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SHORT-TERM RESPONSES FROM CONTROLLED BURNING AND INTENSE FIRES IN THE FORESTS OF WESTERN AUSTRALIA

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SUMMARY

This is a summary of a paper, to be published separately, which sets out the results of 11 experiments which measured relationships between controlled burning, girth growth of pole sized trees and crown damage to sapling sizes. The effect of intense fires was also studied on jarrah poles.

Copies of the full text, with details of experimental method, tables and graphs are available for this conference.

The experiments included jarrah, (Euc. marginata); karri, (Euc. diversicolor); maritime pine, (P. pinaster) and monterey pine, (P. radiata).

The fire intensities used for controlled burning treatments followed normal West Australian forest practice. For pole sizes these intensities were : 13 to 27 B.T.U. per sec. per ft. for jarrah, 9 to 11 for P. pinaster, 22 to 29 for karri and 4 to 5 for P. radiata. These treatments failed to show subsequent differences in G.B.H.O.B. growth between the burnt and control trees, over one to three-year measurement periods.

One experiment included intense fire treatments for jarrah poles. Twenty per cent of these trees were killed in spring and 27 per cent in autumn. Most of the remainder developed dry-siding on the eight-foot butt log. This damage contrasted with the control-burnt trees where only one in 253 treated trees was killed and there was little or no visual evidence of damage to the others. Subsequent girth growth of the salvaged trees treated with intense fires was similar to the unburnt controls.

Small jarrah and karri saplings were shown to be susceptible to crown death after controlled burning. Jarrah saplings less than 11 feet high were damaged by fires of intensities ranging from 9 to 18 B.T.U. per sec. per ft. Within this range of intensity the number of crown deaths was closely correlated with fire intensity.

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Karri saplings less than 17 feet high were severely damaged by fires of 22 B.T.U. per sec. per ft., but 30 foot saplings survived 12 B.T.U. per sec. per ft., without apparent butt damage or loss of G.B.H.O.B. growth.

The G.B.H.O.B. growth of P. pinaster was not affected by 9 to 11 B.T.U. per sec. per ft. More intense fires which caused crown scorch had a marked effect, and growth loss was associated with the length of green tip above the scorched section of the crown.

INTRODUCTION

Regular controlled burning over large areas of the northern jarrah forest has been established practice since 1953.

In the southern forest, which includes karri, widespread controlled burning was hindered until recently by poor access, mixed fuels and dense scrub.

Now lighting techniques developed for aircraft (Packham and Peet, 1967) and refinements to controlled burning techniques (Peet, 1967) have provided the means for controlled burning over about 600,000 acres of the southern forest during the past three seasons.

A restricted programme of controlled burning has developed over the past three to four years in high risk plantations of P. pinaster and P. radiata.

Since 1953 rotational controlled burning has steadily increased in West Australian forests. At present about 800,000 acres of eucalypt forest are control-burnt annually, and about 2,000 acres of pine plantation.

The objective of this burning is fuel reduction with negligible forest damage (Harris and Wallace, 1959). Until recently there was little measured data to support visual evidence that damage was in fact negligable.

Since 1963 experiments have been conducted to study growth responses and forest damage from fire. These experiments are still short-term, and are not extensive enough to provide comprehensive explanations of the effects of controlled burning. They show short term growth responses in burnt and unburnt pole-sized trees, and acceptable fire intensities for controlled burning under saplings.

Three variables were used to describe the results; fire intensity tree species and tree sizes.

EXPERIMENTAL METHOD

There were two types of experiments; firstly, dendrometer plots (Liming, 1957) which measured girth growth over bark for pole sizes and, secondly, observation plots to record crown damage in jarrah and karri saplings.

The controlled burning treatments were measured by McArthur's experimental fire technique, and the intense fires were created by heaping dry slash around the butt of each treated tree (Vines, 1968).

RESULTS

The summarized growth analyses for the dendrometer plots are listed in Table 1 together with tree sizes and fire intensity. Fire intensity was described by Byram's formula I = Hwr, using 8000 B.T.U. per sec. per ft. for H. (McArthur 1968).

Table 1 shows the only trial to be affected by treatment to be crown scorching of P. pinaster. There were no significant differences in G.B.H.O.B. growth for any of the controlled burning treatments, and surprisingly, no significant differences were recorded for jarrah poles treated by intense fires.

