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WANS

West Australian Nutgrowing Society

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SOCIETY PUBLICATIONS

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

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

The current subscription rate is $8.00 per year.

BACK NUMBERS

WANS began publishing in 1975. Back sets of 1975 publications (3 issues of Quandong and the 1975 Yearbook) are available to members at a cost of $6.00. Contact the Secretary for back numbers. The cost of a set of 1976 publications (same as subscription) is $8.00.

MEMBERSHIP DETAILS

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

WANSCO

Members of the Society own a co-operative, West Australian Nut Supplies Cooperative Limited, a legally registered Co-operative Company set up to buy and sell nuts and nut products. Shares in the WANSCO co-operative are sold only to WANS members, each of whom is entitled by the Articles to apply for and hold between 10 and 100 shares of $1.00 each. Members wishing to acquire WANSCO shares (currently available at par, i.e. $1.00 each) should write to WANSCO Secretary and Director, Edmund Czechowski, at P.O. Box 12, Wanneroo, W.A. 6065. WANSCO will always endeavour to sell nuts produced by members, or supply nuts needed by members.

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Editorial

This is the second Yearbook to be issued by the West Australian Nutgrowing Society. Our first Yearbook appears to have gone a long way towards its aim of establishing itself as a basic source journal in the field of nut horticulture and production. The Editor feels that the material contained within the present work will justify his expectation of further improving and consolidating this position.

In the past year, membership has doubled. The Yearbook now goes out to over 300 recipients, in Australia and in seven overseas countries. It is received by many reference libraries as well as individuals, and so goes to a wide readership. Seven hundred reprints of D.H. Maggs' article on the pistachio in the 1975 Yearbook were made at the request of CSIRO for distribution to their enquirers.

In the present issue, we continue our aim of presenting a mixture of articles on nuts of more immediate commercial interest, such as pecan, *pistachio*, hazel, and walnut, contrasted with nuts of outstanding botanical interest or possible future potential, such as *finschia, hicksbeachia*, the *marula,* and the double coconut. The last one has every claim to be regarded as Nature's biggest joke on the human race.

The Editor must acknowledge the ready help offered by individuals and organizations throughout Australia and overseas, in providing the material published herein. These sources include the Kruger National Park, the Seychelles Ministry of Tourism, the Nut Growers Society of Oregon and Washington, the Oregon State University, and the University of New England.

Contributions are invited for our Yearbook from any source. We are particularly interested in bringing to light the possibilities of little-known or unexploited nut plants, to further the place of nut growing in a rational, ecologically balanced system of agriculture.

Let's remake the World into a nut orchard!

THE DOUBLE COCONUT OF THE SEYCHELLES

GUY LIONNET**

The 30 odd granitic islands and islets of the Seychelles, which are great green jutting peaks springing from a large submarine plateau in the deep blue sea of the middle Western Indian Ocean, are not only the only granitic oceanic islands in the world, but are also renowned the world over as the home of the most astonishing palm, the coco-de-mer (*Lodoicea maldivica*).

Up to 200 years ago, before their settlement, these islands were covered from the sea level to the top of the highest mountains with an impenetrable vegetation, which with irresistible tropical luxuriance spanned ravines and valleys and scaled hills and mountains.

Of this ancient sylva, with unique African, Madagascan and Indo - Malayan affinities, only survive today small, precious relicts, especially on the summits of the two highest islands, Mahe and Silhouette, and in the coco-de-mer sanctuaries of the lower island of Praslin. In one of the latter, the Vallee de Mai, is a real botanical wonder, for its 4000 coco-de-mer palms constitute a unique assemblage of one of the most, if not the most, famous palms of the world, which can bear comparison with the most celebrated members of the Vegetable Kingdom, such as the biblical Lebanon Cedar or the stupendous Giant Sequoia of California.

The Vallee de Mai which is suited in the midlands of Praslin, is a little less than 46 acres in area. Landmarks in the valley include the Kiosk, which is on a knoll from which the valley can be surveyed, the tallest coco-de-mer palm, which is 102 feet high, and, especially, the palm and pandanus grove, which gave an inkling of how beautiful Praslin and the whole of the Seychelles must have looked originally.

A Unique Palm

Coco-de-mer or Sea Coconut or Double Coconut is the most remarkable of the six monotypic and therefore unique genera and species of palms of the Seychelles.

Coco-de-mer has also been known by a variety of other European names, such as Maldive Coconut, *Coco de Salomon, Coco Jumeau, Coco Royal, Coco Indecent, Cul de Negresse* and *Coco Fesse*. It has been known, from time immemorial, as *Calappa Laut* in Malaysia and Java, *Hayja* in China, *Daryas Nariyala* in India, *Pauh Janggi, Pau Senghi* and *Tava Karhi* in the Maldives and *Kadil Tagingai, Dyria Kannaril* and *Sumatrapoo Tainkaya* in Ceylon.

It is a tall palm, with an extremely- straight and clean trunk, large, rigid, fan-shaped leaves and very large, astonishingly shaped nuts or seeds which are contained in enormous fruits.

The size and pillar-like appearance of the tall palms, which remind one of the sumptuous aisles of a cathedral, is the first and somewhat awe-inspiring impression which one receives on entering the Vallee de Mai and the other coco-de-mer sanctuaries.

As the coco-de-mer belongs to the *Borassaidae* sub-family of the large *Palmae* family, like other palms of the sub-family, it is dioecious. There are therefore staminate or "male" coco-de-mer palms and pistillate or "female" ones. The two trees usually grow side by side, in equal proportion, in the sanctuaries. The staminate trees are however taller, by some 20

* A considerably shortened version of reference (1).

** C/- Tourism Division, Seychelles Government, Mahe, Seychelles.

feet, than the pistillate ones, and appear thus to mount guard over their small, fruitful neighbours. It is perhaps this "protective" air and the shape of the male inflorescence, which recalls a large male organ (Fig. 1), and that of the nut, which resembles a female human pelvis (Fig. 2), which have given birth to the curious Seychelles legend that coco-de-mer palms meet and unite by tempestuous nights, the male palms walking over to the waiting female ones, but that it is deadly to witness such an amorous encounter.

From the ground, the large, shiny light-green leaves of the coco-de-mer palms look dwarfed against the skyline. In the seedling and still trunkless stage, however, the immense leaves which thus appear to be springing from the ground itself are a startling sight. Three to

Fig 1. Coco-de-Mer Male Inflorescences

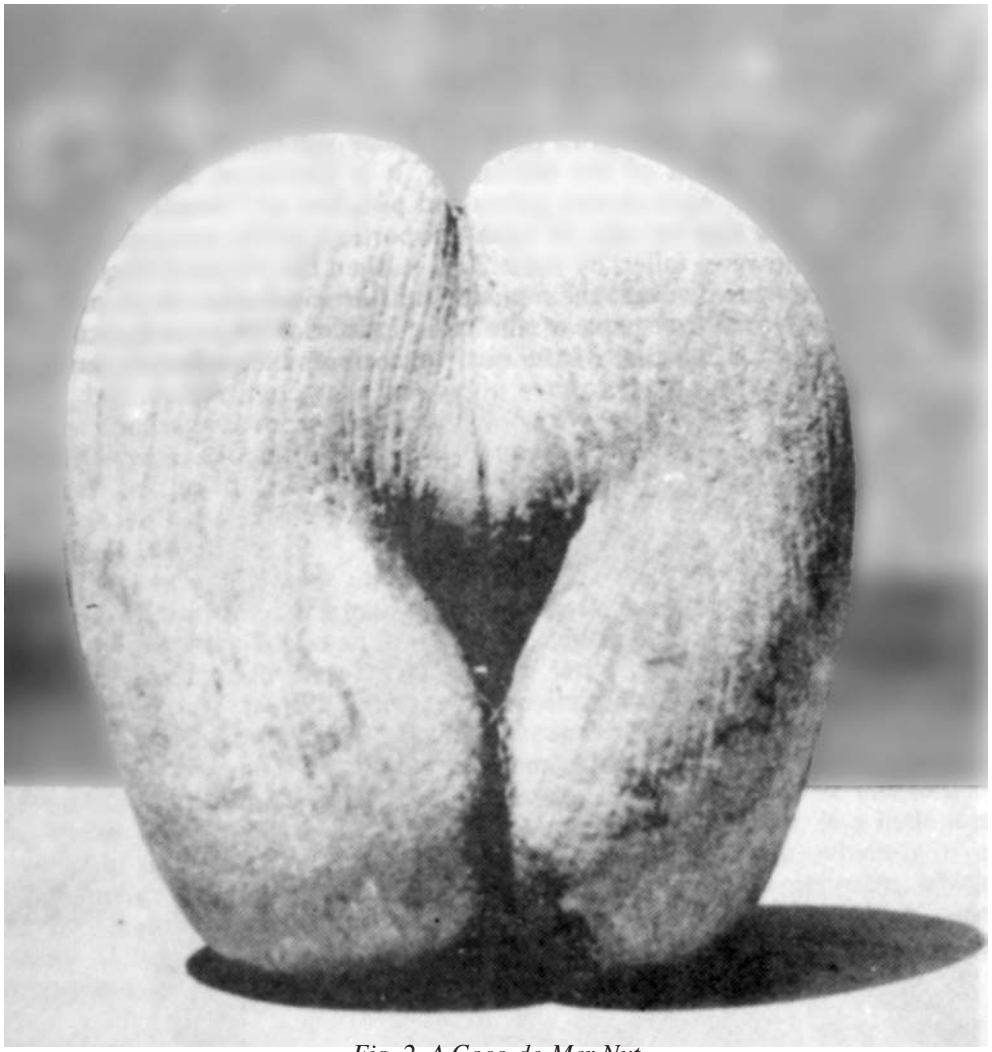

Fig. 2. A Coco-de-Mer Nut

four such leaves, which have a span of 20 feet, are produced each year.

In the axils of the leaves are the male and female inflorescenes. The male one consists of a large subpendulous catkin, of the size and thickness of a man's arm, which bears numerous, star-shaped, yellow flowers, with a fragrant honey-like scent. The female inflorescence, on the other hand, consists of 5 to 13 inconspicuous flowers, which are borne on a thick, two foot-long, zig-zag axis and are covered by large, hard, reddish-brown bracts.

Generally only one of the three ovules of the female coco-de-mer flower develops after fertilization, to produce a bi-lobed nut. It may happen, however, that two or even the three ovules develop, when giant fruits with two or three bi-lobed nuts are produced. Rarer are anomalous tri-lobed or even quadri-lobed nuts.

The coco-de-mer fruit, which looks like a huge green heart, is about 18 inches long and 30 to 40 lbs. in weight. Under its smooth skin and thin fibrous husk is the largest and heaviest

seed of the Vegetable Kingdom, the coco-de-mer nut.

When mature, the coco-de-mer fruit has a rich fruity smell. Usually only three to five fruits develop to maturity on each female inflorescence, but up to 10 have been known to do so. In such cases a mature bunch of coco-de-mer fruits can weigh up to 400 lbs. Three to four branches are produced by a palm every year.

Made up of two hard-shelled, greyish-black lobes, with a deep, graceful sinus, the coco-de-mer nut is an extraordinary vegetable product, a real object of wonder. What is most striking about this nut, is its astonishing shape, which can be disgustingly suggestive as well as strikingly beautiful. Bernardin de Saint Pierre, the famous author of "Paul et Virginie" wrote of the Coco-de-mer nut that "it bears a striking resemblance to the anterior and posterior parts of the body of a negress at its bifurcation" (2). Also most notable is its variety: although coco-de-mer nuts measure usually some 12 inches in length and weigh between 20 and 30 lbs, miniature nuts as small as six inches in length and weighing as little as three to four lbs, and giant nuts, over two feet in length and weighing well over 40 lbs., have been found; moreover, like its human anatomical counterpart, there is an infinite variety in the shape of the coco-de-mer nut, to such an extent that it can be said that no two coco-de-mer nuts are alike. When green, at about nine months old, the coco-de-mer nut contains a delicately-textured and sweetish jelly, which is a dessert delicacy, and when mature a hard ivory-like endosperm or kernel, which has the reputation of being a particularly potent aphrodisiac. It is believed in the Seychelles that there are "male" and "female" coco-de-mer nuts which give rise, if planted, respectively to staminate and pistillate palms, the female nuts having a deeper and more graceful sinus than the males ones and having thus a more feminine appearance - which is yet another pretty legend about the most legendary of palms.

At Anse Aux Courbes, on the island of Mahe, there were however, until recently, 5 coco-de-mer trees growing in a row and which were reputed to have been planted from 'sexed" nuts by a Mr. Despigny Jorre de St. Jorre. They consisted of 3 central female palms and 2 male palms at either end of the row. The latter had also a rough North-West South-East direction. These palms were believed to have been planted in this way, from female and male nuts respectively, in order that the central female palms could be wind pollinated by the male palms during the two monsoons of the Seychelles, the South-East and North-West ones .

As could be expected from such a tall tree, with such a large leaf area and such a heavy crop, the coco-de-mer root system, although shallow, is extraordinarily powerful, being made of numerous, tough adventitious roots which spread far and wide. A curious part of this system, which has intrigued botanists over the years, is what is known as the "bowl" (Fig. 3). It is a large hemispherical, bowl-like structure, made up of hard, durable, tissue, which resembles that of the shell of the coco-de-mer nut, with a diameter of 1½ or 2½ feet and a depth of 6 to 10 inches. This bowl, which is found at the base of coco-de-mer palms, at ground level or just below the level of the ground, and which lasts for a long time, as much as 60 years after a coco-de-mer palm has died or has been felled, is perforated with numerous small holes, of the size of a thimble, through which coco-de-mer roots penetrate into the soil. This huge socket, in which fits the bulbous base of the coco-de-mer palm, is another extraordinary feature of that palm.

The germination of the coco-der-mer is a fascinating process. After six months' quiescence, during which the thin husk of the fruit rots and disintegrates, there appears from the sinus, between the two lobes of the nut, a shoot-like structure which is nothing else but the elongated seed-leaf or cotyledon and which carries in a cavity in its slightly swollen tip, the embryo itself. It penetrates the soil for a depth of about two feet, but if prevented from doing so, by a stone or some other obstacle, can extend horizontally for some 12 feet or more before

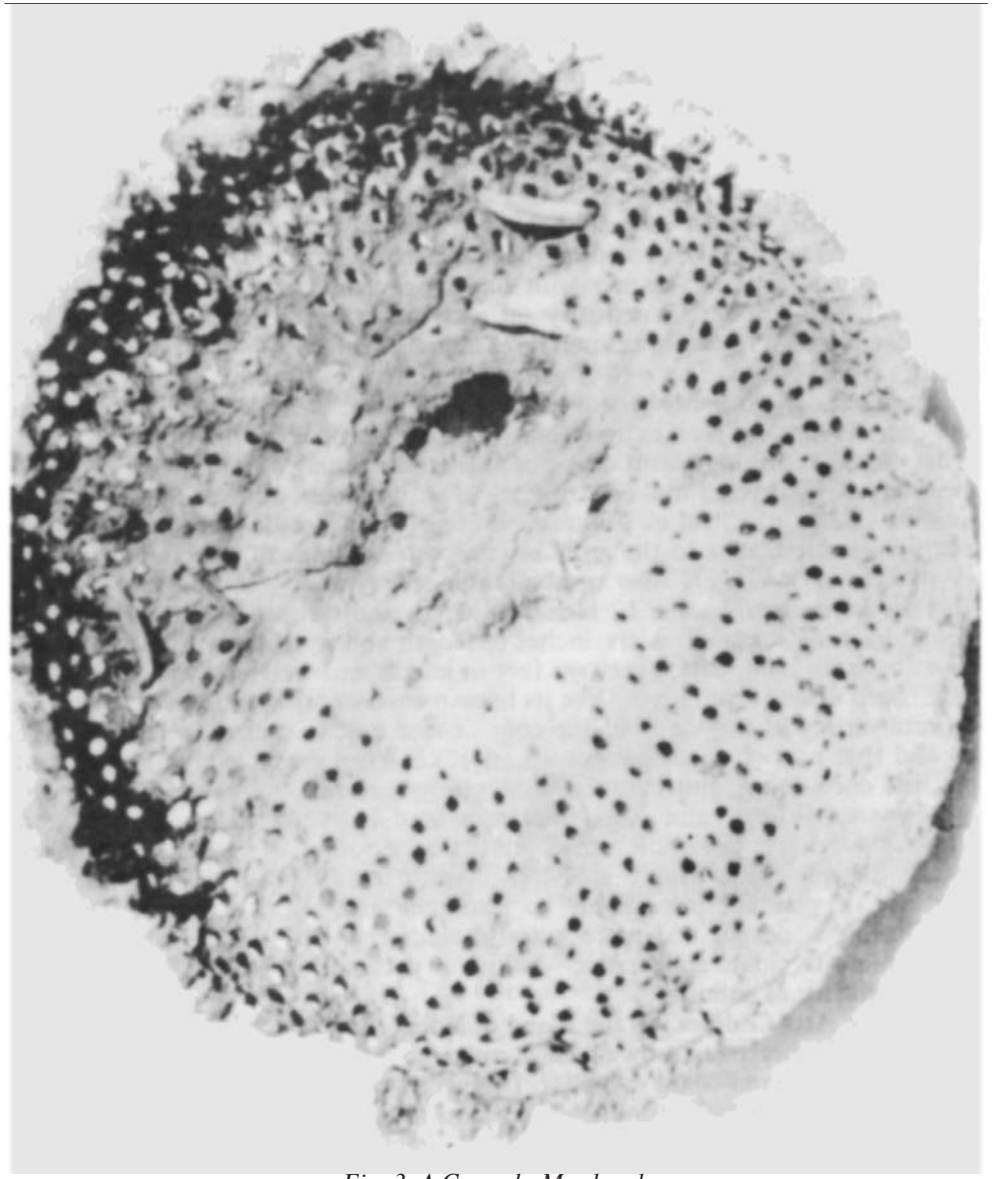

Fig. 3. A Coco-de-Mer bowl.

turning down once more. When the extended cotyledon has reached the required depth, the embryo starts to grow, producing a down-growing tap root and spreading lateral roots; at the same time the embryonic shoot or plumule grows up within the cotyledon and bursts through it eventually. Protected by a hard, pointed sheath, the young shoot grows to about one foot or two above the ground. It is only then, about a year after germination has started, that the sheath splits and the first leaf appears in the air and the light. For two more years, however, the seedling will continue to derive nourishment from the nut, before the cotyledon rots and the young plant becomes separated from the now hollow mother nut.

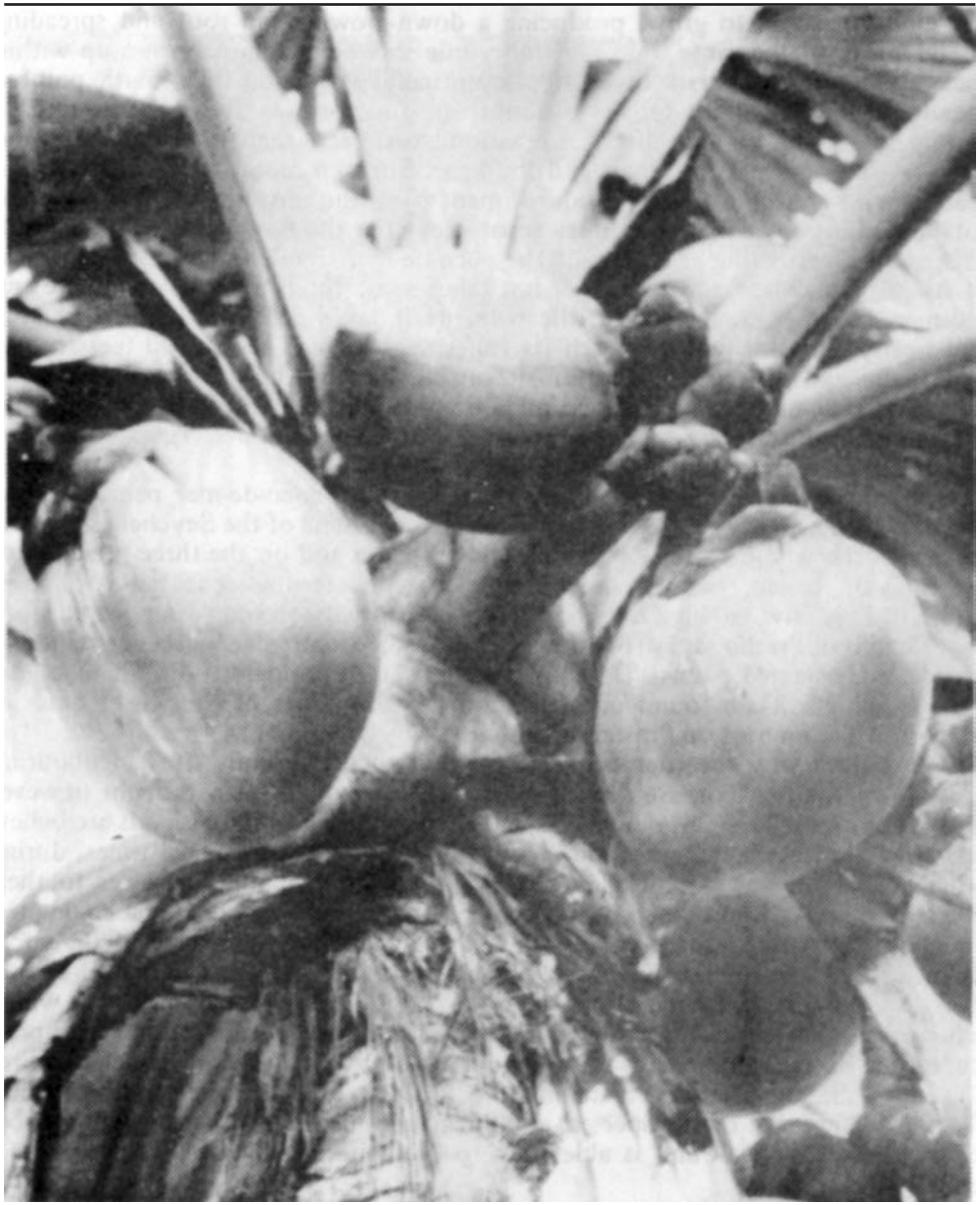

Fig. 4. Coco-de-Mer female flowers and fruits.

