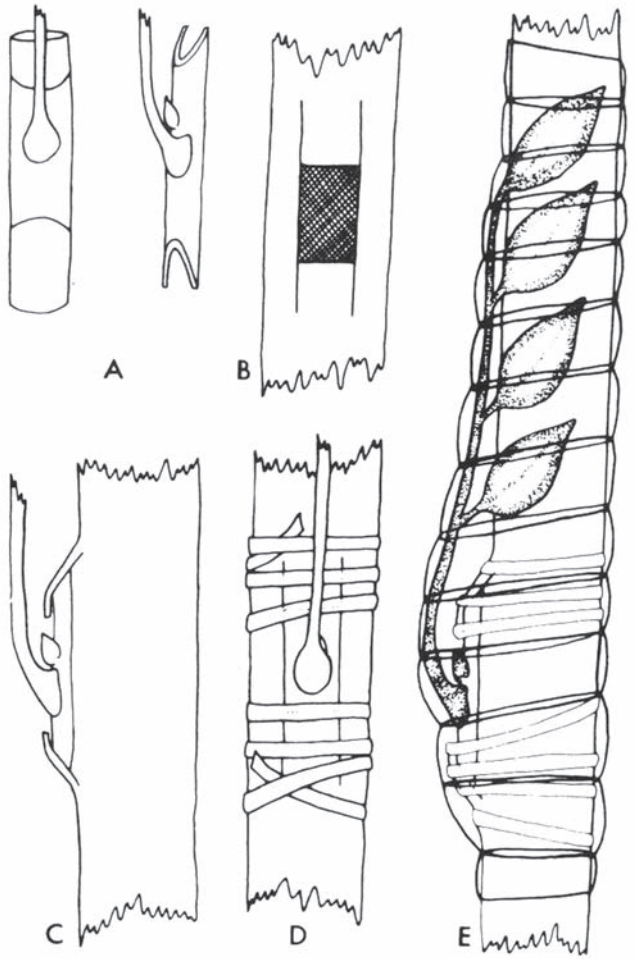

Figure 1. Greenwood budding. A) Bud with leaf. B) Stock cut with bark removed. C) Inserted bud. D) Bud wrapped with budding strip. E) Finished graft wrapped with polyethylene. (From Latson, 1969)

Table 1. 1977 Budding results (5 weeks after budding)

	Sprouted	Dormant	Dead
1- and 2-year black walnut rootstocks[1]			
English (Persian) buds	72	24	8
Black walnut buds	66	1	7
Heartnut buds	---	---	6
3- to 6-year black walnut rootstocks[2]			
English (Persian) buds	33	16	12
Black walnut buds	16	---	15
Heartnut buds	2	---	6

[1] *A large portion of the dormant and dead buds were found in dense shade of larger trees.*

[2] *Some rootstocks had 2,4-D herbicide damage before budding, and this contributed somewhat to the greater number of dead buds, but most of the dead buds were on good rootstocks. None of the larger rootstocks were shaded. The heavy bark of the old rootstocks tended to close poorly over the buds or eject the buds from the single vertical slit. The double-flap-style cut used by Merle Latson might have been more successful.*

If the weather has been good and you have followed these instructions to the letter, you should expect over 90% success with Persian walnuts and black walnuts budded onto black walnut rootstock (Table 1). (Heartnuts and butternuts must be watched very, very carefully. The dead or rotting leaflets must be removed as soon as they start to deteriorate or the bud will rot.) Generally, heartnut buds are so large that exceptionally large rootstocks are required. Do not count on a high success rate with heartnuts or butternuts unless you have larger rootstocks.

When budding through the heavy bark of older rootstocks and/or budding high on them, the budding success rate is considerably reduced from that with one- or two-year-old rootstocks budded within a foot of the ground.

If you have had no experience with budding techniques, you will find an excellent chapter on budding in *Plant Propagation Principles & Practices*, by Hartmann and Kester, published by Prentice-Hall.

Reprinted from the '66th Annual Report' of the Nut Growers Association Incorporated, August 10-13, 1975

HARVESTING FILBERTS BY HELICOPTER

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For the past three years, Cascade Commercial Helicopters has been involved in helicopter assisted filbert (hazelnuts) harvesting.

As you can see from Figure 1, the process is a relatively simple one. Specifically, the helicopter hovers at treetop level either between or directly above the row of filbert trees. We make the decision about the placement of the helicopter according to the individual wishes of the growers. However, we prefer to fly between the rows because it appears slightly more effective. We have found it most successful to maintain an air speed of less than fifteen miles per hour, although this speed is flexible with the age of the trees. We have found that it is necessary to fly at reduced air speeds in older orchards to allow a more direct and concentrated flow of air between the heavier foliage. Care should be taken, however, not to maintain a sustained hover over the older trees inasmuch as these trees are susceptible to limb and trunk breakage.

Figure 1. Harvesting filberts by helicopter.

We make it a policy to ask that orchard owners or managers ride with the helicopter during the nut shaking. We do this for two reasons:

1. It provides the farmer with an opportunity to have an aerial view of the orchard as well as allowing him to customize the harvesting of the trees; and

2. It provides the helicopter company with the security of knowing that the growers have observed the harvesting process and that they know that every precaution was taken in their orchard to assure the safety of the trees and the success of the nut shaking.

Unfortunately, our experience with helicopter nut harvesting has been limited to filberts. We attempted to harvest walnuts with the helicopter and found it to be not very useful and extremely dangerous in that the walnuts can do severe damage to the helicopter rotor system.

COMMENTS ON STARTING AN ALMOND ORCHARD

K. ROUW

C/- P.O. Cowaramup, W.A., 6284

When arriving in the south-west of Western Australia it was my intention to buy a small block of land, build a house and plant my own orchard. On looking around at the old group farms, it became apparent that the strongest and usually the only surviving member of the family orchard was the almond.

My plans to buy a small property did not eventuate and we ended up with a 200 acre property which by most farming standards was considered poor. With this amount of land it was necessary to find a way of making some sort of income from it.

