

EXTENDED ABSTRACT

FOREST HEALTH PROBLEMS AFFECTING *PINUS RADIATA* IN SPAIN WITH SPECIAL REFERENCE TO THE BASQUE REGIONJOSE M^a COBOS SUAREZ and MANUEL M^a RUIZ URRESTARAZU

Diputación Foral de Alava, 01071 Vitoria, Spain

(Received for publication 3 August 1989; revision 25 October 1989)

The main objective of this paper is to present a statement on the health of *Pinus radiata* D. Don in Spain, its most important European concentration, for growers of the species in other parts of the world.

Pinus radiata was introduced to Spain in the 1840s in the grounds of Villa Zubieta in Lekeitio (Biscay). Known at that time as *Pinus insignis*, it became a popular ornamental under this name all along the Atlantic slopes of the Spanish Basque region. From the beginning of this century *Pinus radiata* has been planted mainly on the Atlantic slopes of northern Spain between latitudes 42° and 44°N and now occupies 250 000 ha. The resource is no longer expanding as the Basque slopes are now fully planted while the milder climatic regions to the west (Cantabria, Asturias, and Gallice) favour eucalypt plantations to supply the increasing demand from the pulp and paper industry.

Much of Spain is high in elevation (Madrid is the highest capital in Europe at 667 m) with a continental climate, so that only the north and north-west coasts along with northern Portugal are suitable for fast-growing exotic species. This also accounts for the relatively limited plantings of *P. radiata* in Europe with the Atlantic zone being too cold and the Mediterranean too dry. Even the Basque region is periodically affected by frosts. In 1956 freezing conditions persisted throughout February, with temperatures continually below 0°C in Guipúzcoa Province. Damage to young plantations was so great many were cleared and replanted. In 1985 for a week in January the temperature plunged to -10°C along the French-Spanish coast (-20°C in the interior) severely damaging young plantations and all nurseries. Similarly, an early 4-5 days of frosts in November 1988, while *P. radiata* was still actively growing, seriously damaged nurseries and plantations up to 5 years old. Quite clearly the European climate places severe constraints on the expansion of *P. radiata* plantations.

Insects and diseases can be of considerable importance in plantations of rapidly growing species such as *P. radiata*, and may even threaten their profitability. The most important insect affecting the species in Spain is *Thaumetopoea pityocampa* (Lepidoptera:Thaumetopocidae), the pine processionary caterpillar. The insect causes

severe defoliation and has a serious impact on growth. The skeleton-like appearance of attacked pines covered in the white protective bags of the larvae is characteristic of outbreaks. Although the insect is rarely a direct cause of mortality, it often weakens trees to such an extent that secondary agents bring about death.

Pine processionary caterpillar is controlled using 45% ODC diflubenzuron at a rate of 125–150 g/ha in 5 litres of oil. Stands on dry south-facing slopes are most affected and may require spraying every 3 years. Basque *P. radiata* forests were sprayed in 1982 (28 000 ha), 1985 (6400 ha), 1986 (13 200 ha), 1987 (5500 ha), and 1988 (11 400 ha). Sex pheromone (pityolure) has been used experimentally since 1981 in low-population areas in the years after spraying.

Nurseries and young plantations suffer from attack by *Hylobius abietis* (Coleoptera:Curculionidae) the adults of which feed on the soft bark, often killing the tree. The shoot borer *Rhyacionia duplana* (Lepidoptera:Tortricidae) attacks similar-aged trees, while the closely related species *R. buoliana* does greatest damage in 6- to 12-year-old plantations. Young plantations stressed by drought or attack by other pests are susceptible to damage by the stem borer *Pissodes notatus* (Coleoptera:Curculionidae) although, in Spain, pine species other than *P. radiata* suffer greater damage from this insect.

Mature stands of *P. radiata* suffer from bark beetle attack. The most damaging of this group are *Blastophagus piniperda* (Coleoptera:Scolytidae) attacking the upper parts of the tree, and *Ips sexdentatus* (Coleoptera:Scolytidae) attacking the main stem. Because of their protected life-cycle beneath the bark, both species are difficult to attack directly. Silviculture and trap trees are the main means of control.

Other insects of marginal economic importance on *P. radiata* in Spain are *Porthetria dispar* (Lepidoptera:Lymantriidae) a hardwood defoliator in Europe which caused damage to 250 ha of *P. radiata* in Asturias between 1953 and 1966, *Dioxyctria splendidella* (Lepidoptera:Phycitidae) causing damage in continental Spain in 1963, and *D. nivaliensis* a native pest of *Pinus canariensis* C. Sm. boring shoots of *P. radiata* in Canary Islands plantations in 1960.

Diseases affecting *P. radiata* in Spain can be grouped according to the part of the tree they attack. "Damping off" caused by *Fusarium oxysporum*, *Pythium* spp., *Botrytis cinerea*, and others, affect seeds and seedlings during warm wet springs, especially if soil pH and nitrogen level are high. Preventative measures include disinfection, acidification of soil, and reduced use of organic fertilisers. Control is based on spraying with fungicides and the inoculation of soils with antagonistic fungi such as *Trichoderma viride*.

Armillaria sp. (Basidiomycotina:Agaricales) which attacks the roots of pines is a facultative parasitic fungus which lives saprophytically in forest soils. The disease is characterised by honey-coloured groups of carpophores and white mycelium between the bark and cambium of roots and root-stem collar. Pines die slowly in enlarging patches. Control is by silvicultural methods.

Shoots of *P. radiata* are frequently attacked by *Sphaeropsis sapinea* (*Diplodia pinea*) (Deuteromycotina:Sphaeropsidales). Successive years of infection lead to dieback of apical branches and may finally lead to tree death. The main source of inoculum of the disease is cone scales and leaf bases. The long vegetative growth period of cones

ensures the potential infection period occurs over much of the year. Silvicultural activity during the tree's active growth stage can lead to severe infection. Serious outbreaks of *S. sapinea* are almost always associated with stressed stands, most commonly where trees have been planted on unsuitable sites. Several Basque region forests, which suffered 5 consecutive years of attack from the pine processionary caterpillar followed by severe *S. sapinea* damage, have recently been felled and replanted with *Pinus pinaster* Aiton.

Other fungi that cause defoliation of *P. radiata* include *Scirrhia pini* (*Dothistroma pini*) (Ascomycotina:Phacidiales) which, except on a few isolated sites, is not regarded as a serious problem in Spain and no control measures are carried out. *Lophodermium* sp. (Ascomycotina:Phacidiales) and *Cyclaneusma minus* (Ascomycotina:Rhytismataceae) may cause damage especially when a mild winter is followed by a wet spring and summer.