

Effect of certain fungicides on *Phytophthora palmivora* of cocoa

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INTRODUCTION

PHYTOPHTHORA palmivora (Butler) Butler is a cosmo-tropical fungus, and has been reported as a cocoa pathogen in many countries (Thorald, 1975). Since the time Ramakrishnan and Thankappan (1965) recorded its occurrence on the cocoa pods of Criollo variety causing black pod rot disease in India, the pathogen was observed by the authors to infect every part of the cacao plant in several Criollo and Forestero plantations. The infection was severe on cocoa pods followed by stem and chupon infections. Brown lesions appear on the surface of pods and spread from there onwards. The beans are often discoloured and unfit for use. As the disease advances, the infection spread to the stem portion and cause cankered lesions. The stem cankers also appear by the air borne inoculum. There will be discharge of a reddish or dark-brown fluid which flows in streaks down the surface of the cracked bark below the cankers and dries to a rusty coating. When chupon is affected, it generally dies back from the tip. In addition to young chupons, rapidly growing shoots can also become infected. In view of the economic importance of the cacao crop, the serious damage done to the crop by the fungus, chemical control of the pathogen was attempted both in the laboratory, and in field the results of which are reported here.

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MATERIALS AND METHODS

The relative efficacy of 24 different fungicides on the *in vitro* growth of *P. palmivora* was tested in the laboratory by poisoned food technique (Schmitz, 1930). The fungicides tested were: Bordeaux mixture (a mixture of copper sulphate and lime), Blue copper-50 (copper oxychloride), Fytolan (copper oxychloride), Ziram (Zinc dimethyl dithiocarbamate), Dithane Z-78 (Zinc ethylene bisdithiocarbamate), Thiram (Tetramethyl thiuram disulphide), Dithane M-45 (Product of Zinc ion and Manganese ethylene bis dithiocarbamate), Miltox (37.5% copper and 12.0% Zineb) Ceresan wet (methoxyethyl mercury chloride), Leytosol (phenyl mercury urea), Difolatan (N-1, 1, 2, 2-tetrachloro ethyl sulfenyl cis-4-cyclohexene 1, 2-dicarboximide), Captan (N-Trichloro methyl thio-4-cyclohexene, 1, 2-dicarboximide), Brassicol (Pentachloro nitrobenzene), Bavistin (2-Methoxy carbamoyl benzimidazole), Plantavax (5,6-dihydro-2-methyl 1,4-oxathiin-3-carboxinilide-4,4-dioxide), Vitavax (5,6-dihydro-2-methyl 1,4-oxathiin-3-carboxinilide), Hinosan (O-ethyl S, S-diphenyl phosphorodithioate), Brestan (Triphenyl tin acetate), Duter (Triphenyl tin hydroxide), Panoram (2-methyl-furan-3-carboxanilide), Panolil and Panoctine (each have guanidated 9-aza-1, 17-diamino heptadecane acetate salt), as well as Aureofungin sol. (Heptane antibiotic) and Lorvek (Pyroxychlor). In this, 15 ml of glucose-nitrate agar (GNA) medium incorporated with the test chemical at required concentration aseptically, was poured in 80 mm sterile petri plates and allowed to set. The plates were inoculated with 5 mm discs of actively growing (6 day old) culture of the

test fungus from potato dextrose agar plates and incubated at 25 ± 1 °C for 7 days. Six replications were maintained for each of the fungicide as well as the control.

Field evaluation of five readily available chemicals — Bordeaux mixture, blue copper-50, miltox, ziram, and thiram — was done by spraying the chemicals on seven year old cacao plants. There were three replications with 10 palms per replication. The chemicals were sprayed all over the plants' surface, thrice at 35 day intervals during May-August months. After cessation of rains (early September), the disease incidence was recorded and the results furnished in Table 2.

