POPLAR RUST IN PAPUA NEW GUINEA

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ABSTRACT

The history of poplar (Populus) *introductions into Papua New Guinea, and the diseases and pests of those poplars, is briefly reviewed. The detection and spread of the poplar rust* Melampsora larici-populina *Kleb. is described. The possible origin of the outbreak, methods of control, and significance of the disease are discussed.*

INTRODUCTION

In 1965 scions of a large number of clones of species of *Populus* were introduced into Papua New Guinea from Australia. This material included *P.deltoides* Marsh ssp. *angulata* Ait., *P.deltoides* ssp. *monilifera* Henry, *P.nigra* L., and *P.x euramericana* (Dode) Guinier, all of section *Aigeiros*, the black poplars; and *P.trichocarpa* Torr. & Gray of section *Tocamaha*, the balsam poplars (FAO 1958). The scion material was planted in the humid, warm coastal lowlands at Oomsis near Lae, and in the cooler highlands at Lapegu near Goroka. At Oomsis the few scions which developed roots grew poorly and all scions were eventually destroyed. At Lapegu, however, establishment of scions was good and several clones showed promise for use in erosion control, as shelterbelt trees or as ornamentals and possibly for timber or matchwood production. Consequently, additional introductions of scions were made from Australia in 1967 and 1968 and established at Lapegu. Further observation and field trials indicated that none of the clones introduced to Papua New Guinea was likely to be useful for commercial timber production because of poor growth although some were attractive as ornamentals. According to Office of Forests files the following clones were introduced in the period 1965-1968:— G3, G48, 56/31, 60/106, 60/129, 61/124, 61/165, 61/183, 61/186, 62/2, 62/4, 62/18, 65/27, 65/32, 65/33, 65/34, 65/35, 65/42, Evergreen, Honduras, and Calcurado.

Growth of most clones of *Populus* is strongly influenced by photoperiod, seasonal photoperiod rhythms, and temperature (Pryor & Willing 1965). The more successful clones in Papua New Guinea were semi-evergreen, and usually had as one parent *P.nigra* cv. 'Evergreen' or its hybrids, which have growth rhythms uninfluenced by photoperiod or temperature changes (Pryor & Willing 1965). Many cuttings from the clones established at Lapegu were distributed throughout Papua New Guinea, especially the highlands. The identity of the poplars now growing in Papua New Guinea is not accurately known, although all *P.deltoides* clones are thought to have been eliminated because of poor growth.

Insect pests and disease have not been significant factors in the poor growth of *Populus* spp. in Papua New Guinea. Gray & Wylie (1974) reported severe defoliation of *Populus* at Mt. Hagen by *Ichthyura* sp. near *I.rubida* Druce (Lepidoptera: Notodontidae), and recorded the beetles *Oribus destructor* Marshall (Curculionidae) and *Pterolophia duplicata* Pascoe (Cerambycidae) on poplars elsewhere. At Bulolo a row of *Populus* at the Forest Research Station died from root rot caused by *Phellinus noxius* (Corner) G.H. Cunn..

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Figure 1. — Map of Papua New Guinea showing location of poplar rust outbreaks

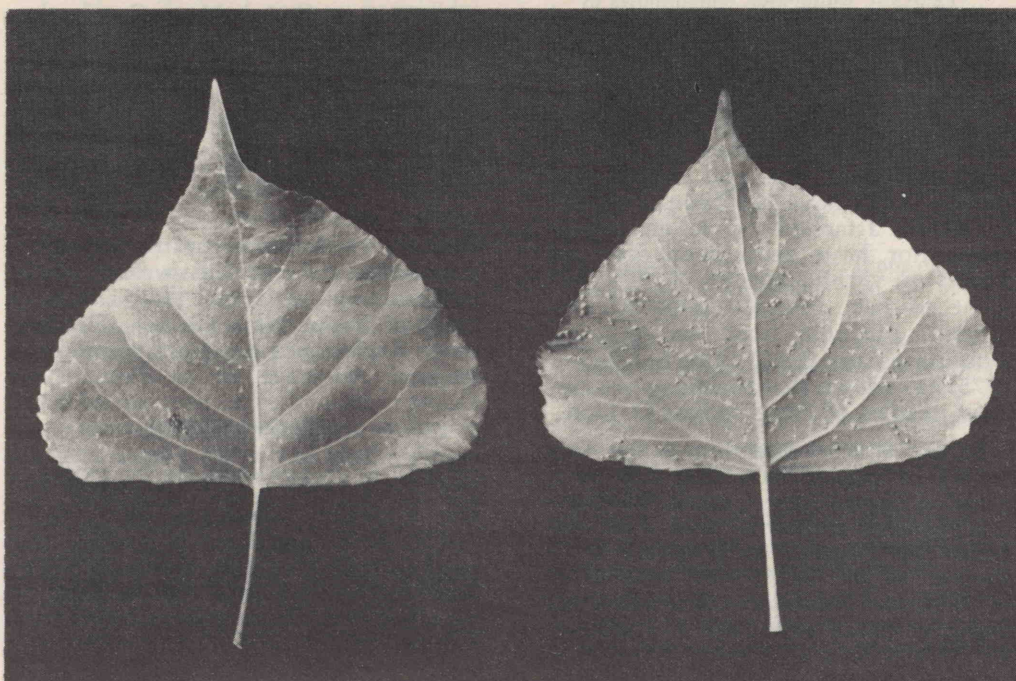

Plate I. — *Melampsora larici-populina* on upper (left) and lower (right) surfaces of poplar leaves

DEVELOPMENT OF POPLAR RUST DISEASE

On 8th January 1975, samples of rust infected poplar leaves were received from Mendi in the Southern Highlands Province. The pathogen was identified as *Melampsora larici-populina* Kleb.. Subsequently an inspection was made between 19th and 26th January 1975, of poplars growing at various localities throughout the highlands. Rust infected poplars were found at Mendi, Ialibu, Mt Hagen and Kundiawa. In each instance the pathogen was identified as *M. larici-populina*. No sign of poplar rust was found at Tari, Goroka, Lapegu, Kainantu, or Bulolo. This distribution pattern (*Figure 1*) indicated that the centre of the outbreak was the Mt. Hagen area. In September 1975, *M. larici-populina* was recorded for the first time at Goroka, Lapegu and Kainantu. It was deliberately introduced to Bulolo in May 1976, and was observed on poplars at Tapini, possibly from scions introduced from Goroka, in September 1977. It has not been observed on poplars growing in the lowlands.

