LONGITUDINAL SPLITTING OF BARK: A LIKELY CAUSE OF "TYPE 3" RESIN POCKETS IN PINUS RADIATA

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ABSTRACT

Cambial damage as a result of longitudinal splitting of the bark of 6-year-old **Pinus radiata** D. Don results in the formation of minor lesions (Type 3 resin pockets) in the subsequently formed wood. The distribution of this type of lesion in 11-year-old trees of **P. radiata** indicates a reduction in the frequency of such defects as bark development proceeds. The origin of resin exudation on the surface of the stem is sometimes related to the presence of these defects, but usually occurs as a result of rupture of resin sacs in the bark.

INTRODUCTION

Resin pockets affect the grading of timber and a method of predicting value losses due to the presence of resin pockets in timber has been developed by Park & Parker (1982). Studies aimed at finding out why they occur may allow for their elimination from timber destined for high grade products. Cown (1973) found no relationship in *Pinus radiata* in New Zealand between the occurrence of resin pockets and stem diameter, tree height, crown class, or wood density. On the other hand, water stress and gale-force winds have been implicated in the formation of resin pockets (Clifton 1969; Cown 1973; Frey-Wyssling 1942).

Somerville (1980) described three types of resin pockets occurring in *P. radiata.* "Type 1" resin pockets are large radial discontinuities in the wood, filled with oleoresin and callus tissue. "Type 2" resin pockets are similar but they are radially flattened, contain less callus tissue, and are open to the external environment at early stages in their development. They later become occluded by cambial overgrowth with the formation of an occlusion scar which may be retained across several subsequent growth rings. "Type 3" resin pockets are small resin-filled lesions with an occlusion scar similar to that of Type 2 resin pockets.

The present work forms part of an investigation into the initiation and development of resin pockets in *P. radiata.*

MATERIALS AND METHODS

Resin Exudation Study

During the 1980–81 growing season, five 11-year-old *P. radiata* trees showing extensive resin exudation were selected for study. The trees, growing in Kaingaroa Forest, had been high pruned the previous season. They were felled and cut into discs at 20-cm intervals up to the first branch whorl, and each disc was examined for the presence of resin pockets. Samples of bark were excised from areas of resin exudation and embedded in paraffin wax for sectioning and microscopic examination. Sections were stained in safranin according to standard procedures.

Cambial Damage Experiment

Five 6-year-old trees of *P. radiata* growing in Kaingaroa Forest were selected at the start of the 1982–83 growing season. These trees had been thinned and low pruned the previous season. The bark of each tree was cut longitudinally in to about the level of the cambium with a scalpel, producing a gash 10–20 cm long. This was done at two heights – near the base of the tree and below the first branch whorl at approximately 1.5 m height. This treatment was intended to simulate "natural" splitting of the bark. After 5 months' growth the trees were felled and discs cut through the central portion of each wound. Blocks of wood from behind the wound sites were excised and a microtomed transverse surface was prepared. The blocks were washed in commercial bleach (sodium hypochlorite) for 4 h, dehydrated in ethanol, and vacuum dried before coating with gold/palladium and observation on the scanning electron miscroscope (Philips PSEM 500). Similar preparations of "natural" Type 3 resin pockets were made for comparison.

RESULTS

Resin Exudation

Trees with heavy resin exudation did not always contain large numbers of resin pockets (Table 1). In these trees resin was found to be exuding from resin sacs which had ruptured at the surface of the bark. Microscopic examination revealed a structural similarity to the cortical resin canals of young stems (Fig. 1). The number of resin sacs, recognised as lumps on the outer surface of the young bark, varied

TABLE 1—Resin pocket frequency per growth season

Tree	Growth ring No.									
	1	2	3	4	5	6	7	8	9	10
1	2	1	15	15	3	0	0	0	0	0
2	6	1	12	9	1	0	0	0	0	0
3	0	1	2	0	0	0	0	0	0	0
4	11	4	17	8	2	0	0	1	0	0
5	11	18	18	10	0	0	0	0	0	0

greatly from tree to tree. In trees with large numbers of resin pockets, the resin was found to originate from both resin sacs and splits in the bark. The splits were usually associated with Type 3 resin pockets and their occlusion scars.

