THE PLANT QUARANTINE BARRIER AND SOME BREACHES IN PAPUA NEW GUINEA

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ABSTRACT

The history of the Ordinances governing Plant Quarantine in Papua New Guinea is briefly given, with a short note on the prohibition or restrictions on the import of some plant species, especially those of the important subsistence food and cash crops. Some of the important plant diseases which have been excluded by the rigorously maintained quarantine barrier are listed. The major diseases which have breached the quarantine barrier are also listed and briefly discussed. Some examples of the type of plant and other material intercepted by the Quarantine and Plant Pathology staff are mentioned.

It is pointed out that if new diseases enter the country, this may mean expenditure on eradication, or on chemical control or other measures by growers, leading to increased cost of production which is often passed on to the consumer. In some cases, the outbreak of a very serious disease may cause great economic loss which will affect the whole community. The best interests of growers and the general public alike are served if all members of the community abide strictly by the Quarantine Regulations.

THE QUARANTINE ORDINANCES

Plant Quarantine in Papua New Guinea originated in the Quarantine Act of 1886, being 50 Victoria No. 25 of Queensland (Australia), and the Quarantine Amendment Ordinance of 1906. These were followed by the Quarantine Ordinance of 1913-37 of Papua. Quarantine in New Guinea operated under the Quarantine Ordinance of 1931-38 of New Guinea. After World War II redrafting occurred, and the above were replaced by the Quarantine Ordinance† of 1953-69 of Papua and New Guinea (pers. comm. J. E. Byrne‡).

Under this latter Ordinance plants or parts of plants including seeds are subject to inspection by Quarantine Officers and if found diseased or suspected of being diseased, are destroyed.

The importation of plants, species of which are already important in Papua New Guinea, is totally prohibited, or has restricted entry only under certain specified conditions as a method of disease exclusion. These plants include the subsistence foods such as coconut, sweet potato, yams (*Dioscorea* spp.), sago and taro and "Kongkong" taro (*Xanthosoma* sp.), bananas (as the great majority of the population of three million is self-supporting for food) and economically important cash crops such as coconut, cacao, coffee, rubber, oil palm, tea pyrethrum, peanuts and others.

Importation of a limited amount of germplasm from overseas by the Government for the improvement of the country's crops is done only after considerable investigation into the best source of material, the diseases (and pests) at source, an assessment of the risks involved (if any) in the introduction, certification for freedom from certain diseases at source for some materials, treatments at source, examination on arrival, destruction of packagings, retreatment and post-entry quarantine.

Sometimes arrangements are made for intermediate quarantine in another country where the crop is not normally grown, or is of no importance. In this way, for example, a limited amount of tea seed has had intermediate quarantine in Australia; Japanese mint (for menthol production) has also been cleared through Australia; and sweet potato cuttings from the U.S.A. and Africa have entered only after screening and indexing at the Glasshouse Crops Research Institute, England for nearly

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† Termed "Act" since Independence in 1975.

