

Fig. 1.—Frames containing Eucalyptus seedlings at the Dryandra Nursey

TREE ESTABLISHMENT IN THE WHEATBELT

By G. E. BROCKWAY, B.Sc. (Adel.), Regional Superintendent, Forests Department

DURING the last half-century, remarkable changes have taken place in the semi-arid lands of the southern portion of Western Australia. Millions of acres of country, once covered by an intricate pattern of hardy woodland, scrub and heath have been converted to productive arable land or pasture. With the widespread clearing and cultivation of vast areas, the correction of soil deficiencies by the application of fertilisers, and the sowing of cereals and annual pasture plants, many of the differences in soil types which were very obvious in the original landscape have now been obscured—adding greatly to the difficulties of successful tree establishment.

In the virgin state, the various soil types in this area could be easily recognised, as each supported its own vegetative association—the particular trees, shrubs and other plants adapted to the conditions which it provided.

Land was commonly classified by the type of vegetation it supported. That carrying large trees was “first-class,” mallee and scrub country was “second-class” and the heath or sandplain was “third-class.” The species of vegetation, their size and vigour and the degree of admixture, offered further indications of differences within the three main classifications.

It is not generally realised that by clearing the country “on a face” much natural evidence is destroyed and subsequent tree-planting must depend largely on trial and error.

This lesson should be taken to heart by every settler opening up new lands. Even today large areas of land are being completely cleared and trees which could be conveniently retained to provide fuel, timber, tan bark, shade, shelter and farm beautification are destroyed.

That it is essential to remove the greater part of this native vegetation is obvious, but unfortunately there is a marked tendency to lose sight of the desirable features which trees and scrub offer.

Isolated open fields surrounded by bush are soon replaced by open fields surrounded by more fields. Aesthetically the result is depressing, and with shade and shelter reduced well below the desirable minimum it will not be long before many farmers are seeking trees for farm and home planting.

Each season thousands of young trees go out from Forests Department nurseries for planting on farms which have been left with insufficient trees. The very fact that so many farmers on long-established properties are prepared to purchase, plant, protect and tend young trees so that they will ultimately take the place of those that were destroyed, demonstrates their recognition that trees on farms are desirable. The failure to retain in the original clearing, strategically-placed, healthy trees either singly or in groups or strips, was and is unwise.

The removal of a tree takes a few minutes—its effective replacement takes years and there are many pitfalls associated with its establishment.

THE ANNUAL DROUGHT

It must be realised that the annual domestic crops receive favoured treatment to free them from competition and to encourage their development. They are drought-escapers in that they complete their life-cycle during the wetter portion of the year, and, unlike the trees, they are not called upon to withstand the rigorous testing period of the annual drought.

The wheatbelt climate, which includes an annual summer drought of at least six months, necessitates the use of hardy trees able to withstand such conditions.

While a number of exotics are able to survive under these conditions, their growth is slow and none has yet been found that can surpass, or even equal, our native inland Eucalypts for rapid initial growth and long life. A wide range of these is therefore raised annually by the Forests Department and sold at cost throughout our farming areas.

OTHER PROBLEMS

The lack of data often available on the original vegetation of an area; the necessity to conform in a planting layout to farm subdivisions (in most cases laid out

on a geometrical pattern without consideration of natural features or soil types), and the desire in many instances to establish trees on farms established on naturally treeless areas, have presented a range of problems.

With the object of learning the answers to the problems of farm tree establishment, the Forests Department some ten years ago commenced the establishment of arboreta or pilot areas throughout the wheat belt. As these regions are beyond the areas of the main forest activities, and visits by forest officers are infrequent, it has been necessary to obtain the co-operation of public-spirited farmers, other Government Departments, local governing bodies and other local organisations. Any advances in our knowledge of tree establishment in our semi-arid areas are in no small measure due to this co-operation and assistance so willingly given and so gratefully appreciated.

FACTS LEARNT FROM RECENT INVESTIGATIONS

Trees for the arboreta and for distribution to farmers became available with the establishment of the Kalgoorlie nursery where activities were confined to the propagation of species considered to be suitable for our inland areas.

This nursery has now been transferred to Dryandra in the Narrogin district where it continues to function satisfactorily and with a continually increasing output.

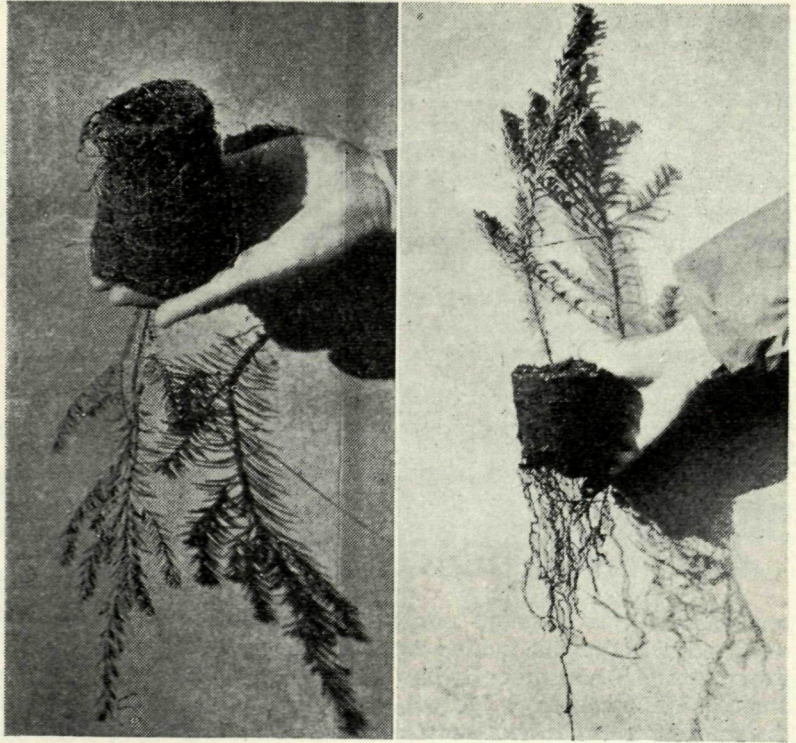
Many thousands of trees have been planted throughout the wheatbelt by farmers, local governing bodies, schools and in the arboreta or pilot areas already referred to. In some instances, establishment has been very successful, in others only moderately so and in others, partial or complete failure has resulted. The time has come to make some assessment of the causes of these various results.

Planting has been carried out on a wide range of sites and the position may be broadly summed up as follows:—

Tree establishment on areas which originally carried forest presents no serious difficulties provided there has been no salting of the area as a result of the rising water-table following clearing.

In view of the enormous areas of light land now being farmed, the need to pro-

Fig. 2.—(Left) A young tree removed from the pot showing the "gachi" or cone of soil with the roots coiled. (Right) The root coils straightened before planting



vide trees able to thrive on the country where nature grew none is a pressing one. While there are difficulties associated with tree establishment on such sites, the task is by no means impossible, except possibly on the poorest of sites, provided due attention is paid to scrub destruction, species selection, spacing distance and subsequent cultivation and protection.

When the writer in 1954, shortly before proceeding on an overseas assignment, examined several arboreta established from 1949 onwards on what are originally non-forest areas, some disturbing features were seen to be developing. After his return in 1957 these had become much more apparent and investigations were put in progress.

While these are by no means complete, the present article aims to give some indication of our present thoughts on the subject.

SPACING IS IMPORTANT

An examination of some of our inland heath land or even jam country at the end of a long dry summer shows much of the vegetation to be in an apparently

dying condition and exhibiting a range of striking autumn colours. With the return of the wet weather, most of this vegetation revives. Beside this ability to go into a summer resting stage, these heath and scrub plants possess a number of other desert characteristics—e.g., small leaves, low quantity of aerial vegetative material, large root systems. For trees to become established in such sites they require all the assistance in the way of cultivation and freedom from weed and scrub competition that can be given—and ample areas from which to draw moisture.

Since sweet underground water is of extremely limited occurrence throughout the wheatbelt, the vegetation must subsist through this summer drought period solely on water stored in the soil at the end of the winter. The nature and depth of the soil and the nature of the subsoil are therefore factors of extreme importance.

At the outset, trees were planted at a spacing of approximately 15 ft. each way. For four or five years, growth of several species was extremely rapid even on the definitely non-forest sites. In the 1954-55 summer, however, a number of the most



Fig. 3.—Result of planting a young tree without straightening the root coils. The tree has been blown down as the coiled roots did not provide sufficient anchorage to withstand heavy wind pressure

vigorous of the trees on non-forest land declined rapidly in health and died in groups, and this process has continued since. The impression gained from these deaths was that the soil moisture from the annual precipitation (with possibly some residual moisture from the previous season) was ample to carry the trees on for a limited period of four or five years, but as crown area of the trees increased transpiration overtook the available mois-

ture supply, and deaths occurred. Support was given to this view by the persistence in a healthy condition of the edge trees of the plots which have unchallenged access to surrounding cultivated land while trees within the central portion of the plots failed.