Rust infected poplars were rarely completely defoliated even in periods of prolonged wet weather. However, the sparsely foliated trees looked unsightly and most poplars in the highlands have been destroyed. No field resistant poplar trees were seen.

Infected leaves developed small angular chlorotic lesions in which the erumpent subepidermal bright yellow hypophyllus uredinia, of 0.1-0.5 mm diameter developed (*Plate* I). Infection usually occurred first on older leaves but uredinia may develop on all but the most recently formed leaves. Urediniospores from the first formed uredinia gave rise to new infections and the leaves soon became finely flecked with irregular chlorotic lesions which eventually became necrotic and coalesced into extensive irregular dead areas. Urediniospores were broadly ellipsoid to clavate, mostly 26-42 × 14-18 µm, with yellow guttule, surface echinulate, with cyanophilous spines to 1.5 µm high, except at one end which was smooth. Telia have not been observed on either attached or fallen poplar leaves, nor have aecia been seen on needles on various species of *Pinus* adjacent to rust infected poplars. The 'natural' alternate host for *M.larici-populina* is *Larix* (FAO 1958) but Spiers (1975) has shown that basidiospores can infect needles of *Pinus radiata* D. Don..

So far *M.larici-populina* is the only species of poplar rust that has been found in Papua New Guinea. In Australia *M.larici-populina* was first recorded on *Populus* in February 1973 (Walker *et al.* 1974) one year after *M. medusae* Thum. was first observed there. In March 1973 both *M. medusae* and *M.larici-populina* were detected in New Zealand (McMillan 1973). Heather & Sharma (1977) have reported finding urediniospores of *M. medusae* in poplar rust samples from Papua New Guinea but we have not been able to confirm this despite an intensive study of the retained portions of the collections sent to them for study, and of large amounts of material subsequently collected from numerous localities.

ORIGIN OF *M.LARICI-POPULINA* IN PAPUA NEW GUINEA

The means by which poplar rusts were introduced into Australia is not positively known but it is suspected that they were introduced on illegally imported scion material. Both *M. medusae* and *M. larici-populina* are presumed to have been introduced into New Zealand as urediniospores blown across the Tasman Sea from Australia (Mcmillan 1973). Wide dispersal of poplar rust in south-east Australia and in New Zealand was very rapid after the initial outbreaks were observed (Walker *et al.* 1974: Sheridan *et al.* 1975). The situation in Papua New Guinea was similar.

It is a possibility that poplar rust was carried to Papua New Guinea from Australia by the south-east trade winds which originate from close to latitudes 25°-30° south during the southern winter period (Ford 1974) but it is unlikely as the airborne urediniospore population in Australasia would then be minimal, and it is the 'dry' season in most of Papua New Guinea. Furthermore poplars are nowhere common in tropical Australia or in Papua New Guinea, thus the chances of *M.larici-populina* urediniospores reaching a susceptible host in the Mt. Hagen area are extremely small. This is the opposite of the situation discussed by O'Brien (1977) who considered it possible that peanut rust *(Puccinia arachidis* Speg.*)* was introduced into Queensland as windborne urediniospores carried from Papua New Guinea by the summer north-westerlies. It seems more likely that poplar rust was brought to Papua New Guinea on scion material illegally introduced from Australia or New Zealand.

CONTROL

There is great variation in the susceptibility of various species and sections of *Populus* to different species of *Melampsora* (FAO 1958; Pinon 1973). Within *Populus* species, clones and progenies also differ in susceptibility to any particular species of *Melampsora* (Stout & Schreiner 1933). Heritability estimates indicate that large genetic gains for resistance can be expected by selecting and breeding from resistant clones (Thielges & Adams 1975) but this work is slow and no resistant clones have been observed in Papua New Guinea. It has been estimated that a minimum of 10 years testing may be required before clones can be confidently recommended for commercial planting (Palmberg 1977). Van der Meiden (1959) and Suzuki (1973) have shown that tree nutrition also greatly affects resistance of poplar leaves to *M.larici-populina*.

In New Zealand copper fungicides at 0.1% elemental copper, or Benodanil at 0.05%, applied at two to four week intervals, have provided effective protection (Fullerton & Menzies 1974; Spiers 1974; Sheridan *et al.* 1975) and would probably be effective in Papua New Guinea.

We have frequently observed uredinia colonised by a species of *Cladosporium,* and by unidentified mycophagous mites but neither effectively controlled poplar rust.

DISCUSSION

Other better adapted species of trees are available which fulfill all the intended purposes for which species of *Populus* were introduced. *M.larici-populina* is apparently not pathogenic to *Pinus* in Papua New Guinea. It is probable that both *Populus* and *M.larici-populina* will become extinct in Papua New Guinea in the next one or two decades. The significance of the poplar rust outbreak has been to emphasise the importance of observance of plant quarantine regulations, of the risks associated with introduction of vegetative plant material, and of the potential windborne spread of plant diseases between Australia and Papua New Guinea.

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