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TESTING OF VIGOROUS REGROWTH TREES FOR RESISTANCE TO SIREX BY INFESTATION WITH CAGED INSECTS

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Summary

An experiment in which thirty trees in a regrowth compartment at Pittwater were selected for their healthy, vigorous, green appearance and subjected to infestation by caged *Sirex* over two seasons is described. Three additional trees were included in the second season's experiments.

From the attack in the first season, eight trees were killed or so severely affected as to merit classification as dead. All of these were classified as poor producers of resin, on the basis of an estimate of the amount of resin which flowed from each tree through oviposition holes within the cage. Four other trees were affected.

After a second season of infestation, only three trees died and ten others showed some effects. All the effects observed are briefly discussed in relation to the strength of the attack and to certain characteristics of the trees.

No definite conclusions have yet been drawn except that the amount of resin flow is related to successful attack and it appears highly probable that resin composition plays an important part. These can overcome the disadvantage of relative suppression in some cases.

Materials and methods

In the first season, 1963/64, artificial infestation was concentrated on regrowth trees approximately ten years old by mounting screen mesh cages, 18 in. and 24 in. long, depending on the internode length, on their trunks at approximately one third of their overall heights. The attack was repeated on surviving trees during the 1964/65 season by placing in one series a cage on each, above the original position and in a second, two cages, one above and one below the previous induced attack. Throughout both seasons, three *Sirex* females were placed in each cage at weekly intervals, thus exposing all three to approximately the same chance and intensity of attack. The females were balanced as evenly as possible as to size. This level of

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attack was maintained for six weeks in the first season and for seven in the second.

Ten trees were selected from each of the following types:

1. The dominant or co-dominant class. Very healthy, vigorous, green trees without any needle yellowing or visible signs of previous Sirex attack.

2. Resinous trees, which were found by inspection of the boles to have resin blisters under the bark, but which were otherwise similar to Type 1.

3. Small trees suffering some competition but of green, healthy appearance.

The regrowth at Pittwater is not quite even-aged and therefore the degree of dominance was not entirely uniform within the types. All selected trees had, however, to be free of mechanical damage, free of resin blobs, streaks or scars, selected from the same open-growing stand, and of such a crown form as to allow the cages to be mounted on internodes without the need to cut off any branches. Stem needles were not considered objectionable and their yellowing proved later to be a valuable first indication that the attack was effective.

At the end of each season the cages were removed and an estimation was made of the number of oviposition holes with the aid of a 10x hand lens, and converted into numbers per square foot of bole area. From two caged sections, the bark was removed and an accurate check count made. These showed the estimated numbers to be acceptable.

The "caged" portions of the eight trees classed as killed in the first season were lopped out and the emergence of Sirex adults from these sections were recorded.

Table I — Emergence of Sirex from killed trees.

Location.	Tree 80	82	73	67	58	66	78	74
Caged area	89	26	17	12	2	27	-	-
Above cage	14	13	2	-	-	-	-	5
Below cage	17	6	-	-	-	-	-	-

It was observed that wild Sirex were attracted to the trees, probably by the smell of the resin beads which formed over oviposition holes in the cages (Fig. 1a). Wild Sirex oviposited mainly in the upper stems above the cages.

The amount of resin (called "resin cover") which flowed from each tree was estimated visually on an arbitrary scale of 1 to 10. Resin pressures were measured with manometric tubes. Relative turgor pressures were based on the percentage of saturation of discs of bark including the cambium and a few layers of sapwood cells; the thick bark was carefully trimmed off.

Trees Nos. 59 and 60 which, despite their small size, were only lightly attacked and did not succumb during the first season, were enclosed during the second season in a single cage 18 ft high, together with three additional trees, Nos. 59A, 60A and 60B. Given a choice, Sirex generally avoided Nos. 59 and 60, prefering to attack No. 60A, which was killed outright. That Nos. 59 and 60 possess resistant characteristics is considered to have been proved.

Five graft scions were taken from each of the trees which survived the first attack.

Results

Growth data, observations and results are set out in Tables 2 and 3. The graph, Figure 2, prepared after the first season, shows some of the relationships found. Resin cover seems to be more closely and directly related to survival of the trees than other characteristics. The estimated resin cover of the trees, Table 3, is generally lower in trees which have been seriously affected. Barrett (1963) found by regression analysis that yield is dependent on tree diameter and resin viscosity. In slash pine, larger gum yields increasing proportionally with tree diameter were mentioned by Lindsay (1932), and Mergen et al. (1955) have found the diameter and growth rate to be associated with the resin yield.

The resin pressures and turgor pressures are not completely reliable because they were measured when the trees were already showing some effects. The values were rounded off for the tables.

The changes in the position after the second season are indicated below.