I decided to plant an orchard of some 250 mixed fruit and nut trees. After a few early set-backs, mainly due to lack of practical experience and a plague of grasshoppers during the initial growing season, it was apparent that my earlier observations were once again beginning to become true. The almonds grew very quickly and after 3 growing seasons they are 2.5 m high, twice the size of other stone fruits planted at the same time.

Last year I decided to put almonds to the test by preparing a site that would hold another 200 trees which were to be all almonds. The ground was high and dry and the soil was hard iron stone country. Their first growing season was a tough one - grasshoppers and no water until Christmas time. The top 30 cm of this type of ground dries out very quickly so the shallow roots of these trees were quite dry by December. By February the trees looked terrible, but with the coming of autumn they picked up and grew all through winter. An interesting point is that part of this site had sandy areas in it and trees in these areas have grown best.

The 20 almonds that were planted initially bore fruit last year - approx. 1/2 bucket full. These trees consisted of 4 popular soft-shell varieties and from observations it seems that the birds did very little damage. With the second orchard I was able to secure some hard shell varieties - 30 Biggs hardshell (pollinates with Johnson's Prolific) and 15 Burbanks (pollinates with Ne Plus Ultra). Both have been considered as poor choices for a commercial orchard. Chellastan and Johnson's Prolific are the popular varieties in the Eastern States. I feel that with a large planting the soft-shelled commercial varieties are better propositions with the necessary attention being paid to bird control.

Almonds are an obvious choice for a coastal planting as ours is. However, make sure you are sheltered from strong on-shore winds during blossom time (August - September). Wind breaks can rectify this problem. To date no apparent disease has been noticed, although 2 early deaths from crown rot occurred in trees planted in sand.

PREPARATION OF HOME-GROWN MACADAMIA NUTS

California Macadamia Society, Box 1352, Vista, California 92083

1. Let nuts fall naturally

   A. Rake from under trees, pick up and separate from leaves. Pick up at least once a week.

   B. Remove husks. A large pair of pliers works well.

   C. Spread the husked nuts in a shallow screen bottom tray in a dry place protected from the sun for two or three weeks.

2. Dry nuts further until shells are dry and brittle or nuts are loose in the shell and approach crispness. This can be done as follows:

   A. Place in a screen bottom container over furnace register for 72 hours or more depending on nuts and amount of heat.

   B. OR - Place in a shallow pan in the oven at lowest temp. (about 100-115°) Stir occasionally and watch that you don't cook the nuts. The warm setting on an electric oven is about right. Time required is usually about 12 hours.

3. Store nuts in a cool place until needed. A heavy plastic bag will prevent nuts from absorbing moisture.

   OR - Crack and store nutmeats in a tightly covered container in refrigerator or freezer.

TO HOME ROAST MADACAMIA NUTS

Nuts thoroughly dried according to the above methods are tasty and ready to eat, but some people prefer them lightly roasted as follows:

1. Use nuts which have been thoroughly dried.
2. Pre-heat oven to 250°.
3. Place nut meats in a shallow pan, no more than two-deep, preferably a pan with screen bottom tray to assure good air circulation.
4. DO NOT ROAST SMALLER WITH HALVES AND WHOLE NUTS AS THEY WILL SCORCH.

   ROAST NUTS 40-50 minutes, stirring occasionally. Remove from oven as soon as they start to tan as the browning process continues after removal from the oven.

   As there are variations in nuts, oven temperature regulators etc., it is best to watch closely and adjust time and temperature to meet your own conditions, and tastes.

5. Remove from heat, add a dab of butter or neutral flavour oil and sprinkle with salt. Serve hot.

   OR COOL and store in a tightly sealed jar in refrigerator or freezer.

THE DWARF COCONUT AND INDIAN OIL NUT IN BROOME

F. LULLFITZ

Tree Adviser - North-West, P.O. Box 65, Broorne, W.A. 6725.

DWARF COCONUT

The Dwarf Coconut has been obtained from New Guinea where it is being cropped for copra.

Three separate introductions have been made over the past six or eight years. The first were germinated and distributed with little success due to inexperienced people insisting they were the ideal recipients and subsequently losing the lot. However, to my knowledge there are two plants bearing now for about three years at W. Fong's residence in Broome. Four plants of the same group are bearing at Morrell's Park in Broome under our supervision.

These six plants are doing very well. They commenced cropping at about four years of age and are bearing well and consistently at about four feet from the ground. The young trees have yellow stems and the nuts are about average size of coconuts. There are another four plants at Kalumburu and they are struggling and not yet flowering.

All plants from the second introduction are established in the nursery at Broome and they are growing well, except for two losses due to attack by *Mastotermes*.

The last group have recently been brought to Broome after germinating in quarantine at Kununurra. They will be planted here in the nursery for seed production. These will be provided with extra water and fertilizer.

The climate in the North-West is not favourable for coconuts and although they produce nuts the quality is inferior, and hence they should be regarded as ornamentals.

Coconuts need a minimum of 1250 mm of annual rainfall with enriched soil, whereas the rainfall for the North-West is from 170 mm to 550 mm and the soil is naturally poor.

INDIAN OIL NUT

Calophyllum inophyllum, locally called Mock Orange, or Indian Oil Nut, is a large tropical tree. In Darwin a single tree can cover a quarter acre and in Broome several trees have reached 10 m in height with a dense crown of glossy green leaves, 15 m in diameter.

The trees are relatively slow growing, tolerate some salt, and flower about four years from seed. Local trees are producing heavy crops of nuts. The nuts should be cracked and the kernel removed for planting immediately. *Calophyllum* makes an excellent shade tree but their prospects for commercial use are unknown in Australia.

A gum and domba oil from its seed is used in India for lighting purposes. Some of the Broome residents have used the nuts in cooking in fruit cakes and claim they are equal to almonds.

WATHEROO GROUP TRY JOJOBA GROWING

MARY BUSHER*

They are not making any predictions about profitability, but the potential of the jojoba bean as a source of high quality liquid wax has so impressed a group of Watheroo people they have now got a planting programme underway.

