

## PESTS AND DISEASES OF RADIATA PINE

Some Observations Made During a Visit to  
Australia, South Africa, Kenya, Spain and Chile

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### SYNOPSIS

*The present and potential importance of the following insect pests of radiata pine is noted: Rhyacionia buoliana, Ips grandicollis, Hylotrupes bajulus, Criocephalus pinetorum, Thaumetopoea pityocampa and Nudaurelia cytherea. Dothistroma needle blight in Kenya and Chile and edaphic and climatic restrictions on the growth of radiata pine in South Africa and Spain are also described.*

### INTRODUCTION

In the latter half of 1972, the writer visited all major radiata pine producing areas outside of Australasia, namely, the Southern and Western Cape regions of South Africa, the Central Highlands of Kenya, Galicia and the Basque Provinces in Spain, and Chile from Valparaiso in the north to Valdivia in the south. In addition, some time was spent in Australia although there was no opportunity to visit the main pine-growing areas.

One object of this trip was to obtain first-hand knowledge of the pests and diseases affecting radiata pine, and this paper presents some observations and speculations on the more important diseases, insect pests, and climatic and edaphic stresses encountered in these countries.

### INSECT PESTS

#### *Rhyacionia buoliana*

The most severe insect damage to radiata pine seen anywhere was that caused by the European pine shoot moth in Spain. This pest has been recorded as attacking many pine species in Europe, North America and elsewhere (Miller, 1967). Although Robredo (1966) states that it is widely distributed in Spain, there was little evidence of insect damage in Guipuscoa and Vizcaya, the main radiata pine growing provinces. In the coastal areas of Galicia, however, it was a most important factor in limiting the growth of this pine. Severely damaged radiata pine plantations were examined near Pontevedra, and south of Puentearreas near the Portuguese border.

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In this area, *Pinus pinaster* grows on the lower slopes of the hills to an altitude of 400 m and it is usual to plant radiata pine above this to 800 m. The plantations examined in this altitudinal zone were 15 to 19 years old and had grown moderately well. In each one, however, the few trees which had not been damaged by *Rhyacionia* stood out clearly, for the great majority had misshapen trunks, multiple stems, or their tops had been blown out.

Small plantings of radiata pine near the coast at lower altitudes generally, but not invariably, showed signs of damage by the shoot moth. The oldest radiata pine in Galicia, a 40-year-old stand in the Cotorredondo Forest Park, was of very poor form, probably as a result of wind damage compounded by *Rhyacionia* attack. On the other hand, a very well grown, undamaged, 18-year-old stand was examined on the outskirts of Pontevedra.

Lugo Province, in northern Galicia, is another area where radiata pine is widely planted. Here, where the climate is not so mild and humid as on the coast, the plantations were not so severely attacked by the shoot moth. In most cases trees could be found with the malformations typical of old *Rhyacionia* attack, but the number of such trees in a stand was fewer.

### *Ips grandicollis*

Since the discovery of this pest in South Australia at Wirrarrarra in 1943, it has spread south to Adelaide and beyond, but has not yet become established in the main forest areas to the south-east. It is also present in Western Australia but obviously affects only a small proportion of the radiata pine stands in the country (Morgan, 1967). However, as Knight (1971) has warned that this bark beetle could become a major pest in New Zealand, the writer was keen to discuss its impact on forestry in Australia and was able to visit one infested area, Mount Crawford State Forest.

It appears that the killing of large groups of trees by the insect is undoubtedly associated with severe drought stress. However, in non-drought years pest numbers are maintained at high levels in logs and slash and, if such material is not continuously available to them in a given area, standing trees may be attacked and damaged. In one instance, the throwing of slash against trees during road construction had resulted in mortality.

The *Ceratocystis* stain transmitted by *Ips* is also important in South Australia. Green logs, which may be attacked 3 or 4 days after felling, quickly become stained and the stain is not confined to the outer layers where the beetle works.