Field examinations appeared to support the moisture exhaustion view particularly when roots of some of the edge trees were found 100 ft. away from the plot.

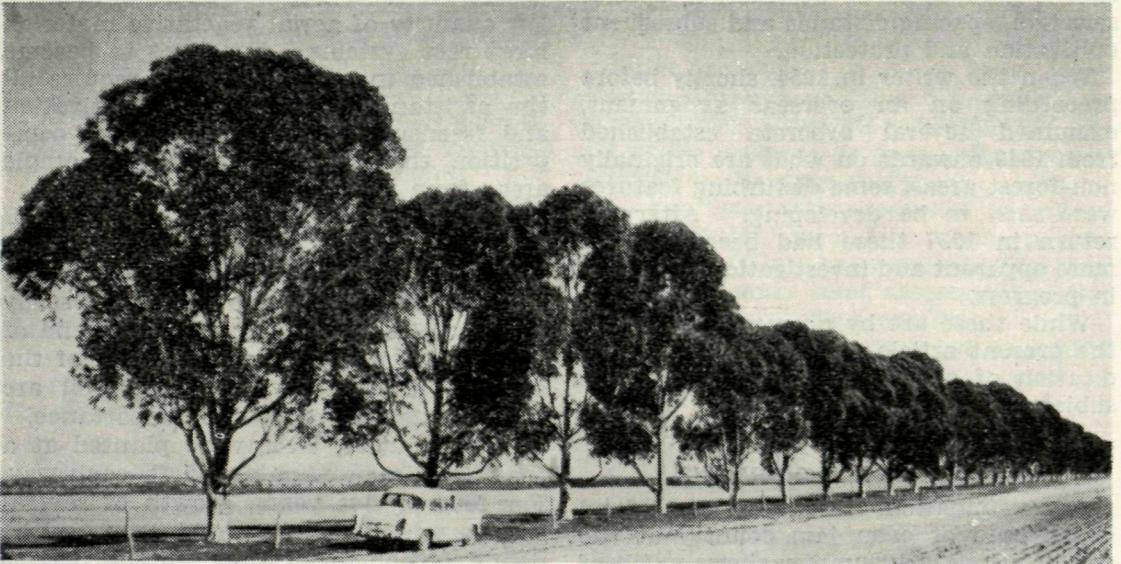
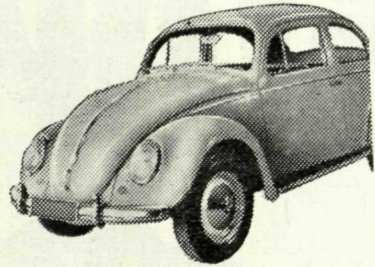
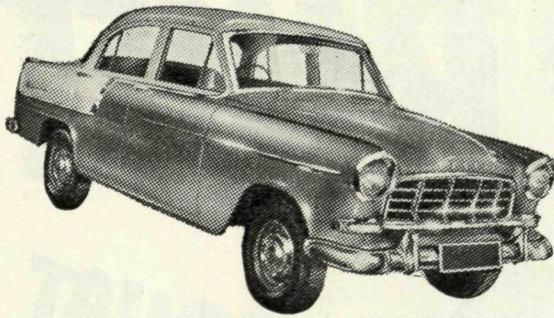


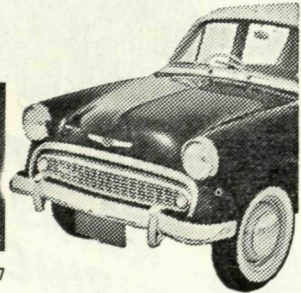
Fig. 4.—A shelterbelt of sugar gums on the property of Mr. G. F. Dennis, Cunderdin



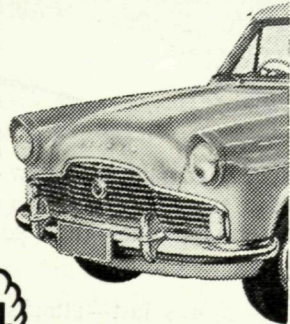
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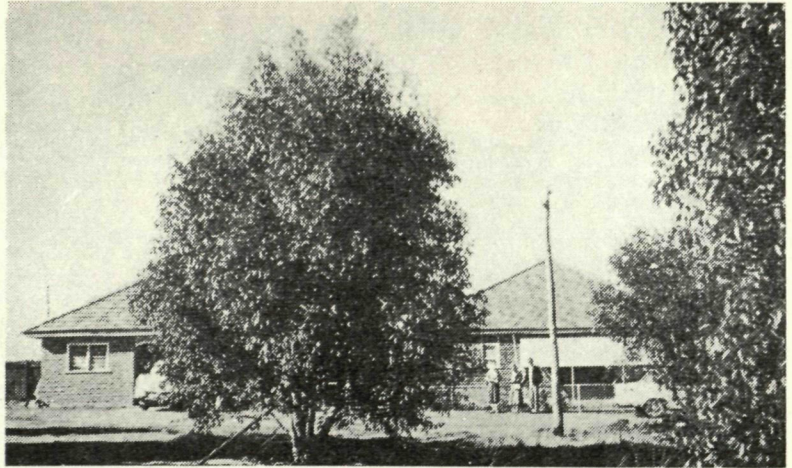
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Fig. 5.—*Eucalyptus Dundasi* used to beautify the home-
stead site



A series of laboratory soil moisture determinations were commenced late in the 1957-58 summer and these will continue.

Several points have emerged from the studies to date, viz.

- (1) A spacing 15 ft. x 15 ft. is too close for trees planted under semi-arid conditions. A figure in feet of 300

R

where R = rainfall (in inches) of the locality is suggested as a minimum spacing distance.

- (2) Block planting, or multiple line planting is inadvisable under low rainfall conditions.
- (3) One or two rows of trees with cultivation on each side to eliminate scrub competition is the most desirable arrangement. This indicates that the multiple row break with tall trees in the centre shading off to dwarfs in the outer rows, while theoretically desirable, is not feasible in our semi-arid land. A double row arrangement—one of tall trees and one of short or medium, appears to be as much as can be expected.
- (4) While inland Eucalypts have received considerable recognition as desirable trees for planting in the wheatbelt areas, for the more difficult sites, species with even better adaptations for drought resistance, e.g., *Callitris* (Native Pine) and *Casuarina* (Sheoak) warrant further attention.

HANDLING PLANTING STOCK

Types of containers used for raising nursery stock vary from country to country and state to state.

Trees in Western Australia are raised in 3 in. or 3½ in. flower pots, or in trays which hold about two dozen plants. For a number of weeks prior to despatch from the nursery, they are given full exposure to ensure that they are sufficiently hardened off to stand conditions in the open field. Prior to despatch they are given a heavy watering, removed from the pots, each "gachi" (or cone of soil) is wrapped separately and the whole lot are packed tightly together in the crate in which they are despatched. In this condition, the soil remains moist for several days. When the purchaser takes delivery of them from the railway siding his first consideration should be to ensure that the trees are kept moist until they are planted. This is important! At time of despatch, plants are from 10 in. to 20 in. high. Any one wanting larger trees is advised to purchase the small ones and hold them for a year in large containers such as kerosene tins. It is not wise to use older larger plants raised in small containers as unless they are watered after planting or encounter very favourable moisture conditions, they are unlikely to survive on the water held in the limited amount of soil in contact with their roots. Even if they do survive, the pot-bound condition of their roots will lead to unstable trees liable to blow over before they are many years old.



Fig. 6.—Salt River gums (*Eucalyptus Sargentii*) growing on Mr. D. Dunwell's property at Narembeen

PLANTING ON FARMS

In farm planting, much of the attention normally recommended for the establishment of trees and shrubs cannot be given. For example, frequent or even occasional waterings are usually out of the question. Under such conditions this early period is critical and to ensure that young trees are given the greatest assistance to become established, the following planting methods are recommended—

Planting should be carried out only on land which has been well cultivated in advance. If on land which has not been previously cropped, at least two ploughings with a year or so interval between them is advisable to ensure that the native scrub is disposed of. **Digging of large holes and filling with enriched soil is inadvisable with trees which will be called upon to survive on the natural rainfall, although such treatment can be beneficial if trees are to be watered.**

Each plant should be unwrapped as it is required and if there is a coil of roots at the base of the "gachi" it should be straightened out and planted in a hole deep enough to take the straightened-out roots. Under favourable conditions it has been found possible to remove this coil of roots altogether but further investigations are needed to assess the risk associated with such treatment. The "gachi" should

be buried about an inch below the ground surface. The soil must be firmed around the roots—good use being made of the fingers to ensure that no air pockets are left. A final gentle pressure with the foot should be applied to the soil surrounding the "gachi" and then a gallon or so of water given to settle the tree in its new home. A small quantity of superphosphate may be worked into the soil around the tree but do not overdo it or place the fertiliser in contact with the roots. One to two ounces per tree is plenty.