The group - Bob Scott, his sister and brother-in-law Meredith and Bruce Crossley, and Mike Sutherland, all of Watheroo - took a first-hand look at jojoba cultivation projects in America earlier this year.

As a result they brought back a quantity of seed and formed the Jojoba Seed and Plant Sales Company.

Few West Australians know much about the unique characteristics of the jojoba (pronounced ho-ho-ba) but whatever its commercial fate, we will be hearing more about it.

A native of the North American desert, it is an attractive, multi-stemmed, woody shrub which produces a seed or nut which contains about 50 per cent liquid wax.

This wax is similar in quality to that produced from sperm whales. The jojoba is the only plant source of big quantities of unsaturated liquid wax.

It is not closely related to any other plant.

With the world's whale numbers declining and pressure from conservationists round the world for an alternative source of high quality liquid wax, the jojoba is in the spotlight.

It is not new. It has survived for thousands of years in desert areas where the annual rainfall can be as low as 75 mm.

The native people of the Sonaran desert used it as a staple food, as a source of cooking and lighting oil and as a medicine.

MIRACLE CROP

With Americans generally concerned about impending shortages of fossil fuels, the jojoba is now seen by many as the miracle crop for the 80s but there is still a long way to go.

Members of the Watheroo company spent some time with the arid land studies department of the College of Earth Sciences at the University of Arizona.

They found that while a lot of work had been done on potential uses, little had been done on its growing and management as a commercial crop.

No commercial plantations are in production, so yields under cultivation have to be proven. In the wild, mature plants yield as much as 18 kg (40 lb) of clean dried seed annually.

Substantial plantings have been made in America in the last couple of years. One estimate puts the total planted in California alone at 600 ha (1 ,500 acres).

Israel is also doing a lot of work with the jojoba.

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* Reprinted from "The Countryman", November 23, 1978.

Australian interest has mushroomed this year. A Victorian company claims to have sold 50,000 plants around Australia in the past year.

World production of the wax has been limited so far to seed harvested by hand from plants in the wild in California and Arizona.

An average worker can only pick about 21/2 kg (5 Ib) of these nuts an hour. Mechanised harvesting is obviously vital for large-scale production.

Bob Scott is confident that with today's technology, which has enabled crops such as wine grapes to be mechanically harvested, this will not be a problem.

In the USA people working on this aspect have, among other things, been looking at ways of changing the low bushy growth of the jojoba to a more tree-like growth enabling existing nut harvesting equipment and techniques to be used.

In the USA some tree-type jojobas have developed where they've been subjected to grazing by stock, suggesting regular pruning may achieve this result.

Hedge-rowing as is now being done with apples for mechanised harvesting, is another possibility.

While it will survive with little rain by going dormant during long dry spells, Bob Scott said the American recommendation for cultivation is between 400 mm and 500 mm rainfall.

With this rainfall, the U.S. experience is for the plants to start flowering after about three years and to produce commercial quantities of seed from five to seven years after planting. They should reach maturity at about 12 years.

Using irrigation to speed up growth and subsequent return is one of several cultivation methods being tried in the USA.

Members of the Watheroo group found in California some syndicates are so impressed with the jojoba's potential they are paying as much as $2,000 an acre for land under full irrigation and replacing citrus orchards and grapevines with jojoba plantings.

But it is as a low cost crop making use of otherwise unproductive or poor land that members of the Watheroo company think the jojoba may have the greatest potential for the WA environment.

SEED TREATMENT

They are following the growing recommendation of the arid land studies department of the Arizona University.

The seed, or nuts are soaked overnight before planting individually in cardboard tubes filled with a mixture of 30 per cent peat and creek sand.

Seed planted in early spring were slow to move until the weather warmed up. To speed up germination an igloo-type polythene covered nursery was built.

The cardboard tubes have no bottoms.

Bruce and Meredith Crossley who are doing most of the propagation work, have found that long before the green foliage has emerged at the top, the tap root has mostly emerged through the soil at the bottom. U.S. estimates put root growth at 2 cm a day.

As soon as the tap root outgrows the 12.5cm (5 in.) container and gets outside the soil column it self prunes.

This triggers the initiation of many fibrous side roots. Side roots do not develop when containers closed at the bottom are used. Instead, the tap root continues to grow in an abnormal coiled pattern which persists in the plant's later life.

Because of this strong root growth, the U.S. recommendation is to plant the jojoba out six to eight weeks after germination.

Bob Scott considers this early transplantation is the key to getting the plant to put its tap root down deep in the soil.

He thinks the tendency to hold the plant in a container until it is bigger, or until the following reason for reports of slow growth in some plants grown experimentally in W.A.

DEEP ROOT

Its strong and deep tap root is how the plant survives in arid areas.

Some U.S. authorities say this root goes to 13 metres, others say it can be found as deep as 25 metres. This is a lot of root for a plant which in low rainfall areas only grows to about 1.2 m (4 ft). In higher rainfall areas it can grow to 3.3 m (10 ft) or more.

Before the end of the year about 2 ha will be planted to jojobas on the Scott family's farm.

Different locations, including some salt-affected land will be used to see how the plants perform, but the biggest planting will be on sandy soil which is useless for cropping purposes.

The U.S. recommended grid pattern with spacings 4½ m by 1½ m being used.

The small seedlings are put in groups of three. For pollination there must be a ratio between male and female plants, and so far these can only be identified at flowering. This is the reason for the group plantings.

All three will grow to the first flowering, then the surplus will be removed to give a balance roughly of six female plants to each male.

A furrow was run along the line for planting the seedlings, but no other preparation was given to the soil.

Plants transplanted earlier this month look to have taken well. Some watering will be given during this first summer but will be limited.

Bruce Crossley thinks too much watering could discourage the plants from sending the tap root deep into the soil. Some plants will be given fertiliser to see if any response is obtained.

In the U.S. some response to nitrogen and phosphate has been obtained with potted plants, but not from plants under field conditions. This could be because the plant draws nutrients from deep in the soil.

At Watheroo a couple of small sites were direct-seeded as an experiment. It was thought these had failed to germinate but last week when Bruce Crossley dug down he found a number which had sent out tap roots although no green foliage had emerged.

