SPECIES OF *PHYTOPHTHORA* AND *PYTHIUM* IN PAPUA NEW GUINEA

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ABSTRACT

The paper records the species of Phytophthora *and* Pythium *isolated from diseased plants of various genera between* 1963 *and* 1971 *and the species isolated from* 52 *of* 82 *mixed soil and root samples from various sites in Papua New Guinea using the lupin bait technique in a survey conducted in* 1970-71.

INTRODUCTION

THE species of *Phytophthora* recorded in Papua New Guinea were listed by Shaw (1963) and included *P. colocasiae* causing leaf blight of taro (*Colocasia* sp.), *P. palmivora* causing pod rot, canker and chupon wilt of cacao (*Theobroma cacao* L.), and *Phytophthora* sp. causing collar rot of *Saintpaulia* sp. A listing of *P. infestans* on potato by Dumbleton (1954), records of *P. palmivora* (Dwyer 1940a, 1940b, 1953) and a possible record (Bryce 1924) on coconut, a possible record of *P. palmivora* on rubber (Mann 1963), a possible record of *Phytophthora* sp. on oil palm (Dwyer 1953) and *P. parasitica* and *Phytophthora* sp. on *Citrus* sp. (Dumbleton 1954) had not been confirmed. A listing of *Pythium debaryanum* on tobacco (*Nicotiana tabacum* L.) by Dumbleton (1954) had also not been confirmed.

ISOLATIONS BETWEEN 1963 AND 1971

Since 1963 other species of *Phytophthora* and *Pythium* have been obtained as isolates from diseased specimens, mainly with damping-off, collar rot or root rot, sent in for identification from various parts of Papua New Guinea. The isolates, made by Shaw and Messrs W. A. Layton, A. Williams and R. M. Burnett, were identified at the Commonwealth Mycological Institute. They were as follows:—

Phytophthora sp. probably *P. nicotianae* str., from *Hibiscus* sp. (IMI 118060);

Pythium butleri from *Citrus* sp. (IMI 140039); from *Nicotiana tabacum* (IMI 142124); from *Phaseolus vulgaris* (IMI 133993); from *Zea mays* (IMI 145235);

Pythium butleri (nearest) from *Nicotiana tabacum* (IMI 134848);

Pythium irregulare from *Citrullus vulgaris* (IMI 145234);

Pythium myriotylum from *Nicotiana tabacum* (IMI 135527);

Pythium vexans from *Cocos nucifera* (IMI 150165); from *Theobroma cacao* (IMI 133526);

Pythium deliense (nearest) from *Nicotiana tabacum* (IMI 116988).

SAMPLING AND LOCALITIES

In the present study 82 soil samples with fibrous roots were taken from the 0-4 inch layer (less litter) from various localities. The plants from all sites were reported as healthy with the following exceptions: three nurseries where damping-off had occurred; one site at which introduced *Pinus* sp. had been reported as slow-growing; three samples from the same general area where introduced *Pinus* sp. was said to be unthrifty, and two samples from a site where death of planted *Eucalyptus deglupta* had been reported. The positions of the sites are shown in the *Figure* and the number of samples from primary forest, secondary bush, drain or creek banks and roadside areas, nurseries or home and village gardens, plantation areas and afforested areas is given in *Table* 1. It is not known what, if any, contamination may have been accidentally introduced at the primary forest sites.

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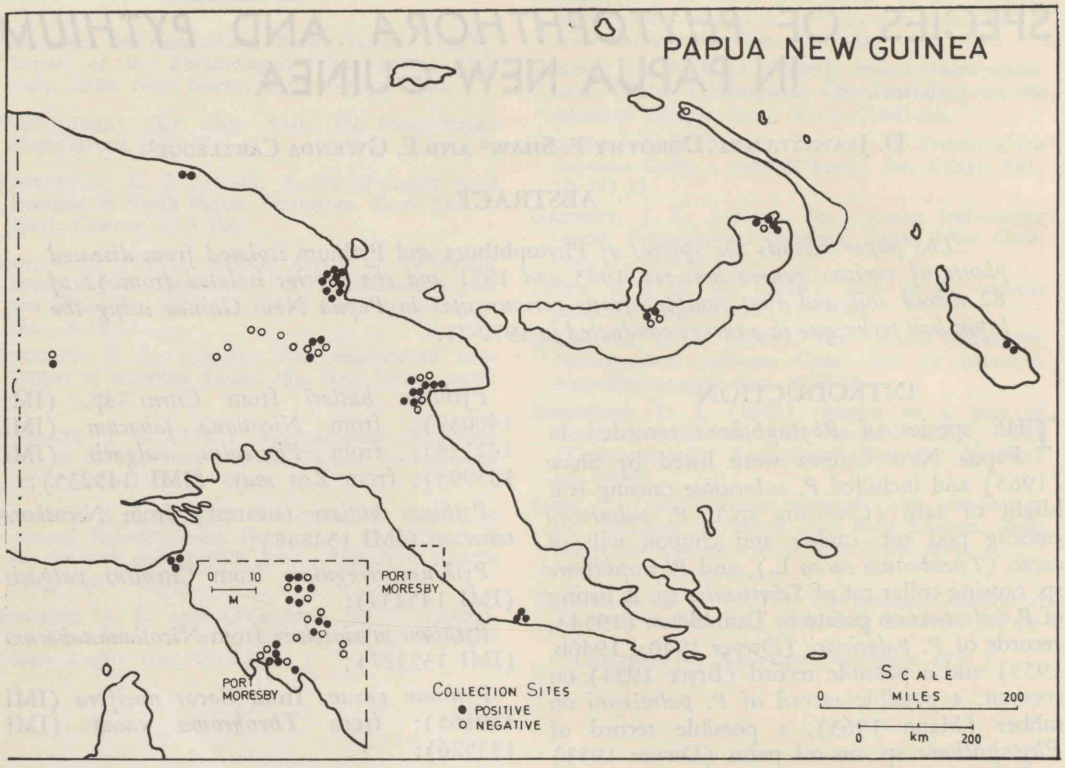

