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PHYTOPHTHORA CINNAMOMI: A NEW PATHOGEN ON CLOVES IN PENINSULAR MALAYSIA

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RINGKASAN

P. cinnamomi telah dapat dipisahkan dari tissu akar kering dari anak pokok cengkeh berumur 2 tahun; ini adalah kali pertama kulat ini dipisahkan dari pokok cengkeh. Kajian di makmal menunjukkan chlamydospore dengan mudah dikeluarkan di midia walaupun sporangia hanya dapat dikeluarkan menggunakan midia LBA dan OMA pada 25°C. Walaubagaimana pun pengeluaran sporangia boleh digalakkan apabila kulat ini dari 'culture' yang muda ditroh dalam extract larutan tanah, larutan perti atau air suling. Kebolehan kulat ini mengeluarkan oespore dengan isolate A_1 *P. palmivora* dari lada hitam membuktikan yang kulat ini ialah terkandong dalam kumpulan 'compatibility' A_2. Hasil dari kajian suntikan menunjukkan kepekaan buah-buah koko dan getah yang muda dan juga anak pokok dan buah 'avocado' pada kulat ini. Mustahaknya kajian ini pada penanaman koko, getah dan avocado di Malaysia dibincangkan dengan ringkas.

INTRODUCTION

Phytophthora cinnamomi Rands is an ubiquitous soil-borne pathogen capable of inciting diseases on over 200 species of economic plants. It is particularly destructive to many of the forest and fruit tree species (THORN AND ZENTMYER, 1954; CHEE AND NEWHOOK, 1965). Its wide distribution in the tropics as well as in the temperate regions of the world indicates its high degree of adaptability to a broad spectrum of physical and physiological environments. In Malaysia, the fungus was first reported to cause root rot and subsequent die-back of quinine (*Cinchona ledgeriana* Moens and *C. succirubra* Pav. ex Klotzsch) in the Cameron Highlands (THOMPSON, 1940). Since then, there has been no further record of the pathogen either from the same hosts or from other host plants. While it is without doubt one of the most important plant pathogens, its biology and behaviour under local conditions remain relatively unknown. A study on the biology and pathogenic potential of the fungus was therefore undertaken when it was recently isolated from infected roots of 2-year old die-back cloves (*Eugenia aromatica* Baill.) planted at the MARDI station in Serdang, Selangor. This is the first record of *P. cinnamomi* on cloves. Infected plants showed symptoms of die-back of young terminal shoots, scorching of older leaves and extensive necrosis of tertiary rootlets, very often with the cortical tissues being sloughed off. The above symptoms were similarly observed on clove seedlings inoculated with the fungus in the green-house.

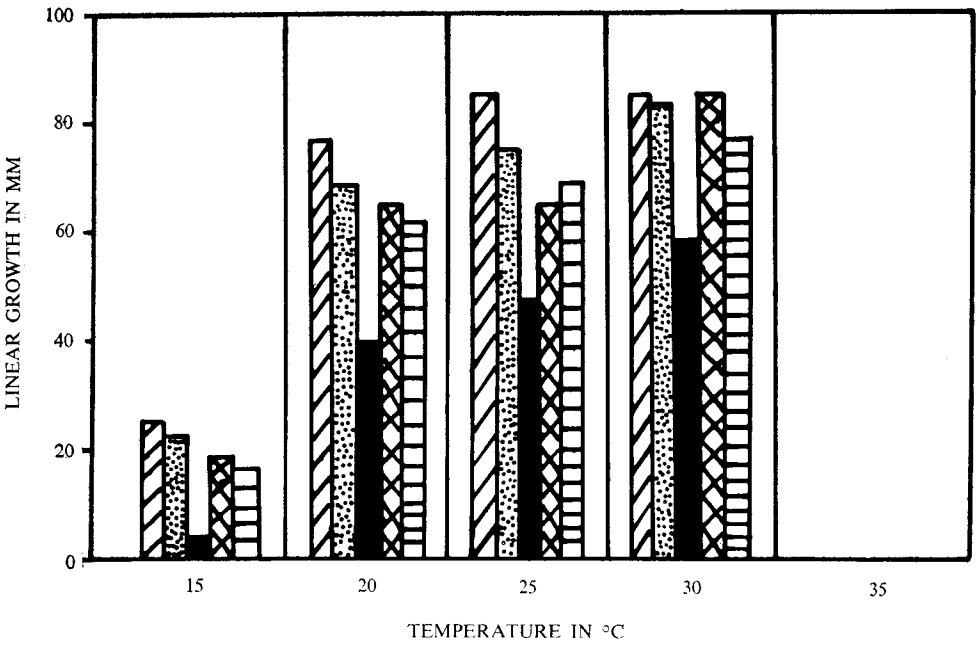
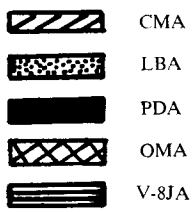


