

INFECTIVITY OF *PHYTOPHTHORA* SPECIES ON CASH CROPS OF KERALA*

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The ravages caused by *Phytophthora* species have been reported from a number of cash crops in Kerala (Mc Rae, 1919; Sam Raj and Jose, 1966; Menon *et al.*, 1972; Radha and Joseph, 1974). These diseases are very serious either causing heavy loss in yield or complete death of the plants. The warm and humid climate prevailing in the state is highly favourable for the pathogen.

Materials and Methods

The present investigation was carried out in the three northern districts of Kerala *viz.*, Cannanore, Wynad and Trichur during the period from May to December, 1981. Plant specimens showing wet rot symptoms were collected and brought to the laboratory for isolation and identification of the fungus. The isolations were carried out by standard isolation methods (Riker and Riker, 1936). All laboratory studies were conducted at the Plant Pathology Laboratory, College of Horticulture Vellanikkara.

Detailed morphological characters of the *Phytophthora* species isolated from the different hosts were studied by slide culture method, with the culture discs intact, except for the deciduous sporangium, using carrot agar. Hyphal tips from seven day old culture were transferred to 5 mm diameter discs of media and incubated at $22 + 1^{\circ}\text{C}$. Deciduous sporangia were collected by dripping sterile water on culture discs. Characters such as breadth of the hypha, length of the sporangio-phore, length and breadth of the deciduous sporangium and length of the pedicel were observed by using four day old cultures. For observing oospores older cultures were used. The mean of 50 observations on each character was worked out.

One week old cultures of each isolate of *Phytophthora palmivora* from the six different hosts namely black pepper, arecanut, rubber, cocoa, coconut and cardamom were used for inoculation experiments, which were conducted during June-August, 1982.

Results and Discussion

Phytophthora species could be isolated from six different cash crops namely black pepper (*Piper nigrum* Linn.), rubber (*Hevea brasiliensis* Muell. Arg.), arecanut (*Areca catechu* Linn.) cocoa (*Theobroma cacao* Linn.), coconut (*Cocos nucifera*

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Linn.) and cardamom (*Elettaria cardamomum* Maton) during the present investigation. The isolations were carried out from the leaves of black pepper showing wet rot symptoms, fallen nuts of arecanut, petiole of fallen leaves of rubber, pods of cocoa showing black rot symptoms, buds of coconut and capsules of cardamom showing rotting symptoms.

The *phytophthora* species from all these hosts exhibited similar morphological characters except for slight variations in the dimension of different structures (Table 1). The growth characteristics on carrot agar, development, shape and germination pattern of sporangia of *phytophthora* species from all these hosts were identical.

Growth on carrot agar produced very sparse aerial mycelium. Mycelium was hyaline and coenocytic. Very rarely septa were observed on the somatic hypha and sporangiophore. The thickness of the hyphae ranged from 4.00—6.00 μm in all the isolates. The difference in the mean values were negligible and it varied from 4.82 μm in arecanut isolate to 5.08 μm in coconut isolate (Table 1).

All the isolates exhibited similar ontogeny of sporangia. Sporangioophores arose from the somatic hyphae and their tip became swollen which developed into sporangia. The sporangiophores were of indeterminate growth and measured 27.50—302.50 μm in length. The minimum mean sporangiophore length (117.40 μm) was exhibited by cocoa isolate and maximum (136.35 μm) by rubber isolate (Table 1).

Sporangia were produced abundantly by all the isolates on carrot agar. Young sporangia were more or less spherical with transparent protoplasm. On maturity the protoplasm became dense and opaque. When fully matured it appeared granular and differentiation into zoospores took place within the sporangium itself. The apical portion of the maturing sporangium developed into a papilla and it became well pronounced when fully matured. Fully matured sporangia were ovoid to limoniform with round base. They measured 30.00—47.50 x 17.50—37.50 μm . The mean length of the sporangia was the lowest (36.15 μm) in cocoa isolate and the highest (44.30 μm) in arecanut isolate. Arecanut isolate also exhibited the highest mean sporangial breadth (30.30 μm). The lowest mean sporangial breadth (25.20 μm) was exhibited by coconut isolate. The L/B ratio (length by breadth ratio) of the sporangia varied from 1.07—1.71. However, the difference in the mean values of L/B ratio of different isolates was negligible. It ranged from 1.34 in black pepper isolate to 1.48 in coconut isolate (Table 1).

