Ho 268/59 67/70

Form F.D. 80B

FORESTS DEPARTMENT

Nannup. 6275. Office,

13th April, 19 73

Western Australia

Reference—H.O.

Local 15/8

To Conservator of Forests,
Forests Department,
Perth. W.A. 6000.

PERTH, W.A.

SUBJECT: Drought Deaths and Associated Ips Grandicollis Attack in The Nannup Pine Plantation

For Notice Mr. Eastman and Supt. Van Noort.

Are we still sure of the species?

The problem of drought deaths and associated Ips grandicollis attack in the Nannup pine plantations has been outlined in many previous letters, especially those dated 4-2-70 (1424/50) and 6-9-72. After checking through these previous reports the following symptoms, evident in Mid March 1973 appear to be new at Nannup.

1. Younger trees appear to be dying. Six year old stands (1967 planting) now have some drought deaths and Ips attack whereas in the past, 10-11 year old stands seem to have been the worst affected.
2. Crowns are now dying from the bottom up. Previous reports all refer to death from the top down. (Autumn brown topping).
3. Green apparently healthy trees have been attacked by Ips. This has not been recorded before.
4. Stands recently thinned to 300 s.p.a. have considerable mortality or Ips attack for the first time.
5. The moisture content in affected trees was checked in 1970 and the M.C. was less near the tip than near the butt of the tree. The reverse now seems to be true.

The most disturbing new trend is the mortality in recently thinned stands where apparently healthy trees have been attacked by Ips. This represents firstly the apparent failure of thinning to arrest the problem and secondly the possibility that the Ips population has built up to the level where healthy trees are being attacked.

Following these initial observations three brief surveys were carried out in the Lewana plantation.

A. General Survey to Assess the Extent of Mortallity and Examine Symptons.

Compartments Lewana A1 to 10, A14 to 16, A21, 22, 31, 34, 36, 37 and B16 and 26 representing thinned and unthinned stands planted between 1961 and 1967 (6 to 12 years old) were checked for the occurance of both drought death and Ips attack. Both were present in each compartment to a greater or lesser degree however less than 5% of trees in each compartment were dying or attacked by Ips except in Compartments A22 and B16. These stands were examined in greater detail and will be discussed later. The following observations were made during this general survey.

27-4-73
1 Mr Eastman
2 Dr Hopkins 8/5
3 Mr Van Noort

1. Most trees in older unthinned stands appear to be dying from the top down although some crowns were dying from the bottom up. All crowns dying from the bottom up had stems affected by Ips but some trees dying from the top down had not been affected by Ips.

In compartment A22 all trees are dying from the bottom up and all are affected by Ips.

It could be that trees dying from the top down are dying primarily from drought and may or may not suffer secondary Ips attack. Trees dying from the bottom up, although predisposed to Ips attack by drought may however be dying primarily from Ips attack which appears to work from the base to the tip of the tree.

2. Compartment A22 which is badly affected by Ips attack was thinned in September 1972 while the neighbouring compartment where no Ips attack has been detected was thinned early in 1972. Compartment B16 suffering Ips attack to apparently healthy trees were thinned in December 1972. Futhermore in compartment A7 (1961 planting) which is unthinned there are very few trees dying and some of these have been attacked by Ips. In this stand a small area, one tenth acre, was thinned in December 1972 to give data on yield and in this area alone there are green healthy trees which have been attacked by Ips.

These observations suggest that thinning encourages Ips attack and that the time of year when thinning is carried out could be an important factor controlling whether a stand is more susceptible to Ips attack or not. Since the severely affected stands mentioned above were thinned in spring or early summer Ips attack could be due to greater exposure of the stem as suggested by Morgan (1) who states that "thin bark represents a hazard (to Ips attack) in the hot dry summer and autumn unless it is well shaded".

3. There is more drought death and Ips attack on exposed north and west aspects than east aspects. This is probably due to increased moisture stress and exposure to the sun.

B. Survey in Compartment Lewana A22

This stand was planted in 1965 and low pruned in July 1969. The stand was thinned to 300 s.p.a. and 100 s.p.a. high pruned in September 1972. Trees in every tenth row were assessed to a maximum of 250 trees giving the following data :-

Healthy	89.5%	
Crown dying from bottom up (top green)	4.5%	10.5% of Total 'affected'.
Whole crown dead.	6.0%	
	100.0%	

Note : All affected trees have Ips attack.

High pruned	10.2% Dying
Not High Pruned	10.6% Dying
Dominants	5.0% Dying
Co-dominants	14.1% Dying

Thus approximately 10% of the 300 s.p.a. in the stand are dying, high pruning does not seem to influence the susceptibility to attack but dominants appear to be less affected than co-dominant trees.

