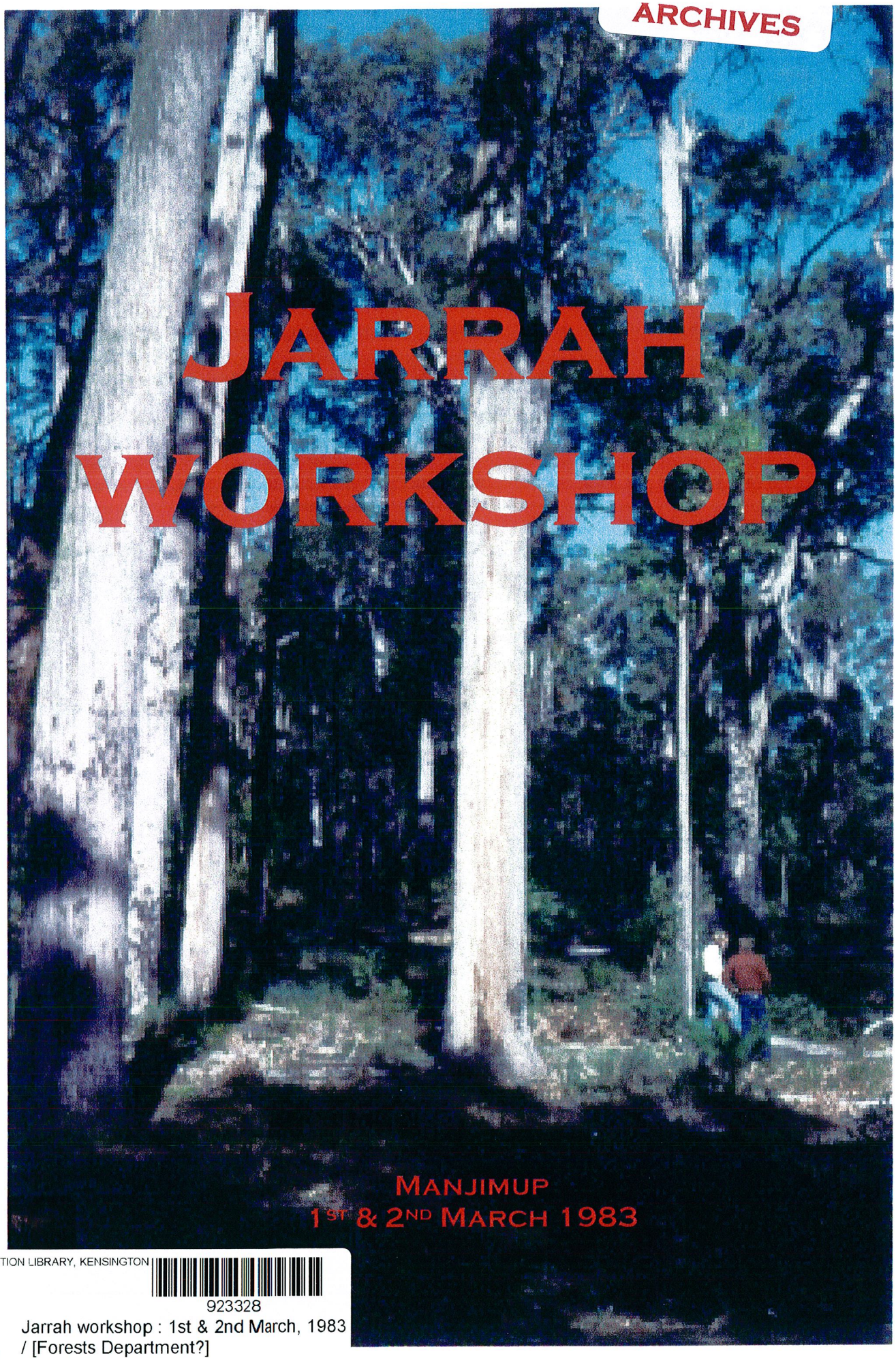


# JARRAH WORKSHOP

MANJIMUP
1ST & 2ND MARCH 1983

# JARRAH WORKSHOP
# MANJIMUP 1ST & 2ND MARCH, 1983

## INTRODUCTION F. MCKINNELL

- Objective of the Workshop was not to develop policy on Jarrah silviculture but to explore factors affecting Jarrah silviculture.

- Some regeneration problems have developed due to a lack of lignotubers.

- There is a trend to more intensive management of the Jarrah forest.

- There should be a varient of Jarrah silviculture according to land use.

- Dieback research is having an impact on Jarrah silviculture. eg. Banksia eradication etc.

- There is a variety of opinion on Jarrah silviculture but we should have a concensus of Jarrah ~~silviculture~~ silvics (growth habits).

SESSION 1 O. LONERAGAN

- Explained five of the seven recognised stages of Jarrah development.
  viz: Seedling (cotyledons present)

  Lignotuberous seedling (cotyledons absent, up to 1 year old)

  Seedling coppice (multiple shoots, less than 1.5m)

  Ground coppice (shoot length up to 1.5m, lignotuber up to 15cm long axis.)

  - Incipient (no defined leading shoot)
  - Dynamic (defined leader)

  Sapling $>$ 1.5m high, $<$ 15cm D.B.H.O.B.

- Advance growth is defined as seedlings, coppice, saplings or poles present before cutting.

- Poles and piles are defined by Inventory and Planning classification.

- Explained stages of lignotuber development and management requirements (see Table 1).

- Explained Jarrah stocking requirements for regrowth.
  (Absolute Density, Suppression Density, Critical Density, Optimum Density and Threshold Density) *(See Table 2)*

- Proposed thinning schedules for Jarrah of varying height classes based on stocking density levels (B.A.) and crown density. *(See Table 3)*

TABLE 1 STAGES OF LIGNOTUBER DEVELOPMENT AND MANAGEMENT REQUIREMENTS

| JARRAH REGROWTH STAGES OF DEVELOPMENT | TIME | CUTTING REGIME | FIRE REGIME |
|---|---|---|---|
| ADD FORWARD OPERATIONS TO REMOVE SEED PRODUCTION OF BANKSIA. | (20) | | |
| FROM SEED | | | |
| 1. SEEDLING - <1 YEAR OLD - COTYLEDONS PRESENT BUT NO OBVIOUS LIGNOTUBEROUS SWELLING. | <1 | CUT TO BETWEEN T.D. AND C.D. ON SELECTION BASIS - ST'S NO MORE THAN TREE HEIGHT. (SHELTERWOOD)* EXPOSE MAXIMUM AMOUNT OF SOIL SURFACE TO REDUCE COMPETITION (ESPECIALLY IN KARRI SCRUB TYPES). | BURN IN SEED YEAR. |
| 2. LIGNOTUBEROUS-SEEDLING - STILL HAS ORIGINAL SHOOT, SWELLING DEVELOPED. | | | |
| 3. SEEDLING COPPICE - MULTIPLE SHOOTS AFTER DAMAGE (FIRE OR INSECT) HAS KILLED ORIGINAL SHOOT. | | | FREQUENT MILD FIRE TO REDUCE COMPETITION AND PROMOTE LIGNOTUBER DEVELOPMENT. |
| 4. GROUND COPPICE - SHOOT GROWTH UP TO 1.5M WITH LIGNOTUBER DEVELOPED TO 15CM IN LENGTH (OR LARGER, STORED). | 20 | | |
| INCIPIENT G.C. - MULTIPLE SHOOT, NO DEFINED LEADING SHOOT. | | | |
| DYNAMIC G.C. - DEFINED LEADER, ALSO MULTIPLE SHOOTS. | | | |
| FROM STORED GROUND COPPICE | | | |
| 5. SAPLING - >1.5M UP TO 15CM DBHOB | 20 | REGENERATION ESTABLISHED. CUT TO 10% CROWN COVER AS REQUIRED. GP SELECT.CUT.* | NO FIRE TILL LEADING SHOOT ABOVE SCORCH HEIGHT. |
| 6. POLE - 15 - 45CM DBHOB | | REMOVE FINAL VETERANS (OR CONTINUE WITH STANDARDS) AS REQUIRED. | |
| 7. PILE - 45 - 60CM DBHOB | | | |

*PREFER SHELTERWOOD (ALSO WITH

TABLE 2 JARRAH FOREST - STOCKING REQUIREMENTS FOR REGROWTH

| STOCKING CRITERIA | RELATIVE STAND DENSITIES FOR INCREMENT/AGE IN FIGURE | OLD STAND CROWN COVER (%) | REGROWTH REQUIREMENTS |
|---|---|---|---|
| OVERSTOCKED STAND | | | |
| ABSOLUTE DENSITY | AD - THE BA TO WHICH A VIRGIN STAND WILL DEVELOP. (AT PHYSIOLOGICAL ROTATION) | 70 | PERIODIC DEVELOPMENT OF LIGNOTUBERS WITH FIRE SUCCESSION (LIGNOTUBERS SUPPRESSED AND GROW VERY SLOWLY). |
| SUPPRESSION DENSITY | SD - THE BA AT WHICH GROWTH BALANCES LOSSES. (ZERO NETT GROWTH) | 70 | |
| FULLY STOCKED STAND | | | |
| CRITICAL DENSITY | CD - THE BA ABOVE WHICH CROP TREES BEGIN TO REDUCE INCREMENT (CAI = MAI) | 50 | |
| OPTIMUM DENSITY | OD - MAXIMUM CAI ON CROP TREES | 39 | |
| | TD - LOWER LIMIT OF BA AT WHICH CROP TREES FULLY UTILISE THE SITE, WITHOUT LOSING CROP TREE INCREMENT. | 28 | THIN TO THIS RANGE FOR FULLY STOCKED STANDS; CUT TO THIS RANGE, TO ALLOW LIGNOTUBERS TO DEVELOP. |
| | | (10) | CUT TO THIS LEVEL FOR OPTIMUM SAPLING DEVELOPMENT INTO POLE STAGE (REFER MANAGEMENT REQUIREMENTS) |

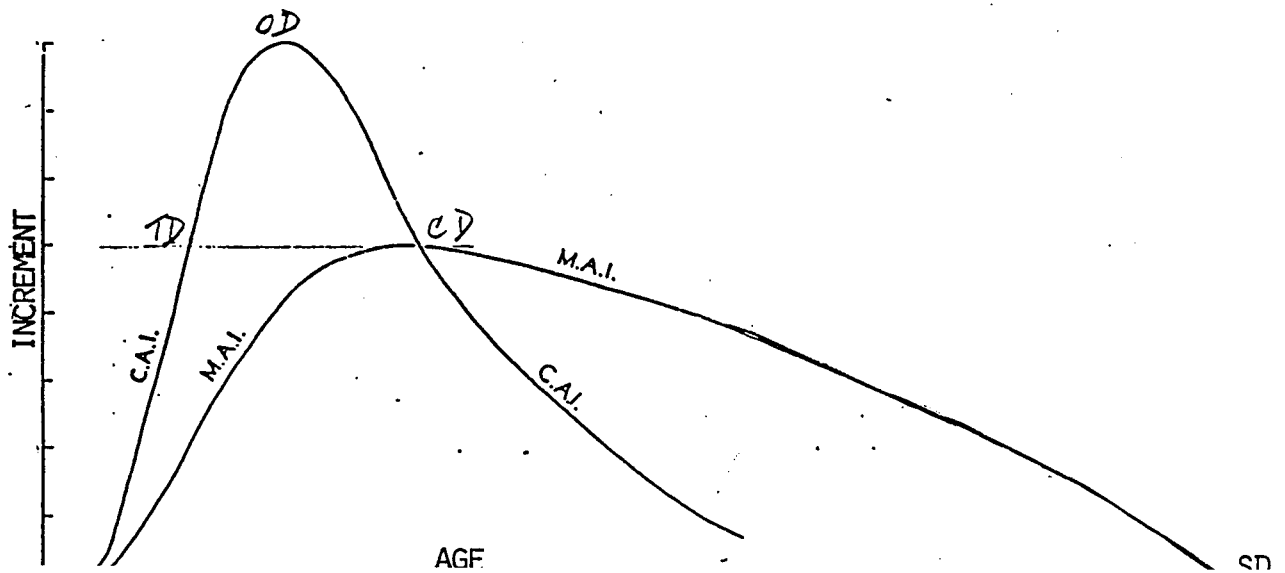


TABLE 3

JARRAH FOREST - DENSITY REQUIREMENTS FOR REGROWTH

| HEIGHT CLASS (OLD CLASSIFICATION) | | C | | B | | B+ | | A | | A+ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-DOMINANT HEIGHT (M) (FT) | | <15 <50 | | 18 60 | 21 70 | 24 80 | 27 90 | 30 100 | 33 110 | 120 | 130 | |
| CROWN RATIO (HARMONISED) | NORTHERN JARRAH | (21) | | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | |
| | SOUTHERN JARRAH | 20 | | 19 | 18 | 17 | 16 | 15 | 14 | 13 | | |
| CROWN RATIO | | (21) | 20 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | CROWN DENSITY (PC CROWN AREA) | |
| ABSOLUTE DENSITY (VIRGIN FOREST) $M^2/HA$ | | (22.7) | 25.0 | 27.7 | 30.9 | 34.6 | 39.1 | 44.4 | 51.0 | 59.2 | STAND 70% | |
| SUPPRESSION DENSITY (100%) $M^2/HA$ | | (17.8) | 19.6 | 21.8 | 24.2 | 27.2 | 30.7 | 34.9 | 40.1 | 46.5 | 70% | |
| CRITICAL DENSITY (70%) $M^2/HA$ | | (12.5) | 13.7 | 15.3 | 16.9 | 19.0 | 21.5 | 24.4 | 28.1 | 32.6 | UPPER STRATA 55% | TOP HALF US 50% |
| THRESHOLD DENSITY (40%) $M^2/HA$ | | ( 7.1) | 7.8 | 8.7 | 9.7 | 10.9 | 12.3 | 14.0 | 16.0 | 18.6 | 40% | 28% |

## SESSION 2 P. KIMBER (PRESENTED BY F. MCKINNELL)

(See Notes Provided)

Comments on this session were:

- Kimber's work applies mainly to high S.Q. stands at Dwellingup.