Another fascinating character of the coco-de-mer tree is the extreme slowness of its growth. While a coco-de-mer nut takes some three years to germinate and seven years to become mature, the palm itself takes 25 years to start bearing and nearly a millennium to reach its full size, which is about 100 feet for the male palm and 80 feet for the female one. It has thus been estimated that the tallest coco-de-mer palms of the Vallee de Mai are over 800 years old and that they must have started growing at about the time the Hundred Years War broke out in Europe between England and France!

Still more fascinating is the distribution of the coco-de-mer palm. It grew spontaneously on a group of only five islands and islets of the Seychelles granitic island in the whole world, on Praslin and Curieuse and on the three neighbouring isles of Ronde, St. Pierre and Jeannette (which is now identified as Chauve-Souris). It is now growing only on Praslin and Curieuse, having disappeared from the islets. On Praslin, apart for the sanctuaries, it occurs in small relict stands or as isolated, dejected palms. On Curieuse there are fewer palms still. The coco-de-mer palms which are found on Mahe and in other parts of the world have all been grown from nuts on Praslin or Curieuse.

The reason why the coco-de-mer existed originally on only five neighbouring islands and islets of the Seychelles is difficult to explain. It is thought however that when the micro-continent, of which the Seychelles granitic islands are believed to be the remnants, split and largely disappeared in geological times, during which numerous species of plants, which could not adapt themselves to their changing habitat, must have been become extinct, others, like the coco-de-mer, found themselves confined to certain islands and islets. In the case of the coco de-mer this isolation was however definitive since three factors militated against the dispersal of the species: the heaviness of the coco-de-mer seed-nut, which when fresh and therefore capable of germination is heavier than water and cannot be dispersed by marine current; the unisexuality of the palm, which requires the establishment of a least a staminate palm and a pistillate one in a new habitat for the furtherance of the species; and the gregariousness of the palm, since coco-de-mer fructifies well and is able to perpetuate itself only when it grows as a community.

Thus restricted to five islands of the uninhabited Seychelles, the coco-de-mer palm was to remain unknown to the world until after the middle of the 18th century. Its existence was however inferred and gave rise to fabulous tales which haunted the imagination of the peoples of the Indian Ocean and, later on, of early European navigators...

A Fabulous Nut

Before the Portuguese rounded the Cape of Good Hope and came into contact with the inhabitants of the Maldives, India, Ceylon and Indonesia, the coco-de-mer nut was unknown in Europe. It had been known, however, to the inhabitants of these lands, who on rare occasions picked up on their shores the partly-decayed, empty bi-lobed nuts, which having become lighter than water by the decomposition of their hard and heavy kernel, had been cast there by marine currents. These nuts appear to have all been picked on the Eastern shores of the Indian Ocean and must have drifted there on the so-called Monsoon (Eastward bound) current.

The strange shape, the mysterious origin and the extreme rarity of these nuts captured the imagination of these peoples. They therefore attributed all sorts of virtues to them and created many legends about them. The partly-decayed kernel of these nuts was thus believed to be an aphrodisiac and their shells a sovereign antidote. It is to one of these legends that the coco-de-mer palm owes its present name, as coco-de-mer nuts were believed to be the fruits of large submarine trees.

These nuts were in consequence greatly prized and became precious possessions. Nuts picked on the shores of the Maldive islands were thus, like ambergris, by right the property of the Kings of these islands and persons retaining them in their possession could have their hands chopped off or could even be put to death.

According to Pison (3), amulets, made of coco-de-mer nuts, were found in China. Rumphius (4) states that there were coco-de-mer idols in China. Fauvel (5), claims however that it was probably the Japanese, not the Chinese, who considered the coco-de-mer as sacred. According to Yule (6), the coco-de-mer palm or Pauh Janggi is the universal Malay

Fig. 5. A young female coco-de-mer palm

name for the tree which grows, according to Malay fable, in the central Whirlpool or Navel of the Seas and which figures largely in Malay romances, especially those which form the subject of Malay shadow-plays.

Through the early European explorers of the Indian Ocean coco-de-mer nuts were introduced into Europe, where they also became coveted possessions. Kings and princes were all eager to acquire such a fabulous nut. It is thus related that Rudolf II of the Hapsburgs, Emperor of the Holy Roman Empire, towards the end of his reign offered no less than 4000

gold florins for one such nut. This nut belonged to the heirs of the Dutch Admiral Wolfert Hermanssen, who had received it as a present from the Sultan or Pangoram of Bantam in 1602, when he saved the Sultan's Capital from a large besieging Portuguese fleet, under the command of Andrea Fortado de Mendoza. Amusingly enough this nut was not complete, since it is reported that the Sultan had had its top part cut off, in order not to hurt the noble Admiral's modesty! So dearly acquired nuts were used as drinking vessels and mounted in gold or silver. They are to-day prized museum pieces (Fig. 6).

The first mention of the coco-der-mer in European literature appeared in Antonio Pigafetta's famous account of Magellan's First Voyage Around The World. After Pigafetta, the first Europeans to write about the coco-de-mer were of course Portuguese. Joaco de Barros thus states, in 1553 (8), without naming it, that the coco-de-mer grows under the sea and that its medicinal properties are superior to those of the precious stone Bezoar. Garcia de Orta, in his Dialogues on India's Pharmacopaeia, which were published in Goa in 1563 (9), reports that the coco-de-mer, which lie calls the Maldive Coconut, comes from palm trees which were submerged when the Maldive Islands became separated from Asia by a marine flood, and that the kernel of the nut is an excellent remedy against poisons, colic, paralysis, epilepsy and numerous other nervous diseases, as well as against bowel diseases which cause vomiting, and that it preserves from other diseases when water, which has been contained in the shell with a little kernel, is drunk. Camoens, the famous Portuguese poet, also extolled the virtues of the coco-de-mer (10).

The other Europeans who followed the Portuguese into the Indian Ocean could not also help writing about the legendary nut. Among them were the Dutch Jan Huygen van Linschoten and Augerius Clutius, the French Pyrard de Leval and the great German-Dutch botanist Georg Eberhard Rumphius. Van Linschoten, who visited the East Indies in 1579, reports in 1610 that the of the Maldives used to keep the precious nuts in order to make presents of them to the great of the land and to foreign sovereigns, and that they are highly esteemed because of their action against venoms (1).

To the physician Augerius Clutius is ascribed a 56 page volume of the coco-de-mer (12), which contains 10 wood engravings, one of which is a natural size cross-section of a nut. This monograph on the coco-de-mer, which was published in Amsterdam in 1634, is as complete as possible for the time. In it he lists 12 kinds of diseases and cases of difficult confinements for which the nut was believed to be a sovereign remedy.

In his account of his voyage to the East Indies, in 1601, during which he was wrecked and lived for years on one of the islands of the Maldives, the French merchant Pyrard de Laval gives first hand information on the presumed origin of the coco-de-mer nut (13).

To Rumphius we owe a long study of the coco-de-mer which was published in his Amboyna Herbarium in 1750 (4). Reviewing all the fables that had been told about the coco-de-mer, Rumphius states that Malay, Chinese and other native sailors believed that the foliage of the coco-de-mer palm could sometimes be seen under the sea. He tried, in vain, to convince the inhabitants of Java and Amboyna that the Pausengi abyss, where the coco-de-mer tree was presumed to grow, could not be on the West coast of Java. About the uses of the nut, he tells how native high-borns did not allow the shell of the nuts to be broken, but had them sawn, so as to obtain boxes with lids, in which they kept their masticatory ingredients, since they believed that these substances, as well as drinking water, if stored in these shells, acquired the virtue of neutralizing all kinds of poisons and of curing many diseases. To Rumphius is also owed the most accurate guess as to the probable home of the coco-de-mer, which he believed to be somewhere in the Western Indian Ocean.

Fig. 6. A coco-de-mer container from the East with carvings representing Burmese Temple dancing girls

An Important Botanical Discovery

The Seychelles must have been known to Arab and other early Indian Ocean navigators who roamed over that Ocean, such as Abou Hassan Ali or Al-mas'udi, who is reported to have visited Madagascar in 916. They were sighted by the Portuguese during their early exploratory voyages in the Indian Ocean in the 16th Century. It is to the English, however, that are owed the first recorded landings on the islands, early in the 17th Century.

These took place in 1609 in the course of an East Indian Company expedition to Aden and Surat. The expedition spent ten days on the islands. However Praslin and Curieuse were not visited; landings were made only on Mahe and North Island. The expedition did not therefore have the honour of discovering the coco-de-mer palm.

It was only 133 years later, that is in 1742, that the Seychelles received other visitors. They were Captain Picault, and Captain Grossin, who had sailed on an exploratory voyage from Mauritius, on the order of Mahe de Labourdonais, the great French East Indian Company's Governor of Mauritius and Reunion. They landed at a small bay in the South-West of Mahe, and left four days later, without also visiting Praslin. Lazare Picault came back two years later, however, in 1744, and this time visited Praslin which he named l'Isle de Palme. Did he then discover that the coco-de-mer was growing on that Island? This is what he wrote in his journal:

"12th and 13th June. Visited l'Isle de Palme (Praslin) and l'Isle Rouge (presumed to be Curieuse). L'lsle de Palme is so named because it contains a lot of *Palmistes* and latans bearing cotton."

These latans were obviously coco-de-mer palms, which have for a long time been classed with latans, while the cotton in question is the fibrous material which is found at the base of coco-de-mer leaves. Lazare Picault was thus the first man to behold coco-de-mer palms. Their actual discovery on Praslin cannot, however, be attributed to him, since he failed to recognise in these palms the trees which bear this astonishing nut. Why was that? Was the coco-de-mer nut unknown to him? This would have been extraordinary since he must certainly have heard about this fabulous nut which haunted the imagination of sailors of that time. What probably happened was that although Picault saw coco-de-mer palms on Praslin, he did not see any coco-de-mer nuts there. This is understandable, since at that time Praslin was wooded to such a extent that it was almost impossible to penetrate on the island. As a result, Picault was unable to see the nuts which had dropped from the coco-de-mer palms and which lay completely hidden in the lush vegetation which covered the island. If Picault thus failed to make an astonishing discovery, he had however the privilege of being one of the first, if not the first, to behold in its primeval state the wonderful sylva which then cloaked Praslin.

It was 12 years later, in 1756, that other sailors landed in the Seychelles. They were Nicolas Morphey and his companions who had also sailed from the Ile de France to take a formal possession of the islands in the name of the King of France, Louis XV, and of the French East India Company. Being short of provisions, Morphey was unable to visit Praslin.

It was again 12 years later, in 1768 that there was another expedition to the Seychelles. It was that of the Chevalier Marion Dufresne, which had also sailed from Mauritius. However, Dufresne's expedition was not only exploratory, as it had as one objective the exploitation of the islands' timber. On board was a surveyor of whom little is known, save that he was named Barre. It is this Barre, however, who had the honour of discovering the coco-de-mer tree of Praslin. It is to the Abbe Alexis Rochon, a French geographer and astronomer of repute who visited the Seychelles in 1769, on yet another French expedition from Mauritius, that we owe a description of Barre's discovery. It reads as follows:

"He found on the Isle de Palme, on the edge of the shore, a fruit which he first took for

a coco-de-mer nut. He hid it carefully, but having penetrated in the forest he saw regretfully that the ground was covered with these fruits and with the trees which produced them. These trees reach a height of fifty feet. Their head is crowned with ten or twelve fan-shaped palms of 20 feet in length; each of these large palms is born on a six-foot stipe and this stipe is indented in its contour. From the axis of the leaves springs a ramified panicle whose branches end in female flowers; the pistil of the flowers gives, in maturing, a fruit which, with its husk, may weigh fifty pounds.

"While examining carefully this forest, Barre persuaded himself that the nut of that island could not be the true coco-de-mer nut. He contented himself in collecting, out of curiosity, about 30 nuts which the famous Poivre formally declared to be this fruit so sought after in India and the whole of Asia; from then on he speeded up our departure in order to obtain quick information on this subject".

It was thus that the coco-de-mer palm was discovered on Praslin, 159 years after the first exploration by the English and 2 years before their first settlement by the French.

This discovery had an unfortunate sequel. In November 1769, Duchemin, who had been the second in command in Dufresne's expedition and who was therefore aware of Barre's discovery, sailed to Praslin on the "L'Heureuse Marie", which he loaded with coco-de-mer nuts which he afterwards dumped on the Indian Market. As a result the coco-de-mer nut lost for ever its fabulous value.

The Tree Of Knowledge

The first scientific description of the coco-de-mer palm was made, soon after its discovery, by Pierre Sonnerat, a naturalist and Sub-Commissioner of the King of France, who visited the Seychelles in 1771. This description was read at the French Academy of Sciences in 1773 and appeared subsequently in Sonnerat's now famous book. *Voyage a la Nouvelle Guinee* (14). The superb frontispiece of this work, which shows Sonnerat sitting beneath a coco-de-mer palm, contains also the first, although inaccurate, picture of that palm.

Sonnerat did not however bestow a name to the coco-de-mer. This was to be effected by the French naturalist J.J.H. de Labillardiere, in a paper entitled *Sur le Cocotier de Mer des Maldives*, which he read at the Paris Academy of Sciences in 1801 and which was published in the Annals of the Paris Museum of Natural History in 1807. The name given by de Labillardiere was *Lodoicea sechellarum*. Coco-de-mer is however known today by the name of *Lodoicea maldivica*, although it belongs only and truly to the Seychelles, the specific name *sechellarum* having been superseded by that of maldivica in 1917, in order to comply with the international convention on botanic nomenclature, which given precedence to anterior names. The specific name *maldivica* dates back to Rumphius (before the discovery of the coco-de-mer palm in Praslin) who had named the still unknown palm *Cocus maldivica*.

In the course of the years, the coco-de-mer palm was to interest numerous scientists and travellers, among whom figure Bory de Saint-Vincent, Sir James Prior, Sir Richard Owen, Sir William Hooker, Karl Friederich Philipp von Martius, Perceval Wright, John Home, Charles Gordon, Charles Alluaud, Carl Chun and Albert-Auguste Fauvel. Three of these students of the coco-de-mer deserve however to be especially remembered.

To John Home, a director of the famous Pamplemousses Botanical Garden of Mauritius, who visited the Seychelles in 1874, is perhaps owed more than to anybody else, since it was on his outcry about the rapidly disappearing coco-de-mer palms that the British Government provided the Seychelles with funds to purchase and preserve for posterity the few remaining reserves of the famous palm.

To Albert-Auguste Fauvel, a French traveller, public servant, naturalist and distinguished sinologue, is owed the most complete workof the coco-de-mer. This 140 page monograph,

the result of 17 years of research, is entitled *Le Cocotier de Mer des Iles Seychelles* (5) and was published posthumously. It is a full historical and botanical study of the palm.

It is however to General Charles Gordon, renowned as "Chinese Gordon", that is owed the most famous, if absurdly romantic study of the coco-de-mer. It is in this work, entitled "Eden and its two Sacramental Trees", which is still manuscript, that Gordon depicted Praslin as the Garden of Eden and the coco-de-mer palm as the Tree of Knowledge.

Several copies of the manuscript are known to exist. They all contain variations; Gordon, who was a prolific writer, thus appears to have expounded his theory several times. One of the manuscripts is reported to be at the Pamplemousses Botanical Garden, in Mauritius. Another is at the Gordon's Boy School, at Woking in England. At least two other copies are known to be privately owned. Sprinkled with numerous short quotations from the Scripture, the text of these manuscripts gives the impression of a feverish, "inspired" writing, rather than that of a logical study. In spite of obvious naivetes it makes fascinating reading.

About the coco-de-mer itself, Gordon has this to say: "On a small isle, that of Praslin, some 5 miles long and broad, 20 miles from Mahe, the chief isle, grows a remarkable Palm. It attains the height of 120 ft., its fruit weighs some 40 to 50 lbs and it carries as many as sometimes as ten on a branch. The fruit takes 7 years to ripen, the leaf is from 20 to 25 ft. long in its fan shape and l4 ft wide. It is called the *Lodoica seychellarum*. It is truly unique among trees, it is the Prince of Palms, only grows naturally, on this little isle, throughout the world: this was where it came from, and it was supposed to grow on a sea plant. When found on shores on Maldives isles, large sums were paid for it, in old times, and it is even sold in India, for the Harems of Princes, at large prices, being supposed to have some mystic effect on newly born babies &, &. There is a Well of Knowledge in some temple of Benares, the water of which is taken out by shells of this fruit. It sprouts by laying the fruit covered with dead leaves on surface of ground. The shoot is a long white serpentine round rod, which grows for 10 to 12 ft. under-ground ere it divides. And it takes 20 years ere it forms the body of the tree, and then shoots upwards. When mature the tree is quite straight, 15" diameter. Exteriorly it is shaped like a heart, when opened out it is like the belly and thighs. Inside is a pink transparent jelly like substance. It is this unique tree which I think is the Tree of Knowledge of Good and Evil".

The Curio Par Excellence

In 1815 landed in the Seychelles an interesting personage, named Antoine Benezet. While fighting the English during the Napoleonic wars he had been made a prisoner and locked up for years in one of the infamous Plymouth pontoons. There, however, he learned to twine and dye straw. When the wars were over, he decided to settle in Seychelles, where he soon discovered what a beautiful twining material coco-de-mer leaf was. Eventually he became a teacher in the Seychelles and, it is said, taught his pupils to twine coco-de-mer leaf during the school breaks.

Thus was born an exquisite craft, which has survived to this day, but which reached its apogee in the 1830's, at the time of the abolition of slavery in the Seychelles, when agriculture came to a standstill because of the ex-slavers' reluctance to work on the land of their previous masters. The artistic objects which were then made consisted of miniature baskets and boxes, fans, glass cases, bride's bouquets and other works. They are now things of the past, being museum pieces.

Objects in coco-de-mer leaf now available in the Seychelles consist mainly of baskets and mats and light sun hats, all made of young and therefore still pliable leaf.

Other uses made of the coco-der-mer leaf, over the years, have been for thatching houses, cottages and huts and also for making light, attractive, golden-yellow, partitions. Coco-der-

mer leaves are so large that only a few are sufficient to cover a hut and only one or two are needed for a partition.

Little use appears to have been made of the attractive coco-de-mer timber, which is light brown in colour and is speckled with ebony-black dots. This is due to the fact that it rots so easily.

The coco-de-mer nut, on the other hand, has been used extensively, although its ivory-like kernel, because it cracks, has no industrial value.

In the past coco-de-mer nuts used to be exported to Mauritius, where they were used for measuring rice and sugar in shops and also for scooping out sugar from the centrifugals in the sugar factories.

A few hundred nuts were until recently exported from the Seychelles every year. They went mainly to India and other Eastern countries, where their kernel is still reputed as a tonic, an aphrodisiac and an antidote. Their shells, on the other hand, made fakirs' bowls and were also used by pilgrims to Mecca to eat their food, since these pilgrims are supposed to use only utensils produced by nature. The export of these nuts is now prohibited.

Of the 3000 odd coco-de-mer nuts which are produced every year, a number are consumed green, in the still immature stage: their unique and delicately-textured jelly is served as a dessert, with a dressing of liqueur, to tourists and other visitors, who are thus afforded the thrill of partaking of the "Forbidden Fruit". The shells of mature fruits are usually turned into fruit bowls, water bottles and plates and cups which are generally known as *Vaisselle de Praslin* or Praslin Crockery. Coco-de-mer shells are also used frequently by Seychellois fishermen as bailing bowls and, especially, as water gourds on their fishing trips. Other nuts are used by curio makers, who polish and turn them into attracting boxes, bowls and baskets which are readily bought by visitors. Some of the latter, however, prefer to acquire the unprocessed and therefore unspoilt nut which, in its pristine beauty, is as startling to the newcomer today as it was then to inhabitants of the Maldives, India, Ceylon and Indonesia, when they picked them on their shores centuries ago...

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FLAIL CULTIVATION IN OREGON NUT ORCHARDS

WAYNE ROBERTS*

I have been asked to provide some information on our use of flail cultivation in nut orchards. We have been using it here in Yamhill County and the Mid-Willamette area of Oregon for at least 7 or 8 years. The original orchard that it was tried on was a block about 3 or 4 miles north of McMinnville. I worked very closely with the grower, Paul Sorbets. He had picked the idea up from seeing it used in some almond orchards in California.

We have been very pleased with it. It is actually not a cultivation, it is a flail mowing. We do not disturb the soil but the flail is set so that it just barely misses the ground by about a half an inch and when the flail is running the blades will actually tick the ground as they go by. It is actually just shaving the grass right off the ground surface. The ground has to be extremely smooth before you can start the program , otherwise it will tear up your flail, so the growers spend the first fall preparing their ground very smoothly, then hope that they can have a season that they can harvest the nuts off this real smooth surface without causing ruts, and then they try to stay out of the orchard that winter and start flailing the next spring. Once they have gone through a season of flailing they can go out in the winter time and find that it is extremely beneficial that they don't sink in - they can spray and many other things without cutting up the orchard.

One of the main advantages that we have seen as far as filbert production is concerned is that we do not have to prepare our ground every fall for the harvest of the crop. They go over the orchard once with a flail mower and it's just like a floor and the nuts are then just swept into windrows and picked up right off that flailed surface. In the past we used to disc and harrow and roll and float and many other things to get the ground as level as possible in the fall, then hope that we get a rain that would cause it to crust so that we would then be able to pick the nuts up off the crusted soil, and of course if it rained a lot they would be very muddy and it would be some time before we could get back in. We have found that there is better water penetration with the flailing program, there is about the same amount of moisture level in the soil if a person follows a good flail program - and this means flailing closely. Every time the grass comes up and grows 4 to 6 inches high they go in and mow it off. This means usually four or five flail mowirigs in the spring, starting in April here - up till about the first of July. Then they usually let it go most of the summer because there isn't much weed growth, and then they flail it once just before harvest.