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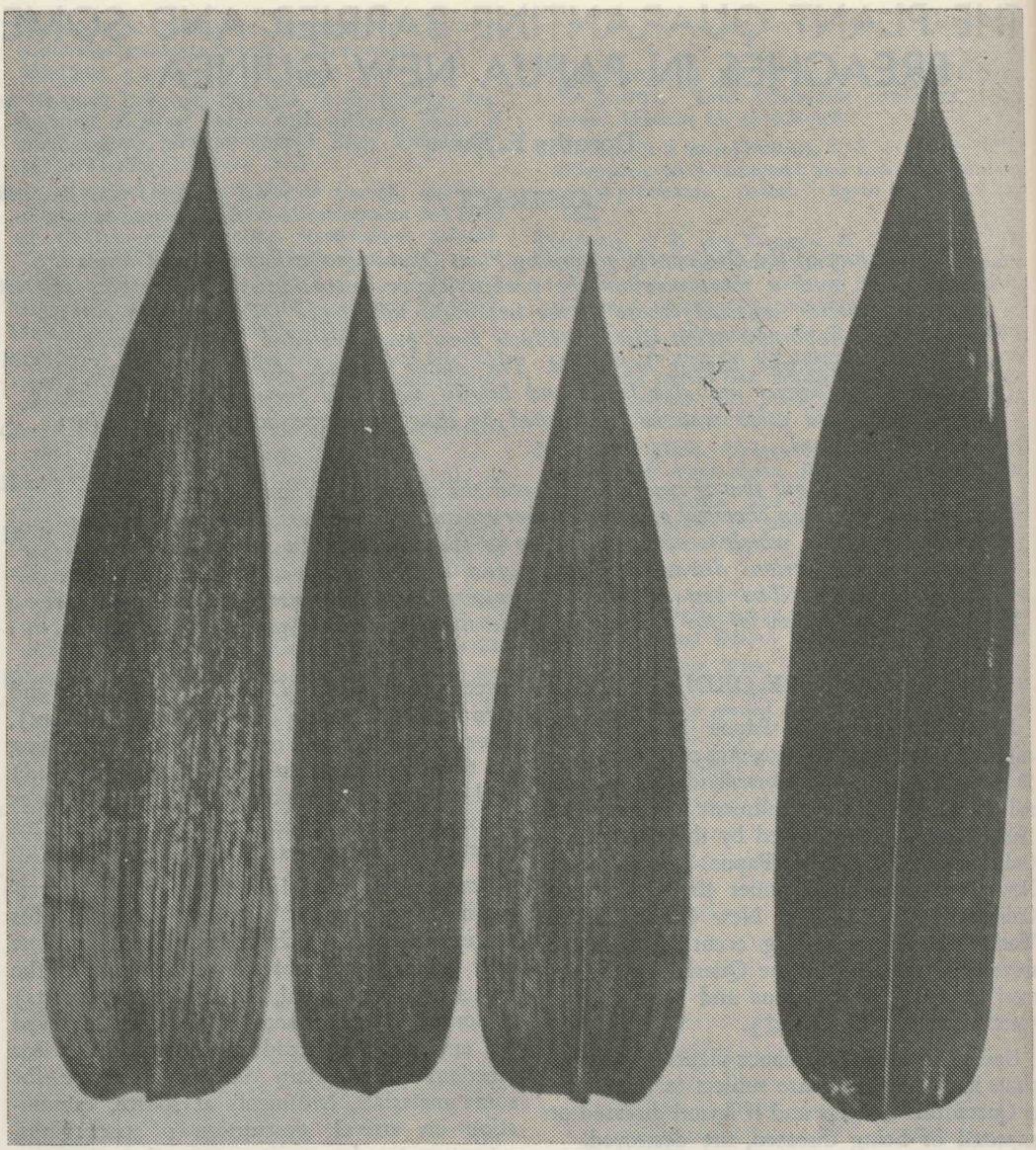

Plate I.—Bamboo introductions in intermediate quarantine in Australia. Three leaves on left with striate mosaic (virus-like) symptoms; on right one healthy leaf. This material was of course destroyed

two years, to ensure freedom from viruses and mycoplasmas. Such material, of course, still undergoes inspection and post-entry quarantine when it reaches Papua New Guinea.

One batch of bamboo imported for a special reason underwent intermediate quarantine in Australia, but was destroyed because of virus-like symptoms on the leaves (*Plate* I).

IMPORTANT PLANT DISEASES EXCLUDED TO DATE

That the rigorously maintained quarantine barrier has been worthwhile is evident from the freedom of some crops in Papua New Guinea from some of the major diseases recorded overseas. A list of a few only of some of the most economically important of

these diseases at present excluded is given in *Table* 1. The list includes coffee rust, which, although outbreaks have occurred, was eradicated in 1965 (see brief account with references in following section).

MAJOR BREACHES IN THE QUARANTINE BARRIER

During the last 80 years or so (that is, since records have been kept, particularly the more detailed records of the last 20 years), there have been some major breaches in the quarantine barrier. Some of these have been fairly fully documented, so are given only briefly below.