In affected areas, the main defence is to avoid any accumulation of slash or logs close to standing trees. For instance, it is the policy at Mount Crawford to clearfell old stands close to younger stands rather than to thin them. Salvage operations involving the harvesting of badly infested trees before beetles emerge from them, are also carried out when necessary.

### *Wood Borers in South Africa*

In Cape Town, an examination was made of specimens of the different borers present in South Africa, and of wood damaged by these insects. The European house borer, *Hylotrupes bajulus*, was particularly destructive, leaving only a thin shell of wood in susceptible timbers. However, a recently discovered cerambycid, *Criocephalus pinetorum*, is now thought to be responsible for some of the damage previously attributed to *Hylotrupes* (H. Geertsema, pers. comm.). This pest was introduced to South Africa from the Canary Islands on wood of *Pinus canariensis*, and, unlike *Hylotrupes*, it has been found to attack pine heartwood as well as sapwood. Moreover, it attacks timber treated with pentachlorophenol, the standard South African treatment against *Hylotrupes*.

Other borers of lesser concern in South Africa include *Anobium punctatum*, *Stenoscelis hylastoides* and *Ernobius mollis*.

### *Thaumetopoea pityocampa*

As noted by Montoya (1965), the pine processionary is a defoliator of some importance to radiata pine in Spain, and a small 15- to 18-year-old stand near Pontevedra was seen where every tree in a 0.5 ha area had been stripped of its foliage by this pest. At the time, however, very few living caterpillars remained, and it was obvious that the outbreak was not spreading. It was not clear why this small block of well-grown pine had been completely defoliated while adjacent trees had remained uninfested.

In Guipuscoa, a very malformed, bushy plot of *Pinus attenuata* was seen. Although free of pests at the time, it seems that in previous years it had been heavily infested by the pine processionary which prefers this species to radiata pine.

### *Nudaurelia cytherea*

The pine emperor moth is an indigenous South African insect which has become an important defoliator of radiata pine in Cape Province. Although the pest was not present in outbreak numbers in 1972, two areas of several hectares each were seen in the Western Cape area where it was causing moderately severe defoliation.

Although *Nudaurelia* is undoubtedly damaging (although not devastating) to radiata pine in Cape Province, outbreaks usually collapse without the need for chemical control as a result of epidemics of a polyhedral virus disease (H. Geertsema, pers. comm.).

## DOTHISTROMA NEEDLE BLIGHT

*Dothistroma* needle blight was the only important disease encountered, and, as expected, Kenya and Chile were the only countries in which it was seen.

### Kenya

As a direct result of *Dothistroma*, the Kenya Forest Department no longer plants radiata pine. In the Eastern Province, young radiata pine stands have in fact been cleared and replanted with *Pinus patula*, and elsewhere new softwood plantings are chiefly of *P. patula* or, to a lesser extent, *Cupressus lusitanica*.

There can be no doubt that, in much of the Kenya Highlands, the decision to abandon radiata pine was sound. Some stands were seen with over 50% mortality, and other young plantings in which the severity of the disease made it seem unlikely that a worthwhile stand would result. However, in the Mt Kenya forests, and possibly in other drier areas, the disease was not limiting the growth of young stands and it appeared possible to continue growing the species in these areas, particularly as radiata pine timber is preferred to that from *P. patula*.

Radiata pine is still being planted on a small scale for the Turbo paper mill project. Afforestation there is proceeding at the rate of 1600 ha/annum, and radiata will be planted on some shallow soils where *P. patula* has failed to establish.

### Chile

Young plantations were inspected in all provinces in which radiata pine is grown, with the exception of the southernmost, Llanquihue. The disease was seen only in the southern portion of this area, namely, in Osorno, Valdivia and southern Cautin (Villarrica). Even here, symptoms were only slight to moderate (not more than 2.5 when assessed by the NZFS disease intensity index). Very severe symptoms were, however, seen on nursery seedlings of *Pinus* × *attenuradiata*, *P. ponderosa* and *P. jeffreyi*.