- In discussion of Jarrah planting, Roger Underwood quoted an example of good planted Jarrah on bauxite pits at Jarrahdale.

- A research requirement is to find out the trigger to development of seedling coppice into the dynamic stage. Could fertilizer do this?

JARRAH WORKSHOP - MANJIMUP - 1ST MARCH 1983

Notes from Mr. P.C. Kimber

## JARRAH - EARLY DEVELOPMENT

Seed: Flowers (Dwellingup Area) in November/December.
Seed - immature but viable by the following April
- mature by the following August/September.

Seeding establishment - aided by fire and by ground disturbance (ploughing)
- success of seeding establishment inversely related to canopy cover.

Seedling: Early development of seedlings under dense canopy was slow - 150mm shoot length and a lignotuber smaller than a hazel nut after 5 years. Seedling mortality over 5 years under heavy canopy was very high (+ 50% of survivors each year).
Seedlings develop relatively rapidly in open, disturbed areas eg. on loose soil on landings the seedling has been observed to develop into a multi-stemmed bush 500m high in 8 years. rapid growth !

### Lignotuberous advance growth

Fertilisation (NPK) increases growth of all shoots on the plant; does not stimulate the production of a dynamic shoot.

Gibberellie acid (GA3) stimulates rapid elongation of all shoots but fails to stimulate the production of a dynamic shoot.

Extensive surveys of advance growth failed to find any association between their number (density) and natural site factors. It was therefore assumed that a man-induced factor, most probably fire, would be associated.

Attempts to determine when stomata opened (indicating transpiration activity), and the seasonal growth pattersn of lignotuberous plants of various sizes in the forest suggested that small plants neither transpired nor grew in mid-summer. Large plants continued both functions. This led to the dypothesis that lignotuberous advance growth would only become capable of producing a dynamic shoot when it was large enough to continue growing through the summer. Its ability to do this was dependent on the root system reaching a depth where soil moisture is available throughout summer.

### Planting jarrah

There is no establishment problem in planting jarrah on cleared, ploughed lateritic gravel. Trials at Inglehope, near Dwellingup indicated that more than 50 percent of planted seedlings had developed a dynamic shoot after 2 years, and 95 percent after 5 years.

Height growth was of the order of 1 metre a year, and could be increased dramatically with heavy application of NPK fertilizer (up to 250gm/tree was tried using a mixture of superphosphate, urea, and suplphate of potash).

The form of saplings originated from planted seedlings was generally poor, even at densities of 10,000 + stems/ha. Attacks to the stem by Cossid Moths appeared to be a possible cause of poor form. Multiple stems were frequent.

Heavy fertiliser application, and the relatively rapid growth rates that followed, appeared to produce saplings of better form.

JARRAH FERTILISER TRIALS

Pot trials with jarrah seedlings gave the following growth responses.

| | | |
|---|---|---|
| N + | N x P | +++ |
| P - | N x K | ++ |
| KO | P x K | 0 |
| | N x P x K | +++ |

Extensive field trials in 40 year old pole stands.

i) Failed to reproduce the N x K interaction found in pot trials.

ii) Failed to reproduce the N x P interaction found in pot trials (possible due to P fixation by laterites)

iii) A response curve for NP was developed (attached)

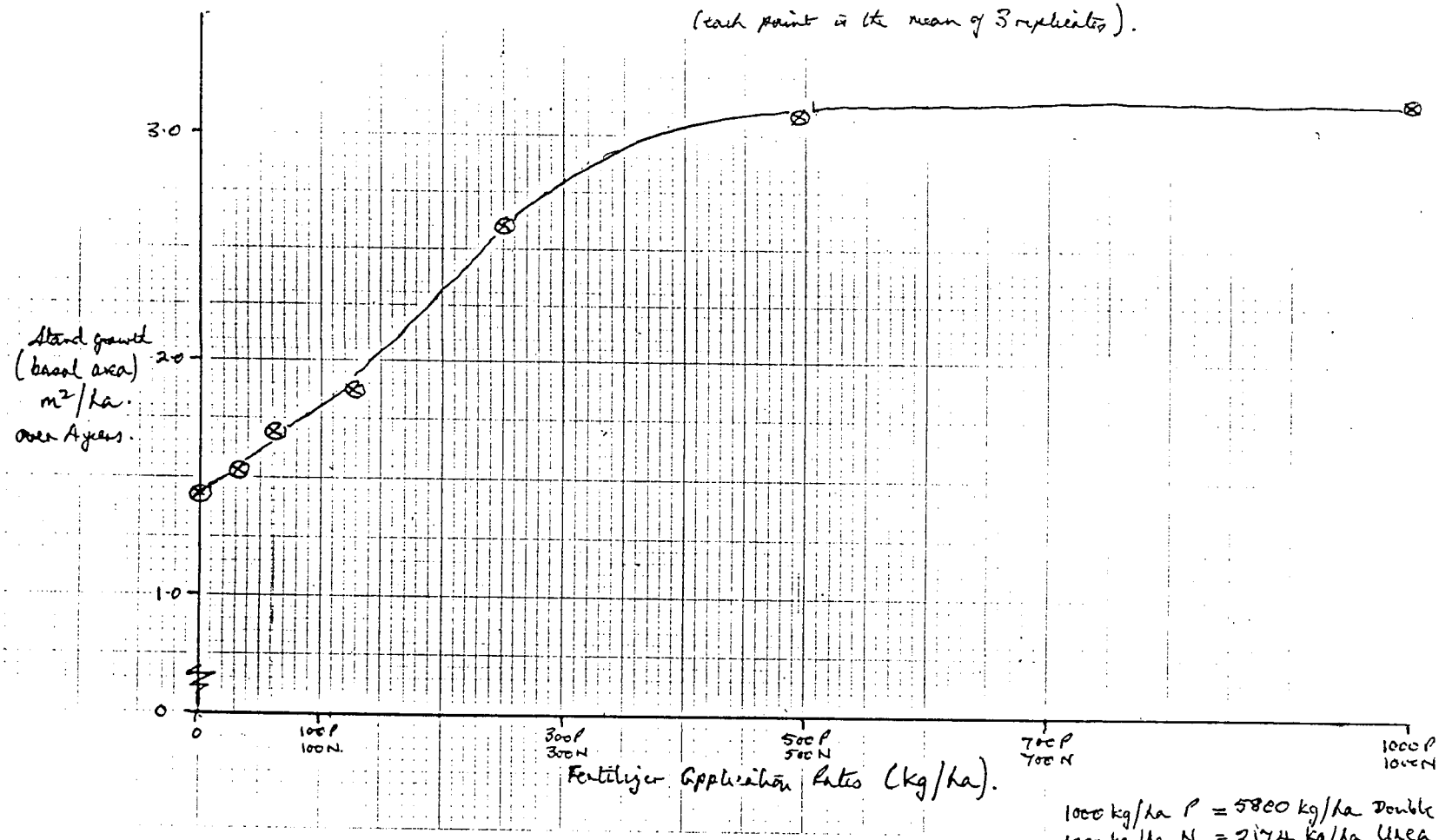
iv) Due to the NP interaction not being reproducible in the field, the response curve for N should be indentical to that for NP.

v) Response to field fertilisation peaked after 2 years and had declined to a low level after 4 years. The total response period can be taken as 4 years.

.....

P.C. KIMBER
23/2/83

RESPONSE OF JARRAH POLES ~~TO~~ NP FERTILISER. (Expt 101).
– 4 year basal area increments, $m^2/ha$.
(each point is the mean of 3 replicates).




1000 kg/ha P = 5800 kg/ha Double Superph.
1000 kg/ha N = 2174 kg/ha Urea

SESSION 3 L. MCCAW

Stand Density in relation to wood and water production.

- Management of Jarrah for wood production is based on its wide distribution and ability to be managed for other compatible uses. Hydrologic characteristics are well suited to the climate.

- Showed graph of Growth (Vol.) vs Growing Stock (Vol.). *(See Figure 1)* Zone III volume increment is independent of stocking. Usual aim of thinning is to keep the stand somewhere in this range.

- Showed results of thinning experiments at Inglehope (High S.Q., Heavily cut around 1920, heavily overstocked ($20m^2$/ha+). Thinned in 1960 at age 40.

  Relationships between: Stand B.A. increment and Residual B.A. *(Figure 2)*
  B.A. (MAI) and Residual B.A. *(Figure 3)*
  Diameter increment and Residual B.A. *(Figure 4)*
  Years to reach sawlog size and Residual B.A. *(Figure 5)*

- Showed that an acceptable Rotation age of 150 years is possible.

- Most stands are now 30 - $40m^2$/ha B.A., even heaviest thinnings are only bringing B.A. down to $20m^2$/ha. (Critical Density is $19m^2$/ha).

- Explored possibility of using fire as a tool to reduce competition, both in small Jarrah and also Banksia grandis. In Hakea "hot burn" over half Banksia stems were killed back to ground level.

