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FORESTERS'
MANUAL

# REFORESTATION AND SILVICULTURAL OPERATIONS

## JARRAH AND KARRI

FORESTS DEPARTMENT
PERTH
WESTERN AUSTRALIA

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Erratum:

Page 10, para. 9, line 5:
for 'considerably' read 'considerable.'

Page 12, para. 25, last line:
for 'Senior D.F.O.' read 'Inspector.'
for 'Inspector' read 'Superintendent.'

Page 21, para. 106, last line:
for 'Inspector' read 'Superintendent.'

FORESTS DEPARTMENT OF WESTERN AUSTRALIA

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## JARRAH AND KARRI

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Prepared under the direction of
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PERTH, 1964

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## FOREWORD

1. The attention of officers receiving this pamphlet is drawn to the introduction in Pamphlet No. 1 which is applicable to the Manual as a whole.

2. It is to be noted that each section as issued will override the instructions contained in circulars covered by the section and such circulars will automatically be cancelled.

## INTRODUCTION

Silvicultural practice in the jarrah and karri forests has evolved over a period of several decades to a stage where little change might be expected. Silviculture, however, is never static. In Western Australia the end of the phase of initial forest roading and development is in sight. Important changes in protection policy and practice have resulted in better fire protection at lesser cost. Use of hormones to control coppice and unwanted trees has initiated an extensive programme of stand improvement. Research activities are extending. Market changes are enabling salvage of the lower grade log.

All of these factors favour better silviculture, greater forest production. The removal of every tree has a silvicultural significance and much detailed thought must be given to silvicultural planning, allocation of cutting and co-ordination of forest operations to bring every acre of forest to the peak of productive capacity.

Therein lies the challenge.

# DRAFT

# FORESTERS' MANUAL II

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## Reforestation and Silvicultural Operations

## Jarrah and Karri

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### PRELIMINARY

The silvicultural aim.

1. The aim of the forester is to produce the highest possible yield of usable wood.

The axe and the spray gun used in treemarking for trade cutting and stand improvement are tools for the manipulation of the forest crop with the aim of applying the highest measure of wood increment to selected crop trees and to ensure that not only is regeneration assured, but that the new crop is as far as possible the progeny of the best trees in the stand.

Methods of regeneration.

2. In Western Australia the two main species, Jarrah (Eucalyptus marginata) and Karri (Eucalyptus diversicolor), regenerate easily under ideal conditions. However, as conditions are frequently not ideal, particularly in the karri forest, it is important for all officers to be familiar with the problems involved and to study the effect on regeneration of factors such as burning, treemarking, seed source and weed competition. The aim is that regeneration shall develop naturally in the openings created by trade cutting. Jarrah regeneration is obtained mainly from lignotuberous advance growth which is commonly present in dormant condition throughout the prime Jarrah forest (see under "Jarrah Regeneration"). Karri regeneration involves burning with close regard to seed availability, supplemented where necessary by artificial means (see under "Karri Regeneration").

Records of regeneration.

3. Every officer in charge of a forest district should have a knowledge of the stocking on his forest, and, in particular, a record of areas where regeneration or growth appears unsatisfactory, and where patches of forest have been seriously damaged by fire. Such areas should be discussed with senior officers and suggestions made for improvement.

The general Working Plan.

4. The first general Working Plan was based on assessments of State Forest carried out between 1920 and 1930. At each revision this original assessment was amended in the light of subsequent work by the Field Staff, and Working Plan records.

5. The dedication of effective forest and accurate separation of forest types and volumes has been furthered by stereoscopic interpretation of aerial photographs which have now been secured for the whole of State Forest. Practically all forest worthy of dedication is now included in State Forest.

6. For convenience of reference and compilation, Working Plan Areas have, where possible, been grouped in recent revisions of the General Working Plan into Planning Sections on the basis of common forest character or a common economic factor. A prescription for each Planning Section specifies permissible log intake for each established sawmill and provides for slight adjustments to permissible intakes and permit boundaries.

Aims and policy.

7. The Conservator, through the treemarker, controls all felling operations and in so doing ensures that the forest is worked systematically to ensure sound utilisation, effective regeneration and the retention of vigorous growing stock.

Cutting section.

8. Logging operations are each year confined to approved cutting sections. These areas are defined well in advance per medium of forward planning for at least five years by the Divisional Forest Officer, etc., in consultation with mill management, to ensure effective road planning and allocation of the cut for silvicultural improvement of stands which have suffered severe fire or other damage, and also to balance summer and winter operations.

Cutting coupes.

The orderly working of each cutting section is secured by allocating fallers to blocks which must be systematically cut over to an accepted standard before a further block can be allotted.

Forest composition.

9. Jarrah and karri forest is comprised of groups, being more or less even aged within groups but frequently uneven aged between groups. Most of the virgin forest is physically mature or overmature and understocking is generally serious in the smaller age classes. In view of the considerably variation which occurs in stand composition and, in some cases, degree of fire damage, the treemarker's approach must be flexible enough to treat each area to best advantage.

Treemarking—historical.

10. Early attempts to control the industry and preserve growing stock were by girth restriction (e.g.: Jarrah, 90 inches; Karri, 108 inches). However, as this could at best have marked silvicultural disadvantages, treemarking was introduced in the early 1920's. The present system of marking trees for removal, with specification of direction of fall, was commenced in jarrah forest in 1928 and in karri forest in 1944.

Regeneration—natural

11. The trade cut is virtually a regeneration felling, the new crop normally deriving from advance growth (Jarrah) or seedling (Karri), following a regeneration burn prescribed to take advantage of the first good seed year after logging (see below). Treemarking, in controlling trade cutting, is, apart from protection measures and seed check, the first step in the regeneration sequence and plays an essential and most important part in determining the post-cutting condition of the stand.

## CURRENT PRACTICE

Current practice.

12. Broadly, the aim in marking virgin forest is to release to the trade the static portion of the crop and to retain for the future the dynamic, or vigorously producing portion. (See under "Treemarking.")

Silvicultural system.

13. Jacobs has applied the term "Australian Group Selection" to the silvicultural system used in W.A. The system is flexible enough to permit the marking of single trees to effect a thinning, also of groups of trees to furnish gaps for regeneration and, in areas of karri which are substantially overmature, to effect a virtual clear felling on a limited scale with retention of seed trees.

Cutting cycle.

14. A cutting cycle of 30 years has long been accepted in management planning. In practice, however, because of variations in stand quality and composition, the cutting cycle must be flexible and will obviously be longer where the site is poor and shorter where the yield is high.

Sequence of operations.

15. The following sequence of operations comprises current practice:—

(a) Fire protection of cutting section and provision of access (advance burn in Jarrah forest).

(b) Prescription for treemarking and regeneration.
(c) Treemarking.
(d) Trade cutting (including "cull felling" where prescribed).
(e) Assessment.
(f) Top disposal (including "cull felling" where prescribed).
(g) Regeneration burning.
(h) Regeneration appraisal.
(i) Compartment subdivision and record (Compartment Register).
(j) Fire protection as prescribed.

Advance burn.