Growers and research workers do not now consider *Dothistroma* needle blight to be an important disease in Chile, and it has certainly had no effect on management practices in the ten years or so that it has been present in the country. This is because the disease is not endemic in the main growing areas, normally occurring only in the more southern provinces where radiata pine is grown chiefly in farm shelterbelts and woodlots.

*Dothistroma* is nevertheless of potential significance to Chilean forestry, because these southern areas are by no means marginal for radiata. Growth rates in Valdivia are equal to those in Concepcion and, if Chile substantially increases its exotic forest resource, this is in fact the most likely area for future large-scale plantings. If this happens, then *Dothistroma* would be an important factor limiting the profitability of radiata pine.

Zobel (1970) has suggested Douglas fir as an alternative to radiata pine around and south of Valdivia, while the Institute of Silviculture at the Austral University of Chile recommends the planting of Douglas fir south of Cautin except on very poor sites (F. Schlegel, pers. comm.).

This species certainly grows very well there (e.g., at Voipir 19-year-old Douglas fir has an m.a.i. of 30 m<sup>3</sup>/ha) and the possible reduction in early growth of radiata pine as a result of needle blight might well result in Douglas fir being preferred.

## SOIL PROBLEMS

### *South Africa*

One of the most striking features of radiata pine in Cape Province is its very good growth and form on some sites, and its equally poor performance on others. Near Knysna, for instance, was noted a vigorous second-rotation radiata pine stand, 6 or 7 years old. Immediately uphill of this stand was another of about the same age together with some *P. pinaster*. This latter radiata pine was stunted and the crowns were very thin, although the *P. pinaster* appeared to be healthy. Soil cores showed a deep sandy soil on both sites, and there was no obvious reason for the marked difference in growth of the two radiata pine crops.

Soil factors usually decide whether radiata pine or an alternative species is planted in any given area. And to a much greater extent than in New Zealand, Australia and Chile, unsuitable sites abound. A 12 000 ha forest at Tsitsikama, for instance, had been planted almost entirely with *P. pinaster* and *P. elliottii*. Nevertheless, several "off-site" radiata pine stands were seen which had been planted because moderately poor radiata pine is preferred to good *P. pinaster* (the next preferred species). On all such sites, the trees had extremely thin crowns and often a chlorosis of the needles as well.

A few fertilizer trials have been laid down by the Department of Forestry to try to determine, among other things, if the failure of radiata pine on unsuitable sites is associated with soil nutrient deficiencies. In one such trial at Lottering, lime had markedly depressed height growth. A single application of phosphate at planting had, however, resulted in increased height growth and greener crowns. The quality of even the best plots was nevertheless poor compared with most radiata pine stands in the Cape, and no recommendations have yet been made for the fertilizing of forest stands.

### *Spain*

The commonest disorder of radiata pine in Spain was a uniform browning of all the older needles, which was sometimes associated with yellowing, little-leaf, and defoliation of all but the current year's needles. These symptoms were said to be worst in the spring; as one forester in Bilbao put it: "There was very little green crown — the Vizcaya radiata looked as if it had been burned — but it has greened up during the growing season."

This condition was particularly common in Vizcaya, the main radiata pine growing area, where most of the stands were affected to a greater or lesser extent. It did not appear

to be serious in Guipuscoa or coastal Galicia, but several moderately affected stands were seen in Lugo Province.

Needle browning did not seem to be associated with site quality. At Trucios, for instance, in south-western Vizcaya, there was a forest in which the stands, mostly second-rotation crops, were 7 to 20 years old. Growth was extremely variable and patchy, being very good in some areas and very poor in adjacent blocks. Regardless of age or site quality, however, browning of older needles was ubiquitous and the other symptoms noted above were also common.