FIGURE 1

THINNING FOR WOOD PRODUCTION

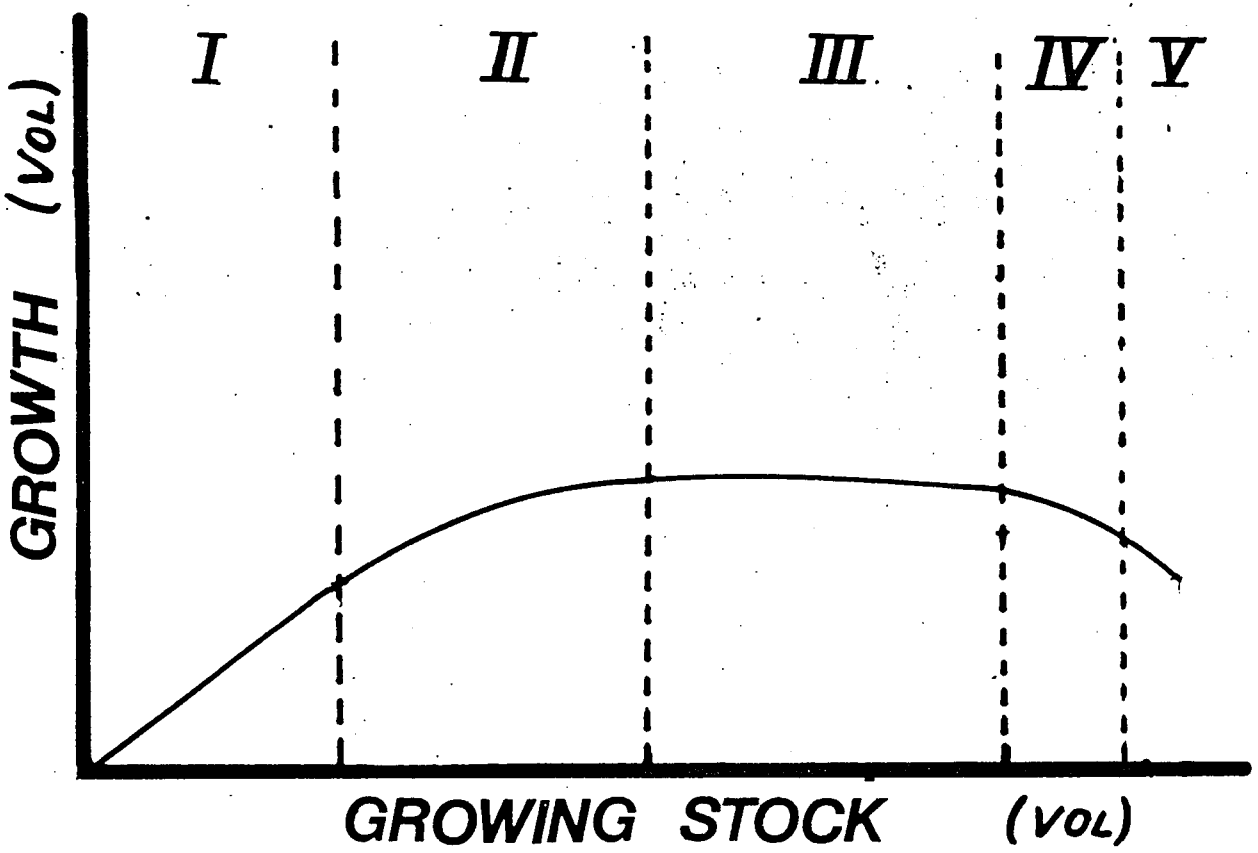
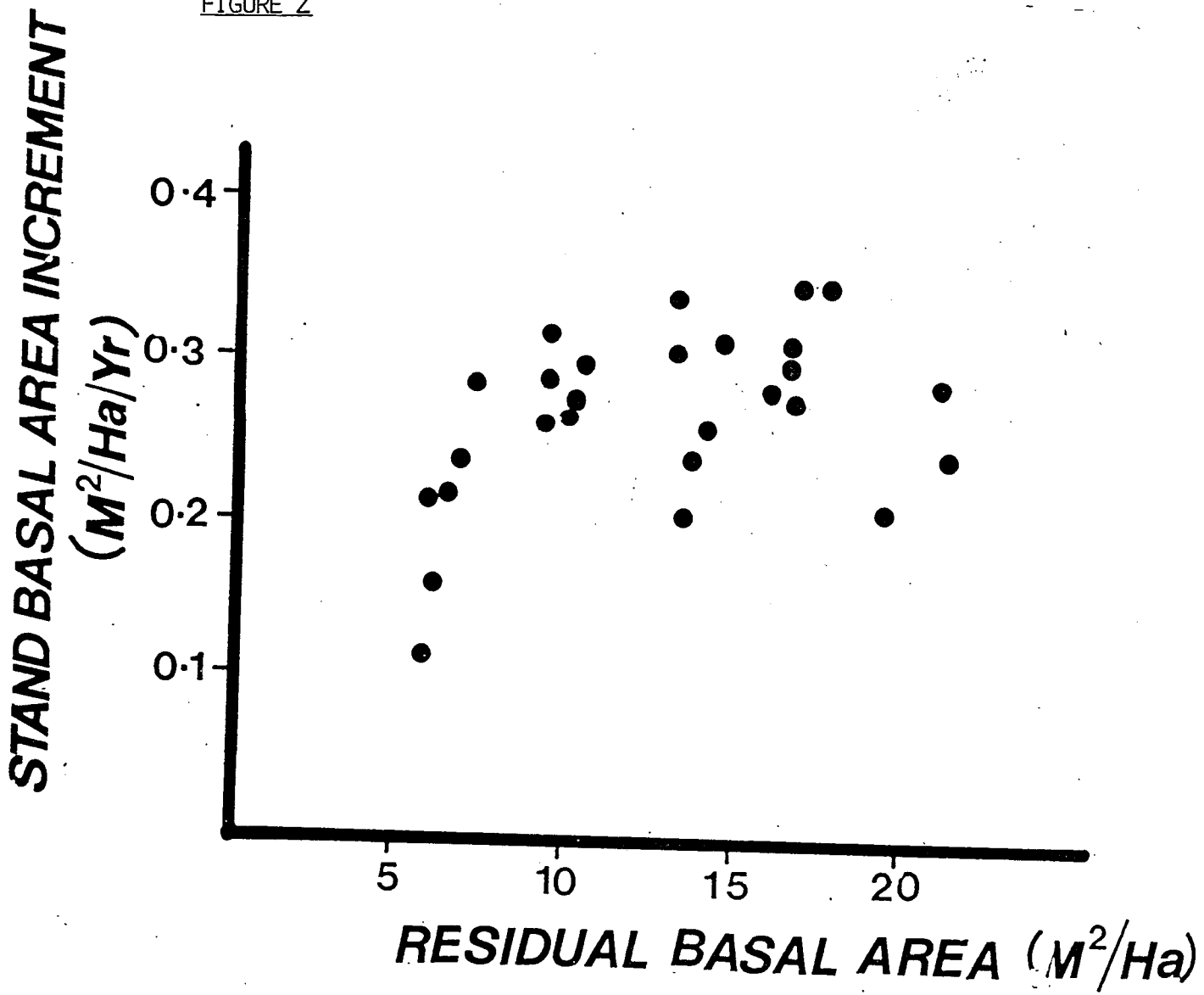


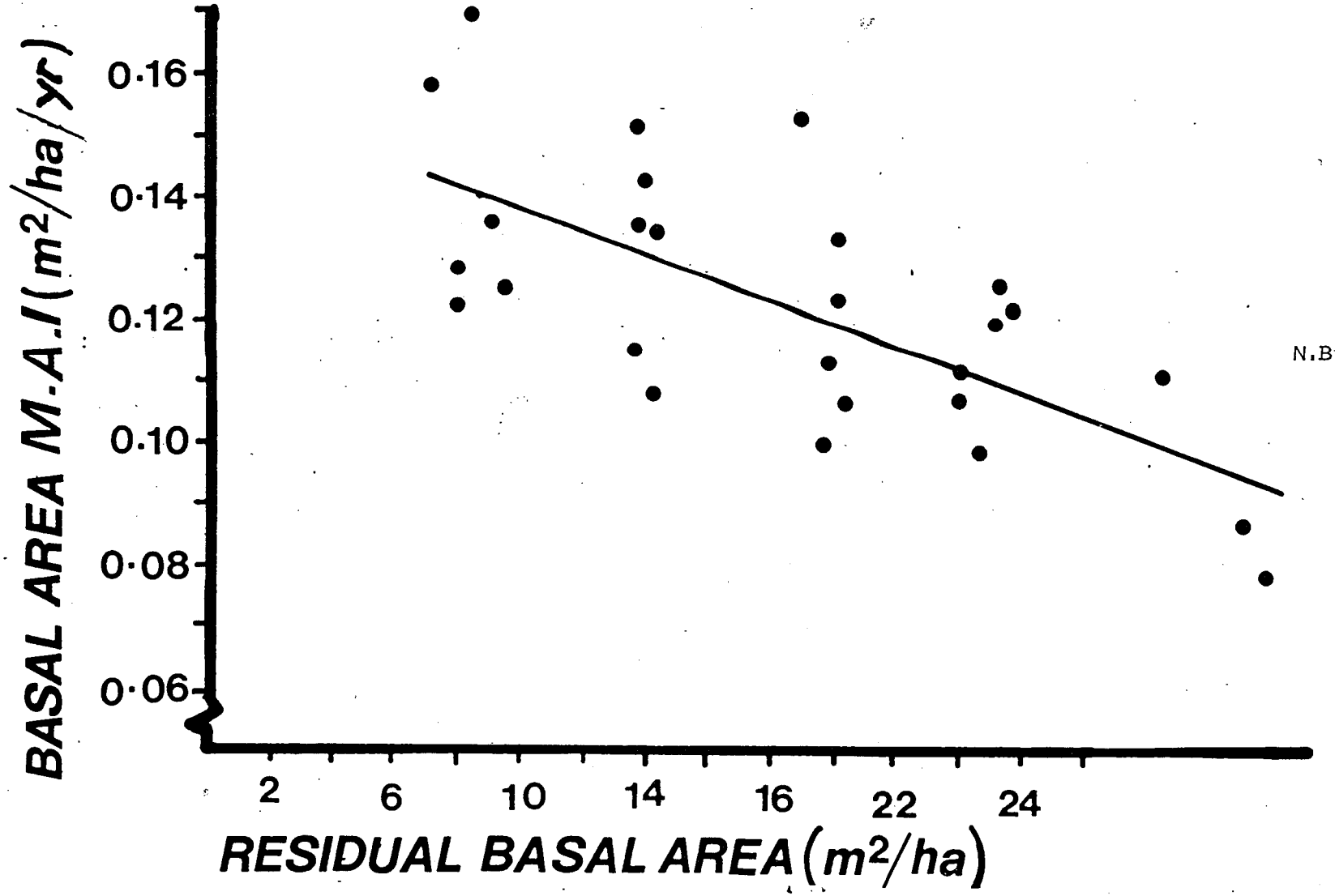
FIGURE 2




THE EFFECT OF RESIDUAL BASAL AREA AFTER THINNING ON THE GROWTH OF ALL TREES

(40 YEAR OLD REGROWTH JARRAH POLES)

FIGURE 3

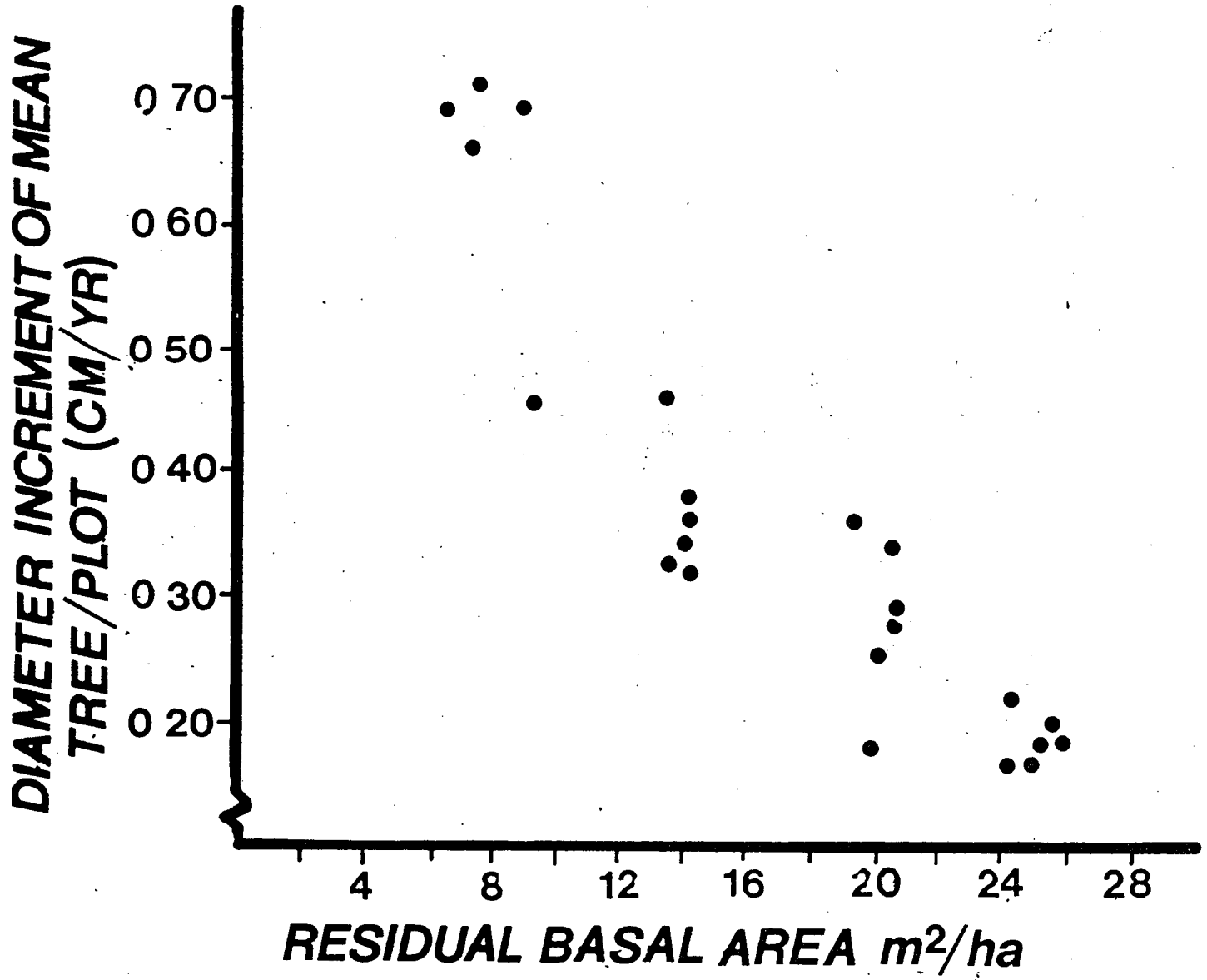



N.B (CROP TREE SELECTED AS BEST 285 WELL SPACED STEMS/HA.)