16. The advance burn, which is standard practice in jarrah forest, has been discontinued in karri forest where its advantages are outweighed by detrimental effects such as—
(a) the difficulty of securing a uniform burn without scorching of canopy and damage to buds and blossom or release of seed which should ideally remain on the tree until after logging;
(b) adverse effect on the regeneration burn which becomes discontinuous and may destroy seedlings developing from the advance burn;
(c) dense establishment of fire weeds which inhibit development of karri.

17. In the few cases where karri advance burning can be justified, e.g., for reduction of extensive areas of dense acacia fire weeds, it is essential that such burning be confined to a karri seed year well in advance of logging.

Protection of cutting section.

18. Karri cutting sections are now opened up with bulldozed access tracks prior to logging and are protected, in units not exceeding 1,000 acres, by burns in the surrounding jarrah and marri forest types and in non-timbered flats.

Treemarking prescription (paras. 19-26).

19. It is essential for the treemarker to receive the D.F.O.'s guidance in respect of atypical areas, particularly where the forest is severely damaged, grossly overmature, or carrying an exceptionally high proportion of marri. These areas will be withheld from cutting until treemarking and regeneration treatment is prescribed. Logging may be arranged immediately after a severe fire in karri forest, provided that seed supplies and/or planting stock are available for regeneration.

20. Karri will be reserved from cutting (preferably by exclusion from the annual cutting section) where it occurs in a marri-karri stand, until such time as the marri can be marketed to enable conversion of the stand to karri.

Regeneration prescription.

21. Prescriptions for regeneration will be made by the D.F.O. in consultation with the Silvicultural Officer. In the karri forest detailed records are maintained of the development of buds, flowers, fruit and seed on each cutting section. From this information, predictions of seed availability can be made. Substantial variations can occur between areas only a short distance apart and additional sampling is required on specific areas to enable completely effective prescriptions. Where prescriptions require protection of regeneration by deferring controlled burning, such areas are to be clearly defined on plans in the Divisional Office and brought to the notice of officers responsible for control burn planning. This applies also to research plots specified for protection by Silvicultural and Working Plans Officers.

Protection prescription.

Protection of research plots.

Compartment Register.

22. All prescriptions for treemarking, regeneration and regrowth protection should be recorded in a Compartment Register, which should clearly define the areas concerned.

Treemarking.

23. The aim in treemarking virgin forest is to—

(a) **Remove static volume** (mature, overmature and defective stems). Merchantable suppressed or defective stems below 90 inch G.B.H. (Jarrah) and 108 inch G.B.H. (Karri) are also marked.

As a rule trees in this class are retained only if their felling would jeopardise valuable growing stock. Vigorous immature trees must on no account be marked for cutting, excepting, rarely, to permit removal of overmature trees.

(b) **Retain dynamic volume,** i.e., vigorous stems in all sizes. In general over 50 per cent. of merchantable volume is reserved in trees over 60 inch G.B.H. It is seldom necessary to retain jarrah trees over 12 ft. G.B.H.; however prime karri trees up to 18 ft. G.B.H. may occasionally be held to silvicultural advantage.

(c) Avoid damage to growing stock.

(d) Create openings adequately served with seed trees and/or advance growth for generation of the new crop. (See also under "Regeneration.")

(e) Remove cull trees (see under "Improvement cutting.")

Seed resource.

24. Dynamic trees in the top canopy are not only the most productive component of the crop, but are also the best seed resource in terms of both quantity and quality. Eucalypt dominants produce more than 80 per cent. of the total seed supply.

Standards of treemarking.

25. It must be stressed that treemarking plays a vital part in determining the future condition and productivity of the forest. D.F.O.s are to ensure that careful instruction and close supervision is given to all treemarkers, especially those in training. Consistent attention to the maintenance of standards is imperative and all questions in this regard should be referred to the Senior D.F.O., or Inspector.

Method of treemarking by branding axe.

26. Trees will be marked by branding in an axe cut at the foot of the tree in such a position that the tree must be felled directly over the brand, i.e., over a radial line extended from the centre of the tree through the centre of the toemark. The brand used is an insert in the back of an axe head and is marked F.D. over a number; the number signifying the authorised officer using the brand. All branding axes are issued from Head Office where the number is registered against the name of the officer concerned. Branding axes may not be loaned or transferred or used for purposes other than treemarking and must be kept in a safe place at all times when not in use.

Care of treemarking axes.

## TRADE CUTTING AND PERMIT CONTROL

27. The main features of control of trade operations under the Forests Act and Forest Regulations are covered in Pamphlet No. 2 of this Manual.

Control of bush operations.

28. The treemarker, as the Conservator's representative in the field, is responsible for ensuring effective control of trade operations in respect of orderly working, satisfactory utilisation and protection of growing stock. He must bring to the notice of the "bush boss," or Company representative any failure by the Company (as permit holder) to observe the Department's reasonable requirements. In the event of disagreement between the treemarker and the bush boss, the subject of dispute shall be referred to the Forester in Charge (or D.F.O.) and the mill management.

Fallers' coupes.

29. Fallers' coupes or blocks must be blazed by the bush boss, or other company nominee. No treemarking shall be commenced until the blocks are marked out to the satisfaction of the Forester in Charge.

30. Regulation 37 of the Forests Act covers the responsibility for demarcation of permit boundaries. Permit boundaries.

31. The treemarker must inspect coupes frequently to ensure that they are satisfactorily cut out before fallers are authorised to commence cutting on new blocks. Inspection of coupes.

32. See Pamphlet No. 2, paragraphs 67-74, regarding renewal of the cutting section. Renewal of cutting section.

33. It is the responsibility of the sawmiller through the bush boss to see that useless or subgrade logs do not reach the mill landing, also that logs are prepared, where reasonably necessary, by long butting or docking out of defect. The treemarker is responsible for ensuring that log preparation at no time involves avoidable waste in long butts, queen cuts, stumps or crowns. Log quality.

34. Should it appear to any officer that neglect of these matters is likely to give rise to complaints by the mill management in respect of log quality or mill recovery, he shall report to the Forester in Charge, who will take the matter up with the mill manager.

## ASSESSMENT

### Temporary Assessment Lines

35. All treemarkers are required to assess a portion of the area cut over at the close of each quarter and to forward the results to the D.F.O., who summarises them and forwards them to Head Office on Form F.D. 423 with a copy to the Working Plans Office. The Forester in Charge should accompany the treemarker as frequently as possible. Quarterly assessments.

The objects of these assessments are— Objects of assessments.

(a) To inform the D.F.O. and the treemarker himself of the volume he is removing and the volume he is retaining per acre.

(b) To inform Head Office and the Working Plans Offices for management and working plans calculations.

(c) To assist the D.F.O. in preparing five-year logging programmes.

36. The assessment lines must be selected so as to be truly representative of the area cut over during the quarter and the D.F.O. must satisfy himself that this is, in fact, the case. Eight acres of assessment line will normally be run in each quarterly coupe and the direction of the line should be chosen so as to cross the prevailing topography. Selection of lines.