Growers here do not plant anything for the most part, although some of them do plant some sub-clover. Most of them just let the wild growth come up in the orchard, various weeds - grasses and broadleaf, both, and then start mowing them very close.

We have had some experience with the rotary mowers, like we cut lawns with. This we used back in the late '50's and early '60's, and in tests we ran at that time we found that we had less moisture in our soils with this type of mowing than we did where we clean cultivated, so we quit it. It was cutting down on the growth of our trees and it was also reducing our crops. We ran quite a study with a grower on this here in Yamhill county. I don't think the rotary mower is any good in our area unless we have supplemental irrigation, and then it works pretty good. Except in the case of filberts, if the nuts fall down into the grass they are

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hard to sweep out and it becomes a real problem.

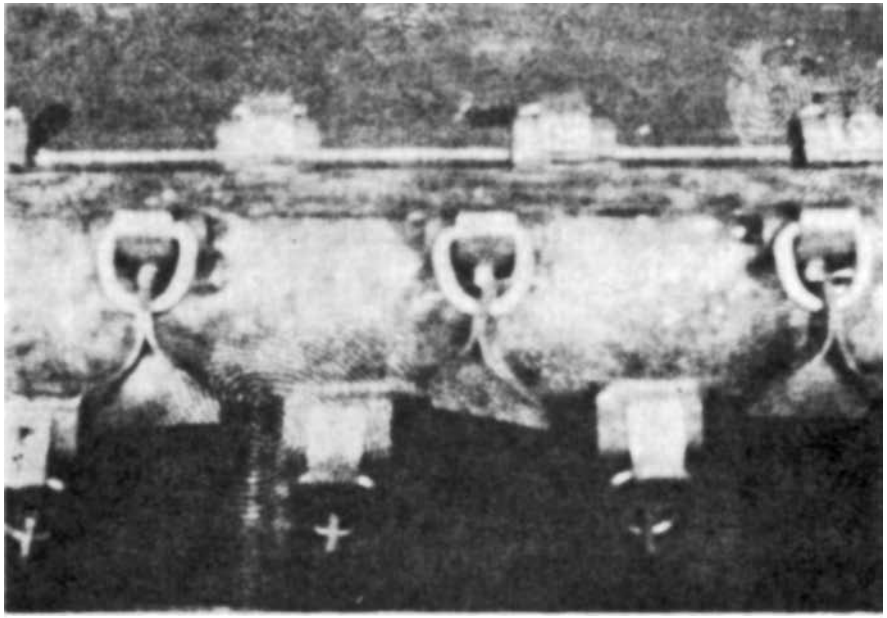

Fig. 1. Four bar cutting reel.

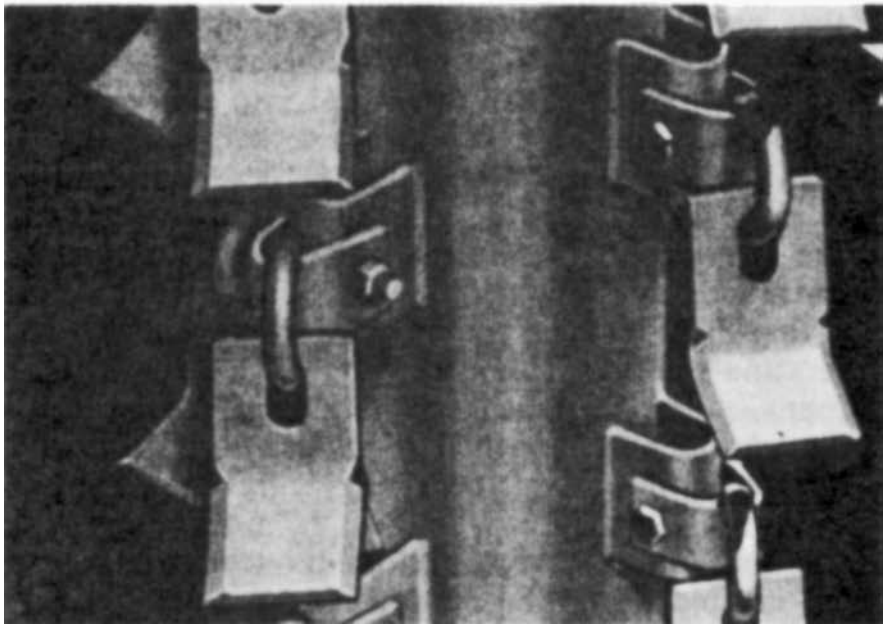

Fig 2. Heavy duty flail knives.

There is a local bulletin (1) on soil management in non-irrigated orchards, and it has a section right at the start on non-tilling soil management which is the flailing program. This was written by Dr. Bob Stebbins, Horticultural Specialist, OSU, based on information obtained from orchards' use of it here, starting in this country. There are two different flails that are used quite extensively in this area. They are both manufactured in California. Both are very good. The pictures of one of them, the Dandl, shows the make-up of how the flails are hung, and how they rotate. It looks like almost a roto-tiller except it does not go into the ground, it just mows the grass off and other material right at the ground surface.

One of these flail mowers is made by the Dandl Manufacturing Co., P.O. Box 687, Chico, California, 95926, and the other by the Vrisima Machine & Welding Shop, Rt. 1, Box 471 C, Chico, California, 95926.

Our use here started out with filbert growers. We now have walnut, cherry, prune and other orchard crop growers using this program. We have some wine grape growers in the hills that are also looking at this as a possibility of growing their grapes under, and I think it will work very well there. I think the key to the whole program is actually a close management of the flailing practices, in other words, never let the grass get very tall. That's the reason our growers start early in the spring and every time the grass gets back up to 4 to 6 inches tall they mow it off again. The first year we tried it the grass got up to 18 inches tall before they mowed it and they had a lot of debris to handle all summer and it didn't work out too well. Like I say, I think the key is keeping it mowed down close.

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Editor's Note:

This short article is potentially one of the most important in the whole YEARBOOK. Weeds must be controlled in established orchards to get the best results. Cultivation with discs and ploughs can damage shallow roots and cause soil erosion. Use of chemicals is expensive, rather dangerous, and ecologically unsound. The flail mowers described avoid all these problems, and have the advantage that the weed materials is returned to the soil in finely-chopped, readily usable form, and the flailed surface is smooth for easy harvesting by machines, and firmed by the weed roots into an easily traversable surface. Every Agriculture Department in Australia should be trying out these machines for a variety of horticultural crops.

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A PROPOSED COMMERCIAL PISTACHIO ORCHARD ON THE LIGHT LANDS NORTH-WEST OF MOORA, W.A.

A.C. BELFORD *

General

Successful production from any type of plant can be achieved more easily when climatic conditions suit the plant. It can be urged on by fertilizers and irrigation, but basic requirements of the temperature/humidity combination at all seasons, together with frequency, amount and time of receival of rainfall are paramount. In a tree like the Pistachio, not far removed culturally from its native state, these factors are very important.

Investigations into the climatic conditions in its native lands show the climate there to be almost identical in all respects with the central west Midlands areas from Mogumber to Eneabba. For these reasons I chose *Pistacia* as a future cash crop to grow in that area. I have the availability of adequate water for trickle irrigation, which I propose to use in the early years of each planting.

The CSIRO at Merbein, Victoria provided me with information and seeds of *Pistacia atlantica* as their recommendation of the likely best root stock. I was assured of supplies of bud sticks of the commercial female varieties, Kerman, Lassen and (15 - 11) and of both early and late flowering males, when my rootstocks were large enough to accept budding.

Germination

Following recommendations of the CSIRO, my first seeds were germinated between layers of wet cloth in May. This gave reasonable results, but the handling of the seeds after germination and planting in 25 x 80 mm tubes, then 75 x 200 mm bags, and finally 13-litre bags, so disturbed the seedlings that by October they were only 50-100mm high.

As a consequence, by March of this year the plants were still too small to bud properly, but this was attempted before planting them in their orchard positions in May this year. At present (September 1976) they have.just begun their new growth for this coming season.

This year I planted seeds late in June in groups of four in orchard positions, and as may be expected, 3 or none have germinated at each place - transplanting will be done next week.

In addition I have tried planting seeds directly into 75 x 200 mm bags in mid August (after placing seeds in a freezer for 3 days, ordinary refrigerator for 7 days) and have got an excellent germination. The plan is to grow these on in their germination pots till next May and plant out. All future budding will be done in the field.

Budding

* Member, West Australian Nutgrowing Society.

I obtained budwood from the CSIRO in late summer. It is recommended that budding be done by mid March, but owing to the late season in Victoria last year, budsticks did not arrive until late March/early April. By this time my seedlings were going into dormancy.

I had enough budwood to try approximately 30 buddings, but only 2 Lassen and 1 Kerman appear to have taken among the female varieties, and none at all among the males. This poor showing was possible worsened by the size of my rootstock which was really too small to bud. I should not have attempted it until next year when the plants were in their orchard positions and much bigger.

Difficulties

My unoccupied farm has rabbits, kangaroos and emus occasionally and indiscriminately present, varying in numbers inversely with my eradication measures.

One or more of these species has taken a casual liking to Pistachios, biting the stems off neatly - as if cut with secateurs - in diameter up to 5mm.

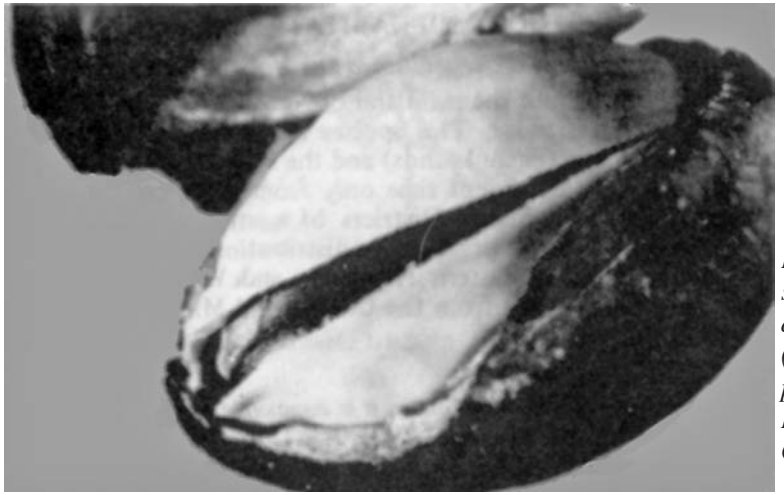
Scratching by rabbits at my trickle irrigated seedlings is causing considerable losses. It has become necessary to erect a vermin proof fence around my orchard.

No other problems have appeared at this stage, but I expect in time that parrots or galahs may be a problem.

My limited experience to date suggests:-

1. Obtain seed from CSIRO, Merbein, Victoria.
2. Place in freezer for 3 days and cool store for 7 days.
3. Use 1 sand, 1 loam, 1 peat moss mix with slow release fertilizer. Place seed 1 cm below surface. Plant August 1. Leave out in rain and/or water regularly (I have a 400 litre rainwater tank and use water from it).
4. Plant in 75 x 200 mm bag for replanting in orchard in following May, or after the first good opening rains.
5. Bud in orchard but not before the stem is 1 cm in diameter. Bud in March.
6. Hope eternally for the best.

I have provided automatic trickle irrigation from a windmill and tank, so am able to transplant at any time.



Pistachio nut showing nut, shell, and husk. (This and cover photo courtesy D.H. Maggs, CSIRO, Merbein)

A NUT TREE FROM NEW GUINEA - *FINSCHIA*

D.B. FOREMAN *

INTRODUCTION

Finschia belongs to the family Proteaceae, sub-family Grevilleoideae, and is most closely related to *Grevillea* and *Hakea*. These three genera belong to the tribe Grevilleeae and share the same chromosome number, n = 10 (2).

There are three species of *Finschia* centred in New Guinea with *F. chloroxantha* Diels being the most common and the most widespread species as well as being the only species to be found outside New Guinea.

The seeds of all three species are cooked and eaten by local people and it is not uncommon to find trees planted close to permanent village sites.

Trees grow up to 36m in height, are often buttressed and sometimes have well developed stilt roots.

F. chloroxantha is widespread throughout most lowland areas of New Guinea and is found up to an altitude of 1830m. The other two species found in New Guinea, viz. *F. rufa* Warb. and *F. ferruginiflora* C.T. White are much more restricted in their distribution and have been recorded from only some areas of Eastern New Guinea, usually at mid-altitudes up to about 2400m.

Trees are found scattered throughout the rainforest and although they produce masses of very attractive, golden-yellow flowers, the number of fruits set by comparison is very small, a characteristic the genus has in common with many other Proteaceae (1).

The fruits are more or less globose in shape, and vary in size from 30-55mm in length x 25-45mm in width and contain one or sometimes two seeds. They are indehiscent and turn a bright yellow colour at maturity. The fruits consist of a thin, 1-2mm thick, fleshy layer on the outside and a woody layer, from 4-10mm thick, surrounding the seeds. This woody layer may be removed by burning, or cracking the nut with a stone (4).

DISTRIBUTION AND HABITAT

General Distribution (*for explanation of New Guinea Districts see Map 1*).

F. chloroxantha occurs throughout the mainland of New Guinea, the Bismarck Archipelago and the Solomon Islands. This species also extends to Southern Moluccas (Aru Islands), Micronesia (Palau Islands) and the New Hebrides.

F. ferruginiflora is known at the present time only from collections from the Eastern Highlands and Western Highlands Districts of north-east New Guinea.

F. rufa is also rather restricted in its known distribution with collections coming from the Madang, Morobe, Eastern Highlands and Western Highlands Districts of north-east New Guinea and from the Central and Milne Bay Districts of Papua.

NOTE: With so many native languages in New Guinea it is impossible to give any standard native names for Finschia.

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Habitat

Many of the soils in New Guinea are shallow and poorly developed when compared to soils in Australia, this is simply a result of the differences in the geology and climate of the two countries. Rainfall in New Guinea is high with some areas receiving in excess of 5080mm per annum and many areas receiving more than 1524mm per annum.

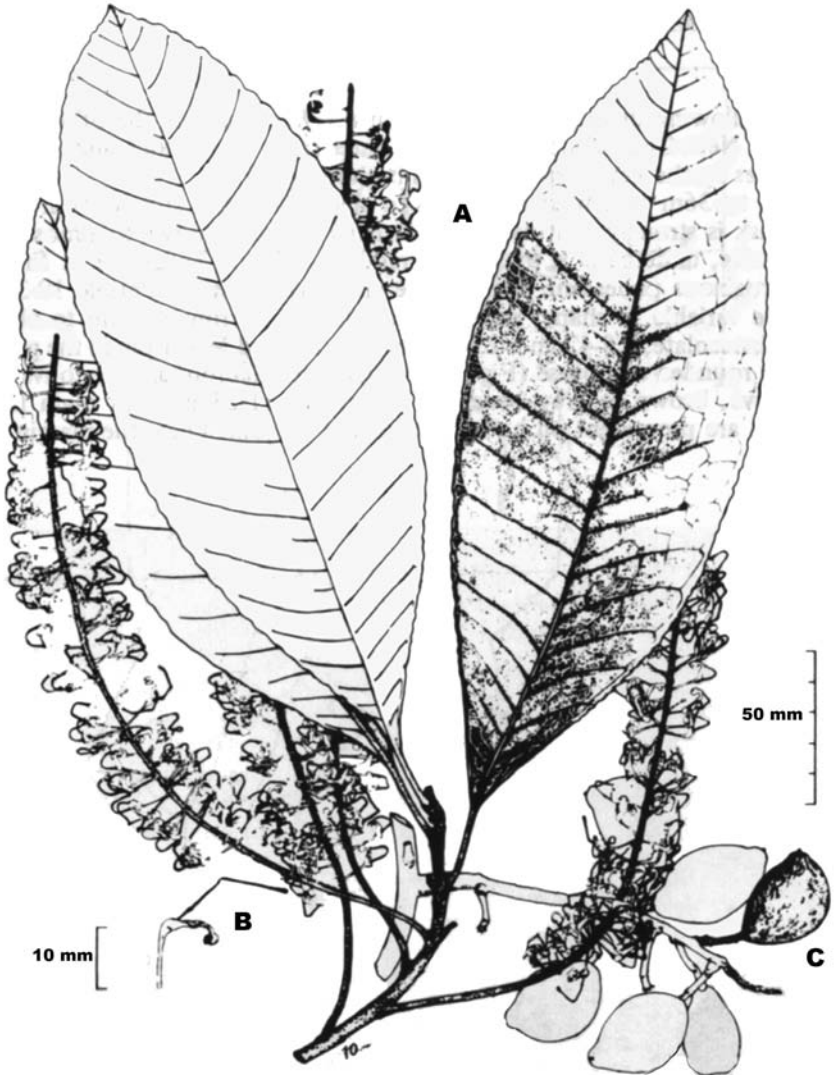


Figure 1. *Finschia cloroxantha* Diels
A. Flowering twig
B. Mature flower
C. Fruiting twig

(Courtesy - Assistant Director Botany, Division of Botany, Lae.)

F. chloroxantha is found in primary and secondary rainforest on slopes and ridges and does not appear to occur at altitudes above 1830m. It is also found in rather swampy conditions on the coast but is usually restricted to sites which are not subject to permanent flooding. *F. chloroxantha* is not found in savanna woodland but may occur in patches of rainforest along the larger rivers and streams which may flow through such areas. Trees may also be found planted near permanent village sites.

F. ferruginiflora occurs in lower montane forest or primary or secondary rainforest at altitudes from 1650m to 2200m.

F. rufa occurs in primary or secondary rainforest and lower montane forest at altitudes from 150m to 2400m.

HABIT

Note: The following description is based on *F. chloroxantha*; the other species occurring in New Guinea may be distinguished from each other and from the former species by the key to species which is given below.

Trees up to 36m tall, with buttresses to about lm high, stilt roots are often present. Bark is strongly pustular, finely striated and dark brown to almost black on the outside, underbark is pinkish to reddish brown. Twigs are at first adpressed ferruginous pubescent but become glabrous with age. Petiole 10-30mm long. Blade variable in shape, more or less elliptic, narrow. obovate to oblong-obovate or lanceolate, 9.5-42cm x 2.6-13cm, base tapered in sharply to the petiole, tip acute to rounded or obtuse (Fig. 1A). Leaves are glabrous and dry olivaceous to grey above, brown to grey beneath. There are 11-23 pairs of main lateral nerves which are prominent on both surfaces and are joined near the margin with a distinct, looped intermarginal vein. Inflorescence axilary or ramiflorous, densely flowered, up to 30cm long. Flowers golden-yellow, 6-10mm long, borne on pedicels 8-12mm long (Fig. lB). Disk annular or horseshoe shaped. Ovary glabrous, on a stalk 3-4mm long. Fruit globose, compressed laterally, slightly oblique, glabrous, 30-55mm x 25-24mm, maturing yellow then turning black. Fruit stalk stout, 15mm x 3mm. (Fig. 1C).