The jojoba's salt tolerance is one of several aspects which the Company wants to study.

It is known the plant does not like waterlogged soil, but in America robust jojoba plants have been grown as close as 3.3 m (10 ft) to the ocean water line.

The Watheroo company has some plants for sale and has been getting orders from centres throughout the wheatbelt, but mostly only for 10 or 20 plants.

Most are people who want to plant them as ornamentals or try them in specific locations just to see how they perform.

In America the Watheroo group found a range of jojoba oil products on the market selling at premium prices, often with a symbol and message on the label indicating that by buying the product the consumer was helping to save whales.

Health food stores were important outlets, but the oil also sells for cosmetic purposes, hair shampoos and even as a hair restorer. A 2 oz bottle of refined oil sells for about $5.

But it is in the lubrication oil industry, and other specialist uses for sperm whale oil, that its real potential lies.

The pharmaceutical, paint and polish making, cosmetics, and textile industries are all potential users. With a protein content of 26 to 32 per cent after crushing, the residues are obviously also valuable.

WANS COMMENT

Enthusiasm, tempered with a little caution, is how people should be approaching the potential jojoba bean industry, according to Mr. Alec Sheppard and Mr. Milan Mirkovic of the W.A. Nut Growing Society.

The wax from the jojoba bean has a variety of uses and so far all attempts to find a synthetic substitute have failed.

If farmers are intending to put a trial plot of jojobas, an area of about one acre should be planted for a fair trial.

One acre would require a capital outlay of about $200 plus time.

Israel, who announced this year that they were seeking international funding to plant big acreages, and the U.S. are putting a massive effort into growing jojobas as it seems they have realised the huge potential of the crop.

At this stage, Australia is only about four years behind the U.S. in jojoba technology and if the momentum is maintained, can catch up.

Mr. Sheppard said he was not sure how advanced the Israelis were because they kept their work secret.

In W.A., jojobas have been successfully tried over much of the State including Mullewa, Daiwallinu, Watheroo, Narembeen, Merredin and Esperance.

The plot at Narembeen had recently emerged unscathed from a severe drought without needing any watering.

Mr. Sheppard said some local growers had bought seedlings from the Eastern States at a cost of up to $3 each.

With a requirement of 1,300 trees per acre, this could represent a very big outlay.

Jojobas could be grown for a fraction of this cost if growers bought their own seed and established a nursery.

Direct sowing was not recommended as germination rates were only about 10 per cent compared with 80 to 90 per cent by sowing in a nursery. Also the young seedlings of direct sown jojobas were very attractive to a variety of pests.

It is advisable to plant seeds into 18 inch cardboard containers.

Mr. Sheppard and Mr. Mirkovic are interested in seeing a jojoba industry established and they are prepared to import harvesting and pressing equipment when it is needed.

In their opinion, the worst thing for the industry at the moment is pessimism.

DESCRIPTIONS OF MACADAMIA VARIETIES

R.M. O'MARA

Department of Primary Industries, Nambour, Queensland*

Cate: Californian selection.
Yield in California at 7 years, 15 kg. Kernel recovery 40%. Nut size 136 per kilo. Very popular in California. Recently imported to Australia.

Daddow: Private Queensland selection.
Yield figures not available, but believed good. Kernel recovery 36%. Nut size 160 per kilo.

Don: Private Queensland selection.
Yield at 10 years at Glasshouse 20 kg; 12 years 35 kg. Kernel recovery 28 - 30%. Nut size - 177 per kilo. Processing quality is good. The tree has not been tried in sufficient areas, and is probably under-used.

D4: D.P.I. 1948 selection.
Yield at Glasshouse at 10 years, 8 kg; 12 years - 27 kg. Kernel recovery 32 - 39%. Nut size 65 per kilo. Yield has been variable and the kernel may be too large for cooking. The variety may have a place in the fresh nut trade. It is a hybrid with upright, straggly growth.

Ebony: Private Queensland selection.
Yield on M.H.R.S. at 9 years, 7 kg. Kernel recovery 35 - 38%. Nut size 87 per kilo. Hybrid variety.

Heilscher: Private Queensland selection.
Kernel recovery 43%. Nut size 140 per kilo.

Hinde: (H2) D.P.I. 1948 selection.
Yield at 10 years at Glasshouse, 18 kg; 12 years- 12 kg. (The variety has performed better on some other properties but is rather variable. Probably best suited to cooler areas.) Kernel recovery 31 - 35%. Nut size 142 per kilo. Nuts are borne in large clusters. The tree has an ascending habit of growth and is reported more than usually susceptible to wind damage. There have been occasional reports of kernels unsuitable for processing.

Ikaika: (333) Hawaiian selection.
Yield at 8 years at M.H.R.S., 6 kg. Hawaiian yields 10 years, 10 kg; 12 years, 15 kg. Kernel recovery 31 -35%. Nut size 174 per kilo.The variety was selected for wind resistance and heartiness, for higher elevations and exposed situations in Hawaii. Processing quality is excellent. There is some indication that its harvest period may be early and short in Queensland.

* Information Sheet, Horticultural Report, 77-4.

Kakea: (508) Hawaiian selection.
Yield at 10 years at Glasshouse Mountains - 18 kg; 12 years - 18 kg. Hawaiian yields 10 years 18 kg; 12 years 18 kgs. Kernel recovery 35 40%. Nut size 161 per kilo. Also an excellent quality nut for processing. Yield is generally lower, but it is not so restricted in its environmental requirements as 246.

Keeau: (660) Hawaiian selection.
Yield at 8 years at M.H.R.S. - 8 kg. Hawaiian yields - 10 years - 11 kg. Kernel recovery 42 46%. Nut size 214 per kilo (relatively small). Reputed to be the most popular variety in Hawaii for new plantings and topworking at the moment. Less selective in its requirements than 246, and probably mature its nuts early in the season (as 333). The tree is upright in habit.