37. Commencing from a known point, such as a Reference Tree or a track junction, the treemarker runs a compass line, preferably across the ridges through the country cut over during the quarter. Distances are measured either by chaining or by pacing. The treemarker records the volumes removed and retained for all trees over 60 inch g.b.h. including Marri, within a distance of half a chain on each side of the line. In open country, where few trees are encountered, a distance of one chain on each side of the line may be used, giving an area of two acres for each 10 chains of line run; where this is done, the Field Book must be noted accordingly so as to avoid confusion in later calculations. Running the line.

38. The treemarker is not required to measure all girths unless specifically requested to do so by the D.F.O. However, sufficient measurements should be taken to provide an effective check on estimation.

Booking procedure.

39. The volumes of each tree encountered, or of each log removed, are recorded in Field Book type I/1954 and the classification of every tree as shown in paragraph 44 is also noted against each entry. The easiest way to do this is to subdivide the vertical columns to accommodate the appropriate tree classifications under their respective girth class headings.

40. All columns of the Field Book must be filled in and if the same comments apply to successive entries, the column should be marked "Ditto" and not left blank.

41. Loadages are totalled for each 10 chains and for the whole of the assessment line and the average loadage, to the nearest 1/10th of a load, may be worked out at the foot of the Field Book page.

42. A summary of the assessment is then sent to the D.F.O. along with a map reference indicating the start point and the direction of the line. The original Field Book is retained at the District Office and it is no longer necessary to prepare a copy of it for the Working Plans Office.

Prescription required.

43. Before completing his assessment, the treemarker should give a description of the forest remaining on the line and should write a prescription setting out his own ideas as to the future treatment of the forest. This is particularly important in areas where advance growth is inadequate or where only small sapling regrowth is present as special burning measures may be required to ensure satisfactory regeneration under these circumstances.

Tree classification.

44. The following tree classification will be used:—

**STANDING TREES**

A. **Over 90 in. G.B.H.** (Karri over 108 in.).

(i) Trees retained as growing stock (or will be retained where bush not previously treemarked). Sometimes only fair trees are retained because there is nothing better.

(ii) Trees held for special reasons. In treemarked bush this includes logs held—

(a) To prevent damage to immature growth.

(b) Trees held to allow a top log to reach millable size.

(iii) Marketable logs which should be taken to a mill in the district. This includes trees M.N.T. because of quality or because they would fall over a road.

(iv) Trees not at present exploitable. These may include some of the M.N.T's.

B. **Trees between 72 in. and 90 in. G.B.H.** (Karri 72-108 in.).

(i) Growing stock for the future.

(ii) Trees that could be removed—too defective for future growing stock.

(iii) Trees not at present exploitable because of defects.

C. **Trees between 60 in. and 72 in. G.B.H.** (Karri likewise).

(i) Dealt with in same manner as B.

(ii) Dealt with in same manner as B.

(iii) Dealt with in same manner as B.

D. **Under 60 in. G.B.H. Piles and Poles** (tree classes).

When above 60 in. G.B.H. engineers' piles and poles will be classified according to their girth class, but the letter "E" will be added in the class columns, e.g., BI (E).

## ENGINEERS' PILES AND POLES

Piles and poles.

**Poles** (all species)—

Minimum length 20 ft.
Minimum crown diameter 6 in.
Maximum crown diameter 9 in.

**Piles** (all species)—

Minimum length 20 ft.
Minimum crown diameter 10 in.
Maximum crown diameter 16 in.

Record position, crown diameter and length of engineers' piles and poles. For others down to 24 in. G.B.H. record number only, but not on a separate line—see specimen page of field book.

## REMOVED TREES

Removed trees.

**Jarrah**—

Over 90 in. over bark—R1.
Under 90 in. over bark—R2.

**Karri**—

Over 108 in. over bark—R1.
Under 108 in. over bark—R2.

The removed trees should be encircled thus in the case of an old cutting (R1), (R2) to differentiate from a further or new cutting which are marked thus, R1, R2.

Poles and piles to be recorded.

45. Owing to the scarcity of heavy poles and piles of all kinds and because of the difficulty in locating them the treemarker should make a special note of all trees which comply with pole and pile specifications on his assessment line. The length and top diameter of all poles and piles over 35 feet long should be recorded along with their position in relation to the start of the line.

Details of co-doms not needed.

46. Now that A.P.I. work is well in hand it is no longer necessary for the treemarker to provide detailed measurements of co-dominant trees, but he must ensure that the co-dominant height of the forest recorded in his Field Book is correct.

## TOP DISPOSAL

Top disposal cleaning.

47. On completion of the trade operation the Department carries out a top disposal cleaning programme to ensure that the burning of logging debris will do little or no harm to growing stock. Inflammable material is moved to a distance of at least three feet from the base of reserved trees and elevated branches are lopped flat. Although mainly axe work is required, chain saws can be used to advantage on large limbs. It is the overseer's responsibility to see that no areas or trees are missed, that the standard set is maintained and that unnecessary work is avoided. The overseer will indicate where the chain saw is to be used. In low quality bush the Inspector will decide whether top disposal is warranted.

Cull trees.

48. As mentioned under the heading "Stand Improvement," the elimination of cull trees may be coupled with the top disposal operation. In general culls will be ringbarked and/or treated with a hormone spray application.

### The Top Disposal or Regeneration Burn

Top disposal burning.

49. See under Jarrah, Karri Regeneration.

## JARRAH REGENERATION

Seedling and advance growth.

50. Jarrah regenerates from seed. However, the seedling, instead of extending as a sapling, develops a woody lignotuber or reserve of food material with dormant buds from which a

number of semi-prostrate stems a few feet high are produced. This lignotuber renders the jarrah "seedling" virutally indestructible for it rapidly produces new growth if the aerial portion is removed or damaged. It develops very slowly and may take 15 years or more to reach the stage where it is able, when stimulated by burning and/or removal of canopy in logging, to produce an erect dynamic sapling.

Problem areas.

51. Although regeneration of jarrah is relatively simple where advance growth is present, it is important to note that such dormant growth is not always present. When this is the case care must be taken to programme the top disposal burn to coincide with the presence of sufficient seed in jarrah crowns. Seed years are not regular in the jarrah forest and a period of five or six years may elapse between general seed years, when roughly 25 per cent. of the stand can be expected to carry a heavy crop of seed. The scattered trees to be found in seed every year are usually insufficient for regeneration purposes. Top disposal burning should be deferred on areas lacking advance growth if jarrah seed is scarce.

Flowering cycle.

52. New flower buds appear in the axils of the leaves of the early summer growth and flower in the following November and December. The fruits mature to shed seed in the following summer or roughly two years after bud formation.

Observation of seed potential.

53. Officers should keep themselves informed on the seeding potential of areas not well served with advance growth.

Seed.

54. The seed is black, three-sided and about one-eighth of an inch long. There are approximately 64,000 to the pound, free of chaff, or 24,000 per pound, chaff included.

Seed fall.

55. Natural seed fall occurs when mature fruits are opened by hot dry weather in mid-summer. Ripening of capsules may be spread over a period of months and some may remain on the tree over winter to release seed the following summer.