Year of attack	Trees in experiment	Whole tree killed	Killed in and above cage	Otherwise affected
1963/64	30	2	6	4
1964/65	25	1	2	10

On the trees which were provided with two cages in the second year a further point was observed. Cages located at the base or on the lower part of the bole, where there was already some true wood, produced from the oviposition punctures beads of heavy oleoresin which quickly solidified. In upper crown parts, which contain mainly juicy sapwood, more parenchyma resin is formed. On trees which did not produce enough of such resin, the effect of oviposition in the higher cages was apparent in the severity of reaction of the foliage in the upper crowns.

Some trees of higher turgor pressures (Nos. 55, 56 and 77) were found to be still growing in height and diameter after the attack, which they resisted in both seasons. These trees have formed sunken bark lesions in the oviposited areas in the cages (Fig.1b) and deformities in the bole. Wood under such lesions is saturated with resin and patches of the cambium have been affected. Renewed wood forms later as callous growth.

The first visible effects of the attack were invariably yellowing and premature shed of the stem needles. These were followed by slow or rapid yellowing, depending on the strength of the attack and the make-up of the tree, of the branch needles, which subsequently turned red and then brown. On some trees these are shed immediately after they die, but on some they persist for some time.

Shock was apparent on the same trees (Nos. 55, 56 and 77), causing wilting and twisting of the tip branchlets after the second attack. These trees have recovered following relatively extensive needle shed. Their bud vigour has been lowered, although as far as could be ascertained, their turgor pressure did not decrease appreciably.

Conclusions

1. High resin content assisted trees in their defence against Sirex attack. High moisture content, when associated with this, helped to produce growth deformities where oviposition holes were numerous.

2. Where satisfactory amounts of both eleoresin and parenchyma resin were produced, occlusion of the oviposition holes was often highly effective. Some trees, notably No.64, produced much larger quantities of parenchyma resin than others.

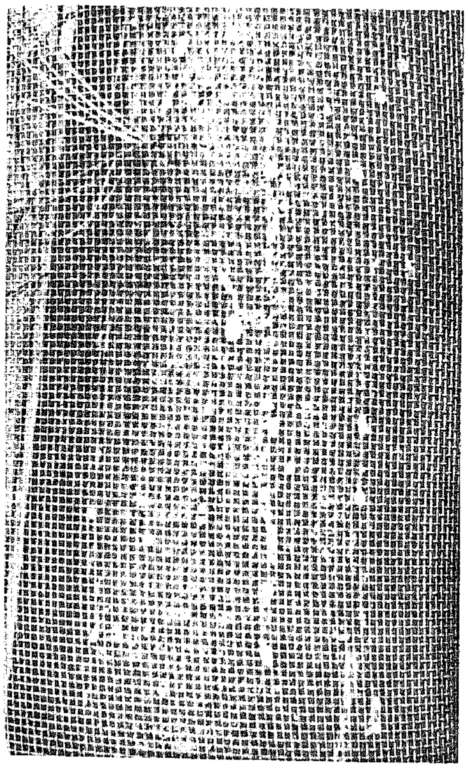

Fig. I(a). Beads of resin exuding from oviposition holes within the cage on P.radiata.

Fig. I(b). Bark lesion on tree No.55.

3. In many cases light initial attack probably stimulated growth. Subsequent moderate attacks had no further effect unless the tree was subjected to another stress.

4. Differences in susceptibility in the crown cannot be fully explained by the strength of the attack, the quantity of resin or the moisture content. Mutton (1962) has discussed the chemical differences between parenchyma resin and oleoresin. In the opinion of the authors, such chemical differences could be significantly related to differences in susceptibility. It is also almost certain that the chemical composition of the parenchyma resin, and the chemical and physical properties of the sap in the crown, differ from tree to tree, and so provide further sources of variation which could affect susceptibility. These aspects are the subject of current investigations.

References

Lindsay A.D. (1932) : Turpentine industry in the United States. Leaflet No.44. For. & Timb. Bur., Canberra.

Mergen F. et al., (1955) : Genetic control of oleoresin yield and viscosity in slash pine. For. Sci. 1(1):19-30.

Mutton D.B. (1962) : W. E. Hillis Ed., Wood extractives and their significance to pulp and paper industries. Acad Press, New York and London : 331-363.

Table 2. Growth and other data for the experimental trees.