**THE EFFECT OF RESIDUAL BASAL AREA AFTER THINNING ON THE GROWTH OF CROP TREES**

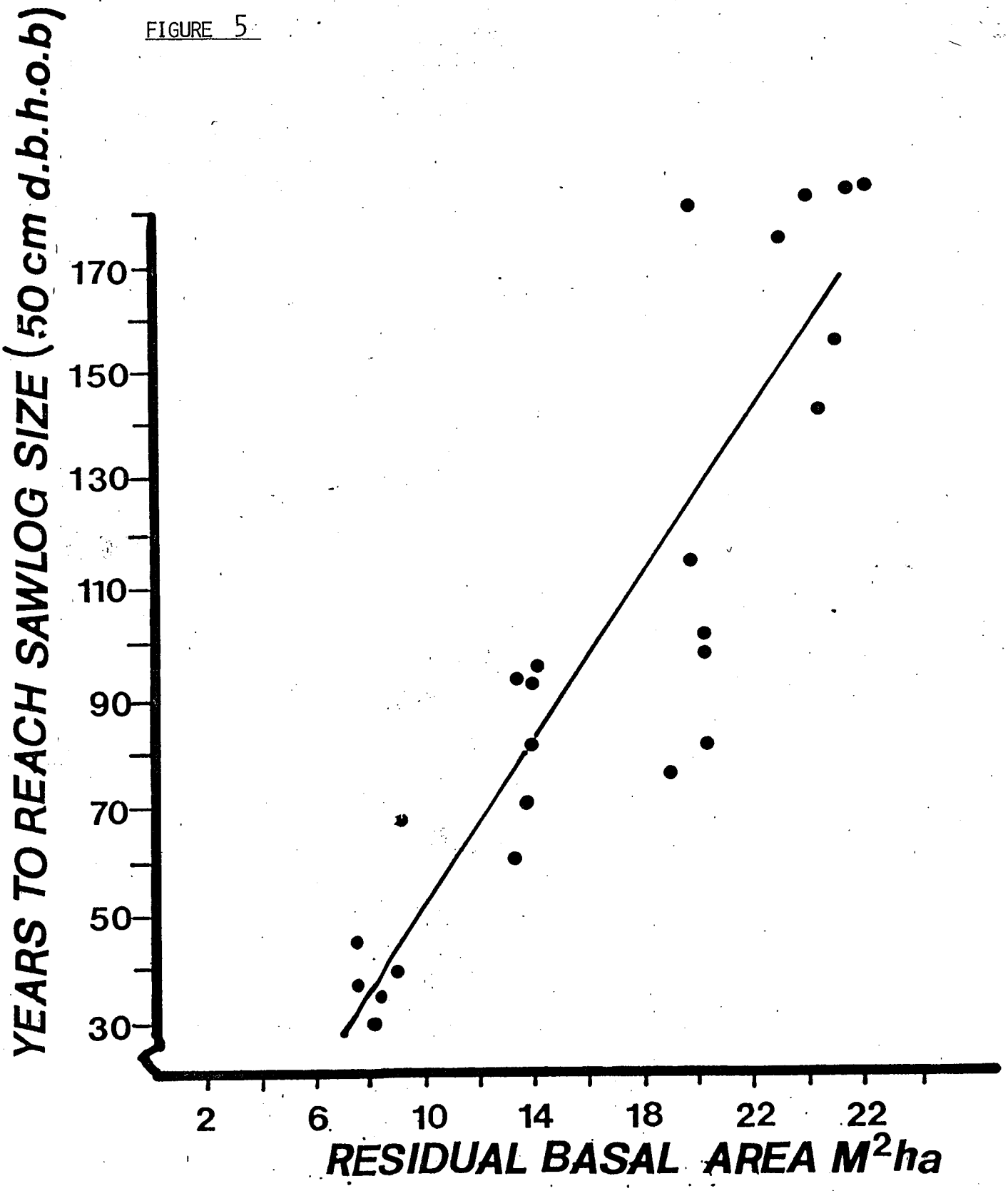
**(40 YEARS OLD JARRAH POLES)**

FIGURE 4




**THE EFFECT OF DIFFERENT INTENSITIES OF THINNING ON THE DIAMETERGROWTH OF INDIVIDUAL 40 YEAR OLD JARRAH POLES**

FIGURE 5




THE EFFECT OF DIFFERENT INTENSITIES O
THINNING ON THE SUBSEQUENT TIME TO REACH
SAWLOG SIZE (40 YEAR OLD JARRAH POLES)

## SESSION 4 FIELD VISITS

### STOP 1 WAISTCOAT ROAD

Virgin "southern jarrah" type,high marri, netic, blackboy and zamia components (not a "Karri" scrub type). Podsol soil. Few and small lignotubers present. A lignotuber (in the dynamic shoot stage) was dug up. Lignotuber diameter was 4cm (approximately). This was much smaller than dynamic lignotuber size for northern jarrah.

### STOP 2 BEAVER ROAD

Another "southern jarrah" type similar to STOP 1. More and better developed lignotubers. Could be due to site characteristics or burning history.

### STOP 3 BEAVER ROAD

Swamp fringe site. More Jarrah and less Marri overstorey, Ti-tree understorey as well as Banksia and Zamia. Very few and very small lignotubers.

Would lignotubers establish on this site by burning in a seed year or by mechanical scrub removal?

High impact site for P.c. introduction.

Havel commented that these sites should not generally be regarded as suitable for wood production.

Hypothesis requiring testing on this site type,is ti-tree scrub competition responsible for absence of lignotubers?

### STOP 4 BEAVER ROAD (IN BEAVIS 2 COUPE)

Virgin high S.Q. Jarrah on laterite. Advance burnt prior to logging large number of Jarrah, Marri and Banksia lignotubers. Mostly 15 months old from spring burn 1981.

Many lignotubers of varying sizes were dug up. Again two dynamic ground coppice with leading shoots were dug up and found to have lignotubers less than 5cm diameter. Is this due to higher moisture content in southern soils?

### STOP 4A CUTTING IN BEAVIS 2 (CUT LAST WINTER)

Many lignotubers in a gap developing into the dynamic stage.

Applicability of Owen Ritson's work in defining site types was raised at this stop. Havel's opinion was that Ritson's work would be more useful than work done in Northern Jarrah. Ritson's site classification placed sites into three categories of lignotuber development - "Strong", "Weak", and "Seedling". Criteria and applicability of this classification need to be checked and can then be categorised into accepted definitions for stages of development.

105216/4/78-20M-MS/3998

Form F.D. 80B

# FORESTS DEPARTMENT

MANJIMUP REGIONAL Office,

To A.D.F.O. L. McCAW
RESEARCH STATION
DWELLINGUP

5 August 1983
Western Australia

Reference-H.O.
Local F23/5

SUBJECT: JARRAH WORKSHOP REPORT

Your letter of 10/5/83 refers.

I wish to apologise for the delay in replying to your queries. I was awaiting information from O.I.C. Manjimup.

Here are the comments:

GORDON 3 BURN

1. Rainfall - 35.5mm in 7 days prior to burn.

| | |
|---|---|
| 5/2/83 | 10mm |
| 6/2/83 | 12.3mm |
| 7/2/83 | 4.3mm |
| 8/2/83 | 8.5mm |
| 9/2/83 | 0.1mm |
| 10/2/83 | 0.4mm |
| 11/2/83 | Nil Day of Burn |

2. S.D.I. on 11/2/83 1350

3. Weather conditions on 11/2/83

Max Temp. 23°, Min RH 46%
Wind S - SE 10 - 20 Kph
Actual SMC Litter 23.5% } Partial Cut
Tops 16% } Area

Open Slash 13% } Clear Cut
Sheltered Slash 23% } Area

4. The burn was carried out with damp soil conditions, with litter drying from the top.

YANMAH 5 FUTURE FIRE REGIME

Following tops disposal burning over the whole area two subsequent options are available:

1. Burn retained groups after 5 years when regrowth in gaps would not burn. Burn whole stand after 10 years, or
2. Keep unburnt for 10 years then prescribe a mild burn over whole stand.

The majority opinion is that the second option will be favoured.

A.W. WALKER
A/INSPECTOR

AWW:SAL

## STOP 5 BEAVER ROAD (BEAVIS 2)

High S.Q. Jarrah/Marri site on laterite. Good sapling development presumably following severe fire damage in overstorey allowing lignotubers to progress into the sapling stage. This "trigger" also needs to be determined since overstorey has now recovered by epicormic development.

## STOP 6 FOURACRE ROAD

A range of site types in Jarrah varying from Jarrah with a "Karri" scrub type to more of a pure Jarrah stand with a Marri dominant lignotuber understorey. Havel's opinion was that we may have to be content with Marri regeneration on these sites. Others expressed opinions that we could manipulate the lignotuber composition by partial cutting and burning regimes.

## STOP 7 GORDON 4

This was a virgin Jarrah stand C/F 1978-80 burnt in Autumn, 1981. Sand a podsol soils. Adequate-good stocking of lignotubers (mostly Marri) pre-burn. Poor stocking lignotuber post burn, except for laterite ridges. Intensive Ac. strigosa scrub development. Havel had a strong opinion that we should do nothing on this site despite poor regeneration result.

## STOP 8 GORDON 3

Another virgin Jarrah stand C/F 1981/82 burnt February, 1983 under high S.D.I. but damp soil conditions aiming to remove debris but preserve lignotuber stocking.

Underwood made the point that someone needs to develop a suitable method of lignotuber assessment both before and after logging.

## STOP 9 WHEATLEY 6

Laterite site type logged 1978-80 and burnt Spring and Autumn 1980/81. Seedling regeneration on and off ashbed was examined. Two year old lignotubers were into the incipient ground coppice stage with lignotubers 2 - 4cm in diameter. Some of these on ashbed looked likely to progress to the dynamic stage within 1 year. Very little scrub competition to prevent further lignotuber development.

## STOP 10 YANMAH 5

Laterite ridges, podsolic lower slopes.
Originally group selection cut and treated in 30's. Recut in 1981, tops disposal burn 1982. Groups of poles from old cutting were good form and development and because they were "genuine groups" able to be protected during the second cut. Lignotuber development in recently created gaps were encouraging.

*How will regeneration groups be protected in future prescribed burns?*

SESSION 5 DAY 2 2/3/83 FIELD VISITS

## STOP 1 POOLE 7

Clearfelled Jarrah/Marri site, podsol soils, scrubrolled and burnt autumn 1982, seeded with Karri 1982. Almost complete absence of Jarrah and Marri lignotubers and without Karri seeding this area would have been totally covered with scrub.

Interesting that the main scrub component here was Acacia strigosa which was also very prominent at Gordon 4 on sites deficient in lignotuber stocking.

## STOP 2 POOLE 11 (SOUTH)

Heavily cutover Jarrah/Marri site, podsol soils, very large quantities of logging debris. Lignotubers absent before burning. Adjacent virgin forest had high (3m) scrub of Acacia species and Isopogon unburnt for 10+ years. Lignotubers were small (0.5m) in the seedling coppice stage. Lack of advance burning could be a reason for poor lignotuber availability.

One suggestion for cutting in this type was to cut all merchantable Marri and salvage Jarrah and leave most Jarrah as a seed source.

