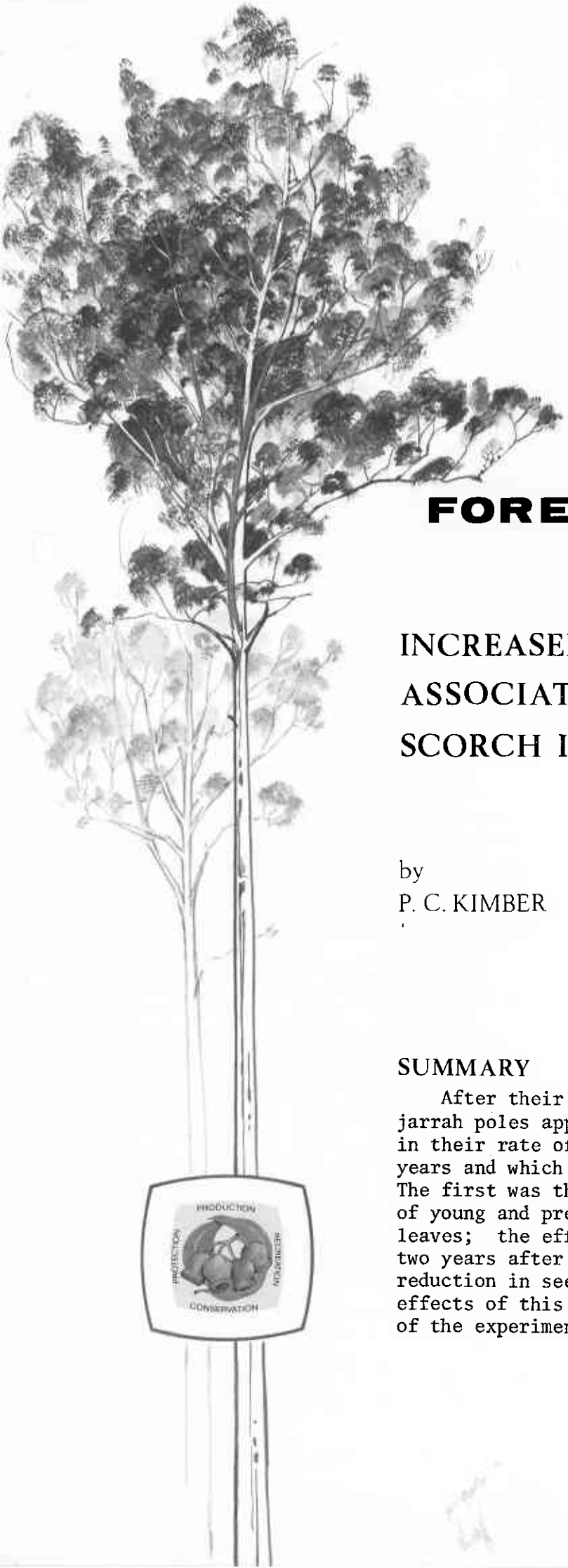

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INCREASED GIRTH INCREMENT ASSOCIATED WITH CROWN SCORCH IN JARRAH

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SUMMARY

After their crowns were scorched by fire in the spring, jarrah poles approximately 40 years old showed an increase in their rate of girth increment which persisted for four years and which appeared to be associated with two factors. The first was the presence of a dense regenerated crown of young and presumably photosynthetically efficient leaves; the effects of this were evident during the first two years after the fire. The second was a significant reduction in seed production in the scorched trees; the effects of this were apparent during the last two years of the experimental period.

INTRODUCTION

Crown scorch, the death of the leaves in the crown of the tree due to excessive exposure to convective heat, is characterised by very rapid browning of the leaves, which remain attached to the crown for some weeks before falling off. Crown scorch in jarrah trees as a result of prescribed burning has for a long time been considered both undesirable and indicative of too intense a fire, but since no research into the response of trees to scorch has as yet been reported, the unattractive appearance of the crown remains the only adverse effect which can at present be substantiated.

It is known, however, that the fire intensity required to scorch the crown of jarrah poles is not high enough to cause damage to the pole, so that wood quality is not impaired (Peet, personal communication). Tables of the height to which crown scorch may be expected to occur under various fire conditions have been compiled by the Forests Department of Western Australia (1976).

Leaf flush in jarrah invariably takes place in summer, and it is in the summer following scorching that recovery of the crown occurs. The length of time that the tree remains without living leaves therefore depends on the season of burning, the recovery period ranging from a few weeks for crowns scorched in spring to nine or ten months for crowns scorched in autumn.

The experiment described in this paper was initiated in 1969 in an attempt to identify the effects of crown scorch caused in spring on the girth increment of jarrah.

METHOD

Study area

The experiment was conducted in an almost pure, even-aged stand of 40-year-old jarrah poles in Kennedy Block, 130 km south-east of Perth. Approximately 100 ha were subjected to a mild prescribed burn in mid-November 1969. A 20 ha block within this area was burnt at a greater intensity in order to cause scorch to the tree crowns; trees outside this block suffered no crown scorch.

Girth measurements

One hundred trees were selected for measurement in each of the scorched and unscorched areas. The loose outer bark was scraped off each tree and a white ring was painted at breast height (1.3 m above ground), where girth measurements were to be taken. Measuring took place one week after the fire in November 1969, in January 1970, and subsequently every September until September 1973. A steel tape was used, and measurements were taken to the nearest 0.1 cm.