Protection from damage by humans, stock, vehicles or fire is essential.

KEEP THE GROUND WEED-FREE

Just as it is necessary to ensure that weeds are eliminated prior to planting so is it essential to ensure that they do not become re-established afterwards. There is no more potent cause of failure among young trees in the wheatbelt than grass and scrub competition during the first couple of seasons.

Weeds must be kept in check and surface cultivation between the trees in the late winter before the grass commences to dry is necessary for at least two years.

Several species can be satisfactorily raised in wooden or metal trays—about two dozen plants per tray. These are cheaper and some purchasers prefer them.

Fig. 7.—Gimlet (*Eucalyptus salubris*) makes an attractive street tree at Kalgoorlie



To remove trees for planting it is advisable to remove the side of the tray and take out each tree in turn in its own block of soil—a knife or edge of a trowel can be used to cut these out. Soil in the tray should be kept damp. Trees should be watered for a few days until they have recovered from the root pruning.

The most suitable planting season is in the early winter as soon as the ground is well soaked. This gives the young trees ample time in which to become established before they are called upon to withstand the summer drought.

It is advisable however, when contemplating planting to place orders for planting stock a couple of months in advance to ensure the reservation of your season's requirements.

HOLDING TREES IN LARGE CONTAINERS

Where only a limited number are planted each year, some farmers prefer to use larger trees. The seedlings as received from the nursery are held for about 12 months in large containers such as kerosene tins, old sanitary pans, etc. This system is also followed by a number of local governing bodies who find the larger trees less liable to theft or damage by vandals. Treated in this manner they require constant attention during the period they are held and considerably

more trouble is involved in the actual planting operation.

The precautions which must be taken are—

- (1) Containers must have provision for drainage through holes at the bottom of the sides.
- (2) They should be supported an inch or two off the ground on blocks or bricks to discourage roots from penetrating the soil below. If roots do get down into the underlying soil and are allowed to persist there for any considerable time, their severance can cause the trees a considerable setback and possibly death.
- (3) They should be given ample space to enable them to develop sturdily without competition from neighbours.
- (4) Trees should be watered periodically as required. The frequency depends on the weather and may vary from daily in very hot weather to about twice per week in cool weather.
- (5) Pruning should be avoided except to correct misshapen growth or double leaders.

Planting is much the same as for smaller trees except that considerable care must be taken to remove the container from

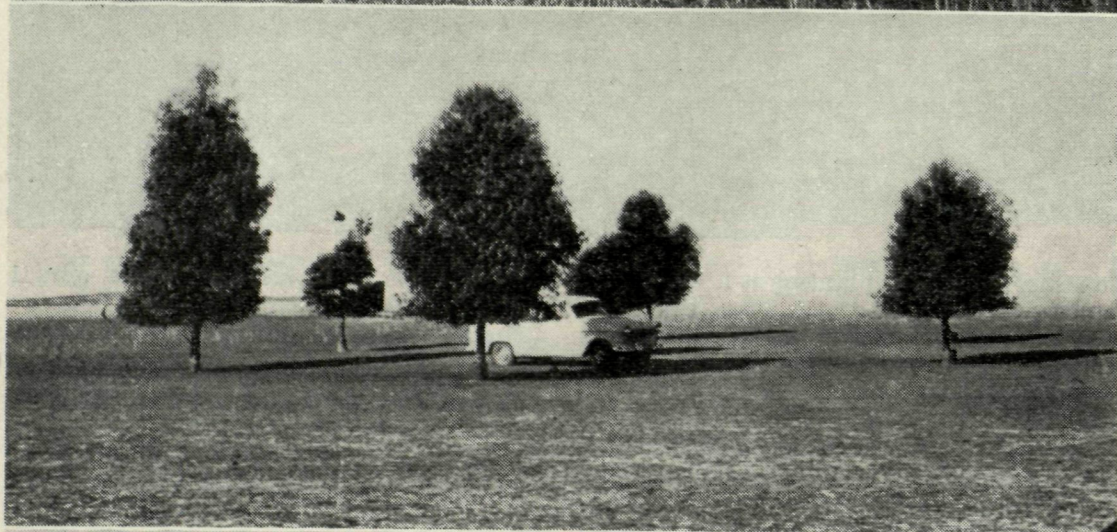
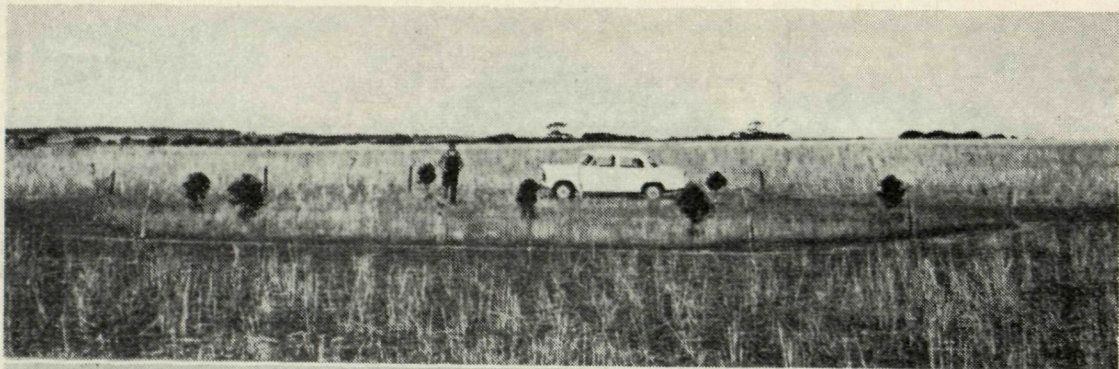


Fig. 8.—Sugar gums on the property of Mr. G. F. Dennis at Cunderdin. Top photo at one year old; Centre—four years; Bottom—11 years

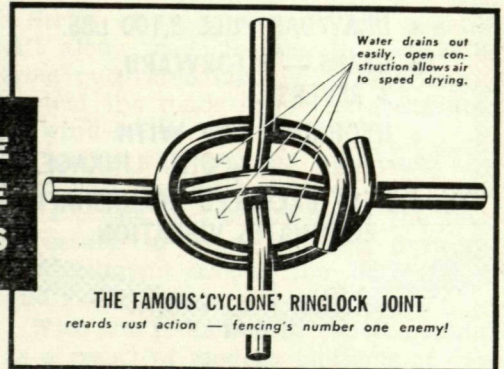
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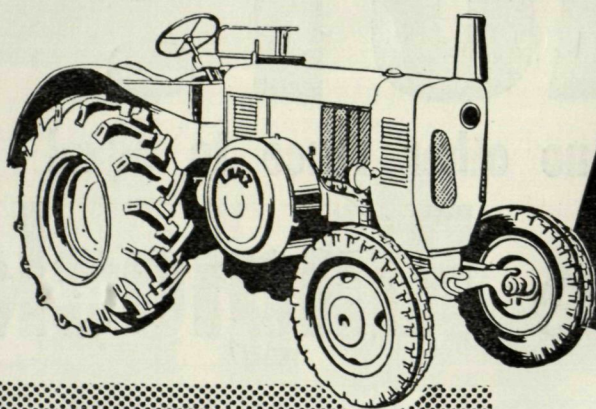
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the tree roots without causing damage to them or the block of soil in which they are growing.

PURPOSES OF PLANTING

Trees on farms may be planted for a variety of purposes, e.g., as windbreaks near buildings, as shelterbelts along contours or fence lines, as shade and shelter groups in paddocks, as ornamental and garden specimens and for the production of tan bark, fuel or farm timber.

The terms shelterbelt and windbreak are often regarded as synonymous but some authorities use the term "shelterbelt" to describe lines of trees protecting fields and "windbreak" for lines protecting buildings.

Shelterbelts.

A number of countries have, for a long time, accepted shelterbelts as a necessary feature of an agricultural countryside without always appreciating their shelter value.

While research into the effects of shelterbelts initiated in the early 19th Century, demonstrated the advantages, particularly on plain country, work was sporadic and it was not until the last 40 years or so that the question has been the subject of organised research in a number of countries—and shelterbelt planting continues.

A survey of the available literature reveals that the majority of countries where research on shelterbelts has been undertaken have been concerned with the reclamation or improvement of agricultural plain areas and not with uplands regions.

(From "Shelterbelts & Micro Climate"—J. M. Caborn).

The comparatively flat terrain of our wheatbelt renders it amenable to such improvement.

Wind velocity near the ground is reduced by the frictional drag of the land surface and by obstructions such as tree belts, etc. A reduction in the velocity of wind means a reduction in its erosive and drying effects.

To be effective a shelterbelt need not be extremely dense; it is in fact preferable for it to be to some extent penetrable by the wind as this prevents the formation

of a low-pressure zone in its immediate lee, which may give rise to turbulence there. In other words, rather than aiming at an obstruction to be by-passed by the wind what is needed is a moderately penetrable barrier which will exert some frictional braking effect on the wind.