Keauhou: (246) Hawaiian selection.
Yield at 10 years in Glasshouse Mountains Variety Trial - 18 kg; 12 years, 30 kg. Hawaiian yields - 10 years, 21 kg; 12 years, 23 kg. Kernel recovery 37 40%. Nut size 134 per kilo. This variety produces an excellent quality processing nut, but appears to require ideal conditions for adequate production. It could not be recommended for marginal areas. A spreading tree.

Nutty Glen: Private Queensland selection.
Yield at 10 years at Glasshouse, 18 kg; 12 years - 31 kg. Kernel recovery 40 - 47%. Nut size 108 per kilo. Good processing quality. A hybrid variety with straggling but fairly dense growth. Another under-tested variety. The shell may be too thin for situations where harvest may be delayed.

Oakhurst: (B20) D.P.I. 1948 selection.
Yield at M.H.R.S. at 10 years - 6 kg; 22 years - 32 kg. Kernel recovery 24 - 25%. Nut size 95 per kilo. This variety is reported to have performed well in some areas.

Own Choice: Private Queensland selection.
Yield at 10 years at Glasshouse Mountains - 26 kg; 12 years, 41 kg. Kernel recovery 36%. Nut size 129 per kilo. This variety is undoubtedly the best bearer under Queensland conditions, but the majority (up to 80%) of the nuts will not fall during the normal harvest period, though they have matured. Until this problem is overcome, it cannot be recommended for commercial planting. Processing quality of the nut is excellent. The tree is very densely foliaged and can be difficult to spray. It appears to be more susceptible to copper deficiency than other varieties.

Probert: D.P.I. 1967 selection.
Yield on M.H.R.S. at 8 years, 12 kg. Kernel recovery 31%. Nut size 126 per kilo.

Rankine: D.P.I. 1961 selection.
Yield at M.H.R.S. at 10 years, 4 kg. Kernel recovery 27 - 31%. Nut size 114 per kilo. Hybrid. More suited to cooler areas, such as northern N.S.W.

Renown: Private Queensland selection.
Yield at M.H.R.S. at 11 years, 11 kg. Kernel recovery 34%. Nut size 103 per kilo.

Rickard**: (B5) D.P.I. 1948 selection.**
Yield at 10 years at Glasshouse, 4 kg; 12 years - 14 kg. Kernel recovery 34 - 39%. Nut size 129 per kilo. Processing quality is good, but yield makes it suitable only as a backyard tree.

Schimke: D.P.I. 1960 selection.
Yield at 10 years at Glasshouse, 17 kg, 12 years - 31 kg. Kernel recovery 28 - 31%. Nut size 118 per kilo. An upright tree. Processing quality is good. This tree deserves further investigation.

Teddington: (B21) D.P.I. 1948 selection.
Yield at 10 years at M.H.R.S., 4 kg; 22 years - 25 kg. Kernel recovery 30 - 40%. Nut size 161 per kilo. The tree is a very upright grower. The nut has a tendency to open micropyle, but is otherwise suitable.

Tinana: (B6) D.P.I. 1948 selection.
Yield at 10 years at Glasshouse, 14 kg; 12 years - 25 kg. Kernel recovery 31 - 34%. Nut size 130 per kilo. This variety has been overshadowed by the Hawaiians, but ought to be more widely planted.

344: Latest Hawaiian release. Well spoken of, but no details yet available.

PROPOSED COMMERCIAL PISTACHIO ORCHARD NORTH WEST OF MOORA, W.A. PART II*

A.C. BELFORD
59 Sulman Road, Wembley Downs, 6019.

ROOT STOCK

Using a couple of variants of *Pistachia atlantica* seeds obtained from the C.S.I.R.O. directly, and through the Western Australian Department of Agriculture from the same source, I meticulously followed germination procedures recommended by C.S.I.R.O. This meant germination between layers of cloth and the planting of germinating seeds in small pots with subsequent re-planting 3 times before their final place in the orchard. This was tedious and caused repeated set-backs to the plants.

I next tried planting the seeds in their orchard positions and although germination was good they were difficult to bring on, being widely separated (and 200 km away from my home).

For my third planting I tried 75 x 200 mm polythene trays - which were easy to handle and bring on but require either repotting into 150 x 300 mm bags or field planting to allow growth to the budding stage.

This time I have used 150 x 300 mm polythene bags and propose to raise the plants to budding size in my backyard. After successful budding I will plant out, (i.e. 2 years after planting seeds).

BUDDING

There are several varieties of commercial female stock available, and two or three each of early and late flowering males - necessary to have pollen available while the female flowers are receptive.

I have tried both chip budding and T-budding with slight success. This year I tried a modified T-budding technique which seems to be much better.

In 1976 I set about 35 buds using the chip budding method and only 5 or 6 took. The following year I used the T-budding method and set 24 dual males (one early and one late per tree) and 25 females. Of these only one male took and again 5 or 6 females. In spite of literature to the contrary I decided to try a spring budding in 1977 and set approximately 30 buds, with no success.

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* Part 1 WANS Yearbook 2, 24-25.

For the autumn budding in 1978 I had favourable conditions. The two previous drought years caused my soak to dry up in December and with it my trickle irrigation. The plants responded by ceasing to grow. Late in February there was a heavy thunderstorm followed two weeks later by another. These caused a burst of new growth from the trees and where I budded at the beginning of April the plants were vigorous with sap running under the bark. Of the 10 males and 50 female buds set, about 40% have grown. These were taken from my local trees and the condition of the buds was good.

The Department of Agriculture provided me with some budsticks in September last and persuaded me that my abject failure the previous year was not the fault of the plants. I have set more males and females (from my own stock) but it is too early to evaluate results from this work.

I have found the female varieties 15-11, Kerman and 14.8 easiest to bud. I have had no success with Lassen. I have successful late males 19-22 and early 15-12.

GENERAL

I use a commercial potting mixture for seedlings and bring them on with slow release fertilizer. They are grown in full sun and are watered twice a week in summer.

Growth can be inhibited by rotating the pot 180 degrees and it is well to plant in the same compass orientation as the plants were grown to reduce shock.

Rabbits and probably kangaroos have caused some damage necessitating fencing to exclude them. A new variety of scarab beetle made a brief attack in January 1978 after a couple of thundery weeks. To date I have had no bird damage but as my trees are small the 28 parrots and galahs have probably not found them yet.