Figure.—Location of soil/root samples

METHODS

The soil/root samples were baited for *Phytophthora cinnamomi* and other species of *Phytophthora* and *Pythium,* using the method which Pratt (personal communication) adapted from the lupin-baiting technique of Chee and Newhook (1965), with slight modifications to suit local conditions. Three lots of 50 cc of each soil/root sample were placed in three plastic cups with 150 cc of de-ionized water (with maximum total dissolved salts less than 1 ppm). Onto this water were floated $\frac{1}{4}$ inch deep corks with three holes through which radicles of pregerminated New Zealand blue lupin seed (*Lupinus angustifolius* L.) penetrated to the water below. The radicles were allowed to reach $\frac{1}{2}$ inch in length before being placed in position: on Dr Pratt's advice, 24-hour fluorescent lighting was arranged to within three inches of the tops of the corks.

Each radicle was removed after three days to a microscope slide, a few drops of water and a cover slip were added, and it was examined under the low power of the microscope and checked for lesions or sporangia. Radicles showing either, and some radicles chosen at random not showing lesions or sporangia, were cut from the seed, cut lengthwise in half, then each half was cut in four. The four pieces of one half were plated on to potato dextrose agar (later PDA with pimaricin and penicillin for bacterial control), and the four from the other half on to lima bean extract agar. The isolates were established in pure culture on PDA. Any apparently different types, and a representative selection taken at random from the remainder of the isolates derived from each sample, were inoculated on to boiled pieces of grass (*Dicanthium aristatum* (Poir.) C. E. Hubbard) in water, as described by Waterhouse (1963, 1967, 1970) and many

Table 1.—Species of *Phytophthora* and *Pythium* isolated from various habitats

Sites and species	Primary forest	Secondary bush, roadside, drain, etc.	Nursery	Home or village garden plantation or afforested area	Total
Sites					
Total	10	11	8	53	82
Negative	3	5	1	21	30
Positive	7	6	7	32	52
With 1 species	7	5	3	23	38
With 2 species		1	1	7	9
With 3 species			2	2	4
With 4 species			1		1
Species					
Phytophthora drechsleri (IMI 154105 and 3 other IMI Nos.)			3	1	4
Phytophthora nicotianae var. *nicotianae* (nearest) (IMI 154098)		1			1
Phytophthora sp., probably *P. nicotianae* str. (no sex organs)	2	1	2	7	12
Pythium aphanidermatum (IMI 154100)		1	3	13	17
Pythium butleri (IMI 154101, IMI 154110)				5	5
Pythium carolinianum (nearest) (IMI 157218)				1	1
Pythium debaryanum Hesse (IMI 158771)		1			1
Pythium debaryanum Hesse (nearest) (IMI 157216)				1	1
Pythium debaryanum auct. non Hesse (IMI 154104)			1	1	2
Pythium irregulare (nearest) (IMI 157211 and 7 other IMI Nos.)	2		3	3	8
Pythium middletonii (IMI 154103 and 3 other IMI Nos.)		2	2	4	8
Pythium sp. (lobulate sporangia, no sex organs; not identifiable) (IMI 154102, IMI 154107)			1	1	2
Pythium sp. (discrete sporangia, no sex organs; not identifiable) (IMI 154111 and 9 other IMI Nos.)	3	2		5	10

were also inoculated on to maize meal agar, lima bean agar and on to sterile bean pods (*Phaseolus vulgaris*) in order to induce sporangial and oospore production, and to study germination.

Isolates not sporulating on any media at Port Moresby were forwarded to the Commonwealth Mycological Institute, where crossings with other strains were carried out by Stamps. Representative isolates of the various types were also forwarded to Stamps for confirmation or identification of the species.

RESULTS

Lupin radicles from 50 of the 82 soil/root samples developed faint lesions or sporangia, and isolates of *Phytophthora* and/or *Pythium* were established from them. Isolates were also obtained from two other samples chosen at random whose radicles showed neither lesions nor sporangia. From radicles of the 52 samples 476 isolates were made and 225 of these were studied on boiled grass in water and on some of the other media, as mentioned under "Methods", for sporangia and oospore production, type of germination and method of fertilization.