Most research results indicate that while the noticeable advantages of shelterbelts occur on the leeward side for a distance of 10 to 20 times its height—the beneficial effects although to a less marked degree, may be recorded over twice that distance, including a cushion zone on the windward side of the belt.

On the cumulative effect, I quote the following:

It would seem that if two parallel belts are separated by a distance equal to 26 times the height of the more windward belt, the entire intervening area will be sheltered to some extent and the un-obstructed wind velocity will not occur between the belts. (1) ("Shelterbelts & Micro Climate"—J. M. Caborn).

Under conditions of low rainfall a dense belt cannot be maintained.

Strips of trees or even low vegetation left along roads in localities where drift from cultivated land is considerable, can protect the roads from the accumulation of wind-blown material.

Possibly the greatest drawback associated with establishment of long shelterbelts is the cost of providing the fencing necessary to protect them, during the establishment stages, from domestic stock and rabbits.

With the reduction of rabbit population as a result of modern methods of vermin destruction and the development of stock movement by motor transport rather than on the hoof, planting along roadside strips outside the fences has possibilities. A test strip cultivated to a width of 25 or 30 ft. adjoining the fence with a row of trees planted down the middle, has been established by the Department of Agriculture at the Newdegate Demonstration Farm and is being watched with interest. A similar belt at the Eneabba Settlement was established in 1958.

It is considered more desirable by advocates of "keyline" development to estab-

Fig. 9.—The athel tree (*Tamarix Aphylla*) is a useful and attractive tree easily propagated from cuttings



lish trees approximately on contours, and by people of an artistic disposition to grow them in anything but straight lines, and while their views can be appreciated it is usually necessary to take into account existing farm subdivisions and make shelterbelts fit into their pattern.

Windbreaks.

Where no provision has been made to retain natural vegetation around a home-

stead site, the establishment of a protective windbreak is highly desirable both for its aesthetic effect and for the shelter and comfort it provides. Bushy trees of medium height with attractive foliage and blossoms are desirable. Trees should not be planted within 30 ft. of any building.

As ornamental specimens for gardens far too little use is made of our smaller Eucalypts, some of which such as *Eucalyptus caesia* and *Eucalyptus erythro-*

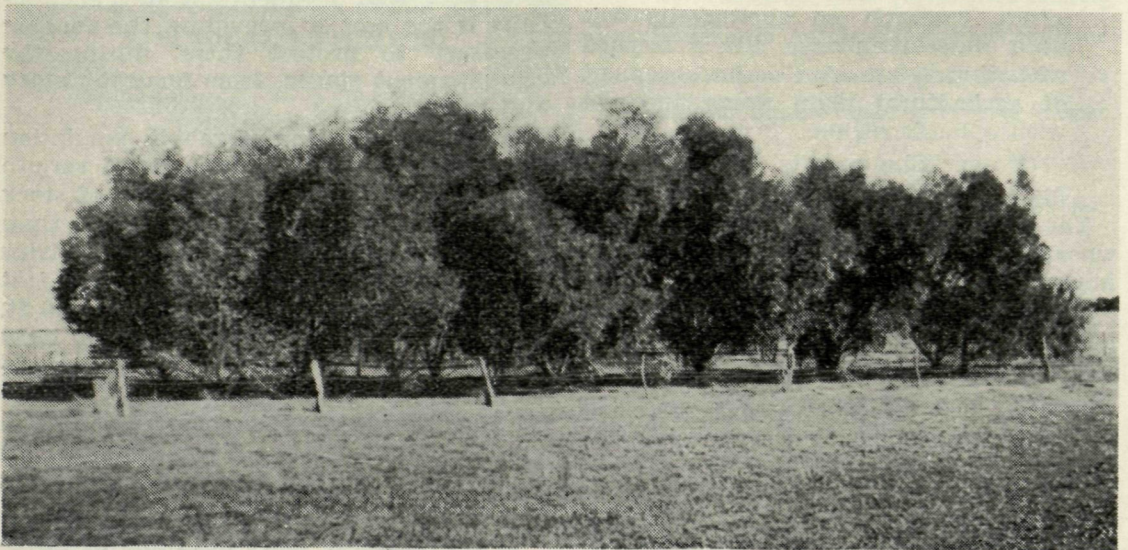


Fig. 10.—Nine-year-old Salt River gums growing on salty land at Yuna

nema to name only two, have large, brightly-coloured, attractive blossoms.

Shelter or Shade Groups.

These may be established near watering places or dotted about the paddock. It is better that these groups should be small—consisting of about seven or nine trees—preferably large-crowned species.

If seven trees are used they should be planted with six trees in the form of a hexagon and the seventh in the centre. If nine are used they should be in three parallel rows of three so that they form a square with one tree in the middle. Spacing between trees should be not less than 30 ft.

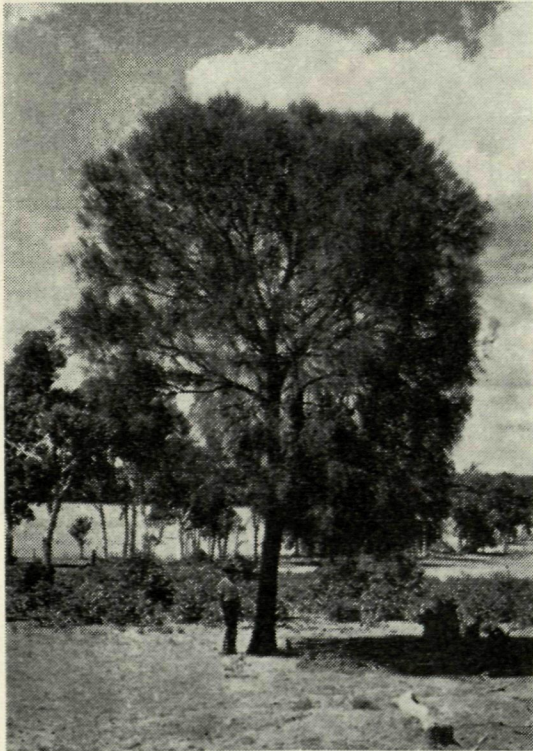


Fig. 11.—*Casuarina huegeliana*, a member of the she-oak family, growing at Dryandra

In each of these arrangements every tree but one is an outside tree able to draw on the surrounding land for its subsistence.

Protection is necessary for four or five years and possibly longer with the slower-growing species. This can be provided by a temporary fence supported by pointed stakes driven into the ground. Once the

trees are nine or ten feet high it is safe to remove the fencing for use elsewhere, provided sheep only are allowed access.

PLANTING OR SOWING ON NON-AGRICULTURAL LAND

It is sometimes suggested that land unsuited for agriculture should be devoted to the growing of trees, but one needs to be very cautious when approaching any tree establishment project on this basis.

Trees respond to good soil and moisture conditions as do any other plants and if they do manage to survive on poorly prepared infertile sites, development is often unsatisfactory. There are however, exceptions as in the case of the stony mallet hills in the region of the Great Southern Railway (and east of it) or the "breakways" throughout the eastern wheatbelt, which normally carry wandoos patches.

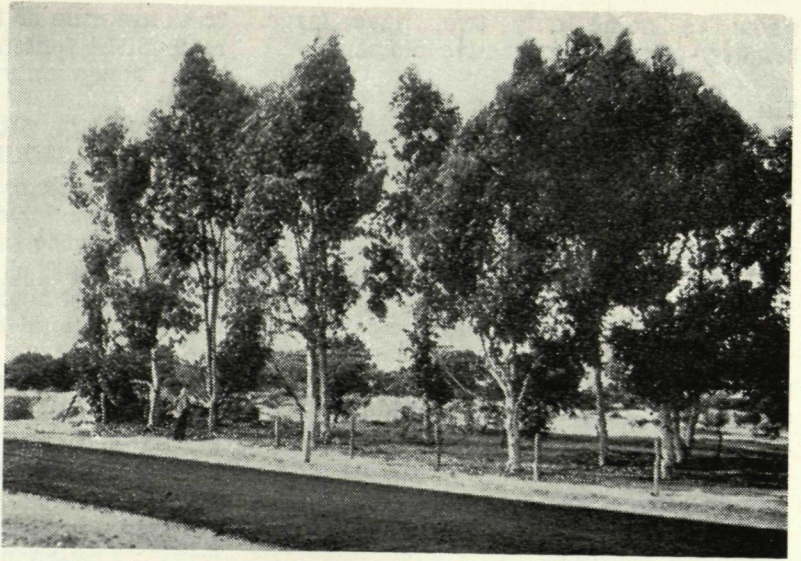
These areas of high ground, if cleared, absorb rain slowly, acting like the roof of a house with the resultant run-off scouring the adjoining fields. Contouring first to stop this erosive run-off and give the rain a chance to soak in, and then planting or sowing with appropriate species, e.g., white, blue or brown mallet or wandoos or powder bark is a rational sequence.