RESULTS AND DISCUSSION

The percent inhibition of growth of *P. palmivora* in different fungicides of varied concentrations is given in Table 1. The mean total growth of the fungus in the control plates was 71 mm. Out of the 24 fungicides tested in the present study, the bordeaux mixture (7500 ppm), blue copper-50, fytolan and thiram (each at 1000 ppm), Ziram and miltox (each at 2000 ppm), difolatan (3000 ppm), Dithane M-45 (4000 ppm), Captan (5000 ppm), brestan (2000 ppm), duter (500 ppm), panoram (3000 ppm), panolil (7500 ppm), panoctine (500 ppm), Aureofungin sol. (200 ppm), and lorvek (150 µg/ml) completely inhibited the growth of the fungus in GNA medium. The other chemicals that have been tested were less toxic. The chemicals — Bordeaux mixture at 5000 ppm, Ziram at 1000 ppm, Captan at 4000 ppm, and panolil even upto 5000 ppm exhibited fungistatic activities. Many of the above chemicals were also reported to be toxic to *P. pal-*

TABLE 1 — PER CENT INHIBITION OF GROWTH OF *PHYTOPHTHORA PALMIVORA* AT DIFFERENT CONCENTRATIONS OF FUNGICIDES

Fungicide	Per cent inhibition						
	Concentration of fungicide in ppm						
	500	1000	2000	3000	4000	5000	7500
Bordeaux mixture	—	—	—	—	—	—	—
Blue copper 50%	—	100	100	100	100	F.S	100
Fytolan 50%	—	100	100	100	100	100	—
Ziram 80% Wdp	—	F.S	100	100	100	100	—
Dithane Z-78 65% WP	—	48	55	62	68	72	—
Thiram 75% Wdp	—	100	100	100	100	100	—
Dithane M-45 80% WP	—	63	75	99	100	100	—
Milttox 66%	—	97	100	100	100	100	—
Ceresan wet 2.5% Hg	93	93	93	93	—	—	—
Leytosol	94	94	93	93	—	—	—
Difolatan 80% Wp	—	93	97	100	100	100	—
Captan 83% WDP	—	—	97	F.S	F.S	—	—
Brassicol 75% WP	—	38	48	65	72	—	—
Bavistin 50% WP	42	36	63	69	—	—	—
Plantavax 75% WP	49	80	96	96	—	—	—
Vitavax 75% WP	87	94	96	96	—	—	—
Hinosan 50 EC	55	73	66	69	—	—	—
Brestan 60% WP	93	97	100	100	—	—	—
Duter 50% WP	100	100	100	100	—	—	—
Panoram 25	—	—	—	100	100	—	—
Panolil 40% W	—	—	—	100	100	100	100
Panoctine 30% W	100	100	100	100	F.S	F.S	100
Aureofungin sol.	70 (100 ppm);		100 (200 ppm)				
Lorvek 7% EC	0 (7.5 and 15.0 µg/ml); 96 (100 µg/ml); 100 (150 µg/ml)						

F.S=Fungistatic

— = Not tested.

TABLE 2 — FIELD EVALUATION OF FIVE FUNGICIDES AGAINST THE BLACK POD ROT OF CACAO

Fungicide	Concentration (ppm)	Block pod infection %
Bordeaux mixture	10,000	12.00
Blue copper-50	3,000	13.00
Milttox	3,000	14.33
Ziram	2,000	16.00
Thiram	2,000	21.00
Control (Water spray)	...	42.33
C.D (P=0.05)	...	13.20

mivora of cacao in laboratory tests (Hislop, 1963). Researchers such as Braudean and Muller (1971), Gorenz (1970), Gregory (1974), and Thorald (1975) also recorded that Bordeaux mixture, copper, oxychloride, cuprous oxide, cupric hydroxide, difolatan, and organic tin compounds like brestan, brestanol and duter were efficient in reducing the black pod infection in the field. The present field trial revealed that

all the five fungicides tested have significantly reduced the incidence of black pod infection. However, the copper based fungicides were superior to others. In years of continuous and heavy rainfall, it is preferable to add adhesives such as resin washing soda, casein, potash alum etc. to the copper compounds as used to control *P. arecae* on *arecanut* (Koti Reddy et al., 1978).

It is a well known fact that infection spreads from the diseased cocoa pods to the stem via the stalk and form cankered lesions (Rorer, 1910 a, b) which bore infected pods in subsequent seasons (Dade, 1931). Young shoots were often infected during wet weather leading to the chupon wilt (Rorer, 1910 a). Preliminary observations made after spraying the entire surface of the plant besides the cocoa pods showed reduced incidence of cankered lesions and chupon wilt also. Since the soil serves as the primary source of inoculum of the pathogen (Okaisaborp 1965) it is desirable to drench the soil around the base of cacao palms also with the fungicides to ward off the soil-borne infection by the fungus.

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