Regeneration burn.

56. Fire in the form of a light broadcast or regeneration burn is frequently used to trigger seed release onto ash bed.

Seed dispersal.

57. Dispersal of seed is usually confined to a radial distance not greater than the height of the tree.

Germination.

58. Germination follows the first winter rains in May and June. Under ideal conditions up to 0.5 million seedlings per acre may germinate. However, losses due to insects, fungi, frost and drought more than decimate the seedling population in the first year.

Fire resistance.

59. During the first year seedlings are killed outright by mild burning. However, with the development of the lignotuber resistance increases to the extent that a three-year-old seedling will recover after a moderate burn.

Fire protection.

60. Protection of the new crop is necessary until it reaches the stage when it can withstand a light controlled burn. The D.F.O. is responsible for inspection after regeneration and for preparation where necessary of a prescription for protection. Owing to variations in stand height, density and condition, it is not possible to issue a general prescription. In general it is considered that in the northern and eastern jarrah forests, where stand heights are lower, complete protection will be required for 8-10 years until saplings are 20 feet high and the lower green crown about 12 feet above ground.

61. In prime jarrah forest consideration may be given to resuming cyclic burning 4-8 years after the top disposal burn, the criterion being always whether burning will prejudice development of the new crop.

62. Night burning should be arranged where necessary.

## KARRI REGENERATION

63. Under ideal conditions karri develops rapidly from seed. Although it does not produce a lignotuber it has a weak capacity to coppice after fire.

Natural regeneration.

64. As natural regeneration depends on seed fall considerable attention is given to the planning of regeneration burns to make effective use of available seed.

Seeding forecasts.

65. Treemarkers are required each quarter to furnish floral samples from karri cutting sections, together with notes on the frequency of buds, flowers, fruit and seed. The record sheet is included as Appendix A (F.D. 480). In addition, a monthly check on roving* seed trays enables compilation of records at the Manjimup Research Station to show the age and relative numbers of floral parts. At the same time the incidence of viable seed is checked so that it is possible to predict the years and seasons (spring and autumn) when regeneration burning may be carried out successfully.

Seeding—field appraisal.

66. These forecasts are supplemented by observation in the field, in particular of the crowns of fallen trees including those of cull trees reserved for the purpose, to confirm the adequacy of the predicted seed supply. The procedure for sampling seed supplies is set out in detail in Appendix B.

Seed sampling procedure.

Floral cycle.

67. Flower bud initials can be recognised in January, but do not differentiate as buds until March, usually becoming recognisable in April as buds about one-quarter of an inch long.

68. Flowering commences 24 to 30 months after bud initiation (i.e., bud development generally takes upwards of two years), usually commencing in February-March, becoming general in May-June and continuing throughout the winter into the following summer.

69. The capsule ripens and seed matures 10 to 15 months after flowering so that the elapsed time from bud initiation to first natural seed fall is approximately four years. It should be noted that whilst seed is mature at four years and its release may be triggered by a regeneration burn at that stage, natural release in quantity may be delayed while the capsule cures, extending elapsed time to five years from the first sign of buds.

70. The major part of the karri forest blooms in phase at intervals of 4-6 years. Between such general flowerings partial intermediate light to moderate flowering occurs, occasionally in successive years.

Seed count.

71. There are 60,000-80 000 seed plus chaff to the pound in a normal sample, or approximately 300,000 clean seed per pound.

Seed fall.

72. Heaviest natural seed fall occurs in midsummer. Falls as high as one million seed per acre have been recorded during the month following the regeneration burn.

Age of seeding.

73. Seeding may commence at approximate age 15 years in open grown karri and at 25 years in dense pole stands. However, in the latter case little seed is produced at this stage.

Seed dispersal.

74. Only a small proportion of seed is carried to a distance equal to the height of the tree.

Regeneration burning.

75. As mentioned above, the regeneration burn is timed to furnish a seedbed (ashbed) for receipt of adequate seed released after the burn. As the first seed matures during spring months and ripening extends over a period and also

* Moved at specified intervals.

as mature seed may carry over the winter, there may be three opportunities for effective regeneration burning in respect of each seed crop—

(a) in early summer: December-January;

(b) in autumn;

(c) in the following spring and early summer.

76. Full natural seed release occurs during the second summer, hence burning in the second autumn is likely to prove abortive and should not be undertaken unless it is conclusively demonstrated that effective quantities of seed remain.

77. Owing to the natural periodicity of karri seeding, it is often necessary to withhold karri tops for periods of up to six years before adequate supplies of mature seed are available for a successful regeneration burn. For this reason, regeneration burning may be carried out during the prohibited period, under special suspension, so as to cover all areas ready for burning within the relatively short period available.

It is therefore essential that district officers, in consultation with the D.F.O., organise advance programmes to ensure that—

(a) The area to be burnt is surrounded by a freshly burnt buffer of adequate width to contain any escapes from the regeneration burn.

(b) All perimeter tracks and subdivision tracks within the area to be burnt are in a trafficable condition prior to commencing the regeneration burn.

Scrub competition.

78. Should burning be carried out when karri seed is lacking, the site is taken over by dense regeneration of scrub species, mainly Acacias (Karri Wattles *A. urophylla, A. pentadenia, A. decipiens, A. strigosa,* etc.) and also *Bossiaea aquifolium* (Netic). Should this occur, regeneration of karri must be deferred until a relatively hot fire can be arranged to take advantage of a subsequent heavy seeding.

79. Where karri germinates on even terms with the scrub species it gains and maintains an advantage. Prior germination of scrub, due to poor timing of the burn may completely inhibit karri seedling development or condemn seedlings to an etiolated condition for several years until they emerge above the scrub level to become active components of the new crop.

Nature of burn.

80. It is axiomatic that the hottest burn produces the best regeneration. More fuel is consumed, and ashbed, most favourable to seedling development, is more continuous. An intense burn, however, may seriously damage growing stock and in most cases burning conditions must be chosen to achieve effective regeneration on the one hand and little damage to upper canopy on the other. Where patches of advance growth occur it is desirable to minimise damage by lighting, firstly, in these under minimum conditions. In all regeneration burning it is desirable to secure a general burn. Karri regenerates vigorously on ashbed and reasonably well on disturbed earth. It does not, however, regenerate on unburned undisturbed soil. It is desirable, wherever practicable, to increase ashbed distribution by falling cull trees, including marri, into openings which lack logging debris.

Preservation of advance growth.

Seed bed.

Germination.

81. Germination occurs with the first winter rains (April, May). Under ideal conditions wheatfield regeneration occurs. As with jarrah the agencies of frost, fungus, drought and insects cause heavy seedling mortality.

Regeneration appraisal.

82. Initial appraisal of regeneration results can safely be made in June. A seedling count of at least 2,000 per acre is regarded as a minimum for acceptable establishment. (A survival count of 500 per acre at age 6 months is equivalent.) D.F.O's. are required to arrange appraisal and to list failed

areas for artificial regeneration. In view of the rapid development of scrub competition, regeneration by seeding or planting must be given urgent priority.