Direct sowing with mallet seed can be successful, but usually only when sowing is carried out on ash-beds on land recently subjected to fierce fire. However, in the mallet areas of the southern wheatbelt when farmers are able to collect ample quantities of seed themselves, direct sowing is worth considering.

To re-establish trees on these mallet hills where they have been inadvisably cleared, the first step after contouring should therefore be to make a number of small heaps of branch wood, etc., sufficient to give a hot fire or fair duration. Just burning a heap of leaves is not enough.

Spots about a foot in diameter are then lightly cultivated in these burnt patches. A pinch of seed is dropped on the cultivated spot and after covering it with a light layer of soil the spot should be firmed with light pressure of the foot. Sowing should be done in late summer prior to the first rains.

Fig. 12.—*Eucalyptus cladocalyx* growing in deep yellow sand between the 180 and 181 mile pegs on the Geraldton Road



TREE PLANTING IN COUNTRY TOWNS

Tree planting in country towns in streets, parks, recreation areas and school grounds is increasing in popularity and reflects a growing civic pride and a greater sense of stability.

For several generations the sugar gum was the best answer to the road board secretary's prayer, despite the fact that

once the trees became established it was often necessary for him to annually devote road board funds to lopping limbs away from overhead wires. Some of the more bushy Eucalypts, e.g., silver gimlet and coral-flowered gum do the job just as well or better, and at considerably less recurring expense. I have it on the good authority of a nurseryman friend in California that one of the most valued street

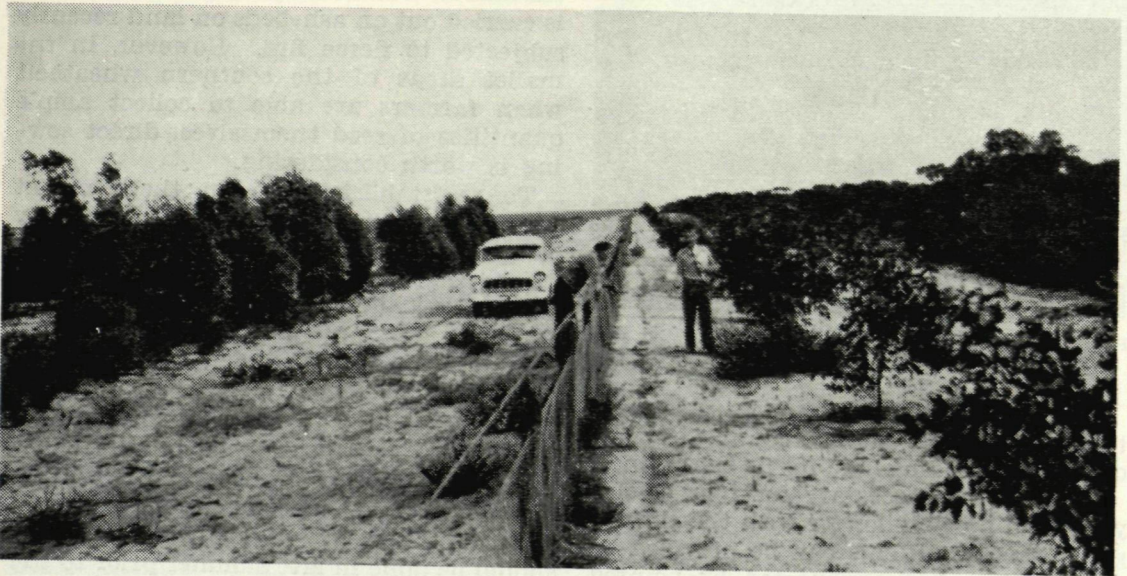
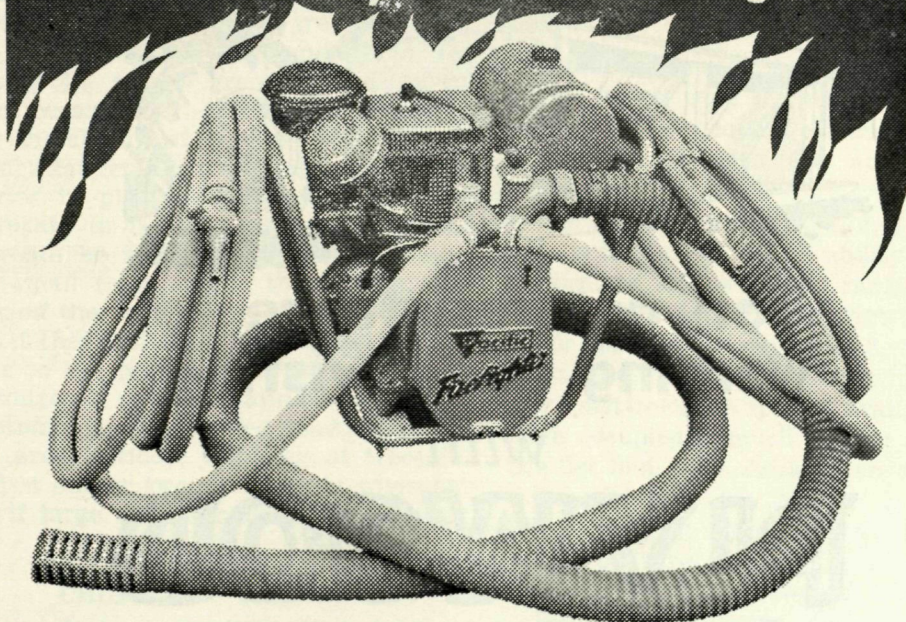


Fig. 13.—Road line planting on the Newdegate Demonstration Farm

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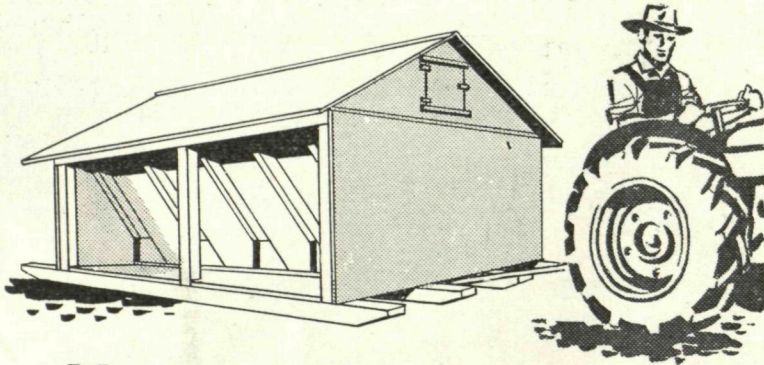
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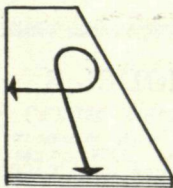
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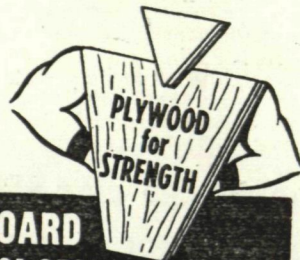
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trees in his region is the "Moort" of our South Eastern wheatbelt. Moort has hardly been thought of in Western Australia, except as something which grows in tangled thickets which have to be cleared to make room for wheat and sheep.

The shorter, more bushy, trees similarly have something to commend them for planting in school grounds and parks. Limbs occasionally fall from trees and while the chance of anyone being injured is somewhat remote, it is inadvisable to run the risk in places where people tend to congregate in large numbers. Dangerous limbs can be much more easily removed from small trees and if they do split or break off they are likely to do less damage than if they fall from a great height.

Due to the possible lack of moisture in the soil as a result of unnatural surface conditions, such as sealed roads within a town area, periodic watering of trees for the first one or two summers is advisable, even if large two-year-old trees are used.

CHOICE OF SPECIES

Although approximately 50 species or varieties of Eucalypts are raised each year, the main demand is for a very limited proportion of these. Thus the three most popular represent 44 per cent. and the ten most popular 72 per cent. of the distributions.

In 1958, the actual numbers distributed from the Dryandra nursery of the ten species most in demand were as follows:—

(1) River Gum (<i>Euc. camaldulensis</i>)	.....	.....	.....	.....	6,900
(2) Sugar Gum (<i>Euc. cladocalyx</i>)	(1,550)	(<i>Euc. cladocalyx</i> var. <i>nana</i>)	(1,080)	.....	2,630
(3) Dundas Blackbutt (<i>Euc. dundasii</i>)	.....	.....	.....	.....	2,620
(4) Coral Flowered Gum (<i>Euc. torquata</i>)	.....	.....	.....	.....	2,500
(5) Wandoo (<i>Euc. redunca</i>)	(500)	(<i>Euc. redunca</i>)	(inland)	(960)	1,460
(6) Brown Mallet (<i>Euc. astringens</i>)	.....	.....	.....	.....	1,400
(7) Dundas Mahogany (<i>Euc. Brockwayi</i>)	.....	.....	.....	.....	840

(8) Yellow Flowered Blackbutt (<i>Euc. Stricklandii</i>)	.....	.....	.....	.....	800
(9) Flat Topped Yate (<i>Euc. occidentalis</i>)	.....	.....	.....	.....	650
(10) Salt River Gum (<i>Euc. Sargentii</i>)	.....	.....	.....	.....	570

It might be noted that salmon gum and gimlet which were at one time extremely popular, now occupy eleventh and sixteenth places, with 550 and 300 trees respectively.