The sporangia were borne terminally on the sporangiophores in a simple sympodial fashion and were caducous. Deciduous sporangia had short and thick stalks filled with semitransparent plugs. Though the pedicel length ranged from 2.00—8.00 μm the mean values were less than 5.00 μm . The minimum mean length (2.92 μm) was exhibited by cocoa isolate and maximum (4.92 μm) by rubber isolate (Table 1).

The germination pattern of the deciduous sporangia of all the isolates was also similar. Germination took place in the presence of free water. Zoospores came out in a mass through the papilla and rested for a while at the mouth of the sporangium. Then, motile zoospores got separated from the mass and swarm away in the film of water. After a few minutes the swarming zoospores came to rest and got encysted. The encysted zoospores were more or less spherical. They later germinated by means of germ tube.

The *Phytophthora* species from all the six hosts produced chlamydospores abundantly in 21 day old cultures on oat meal agar. They were borne intercalarily and were slightly coloured and were more or less spherical.

Sex organs were observed to be produced only by cardamom and rubber isolates of *Phytophthora* on culture media. While antheridia, oogonia and oospores were observed with the rubber isolate, only oospores were observed with the cardamom isolate. The oospores produced by the cardamom isolate measured 27.00—42.00 μm (mean 33.22 μm) and those of rubber isolate 16.00—25.00 μm (mean 23.80 μm) in diameter.

Based on the above morphological characters, all the *Phytophthora* isolates from the six hosts viz., black pepper, arecanut, rubber, cocoa, coconut and cardamom can be identified as one and the same species *Phytophthora palmivora* (Butler) Butler. Eventhough there is slight variation in the dimension of vegetative hypha, sporangiophore, and deciduous sporangium including pedicel, the development and shape of these structures including the germination pattern of sporangia were found to be identical in all the isolates. The slight variation observed does not warrant them to be kept in different species other than *P. palmivora*. Further light on this aspect will be obtained only after studying the chromosome type and other ultra-characters which are stable.

Though *P. palmivora* was recorded on black pepper (Muller, 1936; Holliday and Mowat, 1963; Turner, 1969; Alconero *et al.*, 1972; Nambiar and Sarma, 1976), arecanut (Butler, 1919; Tucker, 1931; Leonian, 1934; Thomas *et al.*, 1948), rubber (Tucker, 1931; Leonian, 1934; Thomas *et al.*, 1948; Chee, 1969; Merz *et al.*, 1969), cocoa (Butler, 1919; Ashby 1929; Tucker, 1931, Thomas *et al.*, 1948), and coconut (Butler, 1919; Gadd, 1927; Ashby, 1929) its association with cardamom is not reported earlier. The *Phytophthora* species responsible for the capsule rot of cardamom in Idukki district of Kerala was identified as *P. nicotianae* var. *nicotianae* by Thankamma and Pillai (1973) and Nair and Menon (1980). The present investigation showed the invariable association of *P. palmivora* with cardamom capsules showing rotting symptoms, collected from a plantation in Wynad district.

The cross inoculation studies with the *P. palmivora* isolates from black pepper, arecanut, rubber, cocoa, coconut and cardamom yielded successful results. The nature of symptoms produced on the same host by the different isolates was

Table 1

Morphological characters of *Phytophthora* isolates from different hosts on carrot agar (in μm)