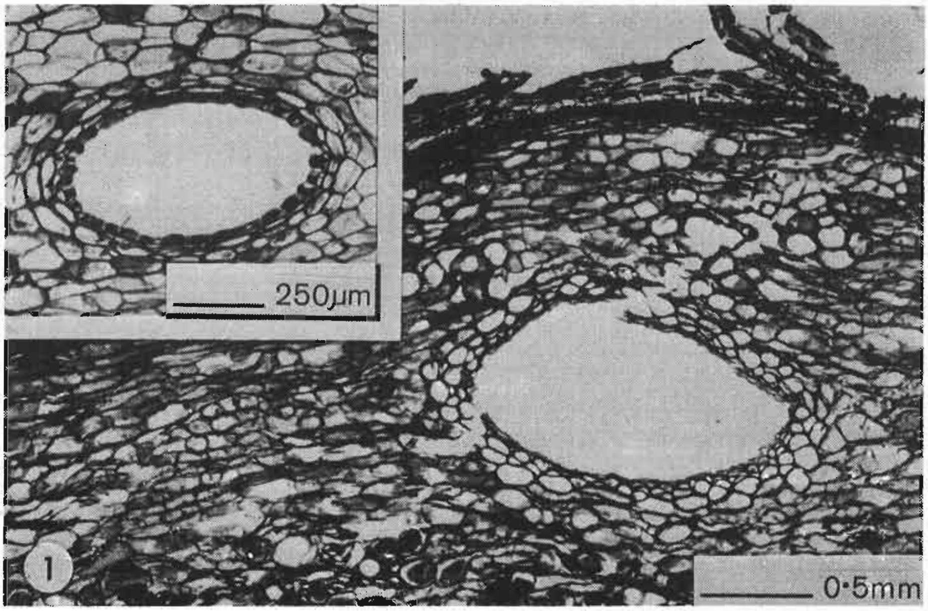

FIG. 1—Transverse view of a resin sac in the bark of an 11-year-old tree of **P. radiata**. Inset is a cortical resin canal from a 1-year-old stem for comparison.

Cambial Damage Experiment

Examination of fresh discs revealed the presence of small lesions in the wood at the site of the bark damage in almost every specimen. One disc did not show any lesion, apparently because the bark had not been cut deep enough to damage the cambial zone. Similar lesions were also observed at sites of natural splits in the bark. Examination of the lesions under the scanning electron microscope (Fig. 2) revealed structures identical with Type 3 resin pockets. The lesions produced in this experiment exhibited occlusion scars with the characteristic indentation of the outer tangential surface of the wood associated with Types 2 and 3 resin pockets. Some of the lesions were associated with traumatic resin canals.

DISCUSSION

These results suggest that the origin of Type 3 resin pockets is related to events in the bark leading to cambial damage. It is known that the bark is placed under tension in the tangential direction because of the rapid growth on the xylem side of the cambium in young trees. This is easily demonstrated by slashing the bark with a scalpel. The two edges of the wound pull away from each other forming a gap several millimetres wide. Such stress could be responsible for the production of splits in the bark during periods of rapid growth, which may or may not result in injury