Tree No.	Crown Class	D.B.H.O.B. in.	Height ft.	D.B.H. a.i. in.	Height a.i. ft.	Cage at Height, ft. 1964	Bottom	Top
(59A)	S	0.25E	8.0E	0.05E	0.50E	nil	common cage	
(60B)	S	1.00E	12'0E	0.10E	1.00E	nil	common cage	
(59)	SD	0.94	10'2"	0.15	0.88	3'2"	common cage	
78	S	1.10	9'7"	0.14	0.10	4'2"	-	-
58	SD	1.29	14'5"	0.01	nil	4'9"	-	-
67	SD	1.44	13'0"	0.06	1.30	4'6"	-	-
(60A)	S	1.65E	15'8"E	0.10E	0.10E	nil	common cage	
(60)	SD	1.50	14'0"	0.10	0.16	5'3"	common cage	
74	SD	1.60	15'6"	0.02	0.10	5'8"	-	-
56	SD	1.95	20'2"	0.03	0.10	5'8"	3'0"	10'6"
82	SD	2.08	18'5"	nil	0.10	7'8"	-	-
62	SD	2.10	18'0"	0.24	1.25	3'3"	-	8'0"
69	SD	2.40	21'4"	0.26	0.90	3'3"	2'0"	10'2"
63	SD	2.50	18'9"	0.24	1.35	8'5"	0'4"	12'6"
80	SD	2.50	23'2"	nil	0.12	9'7"	-	-
76	SD	3.00	24'0"	0.09	2.56	6'2"	-	9'5"
77	SD	3.06	24'0"	0.10	1.25	4'9"	-	10'6"
73	CD	3.47	25'0"	0.08	nil	10'5"	-	-
66	CD	3.50	20'6"	0.37	0.48	10'4"	-	-
65	CD	3.55	21'4"	0.37	1.35	9'2"	5'0"	13'6"
55	CD	3.92	20'3"	0.53	1.20	6'1"	3'6"	9'0"
64	D	3.94	22'6"	0.38	1.65	8'5"	4'7"	13'0"
57	CD	3.97	30'0"	0.14	0.80	8'3"	4'0"	13'0"
61	CD	4.20	27'1"	0.38	0.50	9'5"	-	15'0"
53	D	4.43	25'2"	0.67	1.20	11'0"	-	13'6"
54	D	4.48	27'6"	0.36	1.20	11'4"	-	16'6"
81	CD	4.54	29'1"	0.15	1.15	9'7"	5'6"	13'6"
75	D	4.80	30'6"	0.30	1.20	6'7"	-	19'0"
71	D	5.76	33'5"	0.48	0.75	13'2"	-	18'0"
70	D	5.78	29'0"	0.64	1.30	12'0"	4'9"	15'0"
68	D	5.78	31'2"	0.40	1.40	14'0"	-	20'0"
72	D	6.16	38'4"	0.17	1.15	11'7"	-	17'0"
79	D	6.16	22'4"	0.42	1.00	10'5"	6'6"	16'0"

Explanations: E - estimated values; a.i. - increment for period between the two seasons. Data in brackets refer to whole tree in the common cage.
D - dominant; CD - co-dominant; SD - sub-dominant; S - suppressed.

Table 3. Results and associated measurements.

No. of ovips. per sq.ft.			Resin pressures in Atm.		Resin cover			Turgor pressure %	Effect		Tree No.
	1965					1965					
1964	Bottom	Top	1964	1965	1964	Bottom	Top	1965	1964	1965	
	-	-		n.m.		(-)		n.m.			(59A)
	(4)			5.8		(1)		64			(60B)
40	(22)		3.8	4.3	2	(2)		68		Y	(59)
220	-	-	2.7	-	1	-	-	58	KT		78
160	-	-	nil	-	2	-	-	64	KT		58
303	-	-	2.6	-	2	-	-	57.5	KT		67
	(28)			1.4		(-)		n.m.		KO	(60A)
7	(17)		5.2	2.5	1	(2)		75		Y	(60)'
150	-	-	nil	-	-	1	-	50	KT		74
188	4	92	7.0	8.5	7	6	7	90	Y	KT[a]	56
230	-	-	nil	-	1	-	-	n.m.	KO		82
418	-	5	2.0	4.0	5	-	2	67.5	Y		62
190	32	7	1.9	7.8	8	2	5	62.5		Y	69
30	1	7	2.9	4.0	4	1	8	71		Y	63
126	-	-	nil	-	1	-	-	n.m.	KO		80
222	-	303	3.7	4.0	4	-	1	62	Y	KT	76
235	-	4	6.3	6.0	6	-	4	98.5		Y	77
140	-	-	6.0	-	2	-	-	67.5	KT		73
515	-	-	5.4	-	1	-	-	67	KT		66
-	21	39	3.2	1.5	1	4	4	79.5		Y	65
25	2	13	1.9	2.2	8	7	7	83			55
253	6	2	6.8	7.2	5	2	4	63			64
'1	20	10	6.1	6.1	3	5	7	66		Y	57
3	-	18	5.0	6.5	4	-	3	66			61
5	-	14	6.0	5.7	2	-	3	51.5		Y	53
37	-	5	7.8	8.5	7	-	6	75			54
23	17	18	5.0	4.6	4	4	4	95.5			81
13	-	9	6.2	7.2	7	-	7	63		Y	75
1	-	7	7.0	2.1	4	-	7	65			71
-	49	16	3.3	1.4	6	6	3	73			70
-	-	25	5.5	5.2	5	-	7	62			68
69	-	3	5.5	10.4	6	-	1	57.5	Y		72
-	11	11	4.7	3.3	3	4	8	80.5		Y	79

Explanations: Y - serious yellowing of needles; KO - tree killed outright;
KT - top killed above the cage ; n.m. - not measurable.
a - not actually killed, but very seriously affected.

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