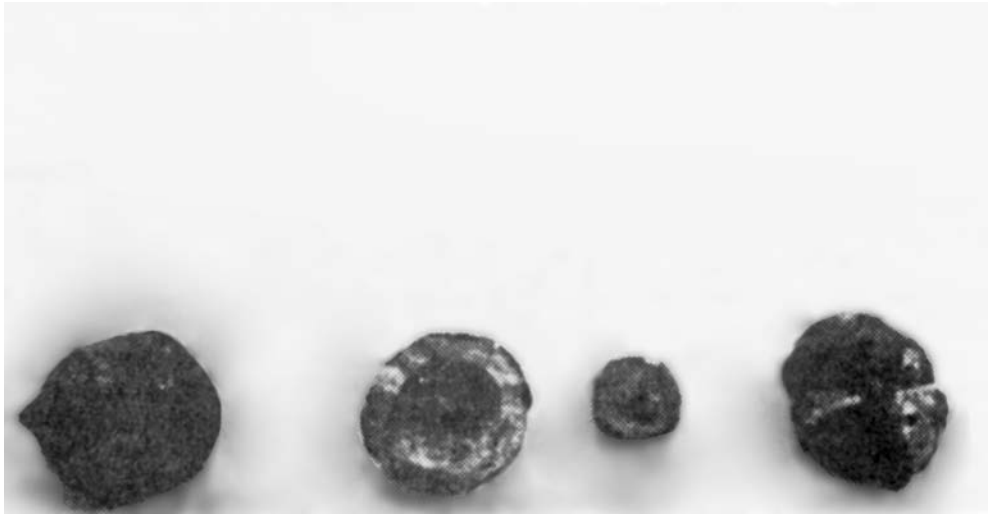
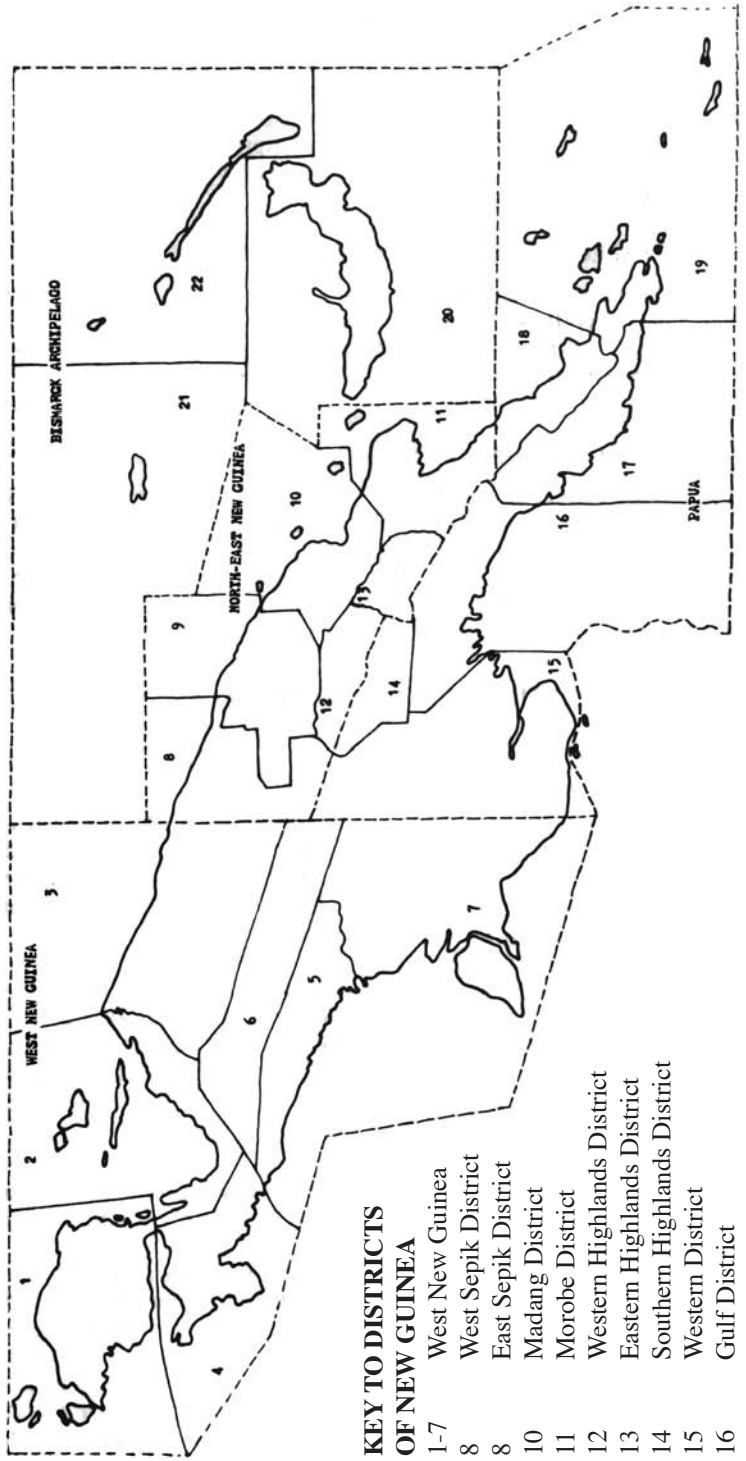


Fig. 2 Finschia nuts



KEY TO SPECIES OF *FINSCHIA* IN NEW GUINEA

1a. Leaves rufous tomentose beneath.....*F. rufa*

1b. Leaves glabrous or nearly so.....2a

2a. Flowers and pedicels furruginous tomentose ; ovary hairy.....*F. ferruginiflora*

2b. Flowers and pedicels glabrescent, laxly ferruginous sericeous in bud; ovary glabrous.....*F. chloroxantha*

FLOWERING AND FRUITING

In New Guinea most flowering specimens of *F. chloroxantha* have been collected during December, January, February, March, April and May with isolated reports through to August. Fruiting appears to be most prolific during August and September and April and May. The only months where fruiting specimens have not been reported are February and March which appears to correspond with the main flowering season in New Guinea.

SEEDS, GERMINATION AND SEEDLINGS

The seeds are circular in shape and have thick, fleshy cotyledons and are flattened laterally. Size of the seed is dependent on the size of the mature fruits and also the thickness of the woody layer surrounding the seeds but an average size would be between 10-30mm in diameter and from 5 to 10mm thick.

The seeds have been planted with the woody layer intact, but this soon disintegrated to a stage where it crumbled easily between the fingers. The seeds were planted in black plastic bags in a mixture of 1 part sand, 1 part garden soil and 2 parts peat moss and watered lightly once every two or three days. Temperature during germination varied between 18°C and 27°C. Time taken for germination was 7 months. Germination was hypogeal. The leaves of the seedlings do not differ significantly from those of the adult plants, i.e. there is no lobing of the young leaves as is the case with many Proteaceae. No proteoid roots (3) were seen on the seedlings. After germination, growth was fairly rapid and the seedlings reached a height of about im in 12 months.

UTILISATION

Fruits are collected from beneath the trees after they have fallen and are cooked before being eaten. At the present time there is no commercial production and all the nuts are consumed locally.

The seeds are somewhat bigger than those of Macadamia nuts and it has been suggested that the thin shelled varieties could be cultivated commercially (4). No information is at present available on the chemical composition of the seeds - they may or may not be similar to Macadamia.

Because of its use as a food tree, timber companies are encouraged to leave large trees which may be found on timber leases, and as such *Finschia* is not usually cut in commercial quantities. The timber has the large rays characteristic of the family and is a pleasant pinkish brown in colour. The timber could be used for light construction or for special veneer.

CONCLUSION

Finschia does not occur naturally in Australia and at the present time I know of no cultivated trees. However, parts of north-eastern Queensland would provide suitable habitats for the trees should they be introduced into Australia.

Although nothing is known at the present time about the chemical composition of the seeds of *Finschia*, they are similar in taste to those of Macadamia.

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NUT NURSERY NOTES

DAVID NOEL*

Anyone interested, as I am, in a wide range of exotic and little-known nut plants, will soon find that most of the more interesting plants cannot be bought from any local nurseryman, perhaps not from any commercial source in Australia. Their only course then is to obtain seed or other propagation material, and grow from that.

During the past eight years I have gained a fair amount of experience in the nursery production of nut plants. My nursery was originally started for my own use exclusively, but in recognition of the difficulty in obtaining nut plants, in recent years I have sold quite a lot to WANS members and others.

The raising of nut plants is frequently quite different to the raising of other plants commonly sold in garden centres. I have no desire to compete with the commercial nurserymen, but it has been my experience that very few of these have the incentive or inclination to master these differences, in view of the small market compared with decorative plants, and the considerable skill and difficulties involved.

In what follows I describe current practices in my nursery, evolved through experience of every sort, from blind trial and error through to testing of techniques described elsewhere. Most relates to raising nut plants from seed.

Containers. One obvious factor with nuts is that the seeds are much larger than the general run of seeds. A consequence of this is that the seed has within it enough food to develop a considerable root and stem system before leaves appear. Conventional small plastic seed trays and pots are comparatively useless with nuts. A pecan nut, for example, may have a root 50cm down in the ground before anything appears above surface.

My practice is to sow almost all nuts in sections of black plastic tubing, about 30cm deep and the same across, secured at the bottom with a piece of packaging tape. This tubing or sleeving is sold by weight by a number of plastics firms, and is used to make the conventional plant bags in which bigger items are sold at nurseries. It is usually gusseted, that is with the sides folded in like two letter M's joined at their feet, and must be black - any other colour deteriorates too quickly in the sunlight.

In these large plastic tubes I plant 10 to 50 seeds, depending on their size and germination percentage expected, and grow on the resulting plants for as long as a year or more. The plants are then potted out into individual plastic tubes of similar depth, but only about 15cm across. The plants grow on in these until ready for their final planting.

These tubes have many advantages for nut trees. The tube bottom discourages formation of very long tap roots, and what roots do grow out can be trimmed off easily. Both these factors encourage side root formation, an essential for later successful transplanting. Nut trees for many years had a bad reputation for transplanting, because they were field-grown and had long tap roots and no fibrous side roots. When these trees were dug for sale, most of the active root system was cut off, and the trees had a low survival rate.

The actual planting operation is very easy with these tubes. The hole is dug and prepared to the correct depth. The piece of securing tape is pulled off the bottom of the tube (if not already rotted), and the tree and tube put in the hole.

*Member and Director, West Australian Nutgrowing Society

If the soil in the tube is wetted, it is then possible to pull the tube up, over the top of the tree, without exposing the roots or disturbing them at all. The tube has no drainage holes for the roots to get caught in, as happens with ordinary plastic plant bags. The one disadvantage is that the tube must be supported underneath if it is moved, or it may decide to do its own transplanting before you are ready!

Soil mix. I usually make my own soil mix, consisting of one part by volume of red eucalypt (jarrah) sawdust, one part of sewage farm sludge, and two parts of yellow sand. This has proved very successful, apparently having the right combination of drainage characteristics, moisture retention, nutrient value, and low cost. Drainage is very important with container-grown stock, and for this reason the securing tape at the bottom of the tube must be short enough (about 6cm) to permit drainage through the bottom folds of the plastic.

Germination. Another special characteristic of nut seeds is that they often have thick shells and require special treatment for good germination. Even under ideal conditions, germination can take a long time, in some cases several years! Moreover, each sort of nut tends to have its own special conditions, so it is difficult to generalize. The following rules are therefore only guidelines.

Oily temperate nuts (walnut, pecan, hazel, stone-pine): these are usually much improved by stratification (see below) for 4-12 weeks, normally in a dry sealed plastic bag.

Starchy temperate nuts (chestnut, bunya pine, acorns): these must not be allowed to dry out. Either plant immediately, or stratify in damp peat-moss or sawdust in a plastic bag.

Tropical nuts (brazil, *pili*, coconut, *kenari*): pack in individual clear plastic bags, in damp peat moss, and keep in a warm place. Check periodically and plant out as soon as they shoot, else they tend to rot.

Arid-origin nuts (*pistachio, jojoba*, almond): very liable to fungal attack. Containers must have good drainage. Dust seeds with fungicide. Sow in spring or summer, so plants get established before cold weather arrives.

Rain-forest nuts (*macadamia, hicksbeachia*): sow in container filled with moisture-retaining mix (much sawdust, peat, etc.), leave container in shallow tray so it is usually standing in some water.

Stratification. Originally meant conditioning layers of seeds in a pit or cellar, covered with soil or straw, through a frosty or snowy winter. Now usually means storing in the refrigerator in a plastic bag, but not usually in the freezer compartment.

Shade. In the hot dry West Australian summers, some shading is essential for raising most nut plants. Most are naturally forest plants, and would be shaded by mature trees when young. I have a large shade area with a wire roof which I cover with hessian in the summer. This only lasts one summer. Plastic shadecloth, e.g. Sarlon, would be a more permanent, if dearer, alternative.

Osmocote. I have had good results from almost all plants by adding a teaspoonful of 280-day Osmocote to each plant at the time of potting into individual plastic bags.

Other plant methods. Very few nut plants can be grown from stem or leaf cuttings except under highly specialized conditions (intermittent mist, rooting agents). However, some (pecan, chestnut) can be grown from root cuttings.

Hazel and chestnut can be grown from layers (bending branches over into the ground

and pegging down till they root). Many difficult tropicals (macadamia, cashew) can be reproduced by marcotting or air-layering (holding peat or soil around a branch till roots form). All these methods have the advantage that they are vegetative, so that the parent variety is retained in the new plant (with root cuttings, it is the root variety which is propagated, of course).

Budding and Grafting. This is a very complex business. For more detail, consult one of the books listed below. Nut trees are often difficult graft subjects. Almonds are easy. Macadamias and some others require highly specialized techniques. Grafting is a very satisfying technique to master, but it comes only through practice.

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BIRD DAMAGE TO NUT CROPS, A 'PAPER' SYMPOSIUM

INTRODUCTION. Many prospective nut growers, particularly those contemplating almond production, are greatly concerned about the possibility of losing part or all of their crop to birds. In an attempt to find out how much of a problem bird attack can be, the letter reproduced below was sent to twelve government organizations covering the whole of Australia. The replies that were received are reproduced, in whole or part, and are followed by an evaluation and summary.

"I am writing to you on behalf of our members to ask if you can give us any information on 'Bird Damage to Nut Crops'. We are interested in such things as types of nut affected, seriousness and economic importance of bird attack, protective measures which have been tried (whether successful or not), and bird species involved (if known).

A similar letter to this has been sent to most state and federal authorities with horticultural interests. Replies received will be collated and the results published in the 1976 edition of our WANS Yearbook. The Yearbook goes out to our widespread membership, currently in all Australian states and in six overseas countries, so any information you can give us on this topic will be widely disseminated among persons to whom it will be of real value."

1. NORTH-WEST AUSTRALIA

(CSIR0 Division of Tropical Crops and Pastures: Kimberley Research Station, Kununurra, WA. 6743. A.L. Chapman, Officer-in-Charge).

I wish to advise that we have no information on 'Bird Damage to Nut Crops'.

2. NORTHERN TERRITORY

(Department of Northern Australia: Animal Industry & Agriculture Branch, P. 0. Box 146, Katherine, N. T. 5780. C.W. Brockway, Pulse Agronomist).

My field of research includes peanuts, which are grown commercially around Katherine and further North to Darwin. Cashew nuts are also grown in the N.T., but termites and labour costs restrict their production to home gardens and missionary settlements.

Peanuts:

Along with wallaby and pig depredation, bird damage to peanuts can be considerable. The kernels are sown 3 to 10cm deep, and if the soil is too wet some seeds may not be covered. Germination is epigeal and the cotyledons are vulnerable following emergence. Galahs and cockatoos can therefore reduce the plant population to a large extent, depending upon the area sown and the size of the bird flock. In one trial area of 2ha last wet season, little corellas reduced the plant stand by about 20%. The damage is often in small patches perhaps near trees etc. and may in the case of trial plots result in completely bare areas of over 100m^2. Apart from odd plants which may emerge late, the damage can only be partly compensated for by the remaining plants.

As the nuts develop underground they are generally safe from bird attack, although wherever wallabies or mechanical damage results in pods being exposed, cockatoos may eat any mature nuts.

Once the crop is dug and windrowed the crop is completely exposed to the elements for at least a week before the nuts are dry enough to thresh and be stored. The longer the nuts are exposed, the greater the population of cockatoos and galahs which appear for several hours in the morning and afternoon, to pick up nuts left on the ground and eat directly from the

bushes. One such trial area was deliberately left windrowed for about a month. At the end of this time little corellas had virtually stripped the 1ha area of peanuts.

Crows have also been observed in small flocks of 20-30 eating windrowed peanuts.

If the crop is harvested promptly, say 3 to 5 days after digging, bird losses are probably less than 10%, but on small crop areas of l-2ha, as large flocks of galahs are attracted, losses may increase to as much as 50% when harvesting is delayed.

Sulphur Crested Cockatoos (*Cacatua galerita*) occur in flocks of 10 to 100, Little Corellas (*Cacatua sanguinea*) usually in flocks of 50 to 100, and Galahs (*Eolophus roseicapilus*) in mobs of 50 to 1,000.

Generally gas scare guns are used to discourage birds, and this is reasonably effective if used in conjunction with a shot gun. Control shooting is ineffective due to the large numbers of birds involved. I have consistently shot up to 50 galahs a day for several weeks without any apparent decrease in crop damage. Such shooting does make the birds more cautious and nervous, thereby increasing the effectiveness of the gas gun. Cockatoos seem to be more easily deterred by shooting, particularly if there is an alternative food source available. A 'safe' sacrificial' crop of Sorghum may be grown to mature coincident with the more valuable crop of nuts. Birds can then be driven off the peanuts into the sorghum and left to feed there in peace.

Cashew Nuts:

Due to the acid-containing seed coat of these tree-borne nuts, they are not subject to bird attack. The cashew apple to which the nut is appended may be eaten by small birds and flying foxes, however. As the nuts are usually gathered from the ground, nuts caused to fall by birds eating the fruits are not lost.

I trust that this information is satisfactory for your purposes and wish you well in the publication of your book. If you require further information we will be glad to assist.

3. QUEENSLAND

(*Department of Primary Industries, William St., Brisbane, Qld. 4000.*

H.M. Groszmann, *Director of Horticulture*).

I would advise that while we do have problems with bird damage in some horticultural crops, the major nut crop grown in this State, namely Macadamia, is not in any way affected by them.

4. NEW SOUTH WALES

(*A. Department of Agriculture: Division of Horticulture, 157 Liverpool St., Sydney, N.S. W. 2000.* **R. Sweedman**, *Principal Horticulturist*).

The following items are submitted for your consideration:

Bird Damage to Almond Planting

The following information was supplied recently by the Department's District Agronomist at Bourke which highlights the very serious threat of bird damage to isolated horticultural plantings.

Mr. J. Buster, "Darling Farms", Bourke last year planted 20ha of almonds and was planning to increase the planting to 40ha this winter. During 1975-76, 500ha of grain sorghum was grown near the almonds.

The common pink and grey galah attacked the sorghum but did not destroy the crop due to availability of natural galah foodstuffs and also to the dilution effect of larger grain crop areas in the Upper Darling this season.

Natural timber for bird roost is not abundant near the "Darling Farms" irrigation.

The galahs, after feeding on sorghum, and for no apparent reason, attacked the nearby almond planting. I have not visited the almonds but Mr. Buster reported 70-80% damage through ringbarking, stripping of bark, and chewing off limbs. Trees would have been about 1m tall.

Mr. Buster is ploughing in the almonds and not proceeding with further planting. Galahs had been anticipated as a problem in the cropping, but not during the establishment phase.

Control of Birds in Pecan Crops

Mr. D. Stahmann of Stahmann Farms Inc. has established a 684ha planting of pecans at Binniguy near Moree N.S.W. Bird damage has caused some concern this season in this planting which is carrying its first light crop since planting in 1971.

Mr. Stahmann reports that the following control measures are the most successful in controlling birds in his New Mexico, U.S.A. plantings - a light plane is flown through the flocks of birds and two men fire at them with shotguns. Apparently the measures are so successful that some large birds, notably crows, have "dive bombed" and been found impaled by their beaks in the soil.

Bird Control Using Cracker Cartridges

Attached is a copy of an information release on bird control using delayed fuse crackers, the same used to control birds at Kingsford Smith Airport. I am unable to comment on the effectiveness of this method, but it obviously has much to commend it and is certainly worthy of trial.

Hoping these items are useful to you for inclusion in the yearbook.

(*B. Department of Industry and Commerce: Munitions Filling Factory, St. Marys, N.S.W. 2760.* **W.N. Wensley**, *Manager*).

With reference to your letter in regard to our "Bird Frite" 12 gauge Cracker Cartridge, I have pleasure in enclosing a brochure giving a description of the usage and performance of the product, together with a current price list.

Being an explosive device, it is necessary to obtain approval of the State Mines Department prior to the sale or usage of the product in each individual state. At the present time, it is registered for sale in New South Wales, Victoria and Queensland. No approach has been made to other State Departments, but we anticipate that acceptance would be a formality if a demand for the product was developed.

In the rural areas, "Bird Frite" has been used on sorghum crops in north western New South Wales, on rice crops in northern Queensland, and numerous evaluations have been carried out by reputable Grazier Co-operatives. In your area of nut crops, an evaluation is at present being carried out by "Sun Garden Packers Pty. Ltd." at Mildura, where there has been bird damage to the almond orchards, but to date we have had no feed-back on performance.

Our descriptive brochures include the following information:

'Bird Frite' 12 gauge cracker cartridges

MFF has developed, for the Commonwealth Department of Transport, a cracker cartridge to scare seagulls, starlings or other birds which can be hazardous to aircraft during take-off or landing.

The cartridge, "Bird Frite", has been used at Kingsford-Smith Airport in Sydney since December 1974 and is approved for sale in New South Wales and Victoria.

By far the most effective method of controlling birds where safety is involved, it has also been used to discourage unwanted birds or other crop-damaging animals in vineyards,

orchards and rice fields and on farms.

Being non-injurious, the cartridge can be used all year round on wild life without risk or loss of livestock or domestic animals. It is suitable for firing from any 70mm-chambered 12-gauge shot-gun, but is not recommended for automatic shot-guns. Maximum range of about 75 metres is achieved with the gun fired at about 20 deg. elevation. Range downwind can approach 100 metres. On firing, a delay fuse attached to the "cracker" is ignited by the propelling charge and burns with a faint smoke trail for two or three seconds before ignition of the "crackers" pyrotechnic bursting charge. The "cracker" burst is accompanied by a brilliant flash of light and small cloud of white smoke. The explosion noise level is about 145 decibels 10 metres from the point of burst.

The delay fuse is timed so that the explosion occurs as close as possible to the birds. The range and elevation should be taken into account by the shooter. The cartridges are not designed to kill wild life.

The cracker should not be exploded close to people or in confined spaces or in the presence of flammable liquids or gases. The cracker cartridges sell for 40 cents each.

The RAAF, which recently carried out a technical investigation into the service role of "Bird Frite" and reported favourably on its performance, is expected to use the cartridge for flight safety, The Army has also evaluated the "cracker" as a battle simulation device; results are not yet known.

5. TASMANIA

(*Department of Agriculture, G.P.O. Box 192B, Hobart, Tas. 7001.* **D.M. Hunt**, *Acting Chief Horticulturist*).

It is advised that birds have presented no problems with the limited plantings of nuts in this State.

6. C.S.I.R.O.

(*Division of Horticultural Research, G.P.O. Box 350, Adelaide, S.A. 5001.* **J.V. Possingham**, *Chief of Division*).

In reply to your letter seeking information on the topic of "Bird Damage to Nut Crops", I can provide the following data supplied by Mr. D.H. Maggs of our Merbein laboratories.

We have experienced little damage to nut crops on our Research Farm experiments, although of course galahs are notoriously destructive to almonds. The species we grow are *Macadamias*, both *tetraphylla* and *integrifolia*, walnuts, pecans, almonds and pistachios.

Crows sometimes take a few walnuts after the leaves have fallen. Galahs have once or twice damaged the highest shoots on pistachios, and where there has been good cover in nearby *P. atlantica*, ring-necked parrots have taken a few nuts.

Gregarious galahs have cleaned up single leafless trees in a small patch of almonds. Bird damage to fruits and fruit tree buds is common in most countries and there is considerable research currently in progress, much of which is reported in Horticultural Abstracts.

On the birds' credit side, it must be remembered that they effectively reduce insect damage by feeding on eggs, larvae and adults, although the beneficial species are not often the same as the harmful.