It is important, before proceeding with enrichment planting, to be certain that seedfall and germination is complete. This applies particularly when a regeneration burn follows the first maturation of seed. In this case it may be possible to accept an initial seedling count of 1,000 per acre in the knowledge that additional germination will occur.

Sampling procedure.

83. The procedure for sampling karri germination and survival is included in Appendix B.

Artificial regeneration.

84. The technique for artificial establishment will be prescribed by the Divisional Forest Officer in consultation with the Silviculturist (Karri). Seeding will depend on availability of seed supplied (see under "Seed Collection"). Broadcasting of seed has proved successful. However, it is extremely wasteful of costly seed and cannot be envisaged. Spot sowing succeeds only when large numbers of seed (at least 40) are sown in each spot. Spot sowing should be confined to openings and within openings to ashbed and soil disturbed in logging.

Spot sowing.

Open rooted stock.

85. Use of open rooted stock is still under test. Wildlings may be transplanted from dense patches of seedlings established under natural conditions—age preferably 12-18 months. Transport may be effected in bundles wrapped in wet bags or in polythene sheeting. Root exposure is to be avoided.

86. The use of nursery stock raised in trays and in peat pots is also under test.

Seed collection.

87. It is essential that Divisional Officers in charge of karri divisions take every opportunity to collect karri seed whenever this can be economically carried out.

Time of collection.

88. The optimum time for collection of seed is from about 12-18 months after flowering and during the period November to March. Maturity of seed vessels is generally indicated by a hardening of the texture of the vessels and a dulling of their colour from green to brownish green. Cutting of capsules with a strong knife or sharp axe will enable a check to be made on the condition of the seed.

Research Station records.

89. Before directing the collection of seed, a check should be made with the Research Station, Manjimup, where progressive records of the development of seed on each cutting section will frequently determine the area best suited for collection work.

90. Seed collection should be done in association with trade cutting. Collectors must keep right up with the fallers as a day or two of delay can mean that seed will be already shed, or much of it will be lost during the collection operation.

Seed tree characteristics.

91. Seed should be taken only from trees of good form and quality. Whilst vigour is a prime criterion this should not rule out a dominant tree with the first two characteristics but which through age is losing vigour. Brefly, seed trees with undesirable genetical characteristics, such as short or crooked bole, wind, etc., should be avoided, but a more tolerant view may be taken of trees which have been degraded by external factors such as fire and mechanical damage.

Method of collection.

92. All branches carrying mature seed vessels are lopped and spread out on a tent fly or tarpaulin which has been treated with a fungicide to prevent rotting by mildew. (Soaking in "Shirlan" is an effective treatment.) It is desirable to lop off as much leaf material as possible. The branches are thrown loosely on the sheets to provide for free circulation of air. Collection of individual capsules by raking should only be used where artificial drying and agitation for removal of seed can be arranged. The use of heat in drying needs care, and temperatures should not exceed 105° F. to 110° F.

93. Two or three days of bright sunlight opens the seed vessels. The branchlets are now discarded after being well shaken to remove all seed and the residue left on the sheet is sifted to remove twigs, leaves and seed vessels, leaving only seed and chaff.

Seed storage.

94. Collected seed, unless required for local use at an early date, should be forwarded to the seed store at Como or to the Research Station at Manjimup where there are proper facilities for storing seed. When stored locally it should be kept under cool dry conditions and protected from insects and rodents.

Seed viability.

95. Eucalypt seed retains its viability under favourable conditions for up to 10 years with a gradual decline after this.

Data collection and recording.

96. Appropriate forms are on issue from the Research Station, Manjimup, to cover—

(a) collection, extraction and testing of seed (KS1, KS5);

(b) recording of floral development (KS2) (see Appendix A);

(c) sampling of seed fall after regeneration burning (KS3);

(d) regeneration appraisal (KS4).

## STAND IMPROVEMENT

Aim.

97. Trade cutting removes the less productive component of merchantable volume. Vigour is the prime criterion in selection of growing stock for retention. Important though it is as a silvicultural operation, the controlled trade cut rarely leaves the stand with the potential for full production. To the extent that useless and surplus stems remain, the site is not fully utilised and improvement work may be justified.

98. Assuming that regeneration is satisfactory, the main avenues for improvement are—

(a) removal of useless overstory;

(b) removal of useless understory;

(c) removal of surplus crop trees;

(d) removal of scrub competition.

99. Removal of all or any of these competing strata can be expected to favour crop trees.

### Historical.

Regeneration cleaning.

100. Improvement work was carried out on a large scale in the northern jarrah forest during the depression years of the 1930's. This work was termed a regeneration cleaning and involved the freeing of crop trees, the ringbarking of useless overstory, mainly marri, and the falling near ground level (mullinising) of small trees which had been too severely damaged by fire to have any crop tree potential. Vigorous coppice regeneration resulted on a high proportion of the 300,000 acres treated.

Coppice thinning.

101. Subsequent trials to test the effect of thinning coppice to one or two stems per stump showed that little advantage, if any, was to be gained.

Sapling and pole thinning.

102. Thinning in sapling and pole stands likewise achieved little advantage, due largely to the development of competition from vigorous coppice which resulted wherever surplus trees were removed.

Thinning potential.

103. Measurement from time to time of stems relatively free from competition has shown that substantial advantage could accrue from thinning if the problem of coppice competition could be defeated.

Hormone sprays.

104. It was not until the successful testing in the early 1960's of the hormone 245-T (Trichlorophenoxyacetic acid) for coppice prevention and eradication that stand improvement works could be planned in the certainty of achieving an effective increase in yield.

Development and protection phases.

105. A further limiting factor in past years was the lack of funds for an intensive silvicultural programme, this in view of the need to first develop and protect the forest. It can be said that access is largely complete in the northern forests and that recent development in protection policy and techniques have set the stage for emphasis on stand improvement programmes.

Prescription for stand improvement.

106. Prescriptions have been developed to cover jarrah stand improvement and the standard prescription is included as Appendix C. Deviations from this prescription are not to be adopted without good reason and the approval of the regional Inspector.

Working plan.

107. Stand improvement at the outset will apply only in prime jarrah forest (type JA, JB+). In each Division where this work is scheduled, the D.F.O. will draw up a working plan to define the sequence required, having in mind—

(a) areas most in need of treatment;

(b) co-ordination with trade cutting;

(c) co-ordination with controlled burning.

Selection of stands to treat.

108. In considering areas in need of treatment selection should favour those which can be expected to produce the best growth response. For this purpose—

(a) co-dominant height of regrowth should be at least 50 feet;

(b) the regrowth stand should be obviously overstocked, i.e., basal area should be at least 100 square feet per acre;

(c) sufficient "crop trees" (see below) should be present;

(d) fire damage, if any, should not be severe.

Co-ordination with trade cutting.

109. Wherever practicable stand improvement should be carried out as a logical sequence to trade cutting to achieve a fully productive condition for the full period of the cutting cycle.

Salvage cutting.