It seems that 6-7 years from seeds to fruit would be reasonable time, although this would depend on care and attention as well as soil and climate. The drought years of 1976 and 1977 with the drying up of my soak did not worry the trees - they just went into hibernation.

At present I have over three hundred trees which will be budded in autumn and my plans are to add 100 plus each year.

THE GREAT NORTHERN HICKORIES

R.D. CAMPBELL

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It is appropriate to start this article with a quotation from Sir Winston Churchill, a man whose parentage included both English and U.S. origins and a man who was very fond of certain tobacco products. Sir Winston on one occasion commented that . When it comes to cigars a man deserves the very best because if the truth be known, even the best is none too good". Growers who are considering the planting of hickory cultivars are well advised to exercise a similar pattern of selection.

Many hickory cultivars were observed and evaluated by me during the period 1970-1974. The tables of evaluations should speak for themselves. A few words will be used in describing the evaluation system.

Kernels per pound

This figure indicates the number of nuts which must be cracked in order to get one pound of edible kernels-the real "meat of the matter".

Nuts per pound

This figure indicates the number of nuts, in the shell, which are required in order to make a pound... an interesting number but clearly of secondary importance.

Crackability, flavour, overall rating

These factors were evaluated by a numerical rating which can be described in general terms as follows:

4 - Excellent
3 - Good
2 - Fair
1 - Poor
0 - Useless

Certain of the well-known hickory cultivars are notable by their absence from the two tables. Many other cultivars were observed in the 1970-1974 period but unfortunately the trees did not produce significant quantities of nuts. The time period in question consisted of several years when hickory crops were notably meager. Late frosts and rainy periods during pollination were the major factors reducing crop yields.

I have consistently observed that the shagbark hickories are more fickle in producing crops than the shellbark hickories. Furthermore I have not been able to substantiate the claims of some observers that the shagbark hickories maintain a consistent edge in eating quality over the shellbarks. The eating quality of an outstanding shellbark hickory is fully competitive with that of an outstanding shagbark. Most certainly a good shellbark hickory is miles ahead of a mediocre shagbark hickory.

Many readers will be asking the question whether any of the hickories have commercial potential. Most of the hickory cultivars are at best interesting curiosities for the nut growing enthusiast. Grainger of the shagbarks and Stevens of the shellbarks might be recommended in a "guarded sort of manner" to have some commercial potential. The size alone of the Stevens nut is sufficient to give it immediate acceptance with the nut buying public. Furthermore there is considerable evidence that Stevens would sell at an attractive price-an important

necessity for the nut grower. The Stevens tree is a bit of an odd thing because it grows more like a large spreading bush rather than the customary upright tree form of most shellbarks.

Table 1 - The great northern hickories

cultivar	Year	Location grown	Kernels per pound	Nuts per pound	% Kernel	Crack-ability	Flavour	Over-all rating
Shellbarks								
Totten's seedling	1970	N.W. Missouri	64.1	15.9	24.9	2	3	2
CES-1	1973	Kent Co. Ontario	130.0	41.8	32.2	2	4	2
COA	1973	S.W. Missouri	51.0	19.3	37.9	2	4	?
Stevens	1973	Franklin Co. Penna.	73.2	19.4	26.6	3	3	3
Henry	1973	Adams Co. Penna.	78.4	20.9	26.8	2	2	2
Keystone	1973	Franklin Co. Penna.	81.0	31.9	39.4	3	3	2
Bradley	1973	Franklin Co. Penna.	92.8	26.4	28.5	3	2	2
Stauffer	1973	Franklin Co. Penna	111.0	34.6	31.3	1	3	2
Fayette	1973	Franklin Co. Penna	111.0	38.2	34.4	3	2	2
Hoffeditz	1973	Adams Co. Penna.	129.0	35.2	27.1	2	2	2
Shagbarks								
Glover	1973	Niagara Region Ontario	212.0	82.5	39.1	3	3	2
Abundance	1973	Franklin Co. Penna.	189.0	66.6	35.3	3	3	2
Nielson	1973	Niagara Region Ontario	161.0	68.8	42.7	2	3	2
CES-8	1972	Lambton Co. Ontario	190.0	85.0	44.8	3	4	2
Grainger	1974	Franklin Co. Penna	143.0	54.2	38.2	3	4	3

The Grainger is a beautiful sight both in nut and tree form. The Grainger kernel is immense for the shagbark species and exceptionally fine eating and easy to crack too The Grainger tree is very upright and impressive in size and vigour. The leaves of the Grainger are a healthy green throughout the summer and render an impressive yellow colour in late fall, indicating an attractive ornamental value.

No doubt there are many more cultivars of hickory to be evaluated than those that I have already viewed. It is significant that most all of the current named cultivars of hickory have been selections from the wild. Recent experience with the controlled breeding of other fruit and nut species has 'proven in a spectacular manner that significant improvement can be made over the initial selections from the wild. This evidence alone indicates that great reward awaits the experimenters who have the persistence to initiate controlled breeding programs to produce the next generation of the Great Northern Hickories.

Reprinted from '66th Annual Report' of the Northern Nut Growers Association Incorporated, August 10-13,1975.

CORRIGENDUM

WANS Yearbook 3 1977

Guide for Commercial Propagation of Some Nut Species in Western Australia

B. Dell

p.20: the following table was omitted

Table 1: Propagation guide for 6 species of commercial nuts.
Only the main commercial propagation methods are shown.

Nut Species	Stratification of seed	Cuttings	Rootstock	Budding	Seed Graft	Seedling Grafting	Top Grafting	Other
Macadamia (*Macadamia tetraphylla, M. integrifolia*)	No	Yes	*M. tetraphylla* *M. integrifolia*	Chip	Yes	Side wedge Special side W & T	Top wedge Split bark	Air-layer
Pecan (*Carya illinoensis*)	Yes/No	Difficult	*C. illinoensis*	Chip	No	Whip W & T	Bark	-
Pistachio (*Pistacia vera*)	Yes	No	*P. atlantica* *P. terebinthus*	Chip T-bud	No	?	W & T	-
Persian Walnut (*Juglans regia*)	Yes	No	*J. regia* *J. hindsii* *J. nigra*	No	No	W & T Side Wedge	Bark	-
Almond (*Prunus amygdalus*)	Yes	No	Almond Peach Plum	T-bud	No	W & T	W & T* Bark wedge	-
Hazelnut (*Corylus avellana*)	?	Yes	*C. avellana*	No	No	Whip W & T	No	Tip-layer Suckers

* Graft onto one-year-old regenerating shoots.