Many protective measures have been tried. Black cotton is good for emergencies in special cases and Cyclone K-M Products are putting out what looks to be a very useful fine netting (Wire Cloth and Netlin Division, 221 East Boundary Road, East Bentleigh, Victoria, 3165 - Leon Slusarski). Mr. Allan Antcliff, also located at Merbein, uses Agrolam to protect

early grapes from damage (Dr. R. Maag AG. Dielsdorf, Zurich, Switzerland).

I hope this information is of use to you.

8. VICTORIA

(*Department of Agriculture.' Scoresby Horticultural Research Station, P. 0. Box 174, Fern tree Gully, Vic. 3156.* **R.N. Rowe,** *Director*).

Concerning your enquiry on bird damage in nut crops, we are unable to be of much help as our Research Institute is concerned with problems associated with stone and pome fruit production.

No bird control measures are known to be used by nut orchardists in Victoria.

Some years ago we did extensive trials on starling control in our experimental cherry block. Of all the methods employed the use of tape recorded starling distress calls amplified at high intensity throughout the cherry orchard showed the most promise. The starlings became habituated to the calls after about 7-10 days. There is no guarantee that a similar system would control birds frequenting nut orchards in West Australia.

9. SOUTH AUSTRALIA

(*Department of Agriculture and Fisheries, 25 Grenfell St., Adelaide, S.A. 5000.* **B.T. Baker**, *District Horticultural Adviser*).

I enclose a copy of some South Australian literature on bird control in almonds. This literature is the result of trial work carried out in the 1972/73 almond growing season to assess an electronic bird scarer, the Av-Alarm. The literature details the result and gives information on species controlled.

Experience shows that a combination of control techniques is necessary for effective control e.g. Av-Alarm, gas scare guns and orchard patrols using live shot at dusk and dawn when birds are most active.

I will look forward to seeing a copy of the 1976 WANS yearbook.

Better Bird Control in Almonds

Are birds of any use in almond orchards? Birds eat insects and grubs. Are the good effects of this activity far outweighed by the damage the birds may cause to the maturing crop? Or is a bit of damage to the crop a small price to pay for reducing the population of harmful insects?

Different species of birds in some areas do cause serious damage to almond varieties. Isolated orchards, those near the edges of settlements and those near swamps or lakes, appear to be the worst affected. Soft shelled varieties are the worst hit.

In general, birds feed most heavily early in the morning and again late in the afternoon. Growers must adjust their control schedules to fit the birds' feeding habits.

Birds are creatures of habit. If food is plentiful in a given area, they will return again and again. After four or five days they will be completely habituated to an area. Once this occurs it is extremely difficult to evict them with any control method. Thus, if birds get used to an orchard and its insects before the almonds mature, they will simply move in on the almonds as they ripen. Bird control programmes must start long before the almonds become vulnerable to attack.

Other factors such as season, weather, location of perches and night roosts, etc., have some influence on bird numbers and habits in a given area, but the effects will vary from locality to locality.

Pest species such as the crows and galahs may be shot or poisoned if this method of control is safe and has been found to be useful. However, fully protected native birds must be controlled by some other means, e.g. many cockatoos.

Most scare methods such as exploders, gunfire, flashing lights, plastic hawks and owls, are only effective for a short time. Most birds adjust to these devices within two or three days and then ignore them.

Careful use of amplified natural alarm sounds of the species causing the damage may scare them away for a short time. But even then many species get used to and ignore their own alarm sounds if they are repeated too frequently.

A new electric gadget which is claimed to discourage birds from remaining in an area by producing high intensity sounds, is the Av-Alarm scarer. This device is said to interfere with normal bird-to-bird communication so that the birds do not perceive each other's mating, warning or territorial calls. They move to a more congenial environment elsewhere.

Realising the bird damage problem in some areas it was decided through the Almond Trust Fund Committee, to assess the recently introduced Av-Alarm bird scaring device in almonds. A four speaker unit was installed at Nildottie on December 20th, 1972 just as nuts were becoming attractive to birds and operated daily, particularly from dawn to noon and late afternoon.

An assessment of the unit was made on March 8th, 1973 prior to harvest. Birds were observed perched in trees cracking nuts or after knocking nuts to the ground by flapping their wings in the trees, eating fallen nuts.

Either way, the broken shell pieces and husks fell close to the tree and this debris was used as the basis for assessment. All debris under 8 trees in each of three sites was raked up and collected. Similar trees in each site were selected and all were the Chellaston variety. The sites were 70, 400 and 800m from the bird scarer. The main birds causing trouble were galahs, cockatoos and crows.

The exposure to birds in each site was similar but trees on a neighbouring property were slightly smaller than the other sites. All sites were also protected with gas scare guns and orchard patrols with live shot.

The debris from under trees was collected and later sorted into the following categories:

(1) Undamaged "in shell" nuts.
(2) Damaged nuts and shell pieces.
(3) Husks.

The number and weight of undamaged husked "in shell" nuts were determined. An estimate of the number of nuts damaged was made by assembling samples of shell pieces into approximately complete shells and weighing to determine the relationship between weight of shell pieces and number of kernels. An estimate of the number of nuts damaged based on cracking percentage of complete "in shell" nuts would be unsatisfactory because the debris collected did not include the smaller shell pieces.

Site	Distance from Scarer Metres	Undamaged Nuts Under Tree g/tree	Bird Damaged Debris Calculated Kernels Lost/Tree	
			g	lb
1	70	183	0.20	0
2	400	186	10.80	0.2
3	800	243	546.00	1.20

The bird scarer was effective in repelling galahs, cockatoos and crows. Crows were observed, however, approaching the scarer from the windward side on windy days.

Gas scare guns and orchard patrols with live shot were considered necessary to maintain the effectiveness of the scarer.

The estimated loss of kernels varied from 0.2 to 546 g/tree, resulting in a maximum economic loss of approximately $225.00 per hectare (85c./lb.) at the site 800m from the bird scarer. The unit under test covered an area in excess of 8 hectares (20 acres) and cost $700 working.

At Nildottie, it appears that the cost of the tested unit could be easily recouped in one season. This may not be the case in other areas, however, if the level of bird damage is not as high as experienced at this site.

Summary:

1. The unit under test was the large 4 speaker Av-Alarm bird scarer valued at $700. It was effective over approximately 8 hectares (20 acres).

2. At Nildottie the normal level of bird damage was high and cost of this machine could be recouped in one season. This may not be so in other districts where level of damage is lower.

3. It is considered that best control is achieved through use of several methods simultaneously. Gas scare guns and orchard patrols using live shot are considered necessary to maintain the effectiveness of the scarer.

4. Whatever control method is used, it must be commenced early and followed through until the crop is harvested. The work must be conducted daily, including weekends.

5. Experiments in other parts of the world suggest that birds become habituated to these devices also. At Nildottie in the 1972-73 almond season it was very effective.

Birds likely to attack almonds:

Willunga Area: Crow, Yellow-tailed black cockatoo, Galah, Adelaide rosella, Red-rumped parrot.

Nildottie Area: Crow, Sulphur-crested cockatoo, Little corella, Galah, Yellow rosella, Mallee ringneck, Red-rumped parrot.

10. WESTERN AUSTRALIA

(*Department of Agriculture: Horticulture Section, Jarrah Rd, South Perth, W.A. 6151*)
No reply was received from this organization.

SUMMARY AND EVALUATION. The lengths and emphasis of the comments printed above generally reflect the importance or otherwise of bird damage in the different areas. The problem is worst, apparently, with almond crops in South Australia, where soft-shelled varieties are especially prone to damage. The next most serious case is with peanuts, in the Northern Territory, although this is largely a reflection of harvesting conditions. There was no mention of peanut damage in the North West or in Queensland, although this crop is grown widely in these two areas, especially the latter.

The New South Wales account of birds attacking young, non-bearing almond trees seems to be almost a freak occurrence. Queensland, Victoria, and Tasmania appear to have no problems with bird damage.

It is a sad, if typical, reflection on our own West Australian Department of Agriculture, that they were the only organization written to which did not even bother to reply. Conditions in the south of our State are roughly comparable with those in South Australia, and our bird

damage problem is also similar; that is, it is most noticeable with soft-shelled almond varieties. With almonds, it would seem a basic precaution to plant hard-shelled varieties.

I have seen, in a suburban Perth garden, a paper-shell almond almost completely stripped of its crop by parrots, next to a hard-shelled variety with its crop virtually complete. Perhaps the best advice would be, not to plant soft-shelled almonds unless you are contemplating a very large operation where the necessary bird-discouraging measures could be afforded.

Although paper-shell and soft-shelled almonds are liked in the sold-in-shell trade, such nuts are more poorly sealed and have insect attack and deterioration problems avoided by harder-shell varieties. Moreover, for the increasingly important shelled-nut or kernel trade, soft shells are no advantage, or even a disadvantage (due to inconsistent mechanical cracking).

Bird problems are rare with walnuts and pecans, probably because of the unpleasant-tasting husk surrounding the ripening nut. With chestnuts, the prickly burr seems to be an effective deterrent. With macadamias and hazel nuts, the thickness of the shells seems to be the main protective factor.

Typical methods of combating bird damage include shooting, scaring with cracker cartridges, electronic and audio alarms, and covering trees with nets or repellent substances, fine thread, etc. A method not mentioned by any correspondent is the use of trained predatory birds such as falcons. These have proved very effective overseas in keeping airports clear of birds (a considerable hazard to jet engines), but of course are not easy to get into operation, due to the complex and personal training these predators require.

Two correspondents brought out the very good point, that birds have useful properties in insect control, and are not purely a negative influence. As in most things, an acceptable ecological balance is the ideal state to achieve.

SOME NUT TREES OF THE NORTHERN TERRITORY

DENNIS A. HEARNE*

One nut tree on which I have recently had several enquiries is *Semecarpus australiensis*, the species is practically unknown in the area, and although edible, (but I would query palatable!), has no apparent commercial application. Pre-cyclone, one existed in the Botanic Gardens, but Tracy took care of it; and most of the other naturally occurring trees are in the Gove area. Personally, I doubt if the species is worth considering, unless some varietal form were discovered which might have a better horticultural application.

A nut that is not well known, but one which is well worth growing both in the home garden, and in plantation, is *Horsfieldia australiana*. To my taste, it runs rings around any almond I've ever tasted; it crops heavily every year, and the fruit all fall on Christmas day plus or minus two days, and it is paper shelled.

Add to that, a kernel of over twice the volume of a reasonable almond, and a taste that is excellent, either raw or roasted, and you have it. The only drawback is the fairly limited "shelf life" of the nut. Deterioration of flavour and texture takes place after three months or so of storage with fresh nuts, but I don't know about the roasted ones, they are never on the shelf for that long!

Other nut bearing trees in this area are:-

Terminalia okari
Terminalia catappa
Terminalia arenicola
Terminalia sericocarpa (Fruit as well, but the kernel is small)
Canarium australianum
Myristica insipida (not palatable)
Artocarpus incisa (Bread nut)
Artocarpus heterophyllus (Jack fruit)

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THE LANGANDA NUT, *TERMINALIA LANGANDA*, OF NORTH-WEST AUSTRALIA

IAN M. CRAWFORD*

Editor's Note. The nut described in this short article is not well known. The botanical name used here is *Terminalia langanda*. The nut is certainly from a species of *Terminalia*, which may not have been previously assigned a species name. It has apparently been erroneously referred to as *Terminalia fitzgeraldii*, but this is a different species.

***

I am in the process of finalising a manuscript for publication on the Aboriginal use of plant resources in the Kimberley region. These plants include a species of *Terminalia* nut, which the Aborigines call 'Langanda'. The State Herbarium has not been able to identify this plant exactly.

The tree is also referred to as the 'bush almond'. It flowers in August or thereabouts, and the nuts are ready from Christmas time to the middle of the year.

The aborigines break the shell and eat the kernels raw. If the fruit is wet, they leave it. The kernels are sometimes also roasted in the fire, like peanuts.

The tree grows in what the aborigines call 'bera' and 'djirulgar' country, that is, in leached sand and laterite country. The aborigines have their own names for the seasons, and regard the langanda gathering time as 'djaward' to 'yirma', which corresponds roughly to December to August.

Another species in the Kimberley which produces an edible nut is *Terminalia grandiflora* Benth. This is a small tree which the aborigines call 'yalu'. Aborigines crack the nuts and eat the kernels without preparation. The tree grows on alluvial flats, and the season is roughly late December to end of April.

Specimens of the langanda nuts have been displayed in the Western Australian Museum. The nuts are almost spherical in shape, and when dry are covered with a hard black pith which cracks irregularly to expose the lighter shell surface. The nuts are 2-3cm across and the shells are thick and woody, so the kernels are quite small.

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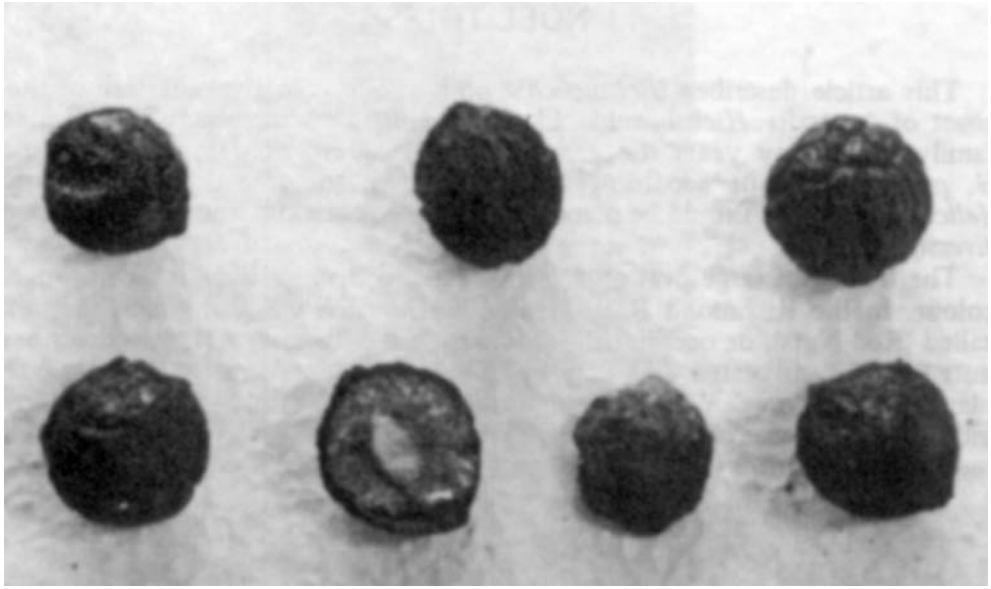

Langanda nuts

Editor's Note 2. The photograph shows some specimens of the nuts, kindly supplied by the Office of the North West (220 St. Georges Terrace, Perth). They also supplied the following comments.

> "The Terminalia species grows on the sandhills that occur on the edge of the Great Sandy Desert. To the best of our knowledge there have been no attempts at cultivation. It is a low, shrubby tree, 3 to 4m in height. The aborigines consume the nuts as opportunity offers."

HICKSBEACHIA, A NEGLECTED NATIVE AUSTRALIAN NUT

NOEL THIES*

This article describes *Hicksbeachia pinnatifolia*, a native nut tree of the east coast of Australia. *Hicksbeachia*, like *Macadamia*, is a member of the Proteaceae family. For many years the genus was believed to contain only one species, *H. pinnatifolia*, but according to Sleumer (1), the tree previously known as Helicia diversifolia should be placed in the same genus and known as *Hicksbeachia diversifolia*.

The tree bears large oval nuts, 3cm long and 2cm in diameter, of a bright red colour. In the Richmond River area of northern New South Wales, the nuts are called 'Red Nuts', or occasionally 'Monkey Nuts'. Rumsey (2), who described the nuts in 1927, suggested that they be called 'Rose Nuts', due to their close resemblance to rose 'hips'. When the nuts are first ripe, the red husk is quite shiny and plum-like; as the nuts dry, the husk wrinkles but does not split off, and remains red for some months (Fig.1).

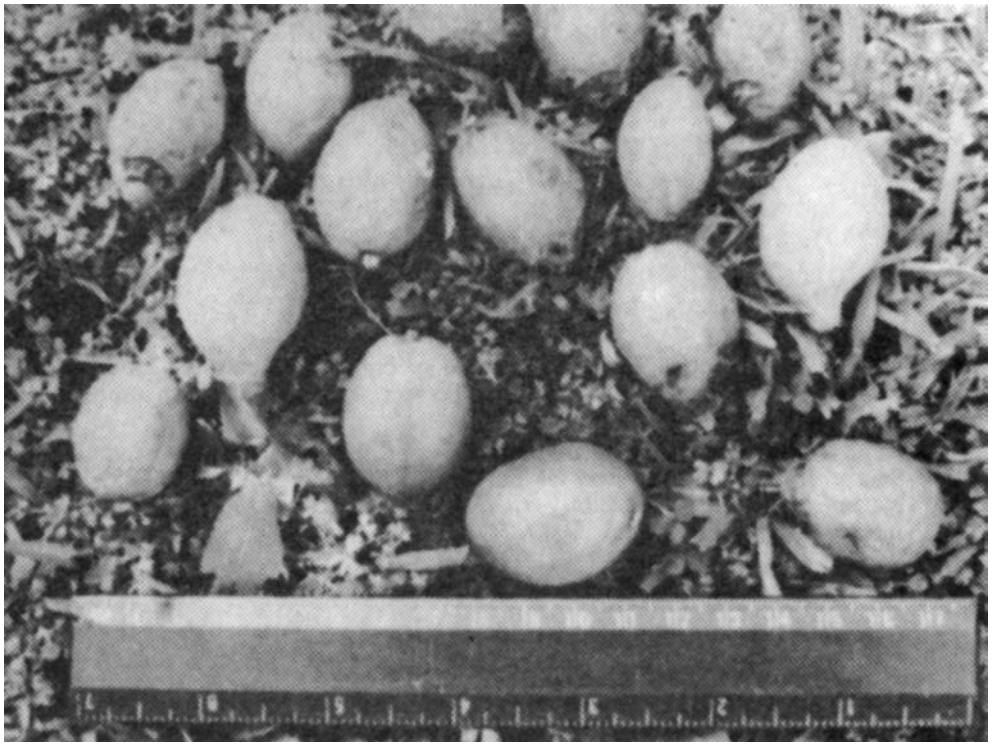

Fig.1. Hicksbeachia nuts

Leaves of the tree (Fig.2) are quite different to those of the macadamia, being made up of a number of leaflets, usually thirteen to nineteen. The complete leaf is up to 60cm long. The leaves are rigid with toothed margins, and have veins which are impressed above and raised below.

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Fig. 2. Hicksbeachia leaf.

The tree (Fig.3) grows to 10m tall, with a trunk diameter up to about 20cm. Because of the small size of the tree, the timber has no commercial value. As well as having edible nuts, the tree has considerable ornamental value, with its large unusual leaves and bright fruit.

The outer red covering of the nut looks quite edible, but this is not the case. If bitten into at this stage, it seems to deaden the flesh, somewhat akin to a cocaine injection. The fleshy outer covering dries out to a very leathery surface, making the nuts hard to open.

The kernel itself is fairly hard, and the flavour is rather agreeable. When ripe, the nuts are eaten by some birds (probably the white cockatoo), and also by some native marsupials. According to Anderson (3), the nuts are not as good a flavour as the 'Bush Nut' (*Macadamia tetraphylla*).

The flowers appear in long racemes up to 30cm long (Fig.4), each containing hundreds of flowerlets, but under natural conditions not many appear to set fruit. The flowers occur on any part of the trunk, in fact I have seen them at ground level (Fig.5). The main flowering period for my area is late winter to early spring (July to September). Flowers and nuts are often present on trees at the same time (Fig.6).

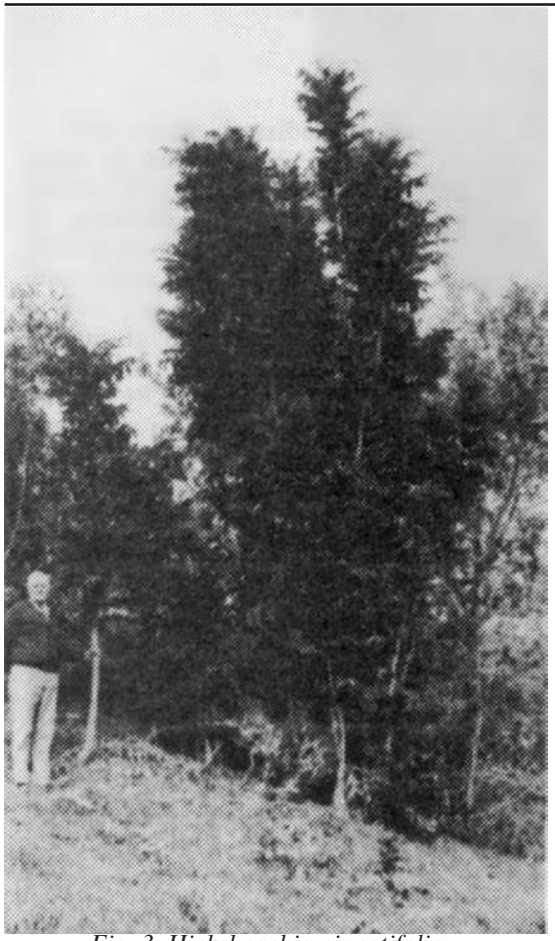


Fig. 3. Hicksbeachia pinnatifolia.