Another suggestion for these sites was to give them a light cut for Jarrah sawlog only in order to allow lignotubers to establish. Frequent burning (at 5 year intervals) would enhance development of lignotubers.

This would enable broad burning buffers (currently excluded from cutting plans) to be considered as a sawlog resource area without compromising the need to burn these areas on rotation. This treatment would enable areas deficient in lignotubers to establish lignotubers prior to a regeneration cut.

## POOLE 11 (NORTH)

Similar site as described above.
Burnt February, 1983.

Some pole sized Jarrah left as growing stock and some cull Jarrah may provide a seed source.

Options for regeneration treatments on this site include:

1. Natural seeding from remaining Jarrah crop trees.
2. Additional "artificial" Jarrah seeding.
3. Seeding of Jarrah plus Karri or Yellow Tingle.
4. Seeding of Yellow Tingle and Marri.
5. Planting of Jarrah seedlings.
6. Planting Jarrah plus Karri seedlings.
7. Combination of techniques above.

## SESSION 6 I. ABBOTT

Banksia grandis. Germination, survival, growth and development.

- Undertook studies on B. grandis (a) Seedlings and (b) Established plants.

(a) Seedlings, examined effect of:

1. Litter type (Control, B. grandis, Casuarina, raking, burning) 5t x 3r.
2. Shading 3t x 3r.
3. Root competition and seed theft. 3t x 4-6r.
4. Fire Intensity. 5t x 2-5r.
5. Logging. 2t x 5r.

Found 1. Raked and burnt treatments gave best germination.

2. B. grandis litter poorest germination.
3. Survival best on raked and burnt treatment.
4. Shading treatments showed no difference in germination, survival or growth rates.
5. Germination and survival were much poorer in uncaged plots. i.e. theft may be a factor.
6. No differences in trenched plots i.e. root competition not a factor.
7. Fire Intensity produced no differences in survival. Growth rates were better on ash beds after 2 years.
8. Logged treatments showed no difference in survival.

(b) Established plants, examined effect of:

1. Shading
2. Watering/Shading/Insect Attack
3. Root Competition paired saplings and paired seedlings.
4. Logging.
5. Cool burning (with respect to lignotuber size).

Found: 1. Shading - No difference between treatments.

2. Watering/Shading/Insect Attack - No difference between treatments.
3. Root Competition - No difference between treatments.
4. Logging - No difference for saplings. Trees in logged areas grew fastest.
5. Burning - only plants with a lignotuber 8cm or more grew back to breast height after burning.

### SEED SUPPLY

- No correlation between B. grandis seeding and rainfall 2 years previous.

- 90% of seeds fall during the year regardless of burning.

- Seeds establish up to 18m from seed source.

- Soils don't affect seedling distribution.

## COMPARISON BETWEEN VIRGIN AND CUTOVER FOREST

- No difference in diameter distribution.

- No difference in stem numbers (This is contrary to general belief).

## LIFE HISTORY

- It takes 15 years for B. grandis to develop from seed to breast height. *At what stand density ?*
- After fire lignotubers grow from ground level to breast height in 4 years, (if lignotuber >8cm).

- First fruiting occurs when tree is 6 - 7 cm diameter.

- First flowering occurs 30 years from seed germination.

- First flowering occurs 20 years from lignotuber release.

- First fruiting occurs 38 years after germination from seed or 28 years after lignotuber release.

## PROPOSED CONTROL METHODS FOR B. GRANDIS

(a) FIRE

N. Burrows results show fire of 1000 kw intensity killed B. grandis 3m+ in height (4cm+ diameter). This intensity fire resulted in less than 10% commercial Jarrah lost by fire damage.

However, significant seeding and sprouting of lignotubers occurred.

(b) PUSH DOWN

No data available on effectiveness of this method.

- what happens if B. grandis is controlled? Will other susceptible species still provide host availability for P.c.?

SESSION 7 L. MCCAW

Jarrah Thinning and Water Production.

Cited literature on this topic:

- Many examples of thinning increasing water yield.

- Many temperate European forest studies have shown increase in water yield is proportional to reduction in forest cover. (Effect begins at threshold of 20% reduction of B.A. in humid areas).

- Selection cuts and thinning have only a transient effect as roots and canopies rapidly extend into unoccupied space.

- Batini's Wungong study showed reduction in cover due to dieback occurrence increased water yield.

- Melbourne Board of Works studies showed that effects of selection cutting in Mountain Ash lasted longer than clear felling.

- All studies showed the importance of canopy leaf area which influences both interception and transpiration.

In W.A. studies on Metropolitan catchments are underway.

- Butcher is working on thinning P. pinaster on Swan coastal plain.

- On the Yarragil catchment the theory that water yield is increased after thinning is under test.

- Study of seven small catchments in Darling Scarp showed water yield was inversely proportional to crown cover %. *(See Figure 7)*

- A wider study of Water Yield vs Crown Cover over a range of sites in the Yarragil catchment showed no trend. *(See Figure 8)*

- However, for groups of sub-catchments with similar characteristics, the relationship between crown cover and water yield is more distinct. *(See Figure 9,10)*

- Explained that crown cover is difficult to use for management purposes and a relationship exists between crown cover and basal area (K/D ratio) $K/D = \text{Crown Cover} / \sqrt{\text{B.A.}}$. *(See Figure 18)*

- Showed graphs relating B.A. to D.B.H.O.B. and S.P.HA to D.B.H.O.B. *(See Figure 19 & 20)*

- Shea has published a cost benefit study on value of managing for:

  1. Water
  2. Wood
  3. Wood + Water

  *(See Figure 21)*

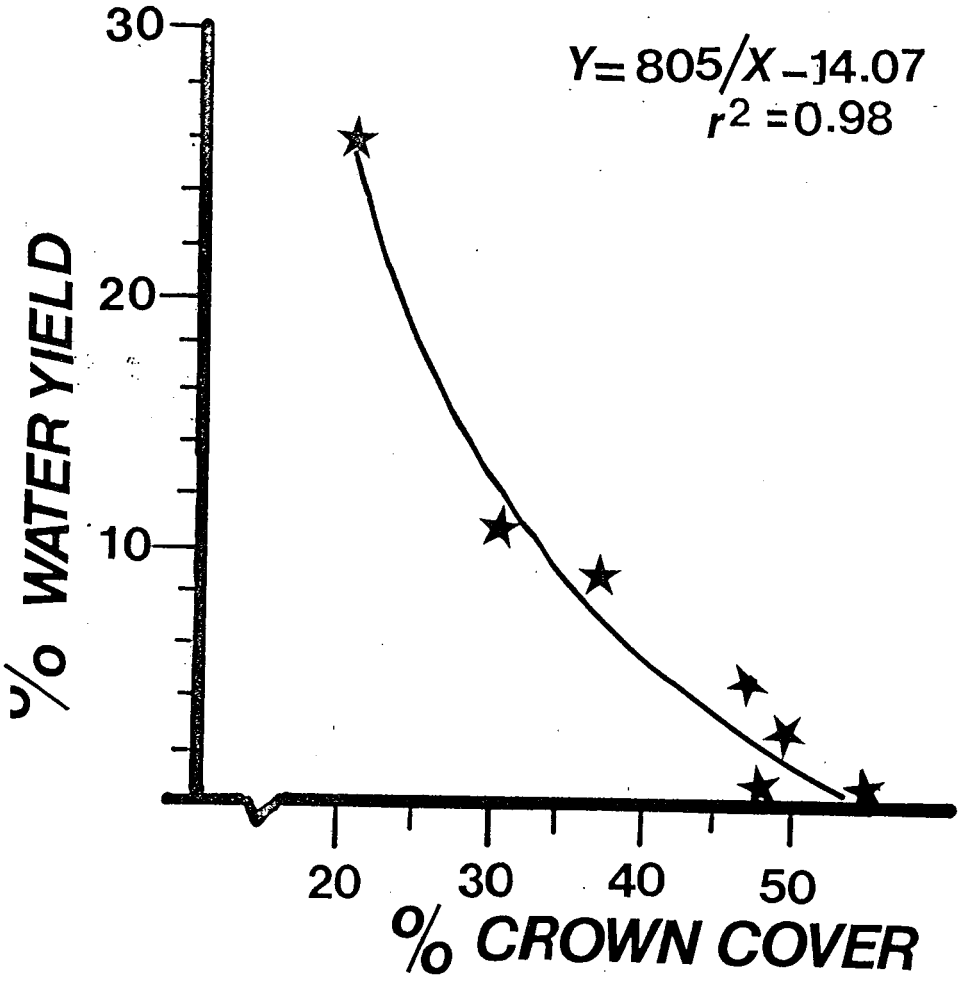
- An increase in water yield of 10% can be gained from reduction of crown cover to 30%, in 1100mm rainfall zone
  1100$m^3$ water/ha/annum is produced.

  Cost of thinning is $100/ha + $20/ha maintenance.

  Benefit is 1100$m^3$ x 10¢/$m^3$ = $110 per year.

  i.e. costs are covered by first year after thinning.