This condition had been noted at least as early as 1966, but the Provincial Forest Service thought it was having no effect on yields and no research work had been carried out to determine its cause or effect. It is true that some badly affected stands continue to grow well, but it is difficult to believe that trees which "look as if they had been burned" each year are producing maximally. The symptoms are, moreover, characteristic of a soil nutrient imbalance and it is possible that a little money spent on fertilizer might be amply repaid. Unfortunately, there seems little chance of the necessary research being carried out in the near future.

## FROST

The only area where frost was a significant factor in the growing of radiata pine was Guipuscoa. The province is liable to very low temperatures in February, which may be preceded by warm southerly conditions which induce plant growth. These low temperatures ( $-10$  to  $-15^{\circ}\text{C}$ ) are not the result of radiation frosts but movement of continental cold air masses which are accompanied by cloud and wind. In 1956, particularly severe conditions killed practically all the radiata pine in about 25 000 ha of eastern Guipuscoa.

Local foresters believe that the few plots of radiata pine which survived suffered so much as a result of this frost that their rate of growth has been abnormally slow ever since. A more logical explanation would appear to be that the trees had survived the frost because they were planted on slow-growing sites anyway, and had therefore not flushed in the period preceding the frost.

## SUMMARY OF RADIATA PATHOLOGY

### *Present Distribution*

Impressions of the situation in the countries outside Australasia are that, in the culture of radiata pine:

- (1) Chile has no significant pest or disease problems.
- (2) South Africa has serious problems associated with the soil. Radiata can be grown there only on restricted soil types, whereas in Chile and New Zealand it grows well on a great variety of soils.
- (3) Spain, too, may have soil fertility problems in Vizcaya and Galicia. In the latter region, the European pine shoot

moth is a major pest, while in Guipuscoa the climate is marginal for radiata pine.

- (4) In Kenya, *Dothistroma* needle blight is persistently severe, and the Kenyans have had to adopt the ultimate defence — a change of species.

### FUTURE PROBLEMS

*Dothistroma* needle blight has made the growing of radiata pine uneconomic in Kenya. Are any of the pests and diseases described in this report likely to prove similarly disastrous if introduced to areas in which they are not yet present? There are too many variables involved to forecast the outcome of any particular introduction, but it is possible to outline the kinds of problems to which particular areas are susceptible.

Radiata pine stands in the Western Cape region of South Africa and Central Chile, for example, regularly endure very hot, dry summers when the trees are subjected to prolonged drought stress. Bark beetles such as *Ips* sp. are therefore more likely to cause mortality in these regions than in Spain or New Zealand. On the other hand, *Dothistroma* seems more likely to flourish in the cool, moist conditions of northern Spain than in South Africa, and might well prove disastrous to radiata in the former country if it were introduced there. The potential impact of shoot- and leaf-feeding insects is more difficult to assess, but the European pine shoot moth might well be a devastating pest if introduced to the North Island of New Zealand, where the climate is not unlike that of Galicia.

Finally, it is clear that any pest of processed radiata wood is more likely to become established in a new area than are pests of growing trees. For this reason, New Zealand, Australia and Chile must all guard against the introduction of *Hylotrupes* and *Crioccephalus* from South Africa and other infested regions.

### DEFENSIVE CAPABILITIES

No country is as well organized as New Zealand to combat the introduction of new pests and diseases of radiata pine. This is the result of several factors, including:

- (1) *Administration*: There are relatively few forest owners so they are well able to act in concert.
- (2) *Experience*: The forest owners have already acted successfully in controlling a new disease, namely, *Dothistroma*.
- (3) *Profitability*: The proven profitability of radiata (and New Zealand's reliance on this species) means that money is available from government and industry for control measures (at least until they are shown to be uneconomic).

- (4) *Research and Teaching* in forest pathology and entomology are well supported, so that most foresters are aware of the dangers of new introductions, and there is a cadre of specialists to advise on control procedures.
- (5) *Quarantine*: Procedures in New Zealand are of a high standard, and the FRI Biological Surveys are a useful "early warning device".

It was clear that the defensive capabilities of the countries visited compared unfavourably with New Zealand on one or more of these points.

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