Graph 1 shows the average monthly G.B.H.O.B. growth for 30 trees treated with spring controlled burning, 30 trees treated by autumn controlled burning, and 30 unburnt control trees. Graphs for the other species, in trials unaffected by treatment, were similar to this one.

Graph 2 shows the relationship between fire intensity and number of crown deaths in jarrah saplings. Each point on this graph shows the number of deaths in population of 200 observed saplings. All the crown deaths occurred in saplings under 11 feet in height. Some of these later replaced a crown by epicormic shoots, and in some cases the whole sapling was replaced by a dynamic shoot. For the purposes of this experiment however the original sapling was considered badly damaged and a loss to the stand.

Forty karri saplings averaging 13 feet in height were also burnt under with an average fire intensity of 22 B.T.U. per sec. per ft. All these saplings except three were killed.

DISCUSSION

The definition of acceptable fire intensities which match the fire resistance of different tree sizes and species must be an important part of research into controlled burning. Without this information the criterion of negligible damage depends on personal judgement, which may or may not be an adequate control; and in either case there is no measured data to show that the objective is achieved.

Except for the karri saplings the fire intensities used for controlled burning in these trials were comparable with those normally adapted in West Australian forest practice. For pole sizes these intensities were 13 to 27 B.T.U. per sec. per ft. for jarrah, 9 to 11 for P. pinaster, 22 to 29 for karri and 4 to 5 for P. radiata.

These intensities failed to produce differences in G.B.H.O.B. growth between the burnt and control trees during one to three-year measurement periods.

One karri pole was killed in the controlled burning treatments, from a log burning next to the butt. The remaining 252 treated trees in the four species failed to show evidence of significant butt or crown damage. These results contrast sharply with the intense fire treatments for jarrah poles, in which 20 per cent were killed during spring and 27 per cent were killed in autumn. For the remainder, 87 per cent were dry-sided and in most cases the butt log will probably be useless for future sawmilling. Surprisingly, (Hodgson, 1967) girth growth of the salvaged trees continued at a similar rate to that of unburnt controls. These results question the relative importance of initial butt damage or death and subsequent increment losses for jarrah burnt by intense fires.

Small jarrah and karri saplings were shown to be susceptible to crown damage from controlled burning. Jarrah saplings below 11 feet high were damaged by fire intensities of 9 to 18 B.T.U. per sec. per ft. Within this range the number of killed crowns was correlated with fire intensity. Karri saplings under 17 feet high were almost completely killed by an average fire intensity of 22 B.T.U. per sec. per ft. but 30 foot saplings withstood 12 B.T.U. per sec. per ft. without apparent butt damage or losses in girth growth.

With safety margins, jarrah saplings 13 feet high could be burnt-under safely, providing fire intensity is controlled to 12 B.T.U. per sec. per ft. or less. The normally accepted 15 to 20 feet heights for controlled burning under saplings should be more than adequate at 12 B.T.U. per sec. per ft.

For karri, 30 ft. saplings could be burnt-under safely at 12 B.T.U. per sec. per ft. The possibility of burning under smaller sizes requires further investigation.

Short-term growth responses from pole-sized pines show 9 to 11 B.T.U. per sec. per ft. to be safe for P. pinaster, and 4 to 5 B.T.U. per sec. per ft. for P. radiata. Crown scorch at higher fire intensities will affect subsequent girth growth.

Experience with wildfire in Somerville Plantation indicates that fuel reduction, even at these low intensities, will greatly assist control of headfire and decrease spotting distances.