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637 C J McDermott Post Office Yallingup 6282
436 G McGregor 25 Irwin St East Fremantle 6158
471 Mrs M K McLean PO Box 48 Gibson 6448
516 M McLean PO Box 48 Gibson 6448
335 McMaster Enterprises PO Box 59 Macclesfield SA 5153
391 H McNally 80 Falls Rd Lesmurdie 6076
473 B A McNamara 9 Central Rd Rossmoyne 6155
645 T G McQueen 'Braemar' Girgarre Vic 3624
27 Mr J Mercer 45 Bridgewater Drive Kallaroo 6025
484 L J Messenger PO Box 72 Brookton 6306

518 B & J Middleton Unit 1, 2 Monash Ave Nedlands 6009
68 Mr Z Mielens Giblett St Bridgetown 6255
539 Mrs G R Miller 2 York St Sandy Bay Tas 7005
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191 Mr M MirkoVic PO Box 69 West Perth 6005
428 P F Monagle 62 Talbot Rd Brunswick Junction 6224
326 K Money Lot 135 Alice Rd Mt Helena 6555
538 Mr F Moore 3 Wren St Mt Pleasant 6153
426 R F Moore Dept Immigration & Ethnic Affairs (Tokyo Office)Canberra ACT 2600
602 P S & L M Moorfoot RMS 394 Busselton 6280
606 A R Morcom PO Box 179 Keith SA 5267
505 P A Morey 8 Cudliss St Eaton 6232
323 C A Morris 570 Berkshire Rd Forrestfield 6058
511 C S & J M Morrison RMB 351 Bridgetown 6255
404 H M Morrissey Thundelarra Station Wubin 6612
284 Mrs M R Morton 3 Claud St Katanning 6317
460 Mr D Mossenson 3 Greenside St Dianella 6062
365 B Moulton Post Office Balingup 6253
356 J Moyle 29 Cross St Shenton Park 6008
565 G N Moyse 7 McCormack Ave Epping Vic 3067
349 Mrs A Mueller 86 Marlow St Wembley 6014
380 W Napier 86 Heath Rd Kalamunda 6076
119 Mr K Nendel 58 Calista Ave Calista 6567
590 E & N Neuman PO Box 289 Geraldton 6530
53 Mr R Nicholls 485 Morley Drive Morley 6062
1 Mr D G Noel PO Box 27 Subiaco 6008
126 Mr V Nolan 3 Adur St Dianella 6062
583 J & M Nugent PO Box 10 Nannup 6275
618 A O'Connell 26 Agett Rd Claremont 6010
249 B M & B J O'Hare RMB 248 Quinninup 6258
466 T C O'Neill 42 Lawley St North Beach 6020
357 Officer in Charge Dept. Agric. Research Centre Lenswood SA 5240
14 Mr A C Orton 210 Mandurah Rd Baldivis 6167
372 G L Orton 23 Searle Rd Applecross 6153
147 Mr C Owen Dental Clinic Margaret River 6285
591 C W Owen RMB 317 Kojonup 6395
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639 G Parata Resident Manager Poon Bros Shay Gap 6761
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193 Mr R Patterson Address unknown
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179 Mr G Paust 15 Hawkins Rd Mount Pleasant 6153
192 Mr I Peacock 71 Grant St Cottesloe 6011
41 Mr A T Pearce 21 Davies Cres Kalamunda 6076
408 W E Pearce P0 Box 133 Mundaring 6073
439 Mr D Pearse P0 Box 252 Denmark 6333
464 R J Pearson 5 Woodhams St Willagee 6156
489 Mrs S R Pedro Dingo Flat Rd Denmark 6333
286 Mr G N Pepper Four Foot Rd Geeveston Tas 7116
546 Mr W Perry 11 Goola Ave Rankin Park NSW 2287
91 Mrs K Petriw Lot 23 Mofflin Ave Darlington 6073
40 Mr G Pfaff 38 Headland St Hamilton Hill 6163
52 Mr C Piesse Unit l3D 25 Victoria Ave Claremont 6010
13 Mr D Piromalli 203 Canning Hwy East Fremantle 6158
111 D Pottinger P0 Box 150 Wyalkatchem 6485
612 A & J Povey 13 Larkin Ct Medina 6167
266 Premier Nurseries P0 Box 400 Griffith NSW 2680
459 Mr Prendergast
168 Mr A Price Red Gully Nannup 6275
342 B Prideaux PO Box 94 Pemberton 6260
659 F M Prochazka P0 Box 41 Ravenshoe Qld 4872
394 Mrs M E Puckridge Coomahl Park Jurien 6516
611 D Quin PO Box 17 Wyndham 6740
662 L & M R Rattigan 13 Roseberry Ave South Perth 6151
569 R Rayner PO Box 7 Flaxley SA 5153
270 Mr R M Raynes K.K.Terrace Taipo Rd, Shatin Hong Kong H.K.
552 M F Read 56 Jinda Rd Koongamia 6056
446 W H Reay 21 Linsfield Way Morley 6060
633 D W Rees Booth St North Collie 6225
414 D V Rees 1A Elizabeth St Nedlands 6009
597 J Rennie RMB 112 Deeside Mail Manjimup 6258
362 G J Rhind 15 Cunningham Terrace Daglish 6008
543 Mr D F Rhodes RMB 359 Boyup Brook 6244
658 Ricardo Nursery PO Box 577 Carnarvon 6701
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553 Mrs M Riddoch Innisfail Nareen RSD 370 Coleraine Vic 3315
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469 Mrs V Robinson PO Box 476 Red Cliffs Vic. 3496
524 C A Robinson Lilydale Gidgegannup 6555
536 D P & G Robinson 53 Kalamunda Rd Kalamunda 6076
194 Mrs C Robinson Post Office Forrest Grove 6287
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151 Mr K Rouw P.O. Cowaramup 6284
333 Mr R Rowe P0 Box 36 Margaret River 6285
144 C H Ruben 23 Waylen Rd Shenton Park 6008
325 A J Ryan PO Box 28 Albany 6330