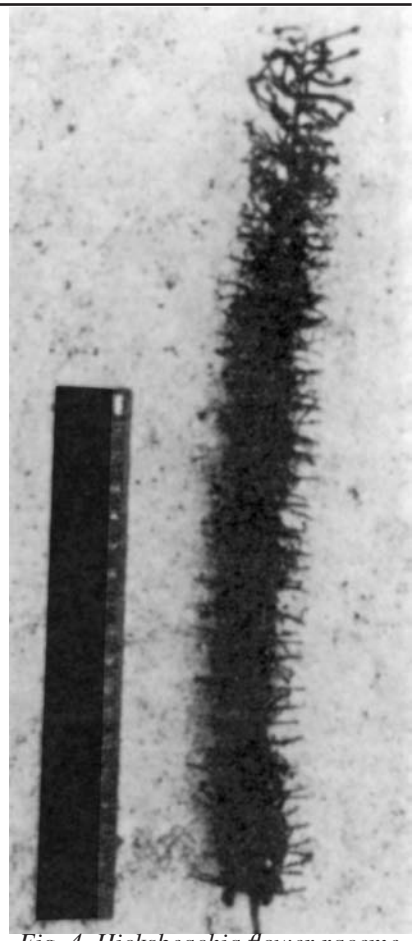


Fig. 4. Hicksbeachia flower raceme.

Nuts seem to germinate fairly readily under natural conditions, but in this area never get much opportunity to develop, because of over-stocking. Very few trees growing now appear to be seedlings, or if they are, they have been broken down and have then suckered from the stump, making most of them multistemmed (Fig.3). Where roots have become exposed on a roadside, suckers have grown up, and these flower and fruit quite freely. Figure 7 shows one of the few trees grown from seed which has grown really well for us. At five years old, it is about 1.8m high, but so far it has not flowered.

The natural area of distribution of the tree is described in Francis (4), but basically it appears in the East Coast rain-forest strip of northern New South Wales (from the Bellinger River), up into north Queensland. It is now comparatively rare. The map shows some locations in northern N.S.W. where I have found a few trees still existing.

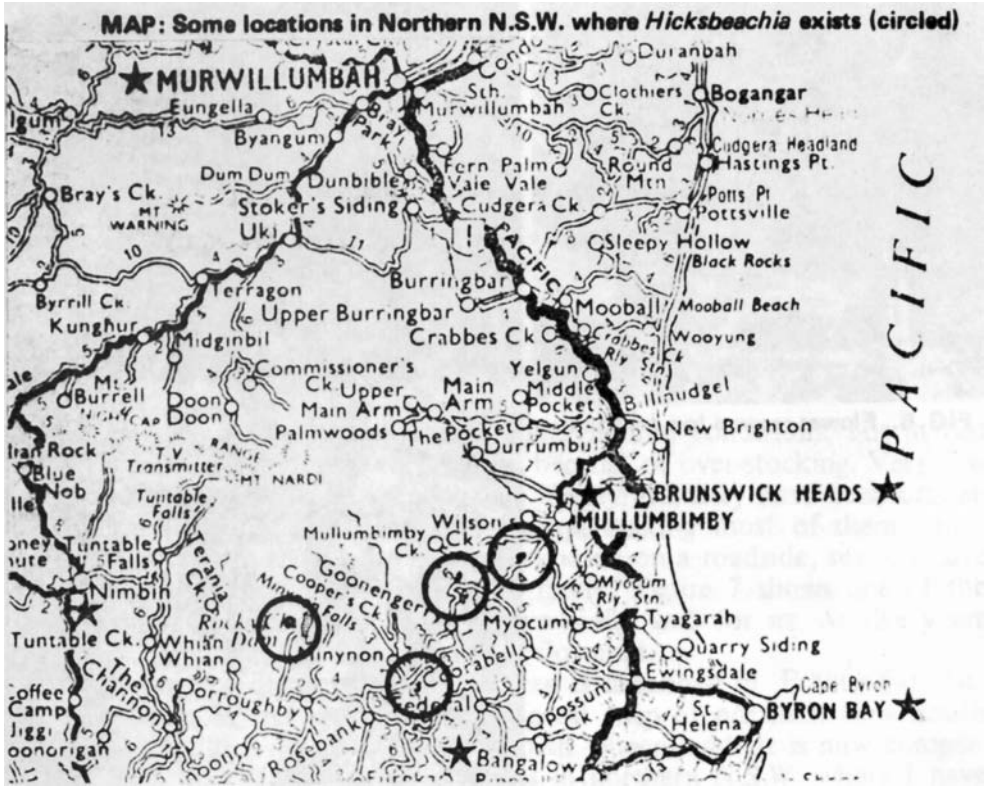
Cribb (5) mentions the striking appearance of the plant, and the fact that the kernels are edible. No serious attempts appear to have been made to develop the tree, as an ornamental or as a food source. Such an attempt seems to be well worth while.

Fig. 5. Flower raceme low on trunk.

Fig. 6. Flowers and green nuts.

Fig. 7. Tree 5 years old, grown from seed.

Map: Some locations in Northern N.S.W. where Hicksbeachia exists (circled).



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SOME NOTES ON NUTGROWING IN THE SOUTH-WEST

NEVILLE SHORTER *

I have been very interested to hear of the progress made by your Society. In my role as Horticultural Adviser for the Department of Agriculture in the South West region, I am aware of the general and increasing interest in the cultivation of nut trees.

We are planning to collect a range of propagating material available from within Australia, and to move into more intensive field evaluation of different types and varieties of nuts including Walnuts, Pecan nuts, Hazel nuts, Almonds and Pistachio nuts. We would be keen to co-operate in any way we can and to receive any suggestions from your Society.

You will be interested to know that there are 2 large 15 year old Pecan nut trees on the property of George Parke, orchardist nurseryman of Donnybrook. Trees are now bearing regularly. Seedlings germinate readily under this tree and Mr. Parkes is interested in re-working more desirable varieties on to these seedlings when material is available. The nuts on the established trees are rather small, although the kernels are well formed.

Walnuts have been fairly widely tried in the southwest, mainly in the established fruit growing areas on better soils. Plantings are usually limited to 2 or 3 trees in a corner of a block. The most favoured varieties have been Franquette and Freshford Gem.

Properties which come to mind are Roelands Native Mission, Roelands (Black Walnut trees were also grown), George Parkes, Donnybrook, A. Compagnone (formerly R. Kitneys, Donnybrook), C. Seia, Balingup (also has Spanish chestnuts), R. Polina, Bridgetown and A. Jeffreys of Bridgetown, (Trave Mayette planted in addition to Franquette and Freshford Gem).

Irrigation with salty water has presented problems in the Bridgetown area where trees, once established, would be better grown without irrigation, unless a suitable source of quality water was available. A salt effect has occurred at V. Scott's, Nannup.

One larger Walnut planting is Neil Fontinini's of Seven Day Road, Manjimup (again also has chestnuts). There is another smaller planting near Pemberton. W. Leutert is establishing a mixed nut planting at Manjimup. At Bridgetown, T. Speers is having some success with propagation of Walnuts.

Lou Bazzani of 'Olea' nursery, Manjimup has grown grafted Walnuts very successfully in the past.

Odd instances known to me of Macadamia trees having grown successfully are at E.P. Dewes, Harvey and one at Glen Iris, Bunbury.

John Dawson of Donnybrook is interested in the propagation of nut trees.

We would be grateful to receive any information on propagating material which might be of value to us.

We have produced 'a general leaflet on Walnut growing (now due for updating and enlarging) which we distribute from this office.

Contact us if there is any way we can be of assistance.

* Horticultural Adviser, Bunbury Regional Office, Department of Agriculture, Bunbury W.A. 6230.

THE MARULA, *SCLEROCARYA CAFFRA*, AN AFRICAN NUT TREE

P. van WYK*

The marula, botanically *Sclerocarya caffra*, is one of the important trees of Africa. It has a very wide area of distribution, and has been a food source for man since prehistoric times, providing edible fruit, and edible kernels from the nuts inside the fruit. It is a source of drugs and timber also. It makes a fairly large, attractive, spreading tree (Fig. 1), and currently is held in high regard by both the African native and the European settler.

Distribution

This very well-known tree species has a wide distribution in Africa: from Ethiopia and the Sudan in the north to the lowlands of Natal in the south, and from the southern part of South West Africa and Botswana in the west to the Transvaal and Mocambique in the east. For some obscure reason, no available literature mentions that it also occurs in Rhodesia or Zambia. In the Transvaal it is found in the central regions from the Magaliesberg Mountains to the Limpopo, and throughout the Lowveld.

The marula has the widest general distribution of all trees in the Kruger National Park, being found in every ecological niche in the area. Its associations in the Park are described more fully in (1). According to Palmer (2), it grows in different types of soil - often on sand - usually in warm frost-free lowveld areas, although trees occur close to the Wonderboom on the outskirts of Pretoria. De Winter (4) says that it is found mainly on sandy soils or occasionally on sandy loams.

Description

It is a moderately large (15 to 18m in height), deciduous (leaves turn yellowy-green to pale yellow before being shed), single-stemmed tree with a rather dense, wide-spreading, round crown. The normally straight, round stem generally subdivides about 3 or 4m above ground level, and often becomes as much as 60cm in diameter.

The young twig terminals are abnormally thick and digitaliform, slightly rough because of small scale stipules which persist for some time, and are brown to browny-green in colour. The twigs display noticeable leaf scars and retain their grey to pale grey colour even on thick stems. The bark on old stems is fairly smooth and peels off sporadically in rather large, flat, irregular, more or less round discs, thus exposing the underlying yellowy bark which gradually turns grey. The stems therefore appear to be pale grey with yellow patches. The inner, living bark phloem is red just under the dead, cork-like layer and pale red where it lies against the wood (xylem).

The leaves are borne close together at the ends of the twigs. They are arranged spirally and may become as much as 30cm in length but are usually about 15cm. Leaves are imparipinnate and generally consist of three pairs of opposite, lateral leaflets and a terminal one. Very occasionally there may be only one or two pairs of lateral leaflets. It has, however, been noticed that on very young trees there may be up to seven pairs of lateral leaflets. The leaflets are subelliptic to lanceolate, acuminate at the apices, usually slightly asymmetrical and cuneate at the bases but occasionally broadly cuneate. They are about 6cm in length and 3cm

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Fig. 1. The marula, Sclerocarya caffra.

in breadth. They are moderately hard and fairly brittle, pale green to green and shiny above but dull, pale green beneath, marginally entire usually somewhat undulate, and sometimes curved upwards or downwards lengthwise. They are also smooth, glabrous, and usually pendent. The leaflets on young trees have conspicuously serrate margins. The veins are quite noticeable on both surfaces with the midrib raised on both sides of the blade and the secondary veins only slightly exserted above. The petioles are pale green to yellowy.green in colour, flattened along their upper sides, glabrous and markedly broadened at their bases.

The petiole and rachis have sharp little ridges along both sides over almost their entire length. Petiolules are pale yellowy-green in colour, are up to about 1.5cm in length, smooth and slightly inspissate at their juncture with the rachis. When the tree is bare of leaves the twigs are seen to be noticeably sturdy with blunt tips, and these and the mottled bark help to distinguish the tree in winter. (2).

Flowering

Male and female flowers are usually borne on separate trees. Male inflorescences are borne below new leaves from axil buds of fallen leaves and also axils of new leaves. They consist of long (up to 15cm), sparse, drooping racemes on which the attractive little flowers are usually borne in small groups of three. The flowers are dark red in the bud stage and pink and white when open. They are about 6mm in diameter with petals that curl backward sharply. The peduncles are yellowy.green with red blotches and are faintly pubescent. Quite a number of female florets are borne singly just below the new leaves on quite long peduncles

(up to 3 cm). They are blood-red in the bud and reddish purple and white when open. They consist of four petals which curl backward, a large number of infertile stamens and a conspicuous, shiny ovary (small fruit) which is at first reddish purple but turns green later. The peduncles are browny-green and smooth.

The flowers usually appear in August/September and in a specific instance a male tree was still in full bloom in February. The fruits ripen in January/February, swell on the tree but are still green when they fall, thereafter turning yellow on the ground. Usually only the female flowers develop into fruits, but sometimes a flower in the male spike may also do so (2).

Fruits and Nuts

Fruits are round/oval, slightly angular when young, smooth, glabrous, shiny and up to about 4cm in length. A thick, soft, rather tough exocarp encloses white, slimy fruit pulp and a large, hard, woody stone. The fruit pulp clings to the stone, is not removed easily, and is very watery. The stone is usually triocular (sometimes with two locules only and each contains a single, white nut-like seed which fills the whole cavity. The openings to the locules are situated close to one extremity and sealed by flat, almost round, hard discs like lids which are level with the endocarp and protect the seeds.

Palmer (2) states that the kernels of the stones are as valuable as the flesh for they are rich in oil and protein, comparing well with an oil seed such as the soya bean. It is claimed that the Vitamin C content is four times as rich as in an ordinary sized orange. The tree recently became of interest to nutrition workers for it solves the puzzle of where Africans of the lowveld get the Vitamin C supply they undoubtedly have. They eat the kernels as nuts, or grind them,

Fig. 2. Fruit.

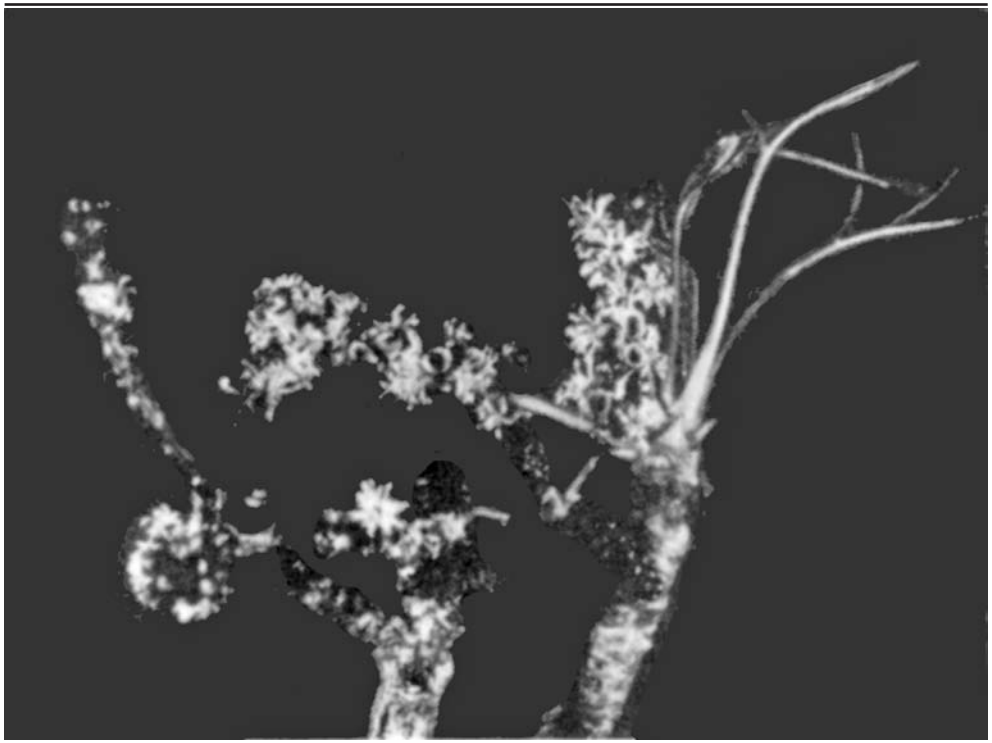

Fig. 3. Male flowers.

using the powder in soups and other foods. The oil from the nut has preservative qualities, and the Vendas use this in preparing meat. They steam this slightly, gradually dripping the oil over it. When dried and stored in a cool place, such meat keeps up to a year.

Naturally the stones are highly prized and are carefully collected and stored by Africans who consider a gift of marula kernels as a mark of great friendship They have been valued and used since immemorial times. Archaeologists and palaeontologists have for many years been puzzled by small pieces of bone, fashioned to a special pattern, found in Iron Age sites in the Transvaal. Not long ago a scientist, passing a lowveld kraal, saw an old African woman wielding just such an instrument, made to the same age-old pattern. With it she was cracking the hard stones of the marula fruits!

The seeds taste very much like walnuts and contain 50-60% oil which is particularly rich in protein (28%). The seeds are eaten raw, or are cooked and eaten with maize porridge. Sometimes the seeds are ground and another type of porridge prepared from the flour. Shelled nuts are frequently offered for sale by Bantu children. The kernels of the fruit have been found by archaeologists on Mapungupwe, the high hill near the banks of the Limpopo, inhabited by a Boskopoid people over 1000 years ago. Because the kernels were unbroken, it was assumed that the flesh only of the fruit was used.

The tree is important to a variety of animals for shade, shelter, and above all for food. Stock and wild animals seek the fruits as eagerly as humans. The fruits normally fall before they are fully ripe, maturing upon the ground, and Africans find it necessary to protect them from marauding animals with rough fences. Elephants travel for miles in order to gorge themselves on the fruit, and monkeys and baboons become drunk on the fermenting flesh. Zebra, rhino, antelope of many kinds, squirrels and porcupines all relish it, and warthogs and

Fig. 4. Trunk and bark.

parrots are known to crack the kernels and eat the nuts. They are also favourites with rats and mice (2).

Watt (3) records that the nut has a very thick shell and the kernel represents 13.9 per cent of the total weight. The kernel is edible and very tasty, especially when cooked. The flavour resembles that of the ground nut. It is rich in a non-drying oil, the yield being 53.5 to 60 per cent. The constants of the oil are available and it is said to contain as much as 28 per cent of protein and some iodine. Other investigations give 90 per cent shell and 10 per cent kernel, the latter (dry) yielding 59.2 per cent of a clear, limpid, pale yellowish-brown non-drying oil. Zulu women crush the kernel and boil the mass with water until an oily residue is obtained, which they use to rub on their skin shirts (sidwaba) to preserve them and keep them soft. In Madagascar the kernel yields 56 per cent of oil which is there known as sakoa oil. The Thonga eat the cooked seed with their mealie meal porridge.

The Pedi use the ground-up kernel for making a porridge, the embryo as a condiment and the leaf as a relish.

Medicinal and Ritual Uses

The bark, fruit, nuts, and leaves of the marula have figured in many native medicines, and also play a part in a wide range of native rituals and superstitions. Some of the medicinal uses

have on occasion been adopted, with some success, by the European.

Infusions of the bark are used as a remedy for dysentery, diarrhoea and, when mixed with brandy, for malaria! The bark contains 10 to 20% tannin as well as traces of alkaloids. It should therefore be a coagulant and quite possibly effective in cases of diarrhoea. Tests showed negative results in the treatment of malaria.

There are a number of interesting superstitions in connection with this species, such as the treatment of a pregnant woman with the pulverized bark so as to determine the sex of the unborn child: bark from a male tree for a son and from a female tree for a girl.

A positive result was obtained by a European in the Kruger National Park when, at the insistence of a Bantu ranger, juicy, mashed, inner bark of a Marula was placed on the painful blisters caused by hairy worms. Immediate relief was experienced and the blisters vanished shortly afterwards.

Watt (3) gives a fairly detailed description of the use of the marula in medicine and ritual. He notes, for example, that the Zulu use a decoction of the bark, externally and internally, as a prophylactic against gangrenous rectitis, and the fruit for the destruction of ticks. They regard the fruit as a potent insecticide. The Thonga celebrate the feast of the first fruits by pouring the fresh juice of the fruit on the tomb of deceased chiefs in the sacred wood; branches of the tree are also used in the funeral rites of the Thonga. The divining dice of the Shangana diviners include a Sclerocarya nut which represents the vegetable kingdom or "Medicine".

Other Uses

The timber is white when freshly sawn and white with a reddish tinge which becomes darker towards the centre when dry. It is fairly light, viz. green 1 070 and air-dry 560 kg/m^3, i.e. 67 and 35 lb/cub ft. respectively. Green wood is easily cut and sawn but becomes exceedingly tough and difficult to work when dry. Linear shrinkage across the grain, for green to air-dry, is about 4%. It is coarse in texture but cross-cuts can be finished quite smoothly. The timber is suitable for fruit-boxes, shelving, pounding blocks, drums and other household articles. It is said to warp while drying unless properly stacked. Borers are particularly fond of the dry timber and preservative treatment is advisable. It is difficult to drive nails into the dry timber.

Among the Bantu in dry areas, the roots of the marula are a well known source of water. The method by which water is obtained is quite interesting. A section of the thick, superficial roots, about 1 to 2 metres in length, is exposed without damaging it by digging from the stem outwards. The root is then chopped free quickly and the bark around one end removed for about 10cm. When the root is held upright with the debarked point downward, clear water starts to drip from it within minutes.

Propagation

According to De Winter (4), the seeds germinate easily; the hard stones should be sown intact. The marula can be propagated by truncheons, 10-15cm thick, which root freely if laid in during early spring. The trees grow fairly fast, and once established are reasonably drought-resistant. However, they will not withstand extremes of cold. In the winter of 1964 (-4°C) large trees were badly injured and even branches of 15 to 25cm in diameter were killed off in the Kruger Park.

The nuts should be planted untreated with the endocarps undamaged to ensure good germination. Each nut consists of a large light-coloured stone with 2-3 cells, each cell containing one seed. The cells are closed with plugs at one end which are forced out as the seeds swell in the moist earth, allowing the embryo to grow out.

Fig. 5. Female flower.

Conservation

The marula is a legally protected tree everywhere in South Africa. Moreover, they have been widely preserved by the native populations for the sake of the valuable fruit. In parts of the Transvaal the marula and the mobola plum are often the only trees left standing by the Africans. Marulas were, however, cut in large numbers by Europeans until some measure of protection was introduced (2).

Botanical Relationships and Names

As noted by Codd (5), the marula is a member of the *Anacardiaceae* family. Most members of this family are trees or shrubs, often with useful edible fruits, for example, the mango, cashew nut, pistachio nut and in South Africa, the Marula (*Sclerocarya caffra*) and Kaffir-plum (*Harpephyllum caffrum*).

The generic name, *Sclerocarya*, is derived from the Greek words for "hard nut" or "kernel", in allusion to the large, woody kernel of the fruit. The species name *caffra* relates to the 'Kaffir' race of South Africa, and has an interesting origin. It stems from the Persian or Turkish word 'Kafir' or infidel, and was originally applied to the South African natives by the Mohammedan inhabitants of eastern Africa.