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TABLE 1

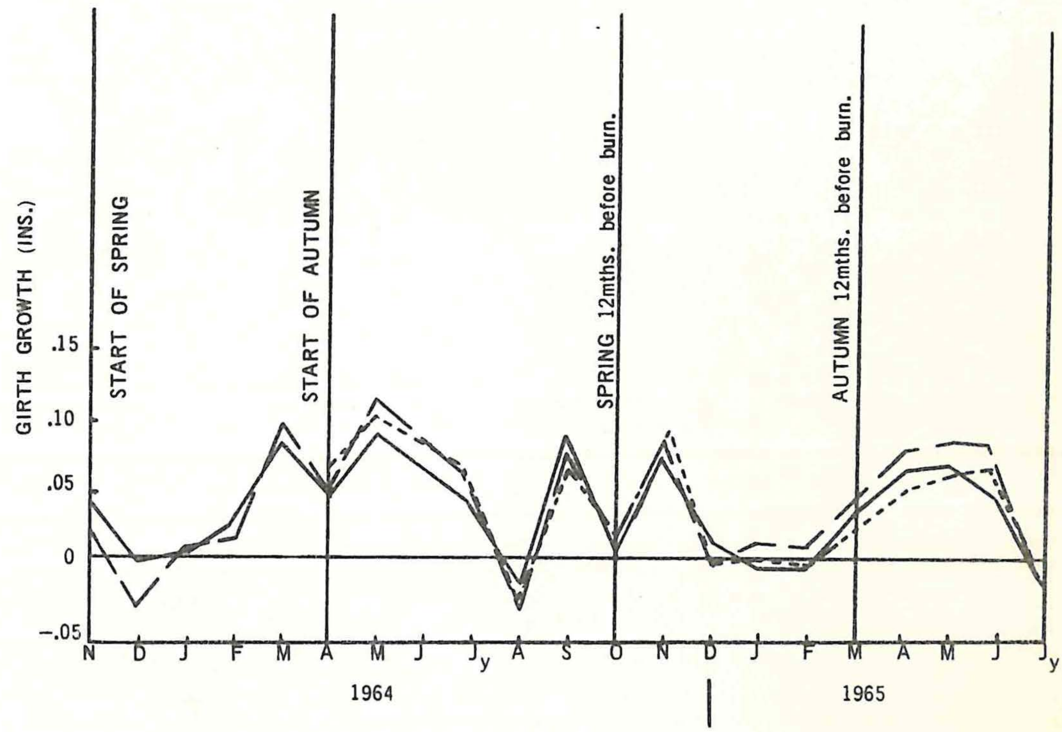
GIRTH O. B. GROWTH OF POLE SIZES AFTER FIRE TREATMENTS

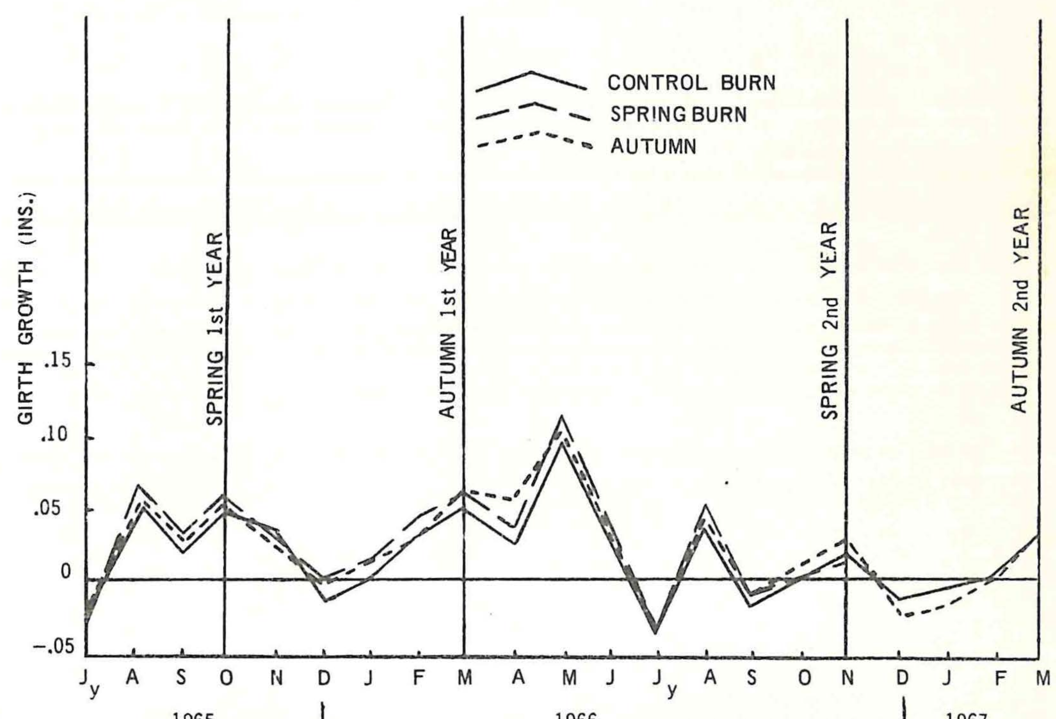
Plot Date							Girth Growth Responses				
Species	Treatment	Fire Intensity B. T. U. per sec. per ft.	M. ment Height	Number of Treated Trees	Average Tree BAOB sq. ft. Burnt	Average Tree BAOB sq. ft. Controls	Growth Period	Av. Girth O. B. Growth ins. Burnt	Av. Girth O. B. Growth ins. Controls	Variance Ratio	Sig. of V. R.
Jarrah Trial 1.	Spring Control Burning	19.6	B. H.	30	0.56	0.58	1 yr. before burning	0.463	0.446	0.1	N. S.
							1st. yr. after burning	0.507	0.423	2.2	N. S.
							2nd. yr. after burning	0.315	0.315	1.7	N. S.
							3rd. yr. after burning	0.217	0.179	1.6	N. S.
	Autumn Control Burn	12.7	B. H.	30	0.65	0.58	1 year before burning	0.422	0.407	0.1	N. S.
							1st. yr. after burning	0.453	0.432	0.1	N. S.
							2nd. yr. after burning	0.254	0.226	0.6	N. S.
							3rd. yr. after burning	0.228	0.204	0.6	N. S.
	Spring Intense Fire		B. H.	6	0.94	0.95	1 yr. before burning	0.657	0.610	0.2	N. S.
							1st. yr. after burning	0.593	0.577	0.2	N. S.
							2nd. yr. after burning	0.915	0.655	2.0	N. S.
							3rd. yr. after burning	0.389	0.222	3.6	N. S.
	Spring Intense Fire		10'6"	12	0.70	0.70	1st. year	0.454	0.338	2.2	N. S.
							2nd. year	0.265	0.260	0.1	N. S.
	Autumn Intense Fire		10'6"	14	0.70	0.71	1st. year	0.263	0.135	3.8	N. S.
Jarrah Trial 2.	Spring Control	27.2	B. H.	30	0.52	0.58	9 mths. before burning	0.230	0.210		N. S.
							1st. yr. after burning	0.283	0.229	2.4	N. S.
							2nd. yr. after burning	0.262	0.261	0.01	N. S.