One of the 52 samples yielded four species of *Phytophthora* and *Pythium*, four samples yielded three species of *Phytophthora* and/or *Pythium*, nine samples yielded two species of *Phytophthora* and/or *Pythium*, while the remaining 38 yielded one species only (*Table* 1).

Two species of *Phytophthora* and seven species of *Pythium* as well as several unidentifiable species of *Pythium* and *Phytophthora* (because no sex organs were produced on any medium) were obtained from the various habitats, as shown in *Table* 1.

DISCUSSION

Relatively few species of *Phytophthora* and *Pythium* were isolated from soil/root samples from a range of habitats over a wide area in Papua New Guinea. The isolates were derived

Table 2.—List of species of *phytophthora* and *Pythium* recorded in Papua New Guinea

Species	Host	Reference
***Records herein or confirmed*:—**		
Phytophthora colocasiae Rac.	*Colocasia* sp.	Shaw 1963* Hicks 1967a
Phytophthora drechsleri Tucker	Soil/root	Herein
Phytophthora nicotianae B. de Haan var. *nicotianae*	Soil/root	Herein
Phytophthora palmivora (Butl.) Butl.	*Theobroma cacao*	Shaw 1963* Hicks 1967b
Phytophthora sp. probably *P. nicotianae* str.	*Hibiscus* sp.	Herein
	Soil/root	Herein
Phytophthora sp.	*Saintpaulia* sp.	Herein
Pythium aphanidermatum (Edson) Fitzp.	Soil/root	Herein
Pythium butleri Subramaniam	*Citrus* sp.	Herein
	Nicotiana tabacum	Herein
	Phaseolus vulgaris	Herein
	Zea mays	Herein
	Soil/root	Herein
Pythium butleri Subramaniam (nearest)	*Nicotiana tabacum*	Herein
Pythium carolinianum Matthews (nearest)	Soil/root	Herein
Pythium debaryanum Hesse	Soil/root	Herein
Pythium debaryanum Hesse (nearest)	Soil/root	Herein
Pythium debaryanum auct. non Hesse	Soil/root	Herein
Pythium deliense Meurs (nearest)	*Nicotiana tabacum*	Herein
Pythium irregulare Buisam	*Citrullus vulgaris*	Herein
Pythium irregulare Buisman (nearest)	Soil/root	Herein
Pythium middletonii Sparrow	Soil/root	Herein
Pythium myriotylum Drechsler	*Nicotiana tabacum*	Herein
Pythium vexans de Bary	*Cocos nucifera*	Herein
	Theobroma cacao	Herein
Pythium sp. (lobulate sporangia, no sex organs)	Soil/root	Herein
Pythium sp. (discrete sporangia, no sex organs)	Soil/root	Herein
***Records unconfirmed at present*:—**		
Phytophthora infestans	*Solanum tuberosum*	Dumbleton 1954
Phytophthora palmivora	*Cocos nucifera*	Bryce 1924 (possible record) Dwyer 1940a, b; 1953
	Hevea brasiliensis	Mann 1953 (possible record)
Phytophthora parasitica	*Citrus* sp.	Dumbleton 1954
Phytophthora sp.	*Citrus* sp.	Dumbleton 1954
	Elaeis guineensis	Dwyer 1953
Pythium debaryanum	*Nicotiana tabacum*	Dumbleton 1954

* Summary of all previous records.

from 63.4 per cent of the samples, but as these included isolates from two samples chosen at random whose radicles showed neither faint lesions nor sporangia, it is possible that more samples would have yielded isolates if other "negative" radicles had been plated in nutrient agar.

The area yielding the most species was one of the nurseries where damping-off had previously been reported. No isolates were obtained from the site with introduced *Pinus* sp. said to be "slow-growing"; *Pythium aphanidermatum* was obtained from only one of the two sites previously reported to have had dead *Eucalyptus deglupta*; *Phytophthora drechsleri* was obtained from one and unidentifiable *Pythium* sp. from another of the three samples from the area with unthrifty introduced *Pinus* sp. Pathogenicity tests would be needed to determine whether any or all of the above pythiaceous isolates were associated with the conditions reported to the authors.

At all the other sites, the plants growing at the time of collection were reported by the collectors to be healthy, and roots taken at random from each sample also appeared healthy when examined in the laboratory. The pythiaceous isolates obtained from many of these were apparently not pathogenic at the time of collection on these plants, which ranged from indigenous forest trees to horticultural species, ferns, weeds and grasses.

None of the isolates was *Phytophthora cinnamomi*, which has been commonly isolated in recent years by the use of the lupin bait technique (Chee and Newhook 1965; Pratt pers. comm.; Jehne 1970).

All the species of *Phytophthora* and *Pythium* listed in *Table* 1 have been recorded in the literature as causing damping-off of seedlings or other diseases of a variety of plants.

The complete list of species of *Phytophthora* and *Pythium* recorded in Papua New Guinea is now as given in *Table* 2.

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