Coffee rust

In 1892-3 living plants of coffee, arriving by ship in an Edwardian case at Rigo, about 56 km (about 35 miles) south-east of Port Moresby, were found to have "coffee leaf disease *Hemileia vastatrix*" and were destroyed (Anon. 1894, 1895; Shaw 1968b). This was the common name usually given to coffee rust at that time, and it is considered that this disease was probably coffee rust, although no specimens are extant.

In 1903 coffee leaves at Sogeri, about 40 km (about 25 miles) east of Port Moresby, were found with coffee rust, collections being sent to both the Royal Botanic Gardens, Kew, England, where specimens are still lodged, and to Queensland. A full report of this outbreak and the decrease in coffee-growing in the area, especially during and between World Wars I and II, and the disappearance of the rust (probably because of lack of host), is given by Shaw (1968b).

In July, 1965, an outbreak of coffee rust occurred at Sogeri, where less than 100 acres of arabica and robusta occurred in scattered plantings, some of them not diseased, and in three gardens in the Rigo hinterland area, south-east of Sogeri, but joined to it by a foot-trail. In an endeavour to keep the rust from the main coffee-growing areas, rigorous measures were immediately taken to eradicate the host after killing surface spores by fungicide application. Aided by a severe drought in the region. which effectively prevented the germination of fallen berries, and regrowth from some incompletely grubbed out bushes, the eradication was successful. The last coffee rust pustule was seen on 1st November, 1965. Subsequent surveys throughout the areas since have failed to find any rust on the relatively small amount of volunteer coffee and coffee planted despite surveillance, before it in turn was eradicated (even though undiseased), as an endeavour has been made since 1965 to keep the area around Port Moresby (the main port of entry for ships and aircraft), the Sogeri Plateau and the Rigo hinterland, free from coffee. Therefore, if coffee rust spores do enter Papua New Guinea on passengers or on their personal effects, the spores may be unable to find the host (coffee) before losing viability, at least around the port of entry. The full report of the campaign, and the surveys carried out subsequently, have been reported by Shaw (1968b, 1970, 1975, 1977).

The cost of the eradication campaign was assessed at $A 70 000 (Shaw 1968b). Since 1965, however, over Kina 200 000 000* worth of coffee has been exported and the coffee areas are still free from rust, so the expenditure of the money for the eradication was well worth while.

As Shaw (1962) pointed out, there has been an increase in aircraft services from coffee rust infected countries, such as Indonesia, Malaysia, Singapore and other parts of South-east Asia, Philippines, New Hebrides, New Caledonia, Fiji, Samoa, India and Ceylon, many parts of Africa, and in recent years, Brazil and some other South American countries. Although some of these are not connected by direct air routes to Papua New Guinea, the improved services mean an increasing risk of the passive carriage of spores on travellers, or on their goods, apart from any on plant material which may be surreptitiously smuggled into the country, despite Customs and Quarantine surveillance. The risk is further compounded by the increase in internal feeder services from the main airport to airstrips in the main and the subsidiary coffee-growing areas in Papua New Guinea.

There is also, of course, the risk of air-borne spores, and while the author does not think that the 1903 and the 1965 outbreaks were due to aerial inoculum (for reasons given by Shaw 1968b) there is always the possibility that such could occur.

With annual exports of coffee now in the Kina 115 000 000* range, an outbreak of coffee

* Kina 1 = approx. $A1.