TABLE 1 continued :

Plot Date							Girth Growth Responses				
Species	Treatment	Fire Intensity B.T.U. per sec. per ft.	M.ment Height	Number of Treated Trees	Average Tree BAOB sq. ft. Burnt	Controls	Growth Period	Av. Girth O.B. Growth ins. Burnt	Controls	Variance Ratio	Sig. of V.R.
Karri Trial 1.	Spring Control Burn	21.6	B.H.	40	0.58	0.55	7 mths. before burning	0.330	0.375	1.5	N.S.
							1st. yr. after burning	0.554	0.572	0.1	N.S.
	Autumn Control Burn	28.8	B.H.	50	0.52	0.55	11 mths. before burn	0.368	0.415	3.4	N.S.
Karri Trial 2.	Spring Control Burn	11.9	B.H.	40	0.012	0.10	7 mths. before burn	0.722	0.649	1.7	N.S.
							1st. year after burn	1.216	1.245	0.1	N.S.
Maritime Pine	Control Burn	11.2	B.H.	50	0.31	0.30	1st. yr. after burn	0.675	0.452	1.4	N.S.
	Crown Scorch to 1.5 ft.)		B.H.	10	0.40	0.40	1st. year	0.125	0.701	31.1	**
	Crown Scorch to 5 ft.)				0.41	0.41	1st. year	0.383	0.735	6.2	*
	Crown Scorch to 10 ft.)				0.47	0.47	1st. year	0.419	0.813	1.9	N.S.
Monterey	Controlled Burning	4 to 5	B.H.	50	0.43	0.43	10 mths. before burn	0.77	0.81	0.3	N.S.
							6 mths. between 1 and 2 Burn	0.35	0.39	1.2	N.S.
							16 mths. after 2nd. burn	1.37	1.35	0.03	N.S.
							8 mths. after 3rd. burn	0.69	0.61	0.7	N.S.

GRAPH 1 INGLEHOPE GROWTH PLOTS ; JARRAH POLE SIZE





GRAPH 2

GLENEAGLE TRIAL
600 JARRAH SAPLINGS
FIRE INTENSITY AND NUMBER OF CROWN DEATHS