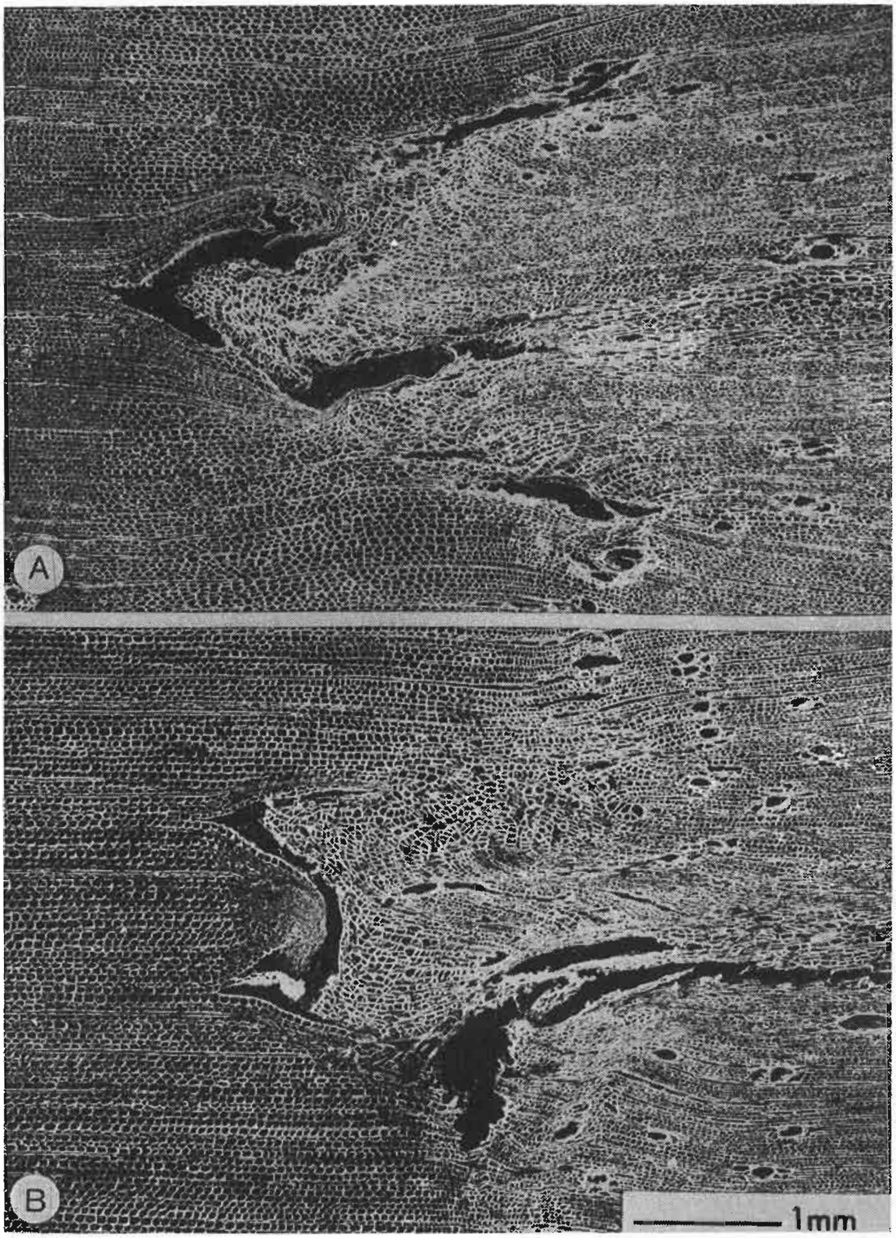

FIG. 2 A—Transverse view of a Type 3 resin pocket produced by wounding.
B—Transverse view of a "natural" Type 3 resin pocket.

depending on whether or not the split reaches the level of the cambium. The results of the present experiment indicate that such damage to the bark and cambium leads to the production of Type 3 resin pockets in the adjacent xylem. However, it is not known whether these defects can occur in the absence of bark damage. It is possible that the cambium could be distorted or damaged by fast growth without corresponding damage to the bark. Splits in the bark of very young trees have not been observed even though Type 3 resin pockets occur in the innermost growth rings.

The trees examined showed the greatest number of Type 3 resin pockets in the first few growth rings. The subsequent decline in resin pocket numbers seems to correspond with the formation of mature bark, suggesting that as the rhytidome becomes more developed the chance of cracks causing cambial damage is reduced. However, this type of defect is known to occur in the outer wood of slow-grown *P. radiata* (D. J. Cown, pers. comm.). In the absence of data on older fast-grown specimens it is uncertain whether this defect will be important outside the corewood.

Sachsse (1982) has reported cambial injury in *Populus* sp. associated with cracking of the bark resulting from fast growth. These wounds produce structures that are macroscopically very similar to Types 2 and 3 resin pockets in *P. radiata*. Although the present experiment did not produce Type 2 resin pockets, it seems likely that they arise in a similar way, but as a result of more extensive cambial injury. This type of cambial damage does not account for the production of Type 1 resin pockets which are formed in mature wood behind the cambium and zone of differentiation (unpubl. data).

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REFERENCES

CLIFTON, N. C. 1969: Resin pockets in Canterbury radiata pine. **New Zealand Journal of Forestry 14:** 38–49.

COWN, D. J. 1973: Resin pockets; their occurrence and formation in New Zealand forests. **New Zealand Journal of Forestry 18:** 233–51.

FREY-WYSSLING, A. 1942: The formation of resin pockets. **Schweizerische Zietschrift fur Forstwesen 93:** 101–6. [Trans.]

PARK, J. S.; PARKER, C. E. 1982: Predicting value losses due to resin pockets in timber from pruned radiata pine. **New Zealand Forest Service, FRI Bulletin No. 6.**

SACHSSE, H. 1982: Schäden an lebenden „Muhle-Larsen" Pappeln. **Holz als Roh-und Werkstoff 40:** 461–9.

SOMERVILLE, A. 1980. Resin pockets and related defects of **Pinus radiata** grown in New Zealand. **New Zealand Journal of Forestry Science 10:** 439–44.