FIGURE 7 THINNING FOR WATER PRODUCTION




RELATIONSHIP BETWEEN % WATER YIELD AND CROWN COVER FROM 7 CATCHMENTS IN THE WESTERN ZONE OF THE NORTHEREN JARRAH FOREST

FIGURE 8

# THE RELATIONSHIP BETWEEN WATER YIELD AND CROWN COVER FOR THE WHOLE OF THE YARRAGIL CATCHMENT 1976 – 1980

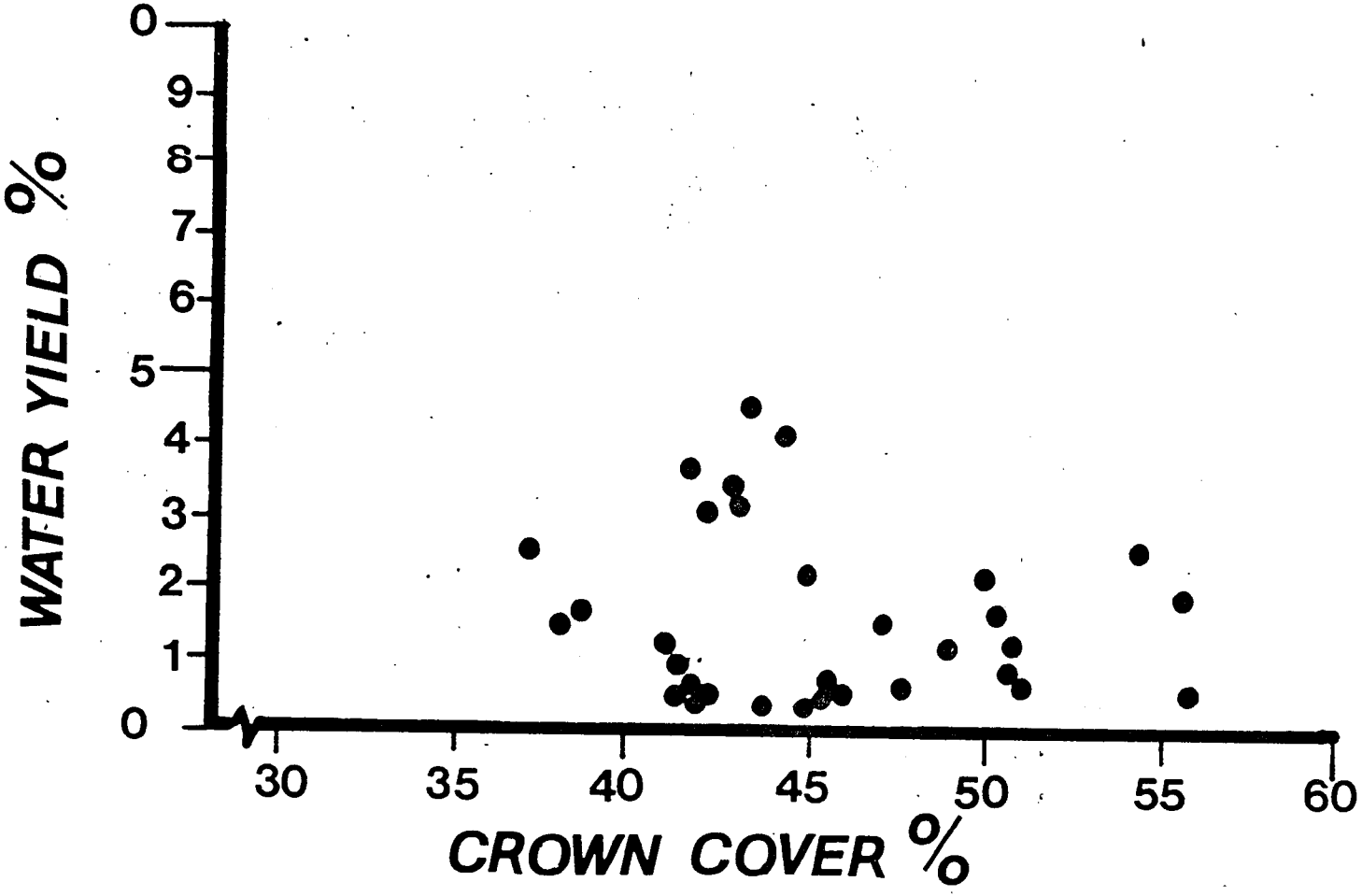


FIGURE 9

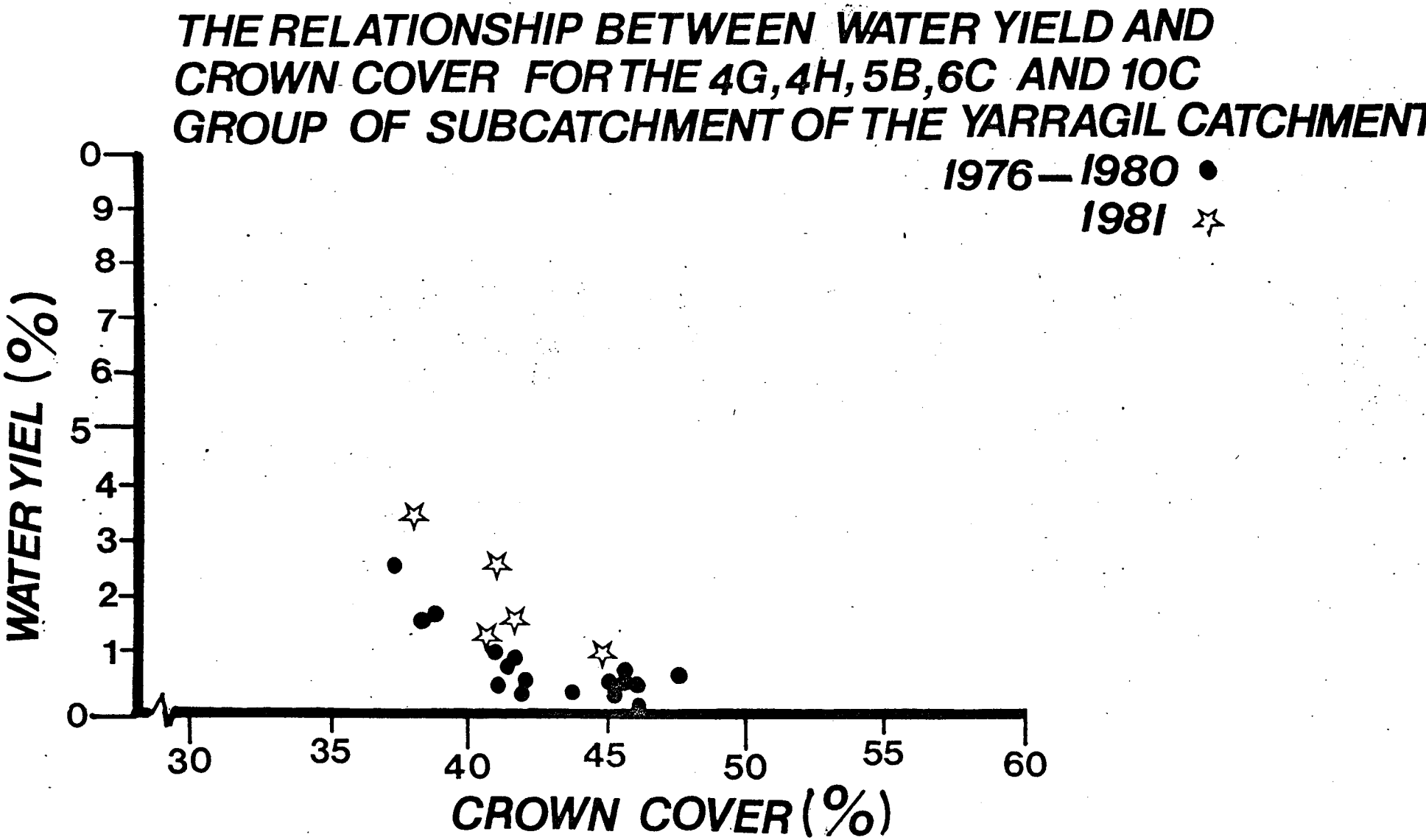

THE RELATIONSHIP BETWEEN WATER YIELD AND CROWN COVER FOR THE 4G, 4H, 5B, 6C AND 10C GROUP OF SUBCATCHMENT OF THE YARRAGIL CATCHMENT
1976—1980 •
1981 ☆
WATER YIEL (%)
0
9
8
7
6
5
4
3
2
1
0
30
35
40
45
50
55
60
CROWN COVER (%)

FIGURE 10

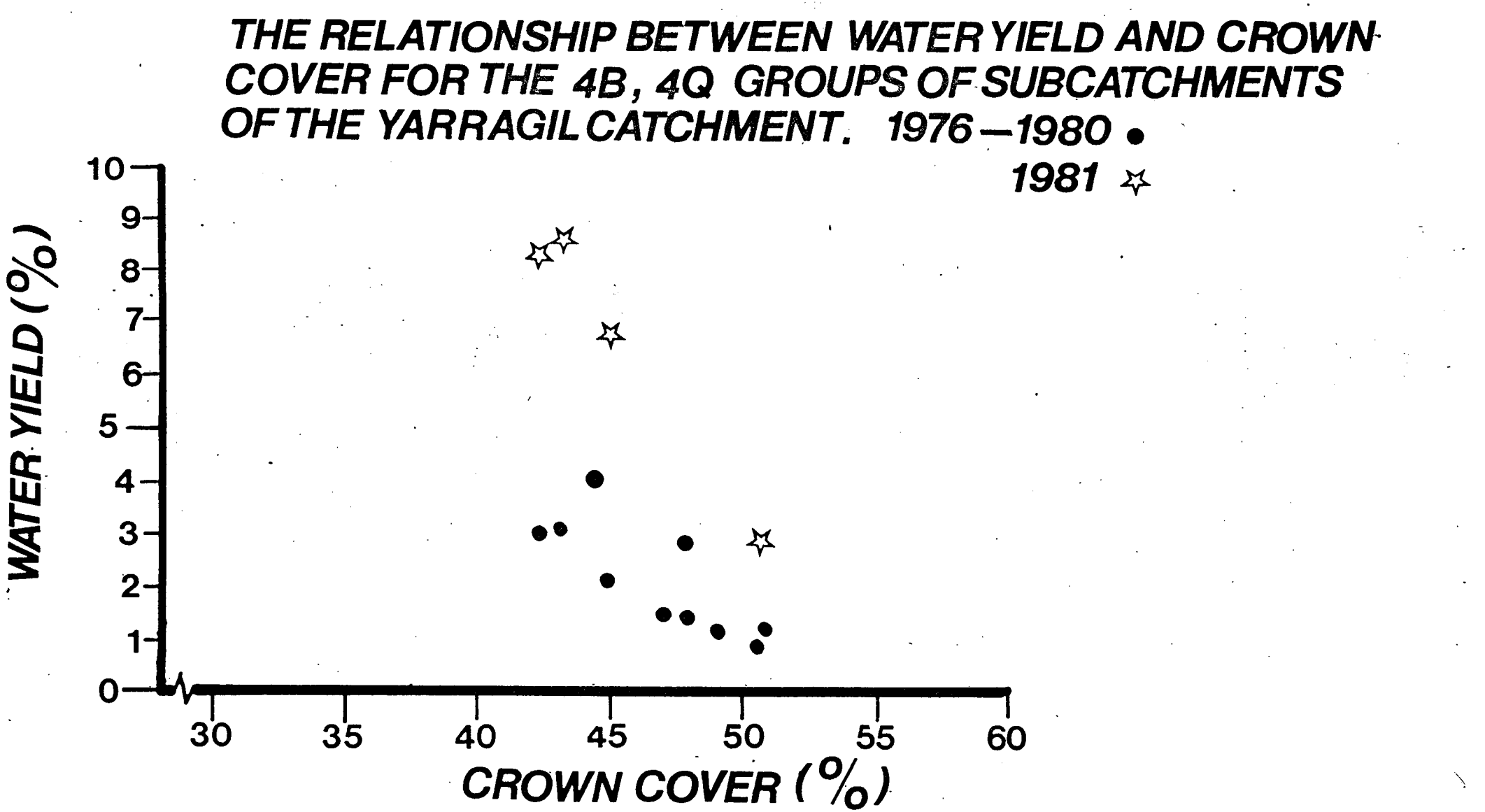

THE RELATIONSHIP BETWEEN WATER YIELD AND CROWN COVER FOR THE 4B, 4Q GROUPS OF SUBCATCHMENTS OF THE YARRAGIL CATCHMENT. 1976—1980 •
1981 ☆
WATER YIELD (%)
10
9
8
7
6
5
4
3
2
1
0
30
35
40
45
50
55
60
CROWN COVER (%)