Table 1.—Some important plant diseases not yet recorded in Papua New Guinea

Host	Disease	Cause
COFFEE	Coffee rust*	*Hemileia vastatrix*
	Coffee berry disease	*Glomerella cingulata* (sometimes given as *Colletotrichum coffeanum*
RUBBER	South American leaf blight	*Microcyclus ulei* (formerly *Dothidella ulei*)
COCONUT	Cadang cadang	?
	Lethal yellowing	Mycoplasma-like organism
	Other "unknown" coconut diseases	?
	Red ring disease	*Rhadinaphelenchus cocophilus* (formerly *Aphelenchus cocophilus*)
CACAO	Witches broom	*Crinipellis perniciosa* (formerly *Marasmius perniciosus*)
	Ceratocystis wilt	Aggressive variant of *Ceratocystis fimbriata* and beetle borers (especially *Xyleborus*)
	Green-point gall	The pathogenic form of *Calonectria rigidiuscula*
	Flowery gall	The condition is said to be "Communicable by contact inoculation when galls are applied to normal flower cushions in gall-free trees" (Thorold 1975)
	Virus diseases, at least 6, including:	
	Cocoa swollen shoot	Virus
	Cocoa yellow masaic	Virus
	Cocoa necrosis virus	Virus
	Cocoa mottle leaf virus	Virus
	Pod rot	*Trachysphaera fructigena*
	Mealy pod	*Monilia roreri*
TEA	Blister blight	*Exobasidium vexans*
OIL PALM	Cercospora spot	*Cercospora elaeidis*
	Sudden wilt	?
	Lethal bud rot	?
CASSAVA	Cassava mosaic virus	Virus
	Bacterial blights	*Xanthomonas* spp.
SWEET POTATO	Russet crack	Virus
BANANA	Moko disease	*Pseudomonas solanacearum* (banana strain)
	Bunchy top	Probable virus
	Panama disease	*Fusarium oxysporum* var. *cubense*
RICE	Blast	*Pyricularia oryzae*
SUGAR CANE	Smut	*Ustilago scitaminea*
POTATO	Late blight	*Phytophthora infestans*
	Black wart	*Synchytrium endobioticum*
	Golden nematode	*Heterodera rostochiensis* etc.

*Eradicated in 1965.

rust, or of coffee berry disease, in the main coffee-growing areas of Papua New Guinea, could be catastrophic to the crop, to the people of the highlands who depend largely on coffee for cash income, and have a serious effect on the economy of the whole country.

Tropical maize rust

Tropical maize rust (caused by *Puccinia polysora*) was first recorded in PNG in 1955 (Shaw 1958). The Plant Disease Identification Service in this country only commenced in 1955, so it is not known how long before this date tropical maize rust may have been present, nor, of course, how it arrived.

Blister smut of maize

Blister smut of maize (caused by *Ustilago maydis*) was recorded for the first time in Papua New Guinea in 1963. The details of occurrence, and the attempted eradication, were reported by Shaw (1968a). Although no direct evidence is available, it is thought that the fungus probably entered Papua New Guinea on seed surreptitiously received from an overseas country, because maize seed, undeclared on the customs declaration, has been found concealed in bundles of second hand clothing and other goods received at the port of Madang, which appeared to be the centre of infection.

Powdery mildew of rubber

Powdery mildew of rubber (caused by *Oidium heveae*) was first recorded in Papua New Guinea in 1967. As stated by Shaw (1967), how, where, or when the fungus entered the country is not known. Seed imported from Malaysia had for many years been permitted entry only if dusted with sulphur before despatch, and imported budwood was only allowed entry after alcoholic mercuric chloride treatment, with dusting with sulphur after drying, before despatch. A survey carried out during the two months following the first recognition of the disease in this country showed that it was present in the Central, Gulf, Milne Bay and Northern Districts, with the heaviest infections in the Central District, nearest to the main port of entry (Shaw 1967). It seemed to the author that the infection again probably derived from infected plant material, and not from aerial inoculum.

Peanut rust

In December, 1972, peanut rust (caused by *Puccinia arachidis*) was first recorded in Papua New Guinea. The source of the outbreak is not known. However, a survey carried out immediately showed that the centre of infection did not appear to be those areas in Papua New Guinea nearest to the peanut rust infected countries of South-east Asia, such as Indonesia. Therefore, while the outbreak may have originated from aerial inoculum, it was considered that the spores may possibly have come in as passive passengers on plant or other material (Shaw and Layton 1975).