Other assessments

The presence of flowers or seed capsules in the crown was noted for each tree at each measurement; accurate measurements of density were, however, not made. Fairly heavy flowering was observe in some of the trees in January 1972, and by September 1972 this had given rise to a moderate crop of capsules.

RESULTS

Total increases in girth which are attributable to crown scorch are given in Table 1.

The girth increment of trees that had suffered crown scorch was appreciably greater than that of trees that had not been scorched: the mean girth increment over the four-year period was 5.13 cm for scorched trees and 3.68 cm for unscorched trees.

Periodic girth increments are shown in Table 2.

Between November 1969 and January 1970, when their crowns carried no live leaves, scorched trees did not increase in girth. During the period January to September 1970, after the flush of new leaves in January and February, the girth increments of scorched trees generally were greater, but this difference was not significant. However, scorched trees grew significantly more quickly than unscorched trees over the next three years.

Annual girth growth data for both scorched and unscorched seeding and non-seeding trees are given in Table 3. Seed capsule development occurred between January and September 1972.

During the year ending September 1971,

TABLE 1

Mean increases in breast height girth (cm) due to crown scorch

	Growth period	
	Nov.69 to Sept.71	Sept.71 to Sept.73
Scorched	2.59	2.54
Unscorched	1.96	1.72
Difference	0.63 (0.39-0.87)	0.82 (0.50-1.14)
Difference*	32.1% (19.9-44.4)	47.7% (29.1-66.3)

(Figures in brackets are 95% confidence intervals)
* Expressed as a percentage of the mean girth increment of unscorched trees.

TABLE 2

Periodic mean girth increments (cm) of scorched and unscorched trees (burnt November 1969)

	Growth period				
	Nov. 69 to Jan. 70	Jan. 70 to Sept. 70	Sept. 70 to Sept. 71	Sept. 71 to Sept. 72	Sept. 72 to Sept. 73
Scorched	0	0.67	1.92	1.41	1.13
Unscorched	0.12	0.59	1.22	0.95	0.77
Difference	-0.12	0.08	0.66	0.46	0.36
Probability of type 1 error		0.07	0.001**	0.001**	0.001**

(Probabilities were calculated from a 't' test)

TABLE 3

Mean girth increments (cm) of seeding and non-seeding scorched and unscorched trees

		Growth period			
		Jan 70. to Sept. 70	Sept. 70 to Sept. 71	Sept. 71 to Sept. 72	Sept. 72 to Sept. 73
Seeding	Scorched	0.70	1.79	1.21	0.98
	Unscorched	0.58	1.23	0.89	0.72
	Difference	0.12	0.56	0.32	0.26
	Probability	> 0.05	0.001**	0.001**	0.05*
Non-seeding	Scorched	0.65	2.00	1.52	1.23
	Unscorched	0.64	1.47	1.44	1.15
	Difference	0.01	0.53	0.08	0.08
	Probability	>0.50	0.05*	>0.50	>0.50

(Probabilities were calculated from a 't' test)

TABLE 4

Mean girth increments (cm) of scorched and unscorched seeding and non-seeding trees

		Growth period	
		Sept.71 to Sept.72	Sept.72 to Sept.73
Scorched	Non-seeding	1.52	1.23
	Seeding	1.21	0.98
	Difference	0.31	0.25
	Probability	0.01 *	0.025*
Unscorched	Non-seeding	1.44	1.15
	Seeding	0.89	0.72
	Difference	0.55	0.43
	Probability	0.005**	0.01**

(Probabilities were calculated from a 't' test)

significant increases were observed in the girth increment of trees with scorched crowns, irrespective of whether or not they were to bear seed capsules in 1972. In the subsequent two-year period ending September 1973, significant growth increases due to crown scorch were recorded only in trees bearing seed capsules.

Crown scorch also affected seed capsule production: 88% of the unscorched trees produced a crop of seed capsules, compared with only 37% of the scorched trees. The absence of seed capsules apparently contributed to the increase in growth rate, for non-seeding trees sustained considerably higher girth increments than did seeding trees, irrespective of scorch. Growth data for seeding and non-seeding trees over the two-year seeding period are compared in Table 4.

DISCUSSION

Two distinct factors may be identified which account for the increased girth increments of trees with scorched crowns. The first, an increase in the density of leaves in the regenerated crown, influenced girth increment until September 1971. During this period, before seed capsule development, all the leaves were young and photosynthetically more efficient than the one- to three-year-old leaves in the unscorched crowns and therefore more likely to induce a faster rate of growth. This difference in leaf age and density accounted for an increased girth increment in scorched trees compared with unscorched trees of at least 20% (Table 1).

The second factor, a reduction in seed capsule production, influenced girth increment after September 1971 in two ways. Firstly, seeding trees that had been scorched showed higher growth rates than those that had not been scorched (Table 3), perhaps because their production of seed capsules had been reduced. Secondly, the proportion of scorched trees that produced a seed crop was much reduced, these non-seeding trees subsequently showing markedly higher growth rates (Table 4). The reduction of seed capsule production accounted for an increase of at least 29% (Table 1) in the girth increment of scorched trees compared with unscorched trees.

REFERENCE

FORESTS DEPARTMENT OF WESTERN AUSTRALIA (1976). Forest fire behaviour tables for Western Australia.