Figure 1. Effect of agar media and temperature on linear growth of *P. cinnamomi*. Colony diameter (mm) taken after 6 days of growth.



GROWTH, MORPHOLOGY AND SPORULATION

Growth of the fungus was compared on 5 artificial media at temperatures ranging from 15° – 35°C. The 5 media used were corn-meal agar (CMA), lima-bean agar (LBA), potato-dextrose agar (PDA), oat-meal agar (OMA) and V – 8 juice agar (V – 8JA). Results of the study are given in *Figure 1*. Excellent growth of the fungus was recorded on CMA, LBA, V – 8JA and OMA while least growth was recorded on PDA. Cardinal temperatures for growth were: minimum 8°C, optimum 28° – 30°C and maximum 34°C.

Morphological characteristics of the hyphae, chlamydospores and sporangia *(Figure 2)* were similar to those as described by WATERHOUSE (1963). Sporangia were sparingly produced on LBA and OMA at 25°C under normal laboratory lighting condition. However, their production could be easily induced by placing culture discs from young colonies in either soil-extract, petri solution or distilled water. Proliferation of sporangia was not observed in the present study. Zoospores were readily formed when sporangial suspensions were chilled at 5°C for 15 minutes followed by returning to room temperature. Oospores with amphigynous antheridia were produced when the fungus was paired with *P. palmivora*