396 Mr K Ryan 20 Hastings Rd East Hawthorn Vic 3123
67 Mr J Saggers 'Morning Glory' Kendenup 6323
73 Mr R Salt Camms Rd Monbulk Vic 3793
240 Mr B Sargent 71 Dorothy St Gosnells 6110
32 Mr A T Sas 52 Croydon Rd Roleystone 6111
272 Mr G R Scarrott Currawong Rd Berowra NSW 2082
327 Mr D Schlumke 'Big Bush' Gidginbung NSW 2695
213 Mr M Schultz P0 Box 328 Katanning 6317
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530 W & P Scott Environ. & Life Sci. Murdoch University Murdoch 6153
387 Mr B Scott P0 Box 174 Ferntree Gully Vic 3156
468 M L Scott Malcolm P0 Box 127 Mundaring 6073
423 Mr A F Separovich Main St Silvan Vic 3795
647 Serials Librarian P2062 Old Agricultural College Lawes Qld 4345
8 Mr J C Serventy PO Box 16 Bridgetown 6255
501 G Shackleton PO Box 47 Katanning 6317
382 B J Shaw 21 Morrah St Parkville Vic. 3052
154 S Shenstone P0 Box 10 Karridale 6298
582 M Sher 261 Railway Rd Subiaco 6008
638 A J & L A Shera Jones 45 Blackburn Rd Blackburn Vic 3130
121 Mrs H I Sheridan P0 Box 119 Carnarvon 6701
94 Mr J H Sherman & Son RMB 242 Man]imup 6258
453 S Sherwin 12 Canton St Canton Vic. 3053
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21 Mr P Sinclair 70 Viewway Nedlands 6009
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210 Mrs L Skipsey P0 Box 96 Pingrup 6343
492 C Slavik 38 Grevillea Cres Kambalda 6444
554 Sgt D G Smithers A223196 Sgts Mess RAAF Pearce 6005
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596 J E South Hastie Rd Geelorup 6230
17 Mr T H Speer P0 Box 71 Bridgetown 6255
75 Mr W Spence 100 Harrison St Rockingham 6168
359 M Spencer 36 Violet Grove East Kew Vic 3101
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103 Mr A Y Steel Viveash Rd Swan View 6056
488 H M Stephenson P0 Box 331 Esperance 6450
513 Mr A A Stoke 43 Moreing Rd Attadale 6156
255 Mr R Stokes Post Office Dwellingup 6213
360 J Stolze 18 Bathurst Rd Dianella 6062
182 Mr R L Stone P0 Box 1007 Albany 6330
196 Mr T M Stone 20 Croydon Rd Roleystone 6111
585 C H Story Post Office Walpole 6398
172 Mr G E Sudholz Kargree Stud P0 Box 89 Pinjarra 6208
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114 Mrs G Sutherland 44 Cliff St Albany 6330
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388 Mr H Swaan 7 Gascoyne St Canterbury Vic 3126
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310 Mr J T Swain 23 Port Hill Rd Shrewsbury Salop 5Y38SE U.K.
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429 B J Sydney-Smith 31 Victoria St Bunbury 6230
500 V Syme 65 Watkins Rd Dalkeith 6009
557 A & K Syme Nornalup Rd Denmark 6333
592 R A Syme 14 Hutton St Collie 6225
562 R Tauss Warburton Ranges via Kalgoorlie 6431
532 J & A Tayler RMB 341 Johnsor Rd Wellard via Medina 6167
199 Mr P Taylor Beauvista Golf Course Bonaccord Road Lower King 6330
598 L Teckenoff Post Office Yallingup 6282
269 Mr A Teese 'Won Wren' RSD Yarram Vic 3971
480 G Thiele 101 Gloster St Subiaco 6008
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164 Mrs J Turner P0 Box 106 Kulin 6365
243 Mr P Uloth 6 The Promenade Mt Pleasant 6153
642 0 A Ure Goodlands via Kalannie 6468
465 J B Vanderberg 29 Lawler St Subiaco 6008
519 W.A.Pines Ltd GPO Box 1565 Perth 6001
401 Wadewitz Pty Ltd Brookside Rd Darlington SA 5047
281 Waldeck Nurseries Pty Ltd Russell Rd Wanneroo 6065
579 P Waller 5 Oyster Ct Craigie 6025
221 Mr A J Walsh 888 Toodyay Rd Red Hill 6016
152 Mr M Warren @ Brunswick Primary School Brunswick Jctn 6224
132 D F Warwick Address unknown
12 Dr M J Washer 9 Suiza Place Waterman 6020
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136 Mr M J Weir Post Office Manjimup 6258
594 Welston Holdings 28 Everett St Nedlands 6009
421 Mr B Wheatland 17 Mundford St North Beach 6020
137 Mrs J White Post Office Moonyoonooka Geraldton 6532
336 C E White 21 Carrick St Woodlands 6018
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632 Mr G W White Post Office Jerramungup 6337
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556 The Wolery Ecological Community Nornalup Rd Denmark 6333
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599 A J Woods 55 Mayfair St Mt Claremont 6010
350 Miss K Woodward 19 Kingston St Nedlands 6009
231 Mr R S Woodward Lacey St Sawyers Valley 6074
620 Dr C K Yeap 72 Sutherland Dr Thornlie 6108
455 Mr R W Young P0 Box 183 Penola SA 5277
167 Dr L ZaninoVich 211 Main St Osborne Park 6017
474 Mr B Zec Lot 2973 Hamersley Rd Caversham 6055
551 Mr E Zotti 27 North St Henley Beach SA 5022