110. In this respect the market for trees rejected by the permit holders ("MNT" and "sub-MNT") should be fully tested. Salvage cutters with lesser commitments than the major companies are frequently able to economically remove logs yielding a lower recovery in sawn timber. These operators are being used mainly for the salvage of trees on dieback areas and of low grade logs from plantation clearings. They are used with silvicultural advantage in the forest and should work in advance over areas listed for stand improvement.

Controlled burning.

111. The programme for stand improvement should also take into account the programme of cyclic burning (and vice versa), of top disposal burning and of the burning prescription in respect of recently established regeneration.

Crop tree—definition.

112. Other basic features of the prescription are:—

(a) **Crop tree—definition:** A tree which occurs in or above the general level of the canopy and has a healthy crown of reasonable vigour. Crown diameter should preferably be at least twelve times bole diameter at breast height (i.e., K/d = 12+). Occasional trees below the general level of canopy may be accepted if they comply in other respects. The bole should be defect-free and reasonably straight.

(b) Surplus trees saleable as poles will be removed whenever possible prior to the improvement operation or concurrently with it. Otherwise such trees will be reserved for removal at an early date.

Surplus trees will be reserved for sale if they have—

(1) minimum straight bole length of 7 feet; and
(2) minimum G.B.H.o.b. of 36 inches.

(c) Ringbarking for removal of surplus trees will not apply—

(1) within 5 chains of main roads; or
(2) within at least 20 chains of private property on peripheral boundaries.

In these cases surplus trees will be felled.

Use of 245-T.

113. The hormone 245-T is purchased in concentrated form (normally as 80% butyl ester) and is broken down by diluting with water or diesoline. White oil may be used as a spreader in aqueous solution and a suitable dye (such as ferrous sulphate) added as an indicator to ensure full coverage of area. The indicator for diesoline solutions is "Waxoline Red" (4-6 oz. per 44 gallons mixed). Appendix D sets out the formula for obtaining the correct proportions of hormone and water or diesoline for given concentrations and includes a table of quantities for the concentrations commonly used.

Application.

Application by brush or spray to foliage, cut stump or frill ring must be complete to be effective. At the same time, as the hormone is expensive (over £5 per gallon) officers must frequently check to ensure that wasteful use is avoided. The injection method of application is under trial.

Waste to be avoided.

245-T is completely non-toxic to animals. Rare cases of skin irritation have occurred where the operator has had an allergy. Irritation following splashing in the eyes has been traced to detergent used as a spreader rather than to the hormone. The use of detergent is to be avoided as white oil is equally as effective and non-irritant. An operator who proves to be allergic to hormone sprays should not be engaged in this class of work.

Detergents undesirable.

Burning nullifies effect.

114. It should be noted that it may take a considerable period of time before translocation through plant or root-stock is complete. Burning soon after treatment can completely nullify its effect. It is essential that no burning should take place within 12 months of treatment.

Costs.

115. The success of the stand improvement programme rests on close control of costs.

Much of the stand improvement work is in the developing stage. Improvements in technique will be covered by the issue of circulars from time to time.

## Cull Felling

Cull tree.

116. **Cull tree—definition:** The cull tree has no millable potential, but has sufficient crown vigour to occupy effective growing space.

117. In jarrah forest the aim is to remove the cull tree during the improvement programme or during top disposal cleaning.

118. In the karri forest stand improvement is at present limited, apart from thinning trials, to cull felling, which is now adopted as standard practice on all karri cutting sections. It is a means by which the industry, as part of the normal trade operation, falls marked useless and doubtful trees and effectively proves the latter. Recovery of millable wood from

doubtful trees is an essential feature of the operation. All useless trees carrying 30 per cent. or more of normal full canopy (including epicormic crown) are marked for culling. Useless trees with decadent crowns do not seriously compete and are not culled.

119. Culls required for seeding or for testing seed availability in connection with regeneration burning are reserved from cutting.

Cull marking.

120. Current marking procedure is as follows:—

All trees marked are felled. Marking separately designates—

(a) Trees with normal millable potential. These are marked in the usual way and the Department admits no claim in respect of them.

(b) Doubtful trees, distinguished by a double toe mark (one above the other). Acceptable logs are paid for by the mill in the normal way. Logs not acceptable are paid for by the Department at mill rates, i.e., standard piecework rate on log volume, provided that the Department accepts no commitment in respect of a tree which yields a log to the mill.

A doubtful tree which shatters in falling or which requires no proving cuts, i.e., is obviously useless when felled, is paid for at cull rates. (See below.)

(c) Cull trees—have three toe marks set one above the other. These trees are merely felled and are paid for by the Department at cull rates.

Cull rates.

121. Cull rates are based on a time study which showed that the time taken merely to fall the tree represents 40 per cent. (average) of the total time from starting one tree to starting the next. The calculated proportion of piecework rates is converted to a sliding scale per foot of stump girth and the scale of rates has been adjusted upwards to 55 per cent. of piecework earnings on cull volume to include shifting, preparation and maintenance of equipment and to compensate the faller for the slightly greater amount of dry wood, sand and charcoal which may be encountered in culls, and for the time involved in measurement.

Cull payment.

122. Payment for culls and for doubtful trees proved unacceptable is on the basis of the faller's record, subject to check and endorsement by the treemarker. The faller records on the stump in crayon and in a record book provided, the serial number and dimensions of each cull or doubtful tree proved useless.

Large trees not culled.

123. Cull trees above 24 ft. stump girth are not felled, this being the reasonable size limit for one-man chain saws. These large culls, incidence one per 15 acres, are marked for ringbarking as part of the top disposal operation.

## APPENDIX A

F.D. 480

**SEEDING AND REGENERATION CARD No.** ..... KS 2

**Cutting Section:** Quarter ...../..... Area ..... acres.

S.M.P. ..... District ..... Landing Nos. .....

Block .....

For exact locality refer to 20 scale A.P.I. plan overleaf.

| Species. | Number of Flowering Trees. | Total Number of Trees Assessed. | Percentage of Trees Flowering. |
|---|---|---|---|
| 1. | | | |
| 2. | | | |
| 3. | | | |

Remarks on flowering time and intensity from examination of crowns of trees felled: .....

.....

.....

ATTACH SAMPLES

| **Attach Samples** | Pin Buds. | Large Buds. | Blossom. | Immature Fruit. | Mature Fruit. |
|---|---|---|---|---|---|
| **Record Frequency** | | | | | |
| Very abundant (v.a.) | | | | | |
| Abundant (a) | | | | | |
| Frequent (f) | | | | | |
| Occasional (o) | | | | | |
| Rare (r) | | | | | |
| Blossom Year | 19 | 19 | 19 | 19 | 19 |
| Seed Crop Year (Estimated) | 19 | 19 | 19 | 19 | 19 |

**Stand Information** **Dates**

When was area last burnt? .....

When was area cut over? .....

Was area cull felled? .....

Any other treatments? .....

Has stand been burnt for regeneration? .....

If so, when? .....

Comment on present stocking and condition of main stand (over 60 in. G.) .....

.....

.....

Assessment of gross volume before cutting ..... 1 p.a.

Removed ..... 1 p.a.

Retained marketable ..... 1 p.a.