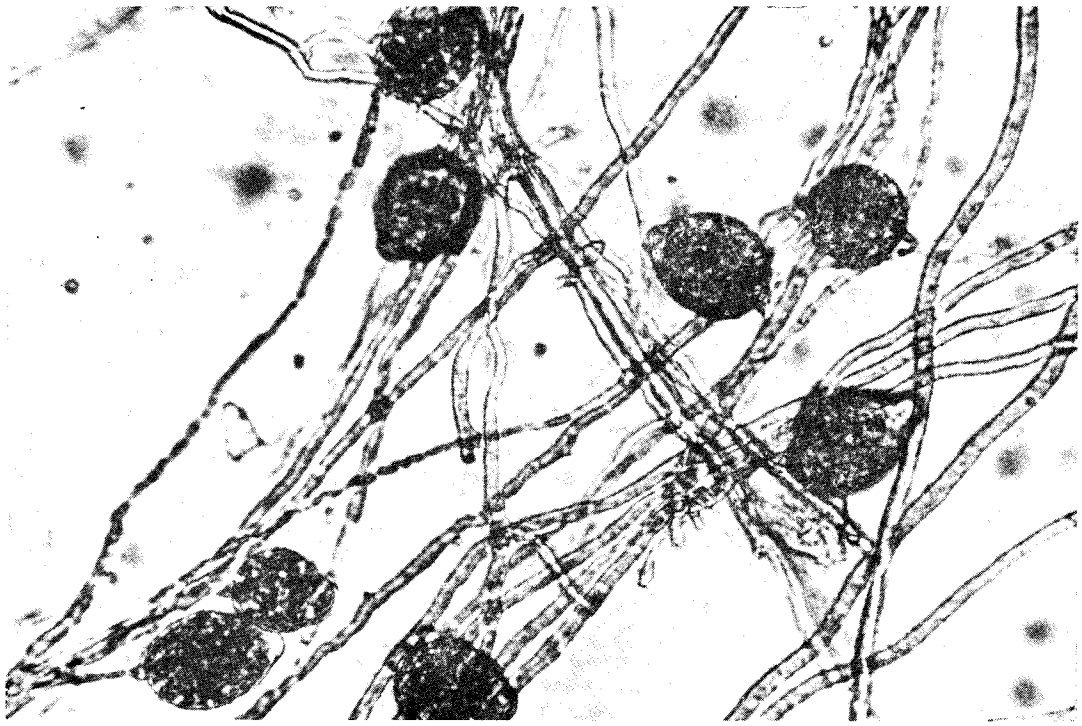


Figure 2. Sporangia of *P. cinnamomi* produced in soil extract at 25°C.

(black-pepper strain) of A_1 compatibility type. This clearly indicated the presence of A_2 compatibility factor in the present isolate of *P. cinnamomi*. Diameter of oospores ranged from 41.8 – 47.2 μ with an average of 45.0 μ (calculated from 50 oospores).

PATHOGENICITY STUDIES

In an attempt to assess the pathogenic potential of the fungus, a series of inoculation studies on the roots and detached plant parts of some of the more economically important plant species were carried out. For root inoculation, macerated mixtures of mycelia and chlamydospores were carefully mixed with the soil planted with the test plants while culture discs as inocula were used to inoculate detached plant parts previously wounded with a small pin. Results of the studies are summarized in *Table 1*.

Unripe cocoa and rubber pods succumbed to infection readily. In both instances, firm brown rot developed within 4 days of inoculation. The ability of the fungus to infect cocoa pods especially those with superficial wounds caused by insect pests strongly suggests that *P. cinnamomi* must be excluded from cocoa fields and that insect pests such as mirids and scales should be judiciously controlled. The fact that the fungus can only infect rubber pods but not other parts of the rubber trees indicates that the fungus is not presently a problem to the rubber industry.

TABLE 1. SUSCEPTIBILITY OF VARIOUS PLANT SPECIES TO *P. CINNAMOMI*

Plant spp.	Parts of plant inoculated	Susceptibility
Rubber (*Hevea brasiliensis* Murr.)	detached stems and leaves	−
	detached unripe pods	+
Oil-palm (*Elaeis quineensis* Jacq.)	roots	−
Cocoa (*Theobroma cacao* l.)	roots	−
	detached unripe pods	+
Black-pepper (*Piper nigrum* L.)	roots and detached leaves	−
Castor-oil (*Ricinus communis* L.)	roots	−
Tobacco (*Nicotianae tabacum L.*)	roots	−
Avocado (*Persea americana* Mill.)	roots, detached stems and fruits	+
Pineapple (*Ananas comosus* Merr.)	detached leaves	−
Passion fruit (*Passiflora edulis* S'ms.)	roots	−
Tomato (*Lycopersicon esculentum* Mill.)	roots	−
Chilli (*Capsicum annum* L.)	roots	−

− = Non-susceptible
\+ = Susceptible

The ability of the fungus to cause root and fruit rot of avocado is expected because *P. cinnamomi* is frequently associated with avocado decline and root rot in countries where the fruit trees are commercially grown (WAGER, 1942; TEAKLE, 1957; ZENTMYER, 1952; ZENTMYER AND POPENOE, 1951). The present finding indicates therefore that the fungus can be a potential limiting factor to avocado cultivation in this country.

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SUMMARY

P. cinnamomi was recently isolated from necrotic root tissues of 2-year old die-back cloves; this being the first record of the fungus on clove plants. Laboratory studies indicated that chlamydospores were freely produced in artificial culture media although sporangia were only sparingly produced in LBA and OMA at 25°C. Sporangial production could be easily induced, however, when culture discs from young colonies were placed in either soil extract, petri solution or distilled water. The ability of the fungus to form oospores with an A_1 isolate of *P. palmivora* from black-pepper indicated that the present isolate belonged to the A_2 compatibility type. Results obtained from a series of inoculation studies showed high susceptibility of unripe cocoa and rubber pods as well as avocado seedlings and fruits to the fungus. The importance of these findings in relation to cocoa, rubber and avocado cultivation in Malaysia is briefly discussed.

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