The European common name is marula or maroela. Native names (2) include: *umGanu* (Z); *umGanu* (Sw); *nkanyi* (Tso); *morula* (Tsw); *morula* (NS); *mufula* (V); *mfula* (Kal); *morwa* (Yei); *uge, muge* (Deiriku); *omuongo* (Her); *omuongo* (Ov).

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PLANNING THE FILBERT ORCHARD FOR FUTURE SAVINGS*

H.B. LAGERSTEDT**

The first year is the most important year in the establishment of a filbert orchard. Planning decisions and cultural practices employed when the orchard is established, set the pattern for much of its future health, growth and ultimate nut yield. Most of these decisions and practices have been researched and reported during the past few years (1,9, 10, 11, 13, 15). They are summarized here as a guide to efficient orchard establishment.

Planning the Orchard. It is false economy to use a cull tree. A higher quality tree may cost a few cents more, but its chances of survival and satisfactory growth are greater than those of a lower grade tree. Figure 1 shows that it is not essential to purchase the best grade, provided the tree is planted early. Time of planting is important, with January and February being better than March or April. Such early planting requires planning and land preparation in the fall. Oregon and Washington weather conditions are not conducive to winter planting, but the earlier trees are planted, the greater are the chances for survival and subsequent growth.

The combined effects of tree grade and planting are expressed in Figure 1 as per cent tree survival. It shows that lower tree grade and later planting both reduce tree survival. Of the two factors, late planting caused the greater losses.

Tree spacing is a major planting decision that will vary for each grower depending upon site, slope, location, soil type, adjacent orchards, and available equipment. The trend is towards high-density plantings because they put more productive units (trees) on each acre, which means more nuts per acre during the early life of the orchard when the yield of each tree is similar (1). There is no single spacing that is ideal for both young and old trees. Generally it is desirable to have some competition for light, water, and nutrients between mature trees. Competing trees will not produce as many nuts per tree as those which are without competition, but by having more trees per acre the net effect is that of greater yields per acre. Data from a 15-year-old spacing trial at Wilsonville, OR, where trees are spaced 15', 20', and 25' apart, prove this point. Trees spaced at 15' have produced the greatest yields in 11 of the 13 years that yield data have been taken (1, 9, 10). The two exceptions occurred in 1972 and 1974 when the 20' trial yielded more than the 15' trial. Trees spaced at 25' have yet to yield one ton of dry nuts per acre under the Wilsonville conditions.

So what is the best spacing for filbert trees? The Wilsonville data do not support the 25' planting, which equals a density of 70 trees I A, because the trees take too many years to come into full production. For equidistant, or square plantings, 20' should probably be considered the maximum; this equals a density of 108 trees I A. The minimum square planting is probably 15', or 194 trees! A, due to cultural and harvesting problems that occur if trees are planted closer. The 15' to 20' spacing range can be used as a guideline and any distance

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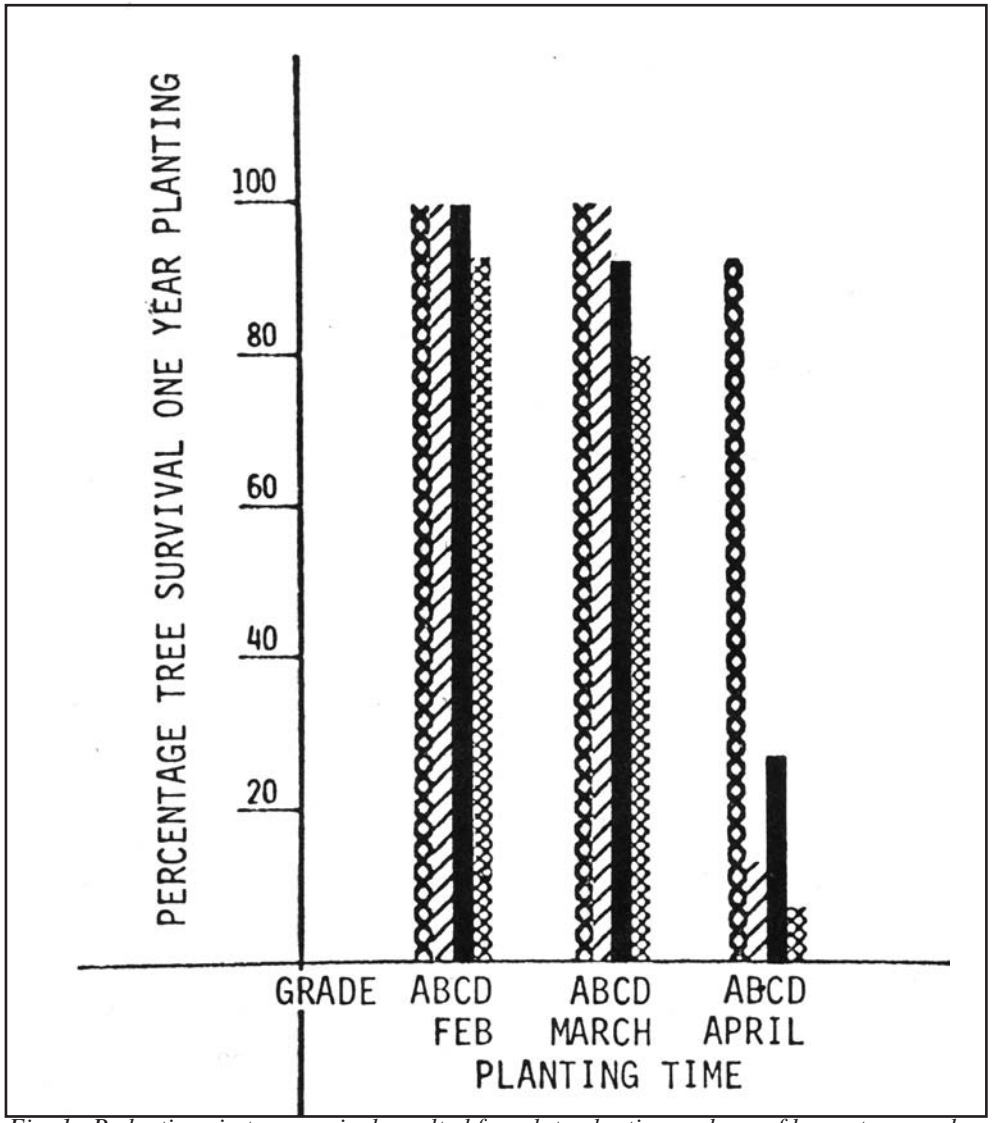

Fig. 1. Reductions in tree survival resulted from late planting and use of lower tree grades. Trees were graded on the basis of height: A=5' to 6'; B=4' to 5'; C=3' to 4' and D=2'to3'.

within this range can be selected, depending, again, on the site, slope, location, soil type, adjacent orchards and equipment available.

The only practicaI way to place more than 194 filbert trees on one acre is to plant trees on a rectangle, to form a hedgerow. Examples of such spacing follow with the number of trees per acre stated in parentheses: 12' x 18' (201), 10' x 20' (218), 10' x 18' (224), 9' x 20' (242), 9' x 18' (268), and 8' x 18' (302). The economics of such spacings have not yet been fully developed, but it is obvious that initial establishment costs will be greater as will routine maintenance costs simply due to the greater number of trees involved. At some of the higher tree densities, certain trees must be considered as filler trees. This will ultimately result in

an added cost for their removal. Presently, the early returns from high density filbert plantings appear promising. Using 1975 information as an example, hedgerow trees at Corvallis, spaced 6' x 18', had an average of 411 pounds more dry nuts than those spaced 12' x 18'. At a price of $0.32/lb., this would amount to $131.52, a return which offsets about half the original cost of the trees in that one year. Until a thorough economic study can be made, the most advantageous spacing will not be known, and no hedgerow planting recommendations have yet been made. However, several grower orchards have been established at 10' x 20' or 9' x 18' to take advantage of the earlier returns of the higher densities. Such spacings would evolve into standard square spaced orchards following filler tree removal. Most of these hedgerow orchards have not been in existence long enough to determine all the benefits and problems.

Use of New Cultivars. Another planting time decision is the choice of cultivars for the main crop and for pollinizers. At the present time this choice is largely restricted to 'Barcelona' and 'Daviana' due to a limited supply of plants of any other cultivar. However, more plants of new cultivars are being produced each year. Good progress is being made in the OSU filbert breeding program, but it will be several years before a new selection will be adequately evaluated for introduction. In the meantime, there are a few new grower selections that have been tested for several years (14). Of these, 'Ennis' and 'Butler' are emerging as the best for use as main crop and as 'Barcelona' pollinizer, respectively. Neither are the ultimate answer for their respective uses, but they do represent a yield improvement over what is currently in use.

The advantages of 'Ennis' over 'Barcelona' are: Greater productivity of larger nuts on a more compact tree. 'Ennis' is not a pollinizer. 'Butler' is a pollinizer for 'Barcelona' and should be considered as a replacement for 'Daviana'. 'Butler' surpasses the latter in yield, has a "blocky" nut that would blend better with 'Barcelona' and has a thicker shell which reduces loss to birds, rodents, and mechanical breakage. A pollinizer for 'Ennis' would be 'Hall's Giant' whose nuts are of a size and shape very similar to 'Ennis'. 'Hall's Giant' is a large tree that is not overly productive, but it does appear to be a compatible pollinizer for many other cultivars (14).

Until the supply of pollinizers, such as 'Butler' and 'Hall's Giant' are adequate, an alternative scheme for orchard establishment is offered: a) Plant a 'Barcelona' orchard with 'Daviana' pollinizers; b) Collect scionwood of 'Butler' during January and place in cold storage; c) Graft 'Butler' scions to the 'Daviana' trees during May-June (5, 8). Trees where grafts fail can be re-grafted the same season or the following season. If re-grafts also fail, the trees could still be used as pollinizers since they are 'Davianas.' There would be no disadvantage to having more than one pollinizer cultivar in the orchard.

Pollinizer Spacing. The standard pattern for pollinizer trees has been to plant one as every third tree in every third row. The 3 x 3 pattern, which originated in 1923, equals over 11 per cent of the orchard in pollinizers and was based on work done with cherries, an insect-pollinated crop. This pattern is too dense for filberts, which are wind-pollinated. With the advent of mechanical harvesting, growers planted solid rows of pollinizers in every tenth row. This pattern was adopted on the basis of convenience rather than research because it permitted easy separation of different-shaped nuts. The pattern, which allows for 10 per cent of the orchard in pollinizers, seems to be working satisfactorily. I am also aware of orchards with pollinizers arranged in 4 x 4 and 5 x 5 patterns, which have no obvious pollination problems. The apparent effectiveness of these greater spacings indicate that the 3 x 3 pattern is excessive.

Several factors favour satisfactory pollination of the filbert flower. Contemporary high-

density orchards place pollinizer trees close together, regardless of the pattern used. High-density orchards also mean more pollinizer trees per acre, e.g. in a 4 x 4 pattern there would be 16 pollinizers I A where trees are spaced 15' apart, but at the 25' spacing there would be only 6 pollinizers / A. Since the filbert is wind-pollinated, its pollen grains are extremely small (25/1000 inch) light, and numerous; each catkin produces about 5,000,000 pollen grains and each tree has several thousand catkins, depending on its size (12). Pollen grains can travel long distances on a light wind. The female flowers are also relatively small, but they, too, are numerous. While they do not present a large target for the pollen grain, they do present that target over a long period of time. The female flower is receptive for a period of 2 to 3 months under Pacific Northwest climatic conditions. This means that whenever the conditions are right for airborne pollen movement, receptive surfaces should intercept pollen. This is not the case in colder climes where the peaks of male and female bloom must be more closely matched.

Empirically, it appears safe to halve the pollinizer density of the 3 x 3 pattern. This would mean having from 5 to 6 per cent of the orchard trees in pollinizers. It would also seem best to distribute the pollinizers in a pattern arrangement throughout the orchard rather than place them in solid rows (3). The latter arrangement does not provide for uniform pollen distribution. As improved pollinizer cultivars become available, to replace 'Daviana', for example, more of them could be used per acre because they would provide greater yields of nuts of the same shape as the main crop cultivar.

Fertilizers. Trees need not be fertilized during the first year following planting. Prior to the second growing season, 1 to 2 ozs of N per tree should be scattered loosely over the area surrounding the trunk. The ideal time for this application is during March.

The objective of irrigation, mulching, weed control, fertilizers, and other good cultural practices is to promote rapid vegetative growth during the first three growing seasons. Since very few nuts are produced during this time, it is logical to promote stem growth and grow the largest possible tree. During the fourth and fifth years the tree should be permitted to slow its growth and make the transition to flowering and bearing. Maximum filbert production comes from an annual growth of 6" to 9" of new wood each year (16). More growth than that after the fourth year is excessive, while less growth indicates a deficiency in one or more important cultural management practices.

Tree Heading Height. Tree heading height is usually established at planting time. This is an important decision as it determines the height and location of the major scaffold branches. From 15 to 20 years ago it was a standard practice to head trees at 24". With the increased use of mechanization, it has been found that a higher head was better because low-growing scaffold branches impeded orchard traffic and were injured by equipment. The standard heading height is now 30", but I have found no disadvantages to heading trees at 36". However, once the 36" height is exceeded, the trees tend to whip in the wind and need to be staked and tied. Staking is an extra cost which is not offset by sufficient benefits.

Weed Control. In the young orchard, it is essential to reduce loss of moisture through surface evaporation and weed competition. For these reasons it is probably best to cultivate young filbert orchards rather than going directly into a non-tillage management program. Simazine is registered for use in filbert orchards, but is not recommended until the trees have been established one year. After that it can be safely used at the rate of 4 lbs of active ingredient/A. This would place the timing of this herbicide application at early spring of the second growing season. It is most economical to treat a 6' to 8' square around the base of the tree and mechanically control weeds in the aisles by means of cross cultivation. Non-tillage orchard management could begin when the trees are 3 to 4-years old.

Simazine is a pre-emergent type herbicide so it has no effect on large, established weeds present at time of application. Spot treatment with the contact herbicide, paraquat, at the rate of 1qt/100gal of water is safe to use near young filbert trees. Direct application to trees should be avoided. These chemical and mechanical means of weed control, done at the proper time, can reduce or eliminate the need for costly hand hoeing as a means of weed control.

Irrigation. During the first few years of tree growth, irrigation produces a larger tree which eventually should produce more nuts. Irrigation during the first growing season results in continued stem growth throughout the season and a larger root system. In contrast, the non-irrigated tree ceases extension growth during July as moisture becomes limiting. The additional growth response made by the irrigated trees is carried over into the second year because they have a larger root system and are better able to utilize the naturally available spring moisture (2).

An irrigation trial, established with cull trees, resulted in 18 percent mortality for non-irrigated trees and only 5 percent mortality for those that were irrigated (15). Average trunk cross-sectional areas of the living tree were 1.09 sq. in. and 2.35 sq. in., respectively. This means that the irrigated trees were slightly over twice as large as the non-irrigated. The non-irrigated trees suffered more from sun-scald and from bacterial blight. Infected trees in the irrigated plot appeared to be without blight symptoms. Results in this trial might not have been as striking if a higher grade of tree had been planted at the beginning.

It is not economical to purchase an irrigation system to irrigate young trees for one or more years. Alternatively, water has been tanked to trees, but this is time consuming even where soils are sandy or have a good structure that permits rapid penetration. However, tests have shown that the effects of irrigation can nearly be duplicated by mulching young trees with black plastic or sawdust (2, 13). Of these two methods, sawdust is the less expensive to purchase and apply. Sawdust mulching should follow chemical weed control, but precede the cessation of spring rains. The mulch should be at least 3" to 4" deep and extend 18" to 24" out from the trunk of the tree.

When using a sawdust mulch it is imperative to provide sunscald protection for the tree trunk. While sawdust is a good insulator, it is also a good reflector of heat. Under the same conditions of solar radiation, the surface of sawdust is hotter than the soil surface (4, 6). One of the areas of the trunk most frequently injured by sunscald is at the soil line. This portion of the trunk receives the combination of direct and reflected radiation.

Sunscald protection can be obtained with collars made from newspaper mats used in printing. These collars are relatively inexpensive, are held in place by encircling wires, and usually last from 2 to 4 years. They do a good job of sun-scald protection, but are frequently too short so that the trunk is injured above them. They also collect debris and impede the control of suckers which have grown up through them. Once they have outlived their usefulness the wire must be removed lest it girdle the trunk. Poor tree survival, occurrence of sunscald and blight are readily apparent economic losses. The difference in tree size, due to good or poor cultural practices, is readily apparent, but the difference in economic return is not realized for several years until the larger tree begins to produce.

An alternative to the paper collar is painting the tree trunk with exterior white latex paint on the S and SW sides (4). The paint can usually be diluted one-half with water, yet be effective. Application can be made with a single nozzle spray gun or a variety of paint rollers or sponges (7). It is essential to have the paint cover the base of the tree trunk at the ground line.

A tree that leans towards the N or NE has its trunk nearly perpendicular to the sun during the warmest part of the day and is therefore most susceptible to sun-scald injury. It is best

to give the tree a slight SW slant at planting time. A second advantage of slanting the tree towards the SW is that that is the direction from which the prevailing winter winds usually come.

Sunscald of the trunk usually does not kill a tree, but it represents a type of stress which predisposes the tree to other problems, the most common of which is bacterial blight. This organism invades weakened tissues and spreads gradually from the point of infection. In so doing it can girdle small stems and young trees. Sunscald usually occurs during the first growing season. The effects of bacterial blight do not become apparent until the second growing season. Thus, tree replacement cannot occur until the third growing season, which results in an orchard with trees of unequal age. This lack of uniformity has an impact on cultural management practices and ultimately on orchard productivity.

Tree Training. Training refers to promoting a strong framework for the tree, one whose scaffold branches are adequate to bear the crop load. Training should be started following the first growing season. Training is accomplished by pruning, the removal of some plant parts to promote the growth of those that remain. Pruning is a dwarfing process, so as little wood as possible should be removed to achieve the goal of developing the framework. In simplest terms, the goal is to promote 4 to 5 main scaffold branches, from which all other branches arise. Ideally, these branches should be evenly spaced around the tree, should be separated from one another by 3" to 6" on the vertical axis, and should form a right angle with the tree trunk. Unfortunately, the tree rarely produces branches that approach the ideal. With the goal in mind, the grower can make a few quick cuts per tree during their first years of orchard life, and this will go a long way towards proper tree structure. The economic benefits of a strong framework become especially evident during ice, snow, and windstorms. Trees with a uniform framework are also easier to prune and to work under.

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Editor's note: the dates given are for the Northern Hemisphere.

NUT TREES AS A REPLACEMENT FOR APPLES IN A SOUTH-WEST ORCHARD*

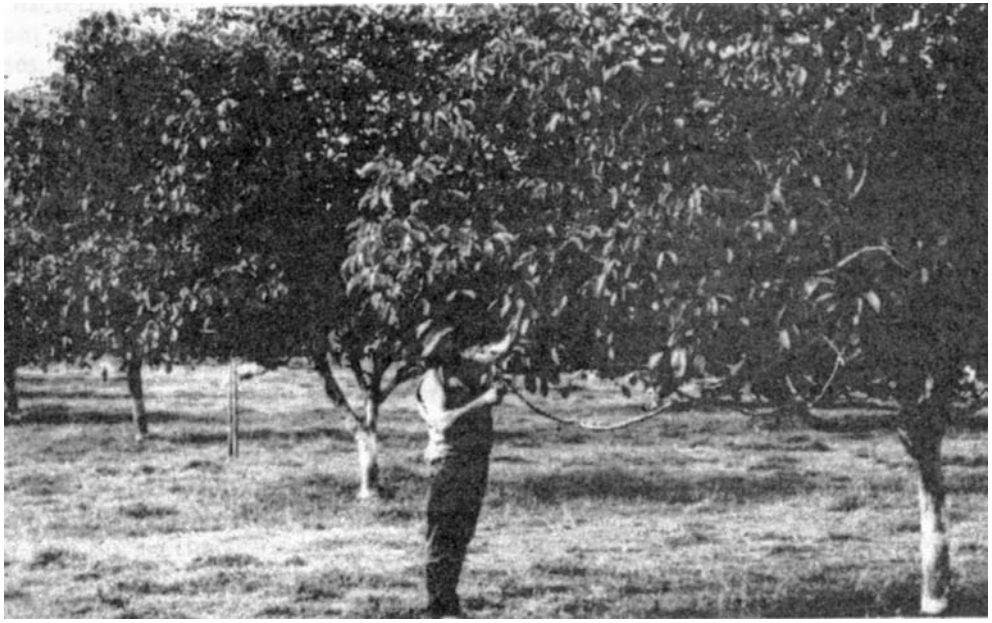
MARY BUSHER**

In search of better returns, an old 6-hectare (15-acre) apple orchard will be bulldozed this year on A. and N. Fontanini's farm at Manjimup for replanting with walnut and chestnut trees.

The nuts are not a new venture. The first commercial planting of 1.6ha (4 acres) was made 25 years ago. A second planting about the same size was made about 15 years ago. Since then, when apple trees have died or become unproductive, they have been taken out and replaced with a chestnut or walnut.

The first chestnut trees on the farm were planted for ornamental purposes as long ago as 1907. The Fontanini family plan to retain about 8ha (20 acres) of apples on their l2lha (300-acre) orchard and beef cattle farm.

The apple trees to be bulldozed were still in production, but returns were not good enough to make them worth while. Between 4ha and 6ha will be planted with seedling walnuts and chestnuts this winter.



Walnut trees with the pasture growing beneath them.

* Based on an article in "The Countryman"/91(4523), Jul. 15, 1976

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Left ungrafted, seedlings take 10 to 15 years to come into reasonable production, but, with grafting, a reasonable crop can be obtained as early as the sixth year after planting.

Tony Fontanini said their practice now was to graft and bud them the year after planting. This meant a lot of work as the success rate was not high in the first year. Out of one batch of 200 trees, less than 25 per cent took on the first graft.