Total marketable volume ..... 1 p.a.

**Advance Regeneration**

| Year (Estimated) | | Species | Frequency | Height |
|---|---|---|---|---|
| 19 | 1 | | | |
| 19 | 2 | | | |
| 19 | 3 | | | |

Remarks on regeneration (include notes on stocking to 60 in. girth): .....

.....

.....

Date ..... Officer .....

## APPENDIX B

### KARRI SEED SUPPLIES SAMPLING PROCEDURE

**1.—Preliminary.**

Successful Karri regeneration operations depend primarily upon the presence of adequate supplies of mature seed at the time of regeneration burning. The following notes serve to condense current practice into a readily usable source of reference, governing collection of information for the prediction of Karri seed supplies, based on data obtained from the collection of the contents of seed trays set out in cut-over bush awaiting regeneration.

**2.—Action at the Start of Cutting.**

(a) Number each new landing consecutively for later reference.

(b) Select two cull trees per landing, to be felled later as a final check on quantity of seed available.

(c) In conjunction with the District Officer, the D.F.O. will prepare F.D. 480 for despatch to Research together with:—

(i) Floral samples.

(ii) 1 lb. of fresh capsules if present. The samples should be taken from 10-20 trees if accessible, and capsules of different crops should be kept separate.

**3.—Frequency of Seed Tray Collections.**

The frequency of collection, and the location of the seed trays is varied so as to maintain a complete picture of all stages in the development of the seed crop. Procedure will be as follows:—

(a) **Quarterly collections—from formation of bud initials to the flowering stage.**—Two seed trays per landing will be set under seed trees located about 5 chains apart.

(b) **Monthly collections—following flowering to the setting of fruit.**—Two seed trays per landing as before, plus two extra seed trays located in openings at a distance equivalent to half the height of the seed tree away from the trays under canopy.

Where staff is not available monthly collection of seed trays may be deferred until the spring following flowering.

(c) **Monthly collections—when mature fruit has set.**—Trays as in 3 (b), but the trays located in the openings will be moved out to a distance equivalent to full tree height away from the trays under canopy.

It is essential that monthly sampling be maintained at this stage.

(d) **End of collections—when major germination has occurred.**

**4.—Clearance and Despatch of Seed Tray Contents.**

(a) Seed trays will be cleared on the second day after rain. Collecting bags will be supplied by Research together with labels stating the descriptive information required for each collection.

(b) **Shifting trays.**—At each collection, trays will be moved about 5 chains to a new position not influenced by seed trees previously sampled.

(c) **Marking positions of seed trays.**—Access lines to seed trays will be pegged in the field to facilitate subsequent relocation.

(d) **Collections from burnt stands.**—Collections from stands following regeneration burning or wildfires must be clearly labelled.

**5.—Confirmation of Seed Supplies.**

In addition to the information obtained from the seed tray collections, final confirmation of seed supplies is required before regeneration burning is carried out.

**Action immediately prior to burning will therefore be:—**

(a) **Inspection with binoculars.**—The district officer and the D.F.O. will confirm the presence of adequate quantities of capsules over the whole stand by inspection with (10 x 50) binoculars.

(b) **Falling cull trees.**—The two cull trees, selected under 2 (b), will be felled and 1 lb. of capsules will be forwarded to Research for testing.

**6.—Advice of Seed Yield and Quality from Research.**

(a) **Initial sampling at start of cutting (2 (c) (ii)).**—Results will be returned to Divisions within a fortnight to indicate the value of the crop for seed collection.

(b) **Seed tray collections (3 (a), (b), (c)).**—Results will be returned to Divisions by 1st December and 1st March each year to assist early programming of regeneration burning.

(c) **Cull tree samples (5 (b)).**—These results will be combined with those from the seed trays on the dates stated (6 (b)). They will confirm the D.F.O's. estimates of seed availability and will enable him to make the final decision as to whether burning can proceed.

## KARRI GERMINATION AND SURVIVAL SAMPLING PROCEDURE

**1.—Preliminary.**

Early assessment of the results of Karri regeneration burning is essential for:—

(a) Determining whether adequate germination of seedlings has occurred.

(b) Determining whether survivals up to the one-year seedling stage are sufficient to fully restock the subject area.

(c) Delineation of problem areas which might require supplementary enrichment.

For these reasons, the following procedure will be adopted to provide full assessment information in standardised form.

**2.—Time of Sampling.**

(a) **For germination.**—Before June 15th following the regeneration burn.

(b) **For survival.**—Before February 15th next following the regeneration burn.

**3.—Density Classifications.**

Results of field counts will be summarised in the following classifications:—

| | Number of Seedlings per cent./acre. | | Equivalent Spacing 1-year-old Seedlings. |
|---|---|---|---|
| | Germinated. | 1-year-old. | |
| Acceptable | Over 40 | 10-40 | Under 5 ft. |
| Inadequate | 20-40 | 5-10 | 7-9 ft. |
| Needs Treatment | Under 20 | Under 5 | Over 10 ft. |

(Note: 10 mil-acre samples equal 1 cent-acre.)

**4.—Seedling Classifications.**

The type of seedling encountered will be indicated by the following initials:—

S.—Sapling over 5 ft.

R.—Established seedling under 5 ft.

G.—Freshly germinated seedling.

**5.—Seedbed Classification.**

The effects of seedbed on the results of regeneration and survival are well known and the type of seedbed encountered will be described by the following symbols to assist in interpreting results of field counts:—

A.—Ashbed from burnt debris.

T.B.—Topsoil well burnt.

T.S.—Topsoil not burnt but scarified.

N.S.—No seedbed, unburnt scrub, litter, or only subsoil.

**6.—Field Book.**

Field book entries, under the columns shown below, have been found satisfactory and will be used for all germination and survival field records.

| BEARING | CHAINS | OFFSET + — | SCORCH HEIGHT | SEED BED | NUMBERS COUNTED | | | | | | | | DOMINANT | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Main Species | | | | Other Species | | | | | |
| | | | | | 1-mil/ac. | | 4-mil/ac. | | 1-mil/ac. | | 4-mil/ac. | | Seedling | |
| | | | | | G | R | G | R | G | R | G | R | SP | HT |
| 183 | 5 | — — | 30′ | A | K15 | .... | .... | .... | M6 | .... | .... | .... | .... | .... |
| | | (Selected for Survival Count). | | | | | | | | | | | | |
| 183 | 10 | — 33′ | 15 | T.B. | K4 | .... | K20 | .... | .... | .... | M10 | .... | .... | .... |
| 183 | 15 | — — | 70 | A | K30 | .... | .... | .... | .... | .... | .... | .... | .... | .... |
| 183 | 20 | — 33′ | 10 | N.S. | .... | K2 | .... | K8 | .... | M6 | .... | M12 | M | 5′ |

**7.—Assessment Procedure.**

(a) **Germination assessment.**—Assessment of germination will form the major part of the work, but whilst it is in progress, sampling points will be selected and marked for survival counts at a later date. (See paragraph (b) (i), (ii).)