The popularity of Nos. 1, 2, 4 and 5 can be attributed to their ability to adapt themselves to a wide soil range including some of the lighter sandplain soils.

For the heavier soils, Nos. 3, 7 and 8 are outstanding, while No. 10, which is the most salt-tolerant species available would have occupied a much higher position in the list had more stocks been available.

Nos. 6 and 9 are trees of a somewhat higher rainfall zone and I would be diffident about recommending their use for the lower rainfall portion of the wheatbelt.

While the relative demands for the various species give some indication of their suitability for wheatbelt planting the choice is often based on rather limited data. Thus if a species is introduced to a district and thrives, the demand for it may increase rapidly, the species selling itself. On the other hand, an equally good, but lesser-known tree may be passed by.

Furthermore, trees which show early promise do not always maintain it as they get old and while the above list, on our present knowledge, appears a good one, it is not unlikely that some other species now little planted, may spring into prominence.

Where farmers have individual problems relating to tree establishment they are invited to communicate with the Forests Department, Perth, or with the District Forester, Dryandra, via Narrogin.

The attached table lists the species normally raised and indicates their possible suitability for the various sites and purposes.

TREE PLANTING GUIDE

THE trees listed below may be obtained by writing to the Forester-in-Charge, Dryandra Nurseries, via Narrogin, and enclosing remittance to cover cost and freight to the purchaser's siding. All trees are priced at 2s. 3d. each or 24s. per dozen, free on rails, Narrogin.

Species and Common Name	Locality and Soil Type	Rainfall of Natural Habitat	Description	Purpose for which Recommended	Remarks
MALLEE (<i>Euc. angulosa</i>)	Esperance to Comet Vale. Sandy soil	8 in. to 25 in.	A rather straggly mallee. Height : to 20 ft.	Fixing heavy sand	Seed from the northern portion of the range recommended for planting in sand dunes in arid area. The Esperance mallee suitable for dune planting nearer the coast.
POWDER BARK (<i>Euc. accedens</i>)	Covers a wide range on the east of the jarrah belt, extending east and north to about the 17th isolyet	17 in. to 30 in.	A rather vigorous shade tree for elevated sites. Leaves glaucous, giving tree a dull bluish appearance. Height : 80 ft.	Shade and shelter in the western and north-western wheatbelt	A possibly useful tree for the medium rainfall areas in the region of the Great Southern Railway. Useful for elevated laterite sites.
BROWN MALLEE (<i>Euc. astringens</i>)	Extends both east and west of the Great Southern Railway from Broomhill to Beverley. Occurs in elevated laterite gravels overlying friable clay	15 in. to 20 in.	An upright tree with bronze-colored bark and dark leaves. A distinct umbrella crown. Height : to 70 ft.	Shade and shelter. Tan bark produces a tough timber suitable for tool handles	A useful tree for the western wheat-belt, not recommended for areas with less than 15 in. rainfall. Will thrive on loam, gravel or sand provided drainage is good and there is a fair depth of soil over a clay sub-soil.
DUNDAS MAHOGANY (<i>Euc. Brockwayi</i>)	Elevated diorite country near Norseman. Medium loams	11 in.	An upright tree of vigorous growth. Bark pinkish-grey and leaves dark green, shining. Height : to 80 ft.	Shade and ornamental tree. Produces a tough timber suitable for tool handles	This tree is similar to Salmon gum in appearance but when young it is of more attractive shape. Should be planted on good loams.
GUNGUNNU (<i>Euc. caesia</i>)	On sandy soils on and near granite rocks in eastern wheatbelt	12 in.	Bark is thin and varies from dark greenish-brown to bronze. Leaves are dull but flowers are large and an attractive pink shade. Height : 25 ft.	Ornamental purposes around homesteads	This tree can be grown on a wide range of soil types. It needs some pruning to keep it compact and shapely.
SUGAR GUM (<i>Euc. cladocalyx</i>)	A South Australian tree. From Flinder's Range, Kangaroo Is., etc.	18 in. to 28 in.	A fast-growing tree with smooth bark and vigorous crown. Height : 70 ft.	Street planting, shade groups, shelter belts, etc.	This is not recommended for heavy soils or shallow soils but usually does well on light or medium loams and in deep sands. Leaves are sometimes eaten by stock and vermin. Should not be planted in localities with less than 15 in. rainfall.
DWARF SUGAR GUM (<i>Euc. cladocalyx</i> var. <i>Nana</i>)	A South Australian tree. From Flinder's Range, Kangaroo Is., etc.	...	A fast-growing tree with smooth bark and vigorous crown. Height : 30 ft.	Street planting, shade groups, shelter belts, etc.	A more compact dwarf form of <i>Euc. cladocalyx</i> .
RIVER GUM (<i>Euc. camaldulensis</i>)	Occurs along river courses in the drier portions of Australia and usually on loams and sands	8 in. to 28 in.	Bark is white or grey and smooth, leaves are dull—smaller branches may be either pendulous or erect. Height : 90 ft.	Ornamental shade and shelter. Windbreaks or shelter belts. (A very good general purpose tree)	A most adaptable species and by far the most popular tree distributed. Thrives on a wide range of soils. Not recommended for shallow gravels.

SILVER GIMLET (<i>Euc. campaspe</i>)	Eastern Goldfields. Loamy sand to medium loam	7 in. to 9 in.	A drought-resistant, wide-spreading shade tree of low height growth. A good tree for planting under electric light lines. Bark is smooth and bronze-coloured. Leaves are bluish in colour and bark on smaller twigs is almost white Height : 30 ft.	Shade, windbreak and ornament	For the better loam soils of the eastern and northern wheatbelt this tree could prove outstanding.
COOLGARDIE BLACKBUTT (<i>Euc. Clelandi</i>)	Hilly country near Coolgardie ...	9 in.	Drought-resistant tree. Leaves glaucous. Lower bark black and rough. Bark on upper trunk and branches light grey and smooth Height : 30 ft.	Shade tree	Has not proved at all outstanding for wheatbelt planting. In its natural habitat it makes a well-cared tree but it requires well-drained loam soils.
DUNDAS BLACKBUTT (<i>Euc. Dundasi</i>)	Norseman District on light to medium loam	10 in.	A drought-resistant, attractive tree with dark shining leaves. Upper bark smooth, bronze coloured, lower bark black and rough Height : 50 ft.	Good all-purpose tree for the better quality loam soils	This tree has proved extremely popular and is very suitable for most purposes but should be planted only on good soils.
MALLEE (<i>Euc. Drummondii</i>)	Great Southern and Northam ...	18 in.	A tall mallee with small oval-shaped rather dull leaves Height : 25 ft.	For planting on poor deep sandy gravel where other species are likely to fail	This tree is not outstanding and is not recommended for the central or eastern wheatbelt. It may be useful on sites where other species fail.
MALLEE (<i>Euc. Ebbanoensis</i>)	In northern wheatbelt and at Comet Vale in red sand (loamy). (Comet Vale strain is used for propagation)	8 in.	A very drought-resistant wide-crowned shady mallee. Bark is grey to bronze-coloured Height : 25 ft.	For low shade	This has proved hardy in arborescence but its growth over the first few years is slow. Appears able to survive on quite poor sites.
WHITE MALLEE (<i>Euc. erythronema</i>)	Throughout greater part of the wheatbelt, usually in medium to heavy loams	10 in. to 12 in.	A rather handsome erect mallee. Specimens with white, red or pink flowers Height : 20 ft.	Ornamental, garden specimen and street planting. Leaves have high Eucalyptus oil content	The pink or red blossomed specimens have proved popular. Recommended for the better loam soils only.
MERRIT (<i>Euc. Flocktoniae</i>)	Eastern wheatbelt - Goldfields, Norseman district in light to medium loams	7 in. to 12 in.	A drought-resistant erect tree with white bark and very dark leaves. Crown rather narrow which detaches from use as a shade tree Height : 35 ft.	For line planting. Along drives and street planting provided no overhead wires	This tree is being tried with some success on sandy loams which originally carried mallee and tamar scrub.
WHITE MALLEE (<i>Euc. falcata</i>)	Southern and south-eastern wheatbelt and Ravensthorpe District. Grows on poor sands and gravels	13 in. to 18 in.	The mature tree has a spreading umbrella crown but does not normally give good shade. Young trees are rather spindly Height : 30 ft.	Will grow on rather poor soils and is worth trying on the poorer laterite and sandy sites in western wheatbelt	This tree is rather disappointing as a shade tree and is not recommended for central or eastern wheatbelt.
FUSCHIA MALLEE (<i>Euc. Forrestiana</i>)	Grass Patch in Esperance District	15 in.	An attractive mallee up to 20 ft. high. Capsules at flowering time are bright red in colour Height : 20 ft.	Ornamental and garden specimen	This species has been widely planted in the west. It has little value for other purposes such as shade or shelter.
BLUE MALLEE (<i>Euc. Gardneri</i>)	Southern and south-eastern wheatbelt. Laterite slopes with clay subsoil	12 in. to 17 in.	With adequate spacing it develops into an attractive specimen with large dense crown. Leaves blue-green in colour Height : to 35 ft.	Shade, windbreak, ornamental. Tan bark	This tree shows promise as a desirable tree for farm planting on a range of soils, particularly in the southern portion of the wheatbelt.