The weather and disease factors were the two big influences. When a graft failed, it was repeated the following year. Apart from the earlier production, grafting is well worth while as, without it, a nut tree could be nurtured for 15 years and then prove barren.

The Fontaninis use a heavy fertiliser application at planting - between three and four bags of potato manure an acre, plus a similar quantity of super.

Walnuts are susceptible to black spot and frequent spraying to combat this is needed. It is not a problem with chestnuts, but they need plenty of water throughout the summer, more than apples.

Tony Fontanini tips walnuts from the tumbler into the washing trough.

The first walnuts were planted 12m by 12m (4Oft by 4Oft) apart, but future plantings will be 6m by 12m apart. The chestnuts were planted 6m by 12m apart and this will be maintained for these trees.

Trickle irrigation will be used for the new planting. The existing walnut orchard is watered by overhead sprinklers. The trees have been allowed to grow high but are kept pruned underneath. This is done to aid light penetration and makes maximum use of the grazing potential.

The summer irrigation fulfils two purposes. Pasture, mainly cocksfoot and strawberry clover, has been established underneath the trees and this green grazing is used to finish baby beef animals during the summer months.

With trees of varying ages, the Fontaninis are still finding out about yields, but their present expectation from a mature chestnut tree about 15 years old is 45kg (100lb). With the walnuts they have produced three tonnes from almost 3.2ha (8 acres) of trees.

With no other sizable walnut planting in W.A., the Fontanini family believe there is an almost unlimited market for their future output, judging by the quantity imported.

They consider chestnuts have a more limited market, but believe they could double their present output (about two tonnes annually) without flooding the market.

Chestnuts are keenly sought after by migrants, particularly Macedonians and Italians.

The Fontanini family sell a big percentage of their present nut output green, direct from the orchard to consumers. Each year, interested people are invited to the orchard to pick their own requirements. They buy on a weight basis.

Nuts not sold this way are dried and stored for later sale through Perth retail outlets.

Before drying, the nuts are tumbled in a washer, made from a 44-gallon drum powered by a small motor. From the tumbler the nuts are tipped into a concrete water trough.

Empty or poor-quality nuts are removed at this stage. Mesh scoops are used to lift the nuts from the water. For drying they are spread on wire racks in a fully enclosed shed. Kerosene burners are used to maintain the temperature at an even 100°F for about 48 hours.

A LARGE COMMERCIAL PECAN PLANTING IN NEW SOUTH WALES*

E.F. GILLIN **

At Biniguy, 25 miles from Moree in the north west of New South Wales, an American firm, Stahmann Farms Inc. of New Mexico, is developing an interesting pecan nut orchard which is probably the largest tree nut project in Australia.

The *pecan* (pronounced in the United States as pe-KAHN) is an edible nut tree, indigenous to North America, which produces highly appreciated nuts which are similar in appearance, taste, and use to the walnut and sold in the upper price range of edible tree nuts.

Of the United States average annual per capita consumption of all tree nuts of about 2 lb. (shelled basis), pecans represent about 25 per cent. Only a very small quantity of pecan nuts is consumed in Australia each year, for they are relatively scarce here and not well known. Most are imported, but there is a small volume of local production.

Experiments have been conducted by the N.S.W. Department of Agriculture at its Narara Horticultural Research Station, near Gosford, for many years, and that department has published an information leaflet entitled “Pecan Nut Culture’ (2nd edition, 1968, Pp. 24.) based partly on results of the department’s experiments and research.

Fig. 1. The nursery.

* Originally published as ‘Pecan nut enterprise at Moree”, in Trends, June 1973. Republished by permission of the Rural Bank of New South Wales.

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Besides being a valuable producer of delicious edible nuts, the pecan is a beautiful, shapely tree with soft deciduous foliage which makes it a desirable ornamental tree.

Of all the tree nuts native to North America, where the pecan has grown wild in valleys for hundreds of years, the pecan ranks first in economic importance. There it is regarded as "the queen of the nuts". It is the state tree of Texas by legislative enactment.

In the United States pecans are grown in 14 south-eastern and south-central states, ranging from North Carolina on the east to Arizona on the west and northward into southern portions of Missouri and Illinois, the growing area being known as the *Pecan Belt*.

Annual production in the United States fluctuates appreciably from about 160 million to 250 million pounds (in shell), but it averages about 220 million pounds. The annual fluctuations cause marketing problems with the crop providing either "a feast or a famine". When there is a crop failure, orchardists experience a period without income. Occasionally two crop failures occur in succession.

For centuries the pecan has grown wild in the Mississippi valley region from Ohio southward and in the river valleys of Oklahoma, Texas and northern Mexico. Pecan trees are very long living, some wild trees are known to be over a thousand years old, and some plantings are now about a hundred years old.

Whilst plentiful supplies of pecan nuts can be obtained from seedlings, better results are obtained, under cultivation, from improved varieties.

The tree does not yield until it is about seven years old. It becomes commercially productive at about 10 years, and increases its bearing capacity thereafter as it grows bigger.

For this reason the cultivation of pecan trees requires substantial long-term investment and considerable patience.

Seedlings are raised in nurseries for use as root stocks which are budded or grafted with improved varieties. They are later planted out in orchards where they grow to a height of about 30 feet. The spread of the trees is such that they need to be spaced about 30 feet apart according to soil fertility conditions. A planting of 33 feet apart allows 40 trees to the acre.

As the pecan has been cultivated for only a century or so, there is not sufficient data available to indicate the long-term productive capacity of the trees under cultivation. Extensive experimentation, research, and horticultural development is taking place in universities, agricultural colleges, government experiment stations, and on orchards in the Pecan Belt of the United States.

Many United States orchardists buy three to four-year old improved stock from nurseries to expedite nut production on their orchards

Pollination

For optimum yields, cross pollination is necessary. Many varieties are only receptive to pollination for a few days each year. For that reason, the selection of appropriate varieties within the one orchard is necessary. This is illustrated in a "diagram showing relative dates of pollen shedding and stigmatic receptivity of pecan varieties at the Horticultural Research Station, Narara", published in the above-mentioned pamphlet of the New South Wales Department of Agriculture, page 5.

Harvesting

In the United States growers usually harvest pecans in the late autumn, after they have been shaken to the ground. The nuts are then taken to processing centres where they are cleaned, graded and packed for shipment. If they are to be shelled before marketing, they are cracked by machines, and the meat (i.e. kernel) removed.

Fig. 2. Deane Stahmann and Ian Mashman (agricultural adviser) inspecting 3-year old budded trees.

Harvesting pecans there presents special problems because of the great size of the trees, the short days at harvesting time, the frequently cold, wet weather, and the short period from the time the nuts mature until the best time for marketing them - during the Thanksgiving (fourth Thursday in November) and Christmas seasons. The pecans can be gathered by threshing the trees with cane poles and picking up the nuts by hand. But this is slow, tedious, hard work. On the larger orchards, mechanical shakers, operated by tractor power, are in common use and these are satisfactory for trees up to about 40 feet in height. Some growers spread sheets under the trees to catch the nuts as they fall, and from these, the nuts are separated mechanically from the leaves and trash. Sweeper-type machines are available for picking up the nuts, and these are practicable for largescale operations.

The pecan needs plenty of water with well drained, deep, loose soil through which its roots may penetrate freely to permit the trees and their nuts to be adequately provided with the food materials and moisture which are essential for good growth. Top growth and fruit bearing are related to root growth.

Fig. 3. Planting cash crops among young pecan trees.

The formation of the nut is the culmination of a series of physiological processes which begin in the tree at least 18 months before harvesting.

Some trees produce 400 to 500 lb. nuts (in shell) a year, but average yields are considerably less. For example, some 30-year-old trees in Mississippi have yielded 82 lb. (in shell) per tree and 981 lb. per acre a year. Irrigated pecan groves regularly yield 1,500 lb. per acre. Under favourable conditions, yields from individual trees should continue to increase with age and size. But as the trees grow larger, the number of trees per acre may need to be reduced by thinning out to provide adequate spacing. Nevertheless, the yield per acre should not decrease by thinning out.

Industry Organisation

In the United States the pecan industry has developed a large number of organisations, such as local and state grower associations, the Federated Pecan Growers Association which combines the state bodies, and the National Pecan Shellers and

Processors Association, Chicago. Field days and conventions are common and the industry has an interesting and informative journal - *The Pecan Quarterly,* which is published by the Texas Pecan Growers Association in co-operation with the Federal Pecan Growers Association.

About 90 per cent of the total United States production is shelled by processors and sold as kernels, halves, and pieces.

Uses

Pecans in shell are used as other nuts in shell (walnuts, etc) on dinner tables and the like on festive occasions. Like other nuts, the pecan is eaten alone and in mixtures with other nuts.

In the United States, about 40 per cent of the total shelled pecan production is used in bakery products - cakes, cake fillings, cake dressings, yeast breads, nut bread, pies and pastries. Sales to households through grocery wholesalers, chain stores and firms which mix nuts, account for 20 per cent of production.

Manufacturers of confectionery use 20 per cent, nut salters about 6 per cent, and ice cream manufacturers 7 per cent. The rest is used in a variety of other end products.

To promote pecan consumption, the industry has developed hundreds of recipes, such as pecan pies, pecan rolls, pecan bread pudding, pecan cake, and pecan candy, and all are popular.

When the nuts are harvested, they are dried and placed in cold storage pending subsequent cracking or sale as nuts in shell. When they are to be cracked, they are first defrosted, and, after cracking, the meat or kernel is returned to refrigeration for storage pending sale. With the United States crop being harvested in the late autumn, producers experience difficulty in getting adequate supplies of the new season's crop on to the local retail market in time for the two seasons of principal demand - Thanksgiving and Christmas.

This deficiency in the United States market supply has a special appeal to the Stahmann enterprise at Moree. If the Australian market does not take up the whole of the supply from the plantings established, the nuts produced there may be cracked on the orchard and the extracted meat shipped to the United States market in time for the peak season, as the Australian crop will be harvested in June.

Stahmann Farms Inc.

Situated on a bend in the Gwydir River, the Moree pecan nut project, "Trawalla", is located on 1,850 acres of deep friable loam. Work began on the project in 1968 and the first-planted trees are now five years old, but still not bearing. The project is being developed by Stahmann Farms Inc. of Las Cruces, New Mexico, a family enterprise long associated with pecan production. The entrepreneur-representative of the company in Australia is Mr. Deane F. Stahmann, who has had considerable experience in the cultivation of pecans on his family properties in New Mexico and Texas.

A pilot project consisting of 80 acres of pecan trees was established in 1966 near Gatton in Queensland. These trees are more advanced than those at Moree.

The first activity on "Trawalla" was that of clearing and levelling the land for flood irrigation. A large proportion of the property has now been planted with trees. By September,

1973, 72,000 will have been planted out.

The initial stock was acquired from Queensland. On "Trawalla", there is a large nursery where seedlings are budded.

The plantings consist of the varieties Western Schley and Wichita which have been specifically chosen for the local growing conditions and their pollination characteristics.

During hot weather the orchard is watered every ten days; at other times every two to three weeks.

As the trees are not yet bearing, no nuts are available for sale. But to provide some cash crops and to maintain a stable work force, several crops have been planted between the young trees and on other land not yet planted with pecan trees.

These crops have included soybean, sunflower, beans and cauliflower.

The present work force on the property comprises 60 persons of whom 40 are permanent employees. Ultimately, the project will employ 100 permanent workers

Fourteen workers' cottages have been built on the property. Eventually there will be 40.

Total capital investment in the property to date approximates $1.8 million.

Most of the planned capital expenditure has already been incurred, but income is not expected to equal current expenditure until about 1982. By that date total capital investment will have exceeded $2 million.

Mr. Stahmann advises that lie and other pecan experts who have visited the property consider tree development on "Trawalla" to have been more favourable than that achieved over the same time in New Mexico. Growing conditions at "Trawalla" are excellent.

The trees are planted closely - at 33 feet apart, about 40 to the acre. Thirty- three bores have been sunk to provide irrigation should the water supply from the Gwydir River be inadequate at any time.

Fig. 4. Irrigating pecan nut trees and cash crops.

Fig. 5. Pecan nuts on 7-year old trees.

Yields per acre are expected to be about 1,500 lb. (in shell). With 1,800 acres of bearing trees, this would mean an annual production of about 2.7 million lb. (in shell) or about 1.4 million lb. (shelled). If the local ex-farm price were to be 50 cents per lb (in shell), this would provide a gross return of about $1.35 million a year for the whole crop, or $750 per acre. With working costs per acre about $150 to $200, the gross margin to the grower would, therefore, be about $500 to $600 per acre.

But there will have been considerable capital costs which will have to be serviced, many years of financial outlay without adequate income and much skill and experience put into the project.

Growing pecans is a complex, highly-specialised form of horticulture. The production of quality nuts, with uniformity of size and shape, and the achievement of optimum yields per acre need competent management.

With an average annual production of about 220 million lb (in shell) of pecans, the United States average annual per capita consumption is about 1 lb. in shell or about ½ lb. shelled.

If Australia were to follow the United States pattern of consumption of pecans (with appropriate trade promotion) the aggregate average annual consumption would rise from its present negligible volume to about 13 million lb. (in shell). The Stahmann project would be able to supply only about one-fifth of that requirement.

It is proposed to establish on the property, possibly within 10 years, a cracking, processing and packing plant which could cost about $1 million. If, and when, this were established, shelled nuts packed ready for marketing could be sold direct from the property.

The first crop of nuts is expected to be harvested in 1977, with a yield of about 145,0001b. (in shell). These will probably be sold in shell.

The Australian market will have to be tested and, if need be, promoted.

Australians are currently consuming about 29 million lb. of edible tree nuts (shelled weight).

The average per capita consumption of these is about 2.2 lb. (shelled weight).

Pecan nuts form only a negligible proportion of the total Australian per capita consumption of tree nuts. They are relatively scarce and generally sell at or near the top of the price range - about $2.20 per lb. (shelled weight) retail. Four ounce packs at 55 cents are available.

It is probable that, with a small expenditure on promotion, the per capita and aggregate consumption of pecans in Australia could be appreciably increased, if the retail price were a little below its present figure. Increased consumption of pecans may be at the cost of the consumption of other nuts. But appropriate promotion, by way of attractive recipes as is done in the United States, could increase total nut consumption.

With the passage of time, the Stahmann orchard may sell three to four-year old improved pecan varieties from its nursery to other growers as is done in the United States and also provide cracking facilities for nuts from other orchards.

The following list of members is essentially in postcode order. The member in your vicinity is usually the best source of information on local factors affecting nutgrowing, so the list is arranged to make it easy to locate such members.

55 Mr G Cox Address unknown
259 Mr T Thomas Address unknown
254 Acquisitions State Library of NSW Macquarie St Sydney 2000
302 Librarian Divn. Horticulture 157 Liverpool St Sydney NSW 2000
163 N Burtenshaw 67 Hordern St Newtown NSW 2042
272 Mr G R Scarrott Currawong Rd Berowra NSW 2082
273 Mr W Stoevelaar 21 Woorarra Ave Narrabeen NSW 2101
250 Mr C Hopkins 4 Britannia St Pennant Hills NSW 2120
294 Mr R De Stradis Lot 3. Annangrove Rd Rouse Hill NSW 2153
288 Mr M B White 61 Hezlett Rd Kellyville NSW 2153
318 R Gray Post Office Lightning Ridge NSW 2392
112 Mr R D Thompson 'Vow Slopes' Old Byron Bay Rd Newry Bar NSW 2479
290 Mr R Magnus Pear1es Creek Wollongbar NSW 2480
139 Deposit Sectn National Library Canberra ACT 2600
266 Premier Nurseries P0 Box 400 Griffith NSW 2680
98 Mr W It Chislett P0 Box 743 Orange NSW 2800
34 Dr W N Chin 1027 Nepean Highway Moorabbin VIC. 3189
201 Mr L A Balmer Rock Lyn Maldon Vic. 3463
311 D Forbes-Wilson PO Box 1 Cabarita via Mildura Vic 3505
218 Librarian WES 60500, CSIRO Hortic Research Merbein Vic 3505
117 Mr L Harvey R.S.D. 20 Woorinen Vic. 3589
317 Mr A D Allen Hortic.Adviser P0 Box 69 Wangaratta Vic 3677
73 Mr R Salt Camms Rd Monbulk Vic. 3793
222 Mr W T Grady 'Greenslopes' O'Grady's Ridge Rd Foster Nth, Vic 3960
269 Mr A Teese 'Won Wron' RSD Yarram Vic. 3971
260 Mr C J Ryan 7 Czar Rd Hamilton Brisbane Qld 4007
307 A A Sutherst Canungra Rd Mt Tamborine Qld 4272
161 Mr L Higgins 'Rhonda Park' Greenbank Road, PS 1637 Jimboomba 4280
234 L Campbell P0 Box 23 Bell Qid 4408
275 Mr R Thurlow 20 Queen St Maryborough Qid 4650
207 Mrs M Boteje Post Office Ruby Vale Qld. 4702
35 Mr D Kumnick Kumnick Rd Lenswood S.A. 5240
212 Mr C S Maloney Watervale South Australia 5452
138 Deposit Sectn State Library James St Perth 6000
149 Mr P Godkin Govt-Chemical Laboratories 30 Plain St Perth 6000
166 Mrs F Clements 4 Ventnor Ave West Perth 6005
191 Mr M Mirkovic P0 Box 69 West Perth 6005
217 Mr K Hauter 248 Nicholson Rd Subiaco 6008
304 Mr E J Holrnan 82 Rupert St Subiaco 6008
314 Mr R J D'Orsogna 135 Hamersley Rd Subiaco 6008
43 Mrs L G Deason 77 Lawler St Subiaco 6008

63 Mr I Davies 57 Gloster St Subiaco 6008
220 Mr C S Edwards 87 Gloster St Subiaco 6008
301 Mr R H Brown-Cooper 42 Subiaco Rd Subiaco 6008
144 C H Ruben 23 Waylen Rd Shenton Park 6008
1 Mr D G Noel P0 Box 27 Subiaco 6008
239 Mr D A Harvey 29 Taylor Rd Nedlands 6009
181 Mrs L Hodan 9 Leura St Nedlands 6009
315 Mr S Hilton 62 Viewway Nedlands 6009
185 Mr C F Cameron 15 Monash Ave Nedlands 6009
42 Mr J G Bennett 30 Hobbs Ave Dalkeith 6009
22 Mr F M Bockxmeer Physiology Dept University of WA Nedlands 6009
21 Mr P Sinclair 70 Viewway Nedlands 6009
200 Mr J Wilson 3, 18 Princess Rd Nedlands 6009
148 Mr A Pearson 22 Phillip Rd Dalkeith 6009
44 Mrs R F Hearne 75 Davies Rd Claremont 6010
58 Mr G K Abbott 47 Claremont Cres Swanbourne 6010
72 Mr P Rolfe 154 Alfred Rd Mt Claremont 6010
285 Mr E A Tocock 11 Garden St Swanbourne 6010
52 M C Piesse Unit 13D 25 Victoria Ave Claremont 6010
26 Mr D E Bailey 58 Lyons St Cottesloe 6011
263 Mr D F Biddles 93 Eric St Cottesle 6011
20 Mr R L Routley 1 Overton Gardens Cottesloe 6011
174 Mr R Wallace 48 A View St Cottesloe 6011
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280 Mr G R Pearson 7 Baramba Rd City Beach 6015
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180 Mr J A Thompson 134 Northstead Rd Scarborough 6019
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208 Mr I R Campbell 8 Todea Ct Duncraig 6023
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27 Mr J Mercer 45 Bridgewater Drive Kallaroo 6025

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140 Miss V M Bristowe 75 Rookwood St Mt Lawley 6050
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287 Mr T Hawthorne 155 2nd Ave Eden Hill 6054
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107 Mr F Jankovic 3 Collins St Yokine 6060
69 Mr B Coussens 151 Moulden Ave Yokine 6060
71 Mr K Edel @ Mr J Slotema 278 Hector St Tuart Hill 6060
176 Mr R H Whitney 105 Royal St Tuart hill 6060
82 Mr P G Dominish 1 Ilumba Way Nollamara 6061
186 Mrs A J Matulich 60 Cleveland St Dianella 6062
53 Mr R Nicholls 485 Morley Drive Morley 6062
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80 Mr A Creswick 22 Shaw Rd Wanneroo 6065
6 Mr E Czechowski P0 Box 12 Wanneroo 6065
50 Mr R Armfield P0 Box 145 Wanneroo 6065
281 Waldeck Nurseries Pty Ltd Russell Rd Wanneroo 6065
65 Mr W B Robinson 16 Mile Peg Wanneroo Rd Wanneroo 6065
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19 Mr C J Glands 1544 Vernon Ave Mundaring 6073
85 Mr E J Barbour McCallum St Mundaring 6073
91 Mrs K Petriw Lot 23 Mofflin Ave Darlington 6073
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114 Mrs G Sutherland 'Chinocup' Nyabing 6341
210 Mrs L Skipsey P0 Box 96 Pingrup 6343
97 Mr R KDuckham Police Station Kulin 6365
164 Mrs G Turner P0 Box 106 Kulin 6365
110 V C Pascoe P0 Box 63 Wil1iams 6391
104 P Van Rijn RMB 709 Williams 6391
177 Mrs K J Mathwin RMB 314 Kojonup 6395
118 Mrs J Barrett RMB 399 Jinga1up 6395
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134 Mrs M James 57 French Ave Merredin 6415
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297 Mr I Downie Lot 198 Sexton Rd Mt Helena 6555
120 Mr R Scudds Lot 115 Clenton Rd Gidgegannup 6555
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57 Mr B Darke P0 Box 59 Chidlow 6556
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305 Mr R Toster P0 Box 9 Ballidu 6606
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169 Mr F J Maitlnd-Smith 25 Cone Place South Hedland 6722
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195 Mr W R Cooper P0 Box 116 Broome 6725
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36 Mr D S White PO Box 249 Kununurra 6743
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