(i) **Location of strip lines.**—Strip lines will be run across the area using compass and chain. The lines should cross the major topography and should be extended into marginal type fringing the main karri areas. Initial coverage at 20 chain centres should be adequate, but a zig-zag pattern may be used to minimise dead walking time.

(ii) **Demarcation of strip lines.**—

Start points—to be waddied and tied to the nearest reference tree, landing or ground mark, by chain and compass.

Intersections.—Intersections of lines with tracks to be waddied.

5 ch. points.—Each 5 ch. mark along the line to be demarcated with a waddy.

(iii) **Location of sample points.**—Samples will be taken at 5 ch. intervals in openings encountered on the strip lines, or at the centre of each smaller opening along the line.

Minor offsets (½ ch.) may be necessary to ensure that counts are taken in openings and that samples are located on the most favourable seedbed in the vicinity.

(iv) **Circular sample plots.**—Circular sample plots will be located at each sampling point using a simple bush compass, consisting of a length of flexible wire pegged at one end to describe the circle.

**The size of the plot will be:**

(a) 1 milacre (length of wire 44.7 in.)
(b) 4 milacres (length of wire 89.3 in.).

1-mil acre plots will be used unless fewer than 10 seedlings are counted on the plot, in which case the size of plot will be increased to 4-mil acres.

4-mil acre plots will be used at points selected for subsequent survival counts.

(v) **Recording field notes.**—The field book set out in paragraph 6 will be used, and the following additional information must be clearly indicated in the front of the book:—

(a) Tie sketches showing start of line.

(b) Tie sketches showing the position of points selected for subsequent survival counts.

(vi) **Plotting field notes.**—The lines will be plotted on 20 ch. A.P.I. plans, and the frequency of seedlings at sample points along the line can be shown by a simple legend.

This will enable the D.F.O. to—

(a) detect problem areas;

(b) decide if further assessment of problem areas is required;

(c) prepare estimates for enrichment of problem areas.

These 20 ch. plans can then be used as the first entry in the Compartment Register.

(b) **Survival Assessments.**—During the germination assessment in June after the burn, plots will be selected and demarcated for counting survivals in the following February.

(i) **Selection of survival plots.**—Two 4-mil acre plots will be selected to represent ashbed and the prevalent alternative seedbeds in the main karri type and the fringe type on each landing.

(ii) **Location of survival plots.**—Where possible, survival plots will be located close to existing tracks. The centre of the plot will be pegged with a stout waddy, and the markers will be placed at 1 ch. centres along the line to enable rapid relocation of the survival plot.

(iii) **Survival counts.**—The same procedure as set out for germination counts will be adopted, but seedlings present at the time of the survey will be pegged with a paint-topped wire marker.

## APPENDIX C

### PRESCRIPTION FOR JARRAH POLE THINNING

**1.—Marking for Thinnings.**

The marking for thinning will include:—

(a) The retention of selected crop trees (to be marked with one horizontal paint mark).

(b) The marking for retention of saleable trees for removal in the future (to be marked with two horizontal paint marks).

**2.—Definitions.**

(a) **Crop trees.**—Crop trees are trees with a reasonably straight bole which is at least 20 feet long and free from visible defect. These trees will normally be dominants or co-dominants with good crowns which are average or better as to width, depth, health and density.

(b) **Saleable trees.**—Saleable trees are of two kinds:—

(i) **Suitable for transmission poles.**—Those trees which have a bole length of at least 30 feet and a crown diameter of at least 7 inches. These trees must also meet S.E.C. pole specifications in other respects.

(ii) **Suitable for saw logs.**—Those trees which have a straight bole of at least 7 feet and a G.B.H. of at least 36 inches over-bark.

**3.—Marking Procedure.**

(a) Mark with one horizontal paint mark:—

(i) All trees selected as crop trees.

(ii) Large sized (A1 and B1 trees) which are to be retained as growing stock at the next cut.

(b) Mark with two horizontal paint marks about 4 inches apart:—

(i) Trees retained for future sale as poles (see paragraph 2 (b) (i)).

(ii) Large sized (A3 and B2 trees) which would be marked for removal at the next cutting and also trees which are saleable as saw logs as defined in paragraph 2 (b) (ii).

(c) Do not mark for retention:—

(i) Any crop trees within 20 feet of retained growing stock (A1 and B1 trees).

In stands of saplings or piles where a spacing of 20 feet is not applicable the following formula may be used:—

Crown Space = 1.5 D feet
where D = diameter OB inches.

(ii) Any trees which would be smashed by falling marketable saw logs at the next cut.

(iii) Any crop tree with a large log or a heavy accumulation of logs within 5 feet of its base.

**4.—Thinning Procedure.**

Two distinct procedures are to be followed for: (a) routine thinning; (b) roadside improvement work and private property boundaries.

(a) **Routine thinning.**—All trees, regardless of species, which have not been marked within 10 feet of a crop tree are to be removed as follows:—

Stump diameter 6 in. or less—cut down by axe and poison the stump.

Stump diameter 6 in. to 14 in.—frill-ring by axe and spray the ring with poison.

Stump diameter over 14 in.—frill-ring by chain saw with sloping and overlapping cuts extending into the heartwood. Spray the ring with poison.

All falling and ringing must be carried out at no more than 6 in. above ground level because the poison acts on the root collar. All useless veterans, regardless of species, which carry 30 per cent. or more of their normal crown are to be rung and poisoned as above.

(b) **Roadside improvement work and private property boundaries.**—When thinning in these locations, all surplus trees must be fallen and their stumps poisoned in a belt at least 10 chains wide along main roads or one compartment wide along private property boundaries.

Treatment in these locations must be referred to the D.F.O. in each case because thinning in areas adjacent to private property will not normally be carried out for fire protection reasons.

**5.—Poisoning.**

Until further notice, poisoning will be carried out by application of a 4 per cent. solution of 2.4.5.T in diesoline with an indicator dye (Waxoline Red).

The poison must be applied to the whole cut surface of a stump and especially to the inner bark and sapwood of trees which have been frill-ringed.

Where stumps have not been treated and coppice has developed, foliar spraying may be prescribed, using a 0.2-0.5 per cent. aqueous solution of 2.4.5.T and a ferrous sulphate dye.

## APPENDIX D

### USE OF 2.4.5.T

22/4/66

2.4.5.T (Trichlorophenoxyacetic acid) is commonly supplied as an 80 per cent. butyl ester. One pint of this concentrate contains ½ lb. (acid equivalent stated on label).

Concentrations commonly used are:—

(1) For foliar spraying—0.2% to 1.0%, depending on species to be treated.

(2) For stump or frill application—2% to 4%.

**Table: 2.4.5.T—Dilution Rate**

(concentrate = 80% butyl ester)

**0.2%**

2 fl. oz. concentrate to 5 gallons
1 pt. concentrate to 50 gallons

**0.5%**

1 fl. oz. concentrate to 1 gallon
2 pts. concentrate to 40 gallons

**1.0%**

2 fl. oz. concentrate to 1 gallon
4 pts. concentrate to 40 gallons

**4.0%**

2 pts. concentrate to 5 gallons
2 gals. concentrate to 40 gallons.