TREE PLANTING GUIDE—continued


Species and Common Name	Locality and Soil Type	Rainfall of Natural Habitat	Description	Purpose for which Recommended	Remarks
YORRELL (<i>Euc. Graefii</i>)	Yilgarn District. Light to medium loam near lakes	11 in.	If open grown, it forms good shady crown. In forest formation umbrella crown. Butt bark rough and limbs smooth and bronze-colored. Height: 40 ft.	Street planting shade and shelter belts	Fairly salt-tolerant and for suitable site should prove very useful.
STOCKING GUM (<i>Euc. Kondininensis</i>)	Kondinin southward, heavy loams, salt-tolerant	12 in.	In open formation is a fine shade tree with umbrella crown. Height: 45 ft.	As shade tree	This is an attractive tree under natural conditions but to date it has not proved a good nursery subject and early growth in the field has been poor.
BOOK LEAF MALLEE (<i>Euc. Kruseana</i>)	About 80 miles east and south-east of Kalgoorlie. On loamy sand near granite outcrops grows in association with jam bush	8 in.	A very drought-resistant tree of unique appearance. Flowers yellow and in spike-like arrangement. Leaves are small, round, sessile and bluish in colour. Height: 20 ft.	Ornamental. Garden planting	The unique appearance of this tree and its ability to survive on shallow soil makes it a desirable species for arid granite country.
GOLDFIELDS BLACKBUTT (<i>Euc. Le Souefii</i>)	Eastern Goldfields, sandy gravel to loam	9 in.	Bark of butt dark and rough. Limbs grey and smooth. Crown umbrella-shaped — generally somewhat open. Height: 35 ft.	Shade tree for medium loam and gravelly loam soils	Generally has been rather disappointing except on the best sites.
MORRELL OR POOT (<i>Syn. Euc. oleosa</i> var. <i>longicornis</i>)	Over most of the wheatbelt. Medium loams often with calcium, carbonate and gypsum, in the subsoil	11 in. to 16 in.	Bark rough and stringy. In forest formation has a rather poor open crown but grown as an isolated tree it develops a good shady crown. Height: 70 ft.	Shade and shelter belt	A useful tree for fluffy calcareous soils near lakes.
BALD ISLAND MARLOCK (<i>Euc. Lehmanni</i>)	South coast and some of islands of Recherche Archipelago. Sands	24 in.	When young has a round bushy crown and retains its globular form with limbs close to the ground for a number of years. As the tree ages it develops an umbrella crown. Height: 30 ft.	Shade tree, windbreak, shelterbelt or as a large ornamental in or near gardens	This has proved one of the best trees for the Esperance Plains but is not recommended for drier portions of the wheatbelt.
YORK GUM (<i>Euc. Lozophleba</i>)	Widespread in western wheatbelt with isolated patches in central, eastern and northern wheatbelt. Loams often associated with granite	12 in. to 20 in.	A fair shade tree and with umbrella crown. Trunk, rough, barked and usually crooked. Height: 40 ft.	Shade tree, for planting in granite country, also along water courses in the western wheatbelt	This tree is fairly salt-tolerant and for this reason is often retained along water-courses.
MOTTECAH OR ROSE OF THE WEST (<i>Euc. macrocarpa</i>)	Central wheatbelt. Poor sands and sandy gravel	14 in.	A low mallee with large sessile grey leaves, which bear very large scattered red blossoms. Height: 15 ft.	As an ornamental for garden use	One or two isolated specimens desirable. Not recommended for planting in large numbers.
YELLOW BOX (<i>Euc. Melitodora</i>)	Central New South Wales	15 in. to 25 in.	Bark is rough and leaves small and greyish-green in colour. When young has rounded crown. Old trees have rather sparse umbrella crown. Height: to 80 ft.	As a honey-producer this is one of the leading trees in Australia. Would be a useful adjunct to local species for honey production. Fair shade tree	Recommended for the western and central wheatbelts for a wide range of soils, but prefers lighter soils.

RED WOOD OR RED MALLEE (<i>Euc. oleosa</i>)	Eastern Goldfields in red sands and sandy loams	7 in. to 10 in.	Bark rough and timber interlocked. Leaves dark and shining. It is usually, but not invariably, has a mallee form. Trunk usually crooked Height : to 30 ft.	As a shade tree in very dry areas but growth is slow. Some varieties provide eucalyptus oil	The outstanding characteristic of this species is its drought resistance. For the higher rainfall areas there are better trees.
FLAT-TOPPED YATE (<i>Euc. occidentalis</i>)	Southern wheatbelt and eastwards to Esperance and Salmon Gums district. Occurs in low-lying poorly-drained country in clay soils with or without a sandy surface	16 in. to 20 in.	A tall tree with umbrella crown when mature. For the first few years it tends to form a very narrow crown, but it grows as an isolated tree later or it starts to spread. Bark on trunk is dark and rough but on limbs bark is grey and smooth Height : to 80 ft.	Shade tree	If planted in the drier portions of the wheatbelt it should be grown in deep light soil and given freedom from competition to ensure its having ample moisture to maintain it.
MOORT (<i>Euc. platypus</i>)	Southern wheatbelt and Ravens-thorpe district in medium to heavy loams	15 in.	A low tree often occurring with poor form in dense thickets. Grown with ample room it develops into an attractive tree with a good dense rounded crown Height : 25 ft.	Shade, street planting. Low wind-breaks or shelter belts	This tree has been too little used in this State and is worthy of much greater attention.
BELL-FRUITED MALLEE (<i>Euc. preissiana</i>)	Scattered from Stirling Range to Esperance district. On poor sandy gravels	16 in. to 20 in.	A mallee which produces attractive yellow blossoms Height : 8 ft. to 15 ft.	Ornamental—garden specimen	One or two specimens for garden use are often desirable. Should not be planted in large numbers.
<i>Euc. macrocarpa</i> (<i>Euc. corrugata</i> var. <i>macrocarpa</i>)	Norseman district in gravelly loam	10 in.	A rather attractive tree with white bark and fairly large leathery leaves. It produces attractive white blossoms and unique ribbed buds, and seed capsules Height : 30 ft.	Shade purposes	This is a little-known tree but the few specimens which have been established both here and at Broken Hill indicate that it has distinct possibilities for farm planting.
WANDOO OR WHITE GUM (<i>Euc. redunca</i> var. <i>alba</i>)	From the face of the Darling Range—inland to the Goldfields. Usually on clay soils although the inland form also occurs on lateritic sands	9 in. to 30 in.	This tree has greyish-coloured bark and fairly smooth green leaves Height : to 90 ft.	Shade purposes. It produces useful timber and is a valuable nectar producer. The inland form is recommended for use on poor gravelly sands	Two distinct forms are propagated, viz., a western form suitable for the heavier rainfall area and an inland form suitable for a wide range of soil types in the wheat-belt.
SALMON GUM (<i>Euc. salmonophloia</i>)	Occurs over the greater part of the wheatbelt and eastwards, well beyond Kalgoolie. Occurs in medium to heavy loams	7 in. to 17 in.	Bark smooth salmon-coloured. Fairly dense crown if grown as an isolated tree but rather light umbrella type when in natural forest. Leaves small and shining Height : to 80 ft.	Shade tree—avenue planting, windbreak or shelter belt (should not be planted in poor or light soils)	This is the best-known tree in inland W.A. Early development is rather slow but ultimately develops very satisfactorily.
COMMON GIMLET (<i>Euc. salutaris</i>)	Occurs over the greater part of the wheatbelt and eastwards to the Goldfields and beyond. In medium to heavy loams	7 in. to 16 in.	Bark smooth bronze-coloured. Trunk usually straight and fluted. Leaves dark green. Umbrella-crowned but if given adequate spacing forms good small shade trees Height : to 35 ft.	Shade tree and for street and avenue planting	This is a good vigorous species and is deserving of consideration for the heavy red loams of the wheatbelt.
SALT RIVER GUM (<i>Euc. Sargentii</i>)	Occurs in central wheatbelt from Cunderdin eastwards. Confined to low-lying sand and loam soils near salt lakes	15 in.	When mature the crown is small and umbrella-like. Young trees, given ample space and freedom from competition, have a bushy globular crown Height : 30 ft.	Shade and shelter or low wind-break in salty areas	This is one of the most vigorous of all species established in arborescence.