FIGURE 18

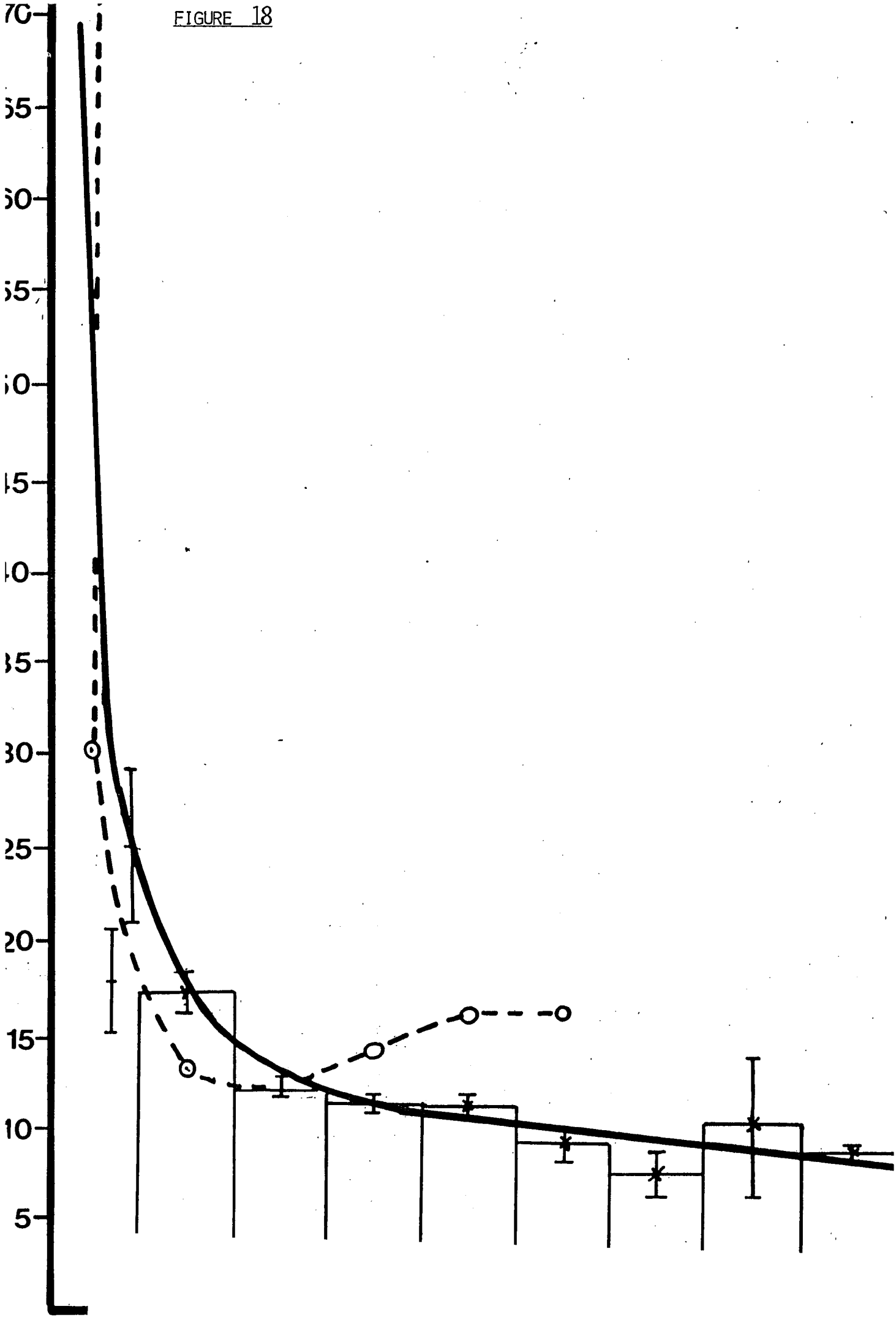
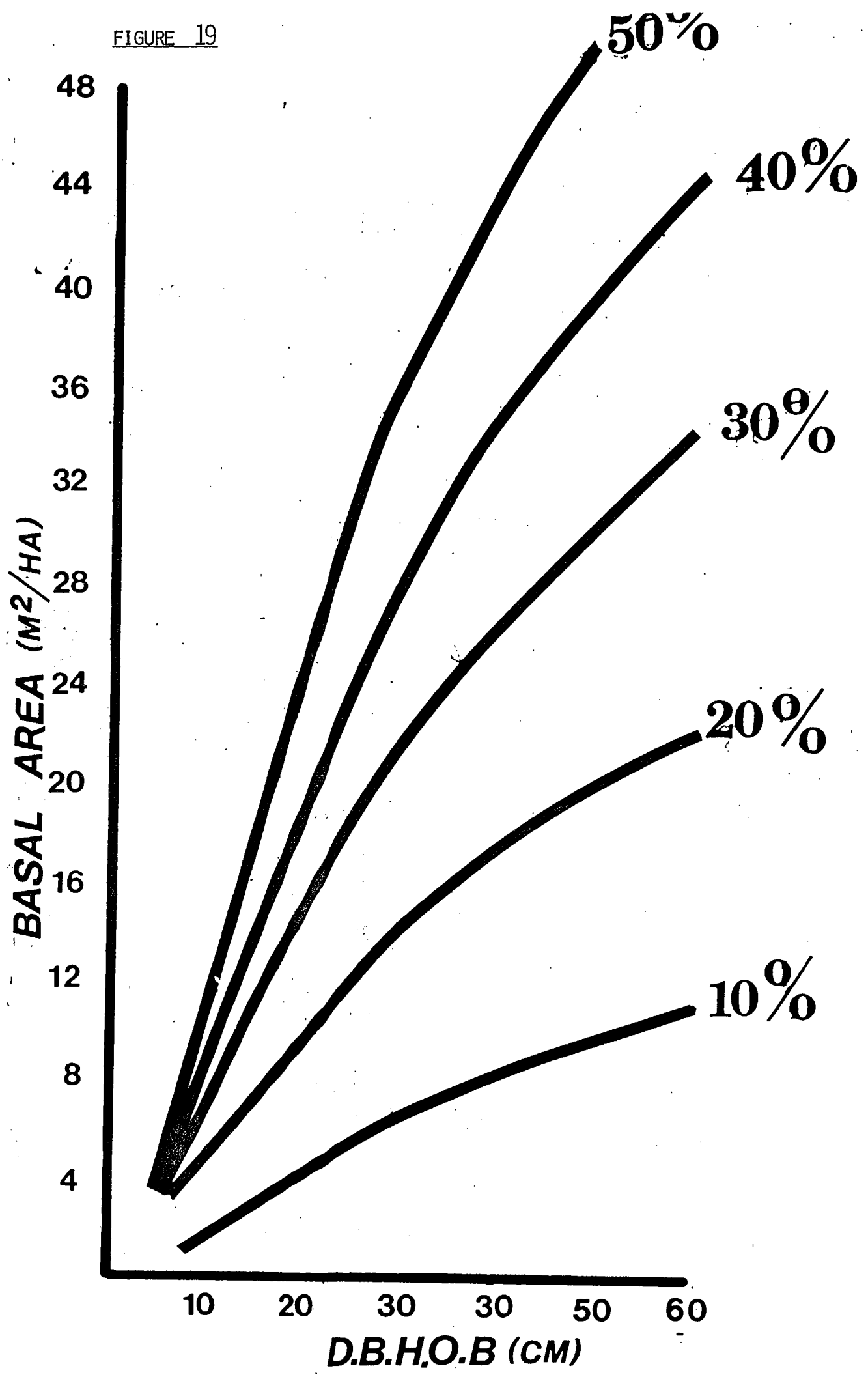


FIGURE 19




THE K/D RATIO ALLOWS US TO RELATE CROWN COVER TO BASAL AREA

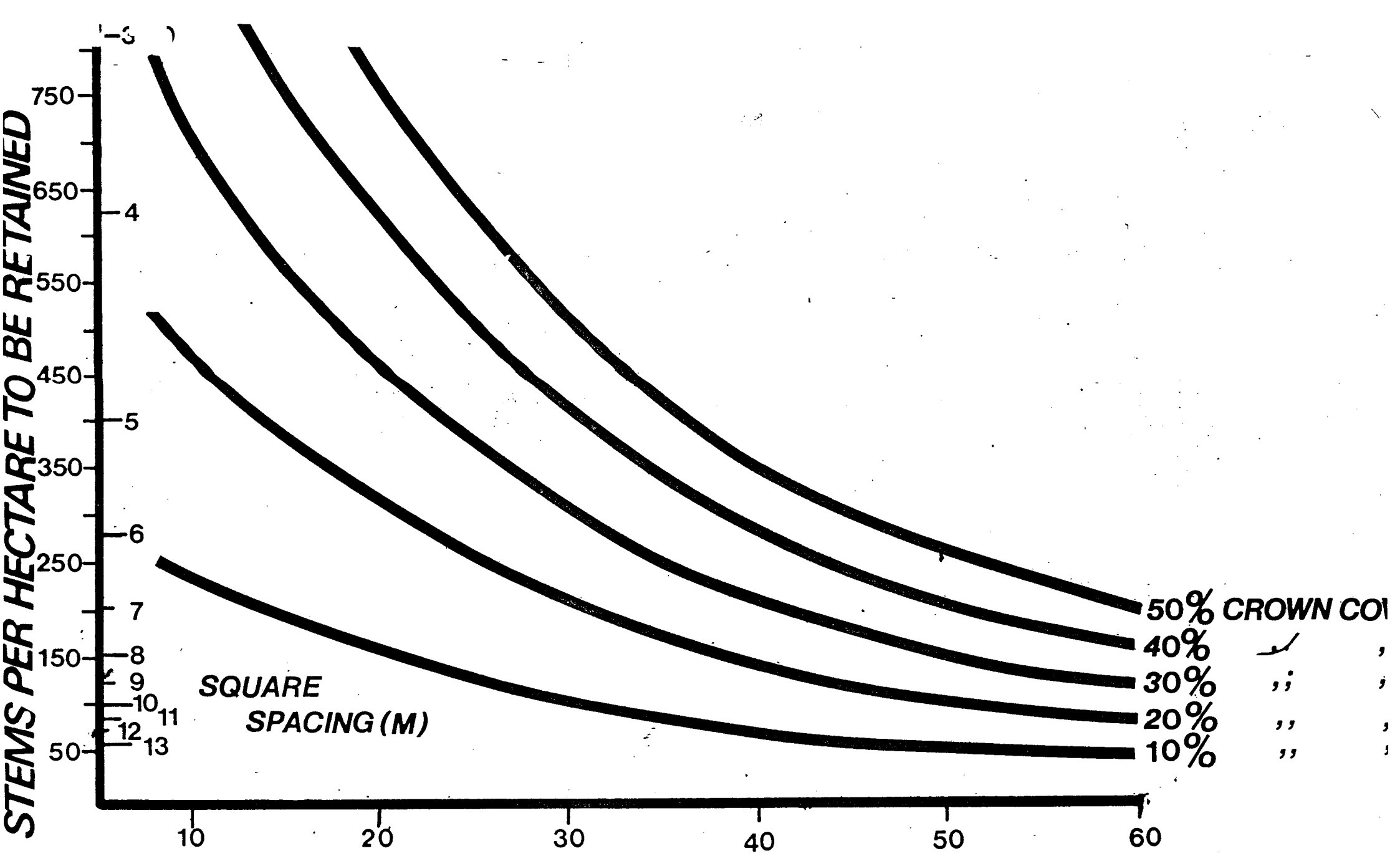
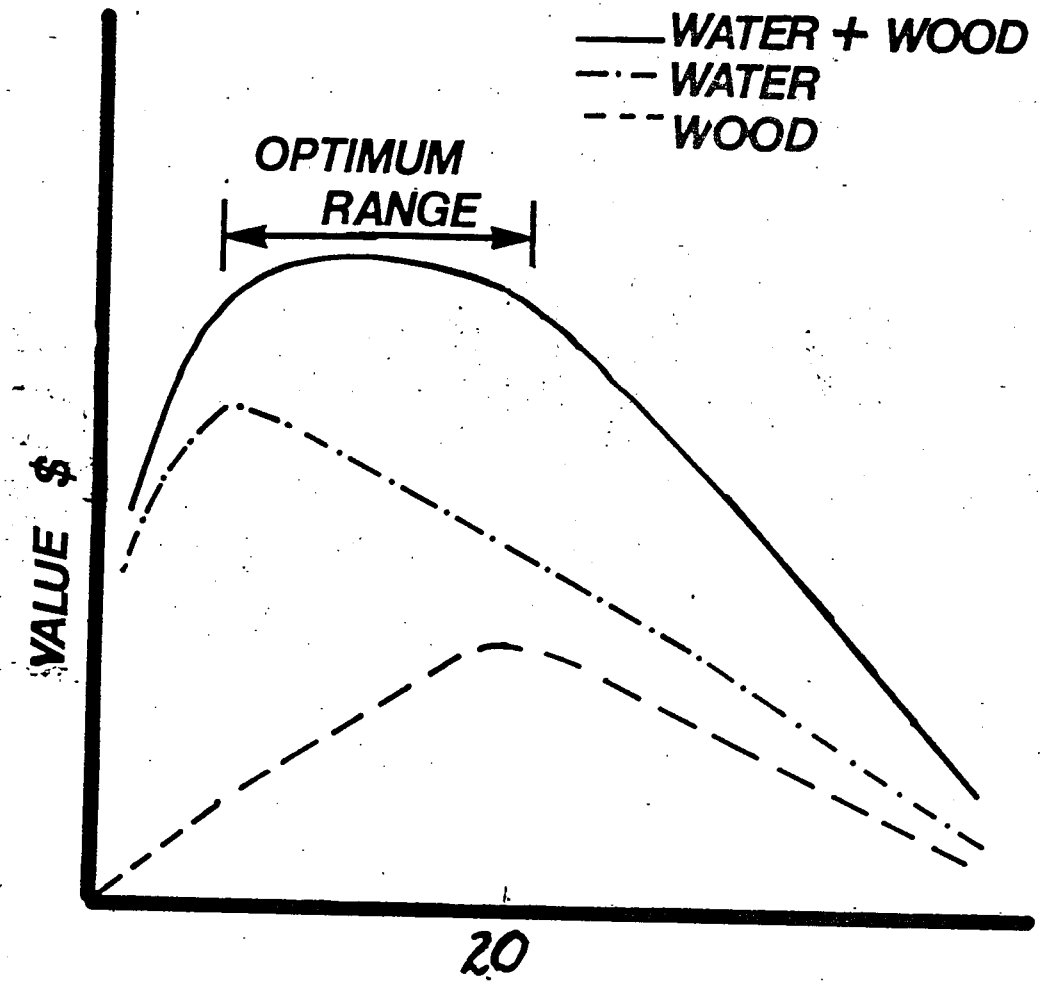