Powdery mildew of tobacco

Powdery mildew of tobacco (*Erysiphe cichoracearum*) was first found in April, 1973, on one plant only, in a garden in the highlands. This and a few other infected plants found during the next two years, as well as symptomless plants found in the same gardens at the times of inspection, were destroyed. It is again not known how, when or where this disease entered Papua New Guinea. Since 1973, no other infections have been recorded on any other tobacco, either in commercial plantings or in village gardens, but the disease seems to persist in the Goroka area, perhaps carrying over on a small number of susceptible tobacco plants in village gardens (Shaw and Layton 1975).

Poplar rust

Poplar rust (caused by *Melampsora larici-populina*) was first recorded in Papua New Guinea in 1975. Simpson (pers. comm.), and the writer, considered that it was unlikely that the spores arrived as aerial inoculum, and thought that the most probable entry was on infected poplar material surreptitiously brought in, or as passively carried spores on other plant material. *M. larici-populina* and *M. medusae* have been recorded in Australia, and the former in New Zealand. Australia has direct plane and boat services, while New Zealand has direct boat, and occasionally direct plane services, with Papua New Guinea.

A summary of the major breaches, as outlined above, is given in *Table* 2, together with the possible form of entry.

Table 2.—Major plant quarantine breaches in Papua New Guinea

Date of first record		Known source	Possible source
1892	"Coffee leaf disease *Hemileia vastatrix*" (probably coffee rust)	Diseased plants*	
1903	Coffee rust	?	Diseased plants?
1955	Tropical maize rust	?	Seed? or ?
1963	Blister smut of maize	?	Seed?
1965	Coffee rust	?	?; unlikely to be wind-blown
1967	Rubber powdery mildew	?	With plant material ?
1972	Peanut rust	?	?; unlikely to be wind-blown
1973	Tobacco powdery mildew	?	?
1975	Poplar rust (M. larici-populina only)	?	?; unlikely to be wind-blown

* Destroyed on arrival.

INTERCEPTION OF PROHIBITED OR RESTRICTED MATERIAL

The Quarantine Service is continually intercepting plant material which is either totally prohibited, or has restricted importation. A few only of these cases are given below, but the examples will serve to illustrate the variety of plant material brought illegally into Papua New Guinea, both in ignorance, and regrettably, often deliberately.

Seed

Seed of many varieties of plants illegally imported into Papua New Guinea is intercepted every month by the Quarantine Service. Some of this seed is found in parcels during Customs inspection, its presence being undeclared. In some cases, as mentioned previously, used clothing sent to Papua New Guinea from overseas countries, and subjected to fumigation under Health Regulations on receipt in Papua New Guinea, is found to contain seeds of plants, and sometimes other products prohibited by Animal Quarantine Regulations, all undeclared on the Customs Declarations.

On one occasion a man, apparently being unaware of the Quarantine Regulations, brought in cereal seed from Africa, which was undetected at the Customs inspection. He planted the seed, and then sent some of the grain from the resultant crop to the Department, pointing out what a fine yield had been produced, mentioning where he had obtained it, and how it had been brought in. An immediate check on the crop showed that it was fortunately disease-free. However, such seed could have been carrying spores capable of causing diseases of other crops already growing and of economic importance in this country.

In a recent case, a plant scientist from another country sent unsolicited, untreated seed to an agronomist in the Department of Primary Industry, who, of course, immediately forwarded it to the Chief Quarantine Officer (Plants) as the seed from that country was a prohibited import. Even some scientists, also regrettably, do not ascertain the Quarantine Regulations operating in the addressee's country before despatch of material.

A few years ago a member of the Department of Forests reported a case where a commercial greeting card was received from friends overseas. Inside the card was an exhortation made intelligible by the inclusion of a small plastic pack of seed (*Plate* II). The seed was wild oats, a serious weed in certain countries, which has to date been excluded from Papua New Guinea.

In another case, seed of pyrethrum was received by the Department from a government department in another country, with fruiting bodies (pycnidia) of a fungus being only too evident on the seed debris, and easily detectable even under the relatively low power of a stereo microscope (*Plate* III).