TREE PLANTING GUIDE—continued

Species and Common Name	Locality and Soil Type	Rainfall of Natural Habitat	Description	Purpose for which Recommended	Remarks
YELLOW-FLOWERED BLACKBUTT (<i>Euc. Stricklandii</i>)	Norseman, Kalgoorlie, Bulong, etc. Usually in hilly country on dark gravels and gravelly loams	7 in. to 11 in.	Bark for lower half of trunk is black and rough. Above that it is grey and smooth. Leaves large and shining. Blossoms large, yellow and attractive. Height: 33 ft.	Shade, shelter and ornament. Very drought-resistant	This tree should be planted on loams or dark gravels. Not suitable for poor light soils.
SWAMP MALLET (<i>Euc. spathulata</i>)	Central and southern wheatbelt on medium to heavy loams, generally in low-lying sites	12 in. to 15 in.	A tree somewhat like gimlet in appearance. In some areas it attains a height of 35 ft. In other areas it is of only small size. Leaves are small and narrow	Shade, shelter and windbreaks in low-lying areas. The bark has a high tannin content but is too thin to be commercially valuable	This tree has proved popular for windbreak planting in Victoria.
PEAR GUM (<i>Euc. Stoddet</i>)	Ravensthorpe district. Poor lateritic sand	16 in.	White-barked with dark green leaves. Buds and seed capsules are large, pendulous and just prior to, during, and immediately following flowering are a distinct red colour. Height: to 25 ft.	Street planting and ornamental	This is rather a compact, slow-growing tree but has proved popular as an ornamental.
WING-FRUITED MALLEE (<i>Euc. tetraglerra</i>)	Ravensthorpe and Esperance district. In poor gravelly sand	14 in. to 24 in.	A small shrubby mallee seldom exceeding about 8 ft. in height. It has large leathery leaves and large unique buds and seed capsules	As a unique garden specimen	Apart from its value as a garden shrub it has little value for farm purposes.
CORAL-FLOWERED GUM (<i>Euc. torquata</i>)	Norseman to Coolgardie and eastwards on loamy gravel hills	7 in. to 10 in.	A low tree with rounded crown. Leaves dark green but lacking lustre. Handsome blossoms from white to deep pink. Height: to 30 ft.	Shade, shelter, ornament or garden use. Useful for the more arid areas	Thrives best on the better loams of the wheatbelt but also worth growing on loamy gravels. A very popular species.
BOONGUL (<i>Euc. transcontinentalis</i>) (syn. <i>Euc. oleosa</i> var. <i>Glaucæ</i>)	Eastern wheatbelt to Goldfields and also as a mallee in South Australia. Medium to heavy loams	7 in. to 12 in.	A tree of very variable form and appearance. The Eastern Goldfields strain which is the one propagated has a clean white bark and glaucous leaves and is quite an attractive tree. Blossoms are fairly large and light yellow in colour. Height: to 40 ft.	Shade tree	This is quite a good tree for shade purposes but is possibly less reliable and less attractive than some of the other species available.
LEMON-FLOWERED GUM (<i>Euc. Woodwardii</i>)	North of the Transcontinental Railway about 100 miles east of Kalgoorlie. Deep sandy loams	7 in.	A rather open-crowned tree which in its mature form bears pendulous branchlets. Leaves are large and glaucous. The large lemon-yellow blossoms are very attractive. Height: 35 ft.	Ornamental	This tree has a tendency to develop a very open crown and to bloom rather too heavily at the expense of leaf development. When grown on good loam it may develop into a handsome tree but on poorer sites it is generally a failure.
(<i>Euc. Woodwardii</i>) (<i>Euc. torquata</i> hybrid)	A number of natural hybrids have been obtained from seed collected from selected trees of these two species planted close together in Kalgoorlie	8½ in.	These are taller than <i>Euc. torquata</i> and more dense crowned than <i>Euc. Woodwardii</i> . Blossoms yellow or brownish-yellow. Bark dark grey and smooth. Mature height unknown, probably 40 ft.	For shade, shelter and ornament	A limited number of these trees are propagated each year. The hybrid appears to be a big improvement on <i>Euc. Woodwardii</i> .

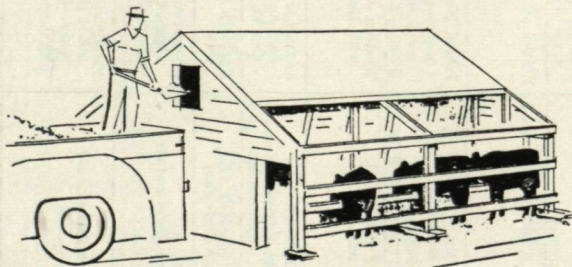
WHITE CYPRESS PINE OR NATIVE PINE (<i>Callitris glauca</i>)	Inland New South Wales on sands and medium loams and in Western Australia on sands and loams near inland lakes	7 in. to 25 in.	The New South Wales form is a tall symmetrical tree which provides useful timber. The Western Australian form seldom exceeds 30 ft. and is used mainly as fence posts	For shade, windbreak or ornamental	The Callitris are much slower and less spectacular than most Eucalyptis in their early years but appear able to survive under adverse drought conditions for sandy sites where Eucalyptis fail.
(<i>Callitris propinqua</i>)	Inland New South Wales	18 in.	A symmetrical tree with more brightly coloured foliage than <i>C. glauca</i> Height : 40 ft.	For shade and ornamental	Grown in aboretca on poor sands this tree is developing very similarly to <i>C. glauca</i> .
BLACK PINE (<i>Callitris calcarata</i>)	Inland New South Wales	15 in.	A symmetrical tree with more brightly coloured foliage than <i>C. glauca</i> Height : 40 ft.	For shade and ornamental	Appears satisfactory on poor sites, including laterite gravels.
ROTTNEST CYPRESS (<i>Callitris robusta</i>)	Western coast of W.A. On sand with limestone	35 in.	A symmetrical tree with more brightly coloured foliage than <i>C. glauca</i> Height : 30 ft.	For shade and ornamental	Suggested for sandy sites in southern wheatbelt.
SWAMP SHEOAK (<i>Casuarina glauca</i>)	Swamp areas in Western wheatbelt and closer to the coast; also in South Australia	12 in. to 35 in.	A dense-crowned sheoak—quite a good shade tree. Height : to 30 ft.	A shade tree for low lying salty areas	Should not be planted right in salt channels but close to the edges of them.
NORTHERN SHEOAK (<i>Casuarina Dielsiana</i>)	Northern wheatbelt on poor stony soils	12 in.	A drought-resistant sheoak—suitable for elevated rocky areas	Shade tree	This is a recent introduction with possibilities for the heavier soils.
DESERT OAK (<i>Casuarina Decussanana</i>)	Desert country near Canning Stock route, etc. On sandhills	6 in.	A drought-resistant sheoak Height : to 30 ft.	Shade tree. (Stocks unavailable at present owing to shortage of seed supplies)	Difficulties have been encountered in establishing this species, but two in an arboretum at Morawa have grown vigorously.
ROCK OAK (<i>Casuarina Huegeliana</i>)	Throughout the wheatbelt on sands in the vicinity of granite rocks. Also in the eastern jarrah bush	12 in. to 30 in.	A symmetrical tree. Carries dense globular crown Height : to 30 ft.	As a shade tree on poor shallow sands	This tree will persist on shallow sandy soils around granite rocks areas where Eucalyptis would perish. Warrants considerably more consideration than it now receives.
ARIZONA CYPRESS (<i>Cupressus arizonica</i>)	U.S.A.	.....	A symmetrical cypress with greyish-green foliage Height : 50 ft.	Shade, windbreak, ornament	Quite a drought-resistant tree. Its main drawback is its slow rate of growth.
PEPPER TREE (<i>Schinus molle</i>)	Brazil	.....	A well-known tree. Fine pinate leaves and pink berries. Crushed leaves have aromatic odour Height : 30 ft.	Shade or ornament	This tree seldom thrives unless well protected from heavy wind, etc. Should not be planted near septic systems or flower gardens.
ATHEL-TREE OR TAMARISK (<i>Tamarix articulata</i> (Syn. <i>T. aphylla</i>))	India, North Africa, etc.	6 in. upwards	A fine-leaved tree. Foliage greyish and dense. Flowers small and pink Height : 50 ft.	Shade, windbreak, ornament	Useful for the heavier soils. Salt-tolerant. Easily grown from cuttings.
JAM (<i>Acacia acuminata</i>)	Western wheatbelt	12 in. to 20 in.	A small tree with rounded umbrella crown Height : 25 ft.	Shade and for use as fence posts	While jam posts are very durable the small size and comparatively slow growth of the species makes its growing for this purposes unattractive.
MANNA GUM (<i>Acacia microbotrya</i>)	Wheatbelt—near creeks and in granite country	11 in. to 20 in.	A small tree with bushy irregular light green crown Height : 25 ft.	Shade, ornament, manna-gum production	A fast-growing small tree which will make a quick shade while more permanent species are becoming established.



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