C. Survey in Lewana Compartment B16

This stand was planted in 1964 with the first and second low pruning operations in early 1968 and late 1970 respectively. The area was partly thinned (to about 400 s.p.a.) in December 1972 and the compartment was further thinned to 300 s.p.a. in March 1973. The compartment was assessed in the same way to compartment A22 to give the following data :-

Green healthy trees unaffected by Ips	70%	
Green apparently healthy trees attacked by Ips.	16%	30% Affected
Trees dying from bottom up and attacked by Ips.	14%	
	100%	

High pruned	20% Dying
Not high pruned	31% Dying
Dominants	19% Dying
Co-dominants	37% Dying

Thus 30% of the 300 s.p.a. in this stand have been attacked by Ips and will most probably die. Although less high pruned trees than those not high pruned seem to have been affected this could be because more high pruned trees are dominants and only half the percentage of dominants compared to co-dominants were attacked.

Examination of Tree Vigour and Moisture Content

It was considered that what could be the primary Ips attack on apparently healthy green trees could be due to a reduction in vigour ~~or~~ moisture content (or both) due to drought. To provide more data on this the following work was carried out.

Two trees of similar dimensions from Compartments A22 and B16 were selected. They had the following symptoms.

Compartment A22 (Planted 1965, Thinned Sept. 1972).	Tree 1	Healthy green, no Ips attack.
	2	Dying from the bottom up but tip and upper whorl still green. Attacked by Ips.
Compartment B16 (Planted 1964, Thinned Dec. 1972).	Tree 3	Healthy green no Ips attack.
	4	Healthy green but attacked by Ips.

All trees were felled, the length of each internode measured and cross sectional discs cut from the centre of each internode to measure radial growth. Three moisture content sample blocks were cut from the base and tip of the stem of both trees in Compartment B 16.

Either height or radial growth can indicate tree vigour and these graphs for these four trees are attached. The graphs of radial growth will be discussed since they are more consistent than those of height growth which have probably been complicated by the fact that this is a multinodal species and growth is dependent on weather conditions in early spring.

The following observations can be made :-

1. There is little difference between the growth pattern

of the healthy and affected trees in one compartment except that in Compartment A22 the unhealthy tree was slightly less vigorous than the healthy tree in the most recent year. It appears likely therefore that it is not a difference in tree vigour which influences whether a tree is affected by drought or Ips in these stands.

2. Both trees in both stands do however show a decline in vigour in the last two growing seasons. Other studies indicate that the growth pattern of all trees in a uniform stand (on a similar site) is similar. Most likely therefore all trees in both stands have been under stress in the last two years. The graphs of trees 3 and 4 indicate that compartment B16 also suffered a loss of vigour in the 1969 drought year.

In summary then it is apparent that these compartments severely affected by drought and Ips were suffering a decline in vigour but there was little difference in the vigour of healthy or affected trees within the stand.

The results of the determination of the moisture content at the base and tip of both trees in Compartment B16 is set out below.

	Tree 3 (Ips Attack) % Moisture Content of 3 Blocks		Tree 4 (No Ips) % Moisture Content of 3 Blocks	
	Mean	Range	Mean	Range
Near Tip	91	78-100	78	66-94
Butt	43	33-61	115	109-122

There seems little difference in moisture content between trees near the tip of the stem but the butt of the tree attacked by Ips was considerably drier than the tree unaffected. Although this data is restricted to two trees other green trees affected by Ips also have a low moisture content in the butt. The gradient of moisture content up the tree ties in with the pattern of Ips attack and crown death from the bottom up. But from this data it is not possible to tell if trees infected with Ips had drier butts before attack.

Discussion

The information presented here has some important implications for the management of these drought affected stands. It appears that Ips are now causing death in stands predisposed to attack by moisture stress and that without this Ips attack, the trees would not die. There appear to be several factors leading to mortallity due to Ips attack. The stand is weakened by moisture stress (as shown by the attached graph) so undoubtably aspect and stand density are also important. Furthermore time of thinning in these weakened stands appears to be important as stands badly attacked by Ips were thinned in Spring and Summer. The level of the Ips population may also be important. The severe Ips attack on green trees in Compartment B16 could be explained by the fact that this stand which lacked vigour due to moisture stress was thinned to 400 stems per acre in December inviting Ips attack on the exposed stems and debris and that the subsequent population buildup facilitated an even greater attack when these stands were further thinned to 300 stems per acre in March 1973.

This study reveals that not enough is known about the pattern of growth on various sites and under various management treatments in this plantation. Since the vigour of trees in the stand can be affected by density as well as yearly weather variations it may be that thinning could be carried

out at an age before vigour declines due to competition removing the possibility of Ips attack, even in a drought year.