FIGURE 20

THE K/D RATIO ALSO ALLOWS US TO RELATE

FIGURE 21



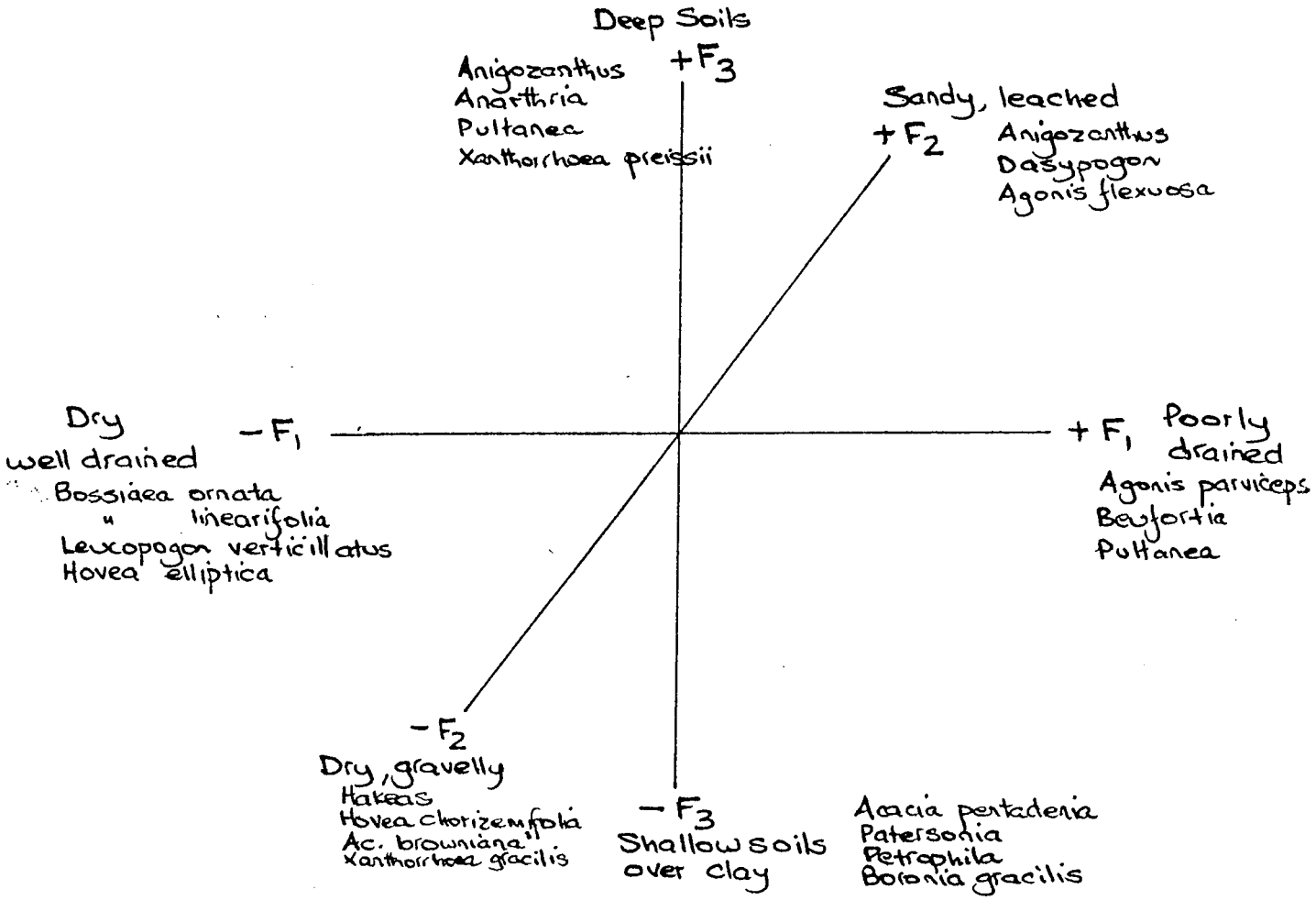

CANOPY COVER (% OF GROUND AREA)
HYPOTHETICAL RELATIONSHIP BETWEEN CROWN COVER AND VALUE PRODUCTION FOR WOOD AND WATER

SESSION 8 J. HAVEL

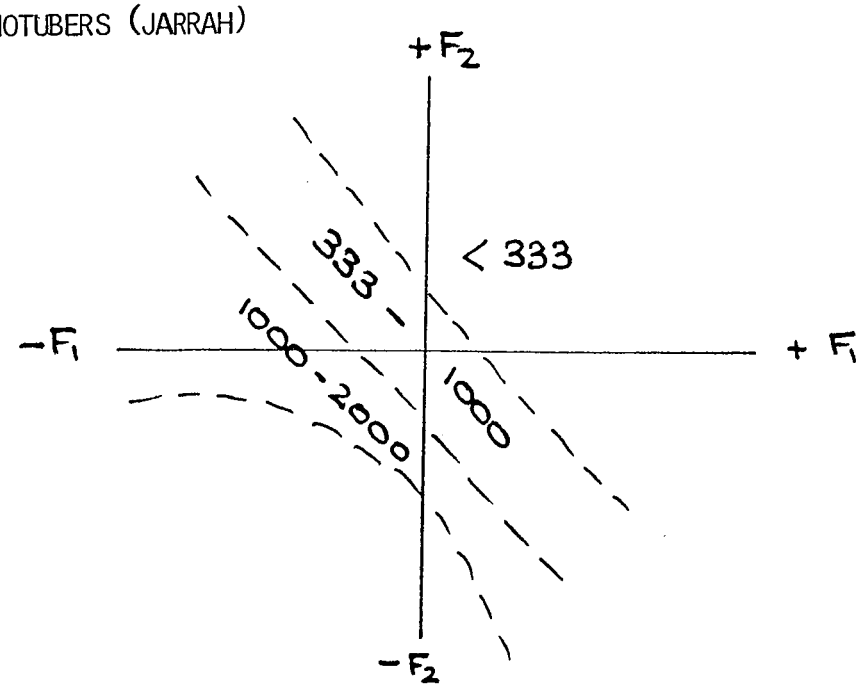
O. Ritson's Site Vegetation Study in Southern Jarrah.

- Ritson's work was based on Havel's and was weaker on the vegetation side but stronger for silvicultural parameters.

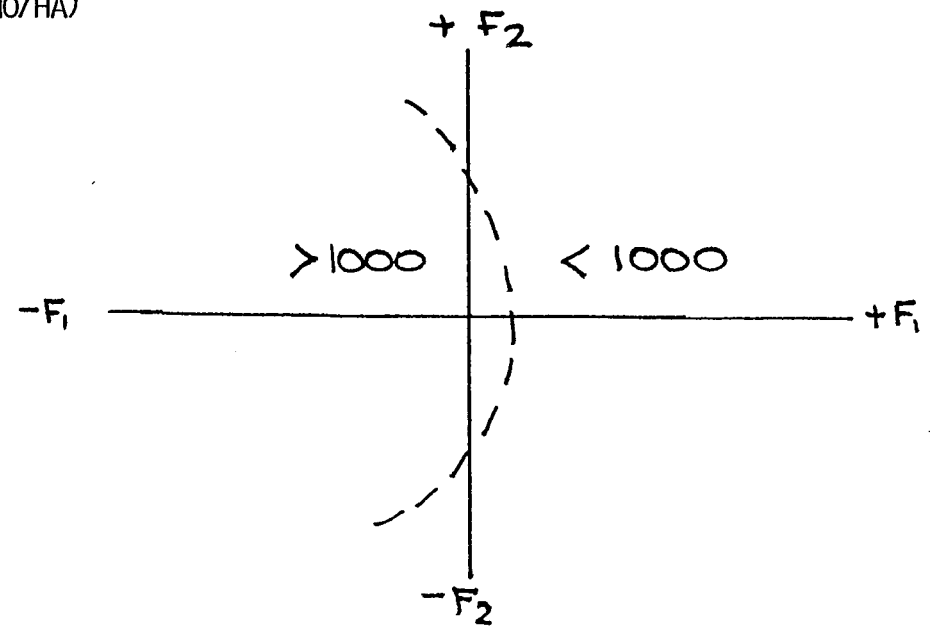
- INDICATOR SPECIES




- STRONG LIGNOTUBERS (JARRAH) (NO/HA)



- STRONG LIGNOTUBERS (MARRI) (NO/HA)




- Ritson worked in areas which were clearly defined by McArthur's maps and sites were within McArthur site types.

- McArthur's maps will be broader classification of Ritson's vegetation types and should be adequate for most management purposes.

- Should be able to fit McArthur's maps into F.M.I.S.

- Selected Continuum Segments

(a) $-F_1$, $-F_2$, $-F_3$.

Characterised by Bossiaea ornata, Hakea lissocarpa, Leucopogon verticillatus, Acacia browniana, Xanthorrhoea gracilis, Patersonia. These are upland, well drained gravels over clay. Low dieback susceptibility.

(b) $+F_1$, $+F_2$, $\pm F_3$

Characterised by Agonis parviceps, Beaufortia sparsa, Pultanaea, Anarthria, Anigozanthus, Dasypogon.

These are high rainfall, poorly drained leached sandy soils. High dieback susceptibility. Very poor Jarrah regeneration potential, poor Marri regeneration potential.

i.e. High Risk - What action?

## SESSION 9 SUMMARY F. MCKINNELL

- Owen Loneragan showed that Jarrah regeneration depends on established lignotubers. In the southern forest it appears that the timespan is shorter for lignotubers to develop dynamic shoots.

  Stool coppice does have a place as effective regeneration.

  Stump coppice have no value except for hydrological purposes.

  Showed how crown cover affects lignotuber development and growth.

- Peter Kimber's work showed that we may stimulate seedling development using fertilizer (This needs field testing).

  Mid rotation fertilizer applications give only transient responses.

- Lachlan McCaw

  Showed that we need to have stands in the range of 6 - 10$m^2$/ha B.A.to get maximum combined value of sawlog growth and water production in Northern Jarrah. Providing we can find markets for poles (thinning) we may get sawlog sized Jarrah in 150 years as well as producing water. Keeping regrowth under control and preventing dieback disease introduction emerge as problems.

- Ian Abbott

  Gave us a basic ecological understanding of B. grandis. He exploded a few myths on why B. grandis is found where it is. We must evolve ways of reducing B. grandis. Once B. grandis is controlled will other host species provide alternative for P.c. populations?

- Joe Havel

  Jarrah covers an extremely wide range of sites. (This could be because of a deficiency of tree species,Jarrah occurs on more sites than it normally would).

  Developed the site classification system. Showed we could expect growth rates to vary on magnitude of 4 or 5:1 on different site types. Reported on Ritson's work. Lignotuber absence is a problem on certain sites.

  Ritson's work has a lot to offer the manager, provided the manager takes the time to understand the continuum.

### GENERAL

- We need to "get our act together" on Jarrah silviculture.
- We are vulnerable to criticism from outside the Department.
- We are self critical of progress in Jarrah silviculture.
- There is a need for a variety of silvicultural regimes because of:
  - Land Use
  - Past Treatment
  - Site Variation
- We need more intensive planning.
- Most input to Jarrah silviculture research should be on regeneration aspects.

# JARRAH SILVICULTURE RESEARCH NEEDS
## (IDENTIFIED BY SOUTHERN REGION)

| | WHO TO UNDERTAKE |
|---|---|
| **LIGNOTUBER ESTABLISHMENT** | |
| (i) Identify Problem Sites - eg. Poor Sands, Clay Podzolics etc. | D.F.O. STRELEIN |
| (ii) Lignotuber stocking considered adequate. | |
| (iii) Lignotuber size - critical size of various stages. | EXAM CANDIDATE |
| (iv) Use of fire, site disturbance to establish seedling lignotubers. | |
| (v) Seeding - Rate, when to seed, species. | |
| **LIGNOTUBER DEVELOPMENT** | |
| (i) Use of fire to stimulate and enhance advance growth. | |
| (ii) Use of fertiliser, ashbed influence. | |
| (iii) Jarrah/Marri ratio, and growth rates. | |
| (iv) Coppice - Stool/Stump coppice development. | |
| **REHABILITATION OF FAILED SITES** | |
| (i) Methods of scrub control, site establishment, planting. | |
| (ii) Species response. | |
| **RESUME OF PAST WORK** | |
| (i) Review written work. | |
| (ii) Resume past trials eg. Wh6, Le5, Go2 and Qb1. | EXAM CANDIDATE |
| **GENERAL** | |
| (i) List problems (both long and short-term) need resolving. | |
| (ii) Set priorities. | |
| (iii) Indicate who is to be responsible for establishment, maintenance, measurement, analysis and write up. | |
| (iv) Review dates to be listed (Bring-ups.) | |