Sl. no.	Isolate	Breadth of hypha	Length of sporangio- phore	Length of sporangium	Breadth of sporangium	L/B ratio of sporangium	Length of pedicel
1	Pepper						
	Mean	5.02	118.50	36.65	26.90	1.34	3.50
	Mode	5.00		37.50	25.00	1.33	4.00
	Range	4.00-6.00	27.50-247.50	32.50-40.00	22.50-37.50	1.07-1.67	2.00-5.00
2	Arecanut						
	Mean	4.82	127.75	44.30	30.30	1.46	3.14
	Mode	5.00		45.00	32.50	1.57	3.00
	Range	4.00-6.00	35.00-210.00	37.50-47.50	27.50-35.00	1.25-1.71	2.00-5.00
3	Rubber						
	Mean	5.06	136.35	38.90	26.90	1.45	4.92
	Mode	5.00		37.50	27.50	1.33	5.00
	Range	4.00-6.00	47.50-255.00	30.00-42.50	17.50-30.00	1.25-1.71	2.00-8.00
4	Cocoa						
	Mean	4.92	117.40	36.15	25.25	1.43	2.92
	Mode	5.00		37.50	25.00	1.50	3.00
	Range	4.00-6.00	35.00-230.00	30.00-40.00	22.50-30.00	1.18-1.60	2.00-5.00
5	Coconut						
	Mean	5.08	120.95	37.30	25.20	1.48	3.50
	Mode	5.00		37.50	25.00	1.50	3.00
	Range	4.00-6.00	27.50-302.50	30.00-40.00	22.50-27.50	1.27-1.60	2.00-5.00
6	Cardamom						
	Mean	4.96	119.30	39.15	27.50	1.42	3.24
	Mode	5.00		37.50	27.50	1.36	3.00
	Range	4.00-6.00	35.00-255.00	35.00-42.50	25.00-32.50	1.23-1.70	2.00-5.00

more or less identical. The time taken for the appearance of initial symptoms varied depending mainly upon the host. It ranged from 24 hours on arecanut to 72 hours on cocoa pods. Similar successful crops inoculation experiments were reported with arecanut and cocoa isolates (Coleman, 1910), with cocoa, rubber and coconut isolates (Gadd, 1927), with cocoa and rubber isolates (Pereis, 1963) and with cardamom, rubber and coconut isolates (Radha and Joseph, 1974). In contrast, the cross inoculation studies conducted by Tucker (1927), Holliday and Mowat (1963), Turner (1971), Chandra Mohan *et al.*, (1979), Nair and Menon (1980) and Sarma *et al.*, (1981) did not give positive results. However, all the hosts inoculated with the different isolates of *P. palmivora* obtained in the present investigation took infection without any difficulty.

Summary

The *Phytophthora* species infecting black pepper, arecanut, rubber, cocoa, coconut and cardamom in the northern districts of Kerala exhibited similar morphological characters and were identified as *Phytophthora palmivora* (Butler) Butler. Only cardamom and rubber isolates produced sexual structures on culture media. Cross inoculation studies with all these isolates yielded successful results.

സംഗ്രഹം

കേരളത്തിലെ വടക്കൻ ജില്ലകളിൽ നിന്നും ശേഖരിച്ച കുരുമുളക്, കച്ചക്, റബ്ബർ, കൊക്കോ, തെങ്ങ്, ഏലം ഇവയിലെ 66ഫ(3000ഫ)Sത്ത00 എന്ന കുമിളിനെ പഠിച്ചതിൽ നിന്നും, അവയെല്ലാം ഫൈറ്റോഫ്തോറാ പാമിവാറ (ബട്ലർ) ബട്ലർ എന്നതാണെന്നു fflonca)1e)ocsj)1. എന്നാൽ ഏലത്തിൽ നിന്നും റബ്ബറിൽ നിന്നും ശേഖരിച്ച കുമിളുകളിൽ മാത്രമേ ലൈംഗീകാവയവങ്ങൾ ഉണ്ടായി കണ്ടുള്ളൂ. ഓരോ വിളയിൽ നിന്നും കിട്ടിയ കുമിളിനെ പ്രത്യേകം പ്രത്യേകം മേല്പാഞ്ഞ മറ്റൊല്ലാ വിളകളിലും കുത്തിവച്ചപ്പോഴും അവ രോഗ ലക്ഷണങ്ങൾ കാണിയ്ക്കുകയുണ്ടായി.

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