From the slender information of the radial growth in the trees analysed in this study it appears that a thinning at age 5 under the "Silviculture 70" regime could be correct to maintain vigour but this requires more investigation. In the meanwhile since it is obvious that the annual variations in weather are important in determining vigour, thinning in Spring or Summer is risky because it may predispose the stand to Ips attack if it turns out to be a drought year.

Recommendations

Ips attack associated with drought may potentially be a serious problem when one third of the trees remaining after thinning have already been lost in one stand.

The following recommendations are therefore made.

1. Non commercial thinning in young stands be restricted to the period from April to August when Ips activity and the effect of exposure is low. This restriction need only be vigourously applied on shallow soils, dry hillsides and ridges and exposed aspects.

2. Further research be carried out to determine the pattern of growth in various stands and the relationship between thinning, tree vigour, drought deaths and Ips attack.

A. R. Gadsby (signature)

ASSISTANT DIVISIONAL FOREST OFFICER.

Distribution

Dr. F. McKinnell,
Busselton.

Mr. S. Currie,
Ag. Dept.,
S. Perth.

Insp. Edwards,
Manjimup.

ARG:LLD

This is an interesting report but it is important to note that the stands exhibiting deaths were over 7 yrs before thinning — eg P. 64 + P. 65. Drought stress had already set in.
Our standard treatment is do this at 4 - 5 yrs.
(initials) 8/5.

Agreed ERH

Reference :

1. Morgan F.D., 1967. Ips grandicollis in South Australia Forestry, Volume 31(2) Pages 137-155.

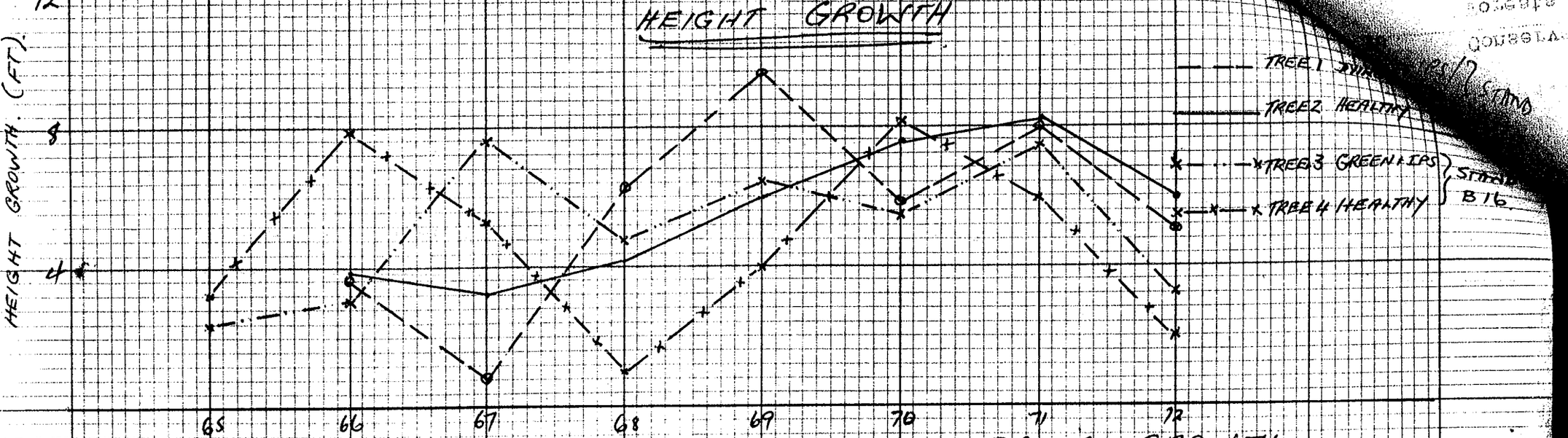
WDH 4 May.

1. Mr. ~~Eastman~~
3. 2. Dr ~~Hopkins~~ ERH 8/5
4. 3. Mr ~~Havel~~
2. 4. Mr ~~van Noort~~ & P64

~~also P67~~

(initials) 8/5.

HEIGHT GROWTH



AVERAGE of TWO TYPE 3 SEQUENCES of RADIAL GROWTH

TYPE 3 SEQUENCES COMPARE THE ~~[illegible]~~ WIDTH OF RINGS LAID DOWN IN THE SAME RELATIVE POSITION FROM THE TIP OF THE TREE EACH YEAR. (EG THE WIDTH OF THE RING LAID DOWN IN THE 2ND INTERNODE FROM THE APEX EACH YEAR) THEY ARE THEREFORE FREE OF THE EFFECT OF INCREASING CIRCUMFERENCE & SHOW ONLY VARIATION DUE TO CLIMATE, STAND COMPETITION & THE INHERENT NATURE OF TREE DEVELOPMENT.