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Short Communication

Efficacy of certain fungicides against *Phomopsis theae* under *in vitro* conditions

P. Ponmurugan[1], U.I. Baby[2] and C. Gopi[1]

[1]School of Biotechnology, K.S.Rangasamy college of Technology, Tiruchengode-637 209, Namakkal District. Tamil Nadu, India.
[2]Division of Plant Pathology, UPASI Tea Research Institute, Valparai-642 127; Coimbatore District, Tamil Nadu, India.

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Four contact fungicides, Blitox (copper oxychloride), Kocide (copper hydroxide), Mancozeb (dithane M-45) and Bordeaux mixture and four systemic fungicides, Baycor (bitertanol), Calixin (tridemorph), Contaf (hexaconazole) and Bavistin (carbendazim) were evaluated against *Phomopsis theae* under *in vitro* condition. The results indicated that carbendazim was found to be the most effective in suppressing the growth followed by dithane M-45. Among the different concentrations tested, carbendazim at 4 ppm and dithane M-45 at 8 ppm were found to be optimum for the control of pathogen's growth.

Key words: *Phomopsis theae*, fungicides, *in vitro* screening, phomopsis canker.

INTRODUCTION

Collar canker disease caused by the fungus *Phomopsis theae* Petch is the most common stem disease in young tea (*Camellia sinensis* (L.) O. Kuntz). This disease is a serious problem in all tea growing areas of the world leading to replanting debacle (Shanmuganathan, 1965; Venkata Ram, 1973; Rattan, 1986). The disease has great economic importance as the area under replanting and new clearings with clonal tea is increasing in recent years. Despite its importance very little work has been carried out on its control measures. In the present study attempts were made to evaluate certain fungicides against the pathogen *in vitro*.

MATERIALS AND METHODS

Phomopsis theae was isolated from diseased tea stem and identified (IMI No. 384005). Fungicides were tested against the pathogen by means of conidial germination and radial growth.

Four contact fungicides, Blitox (copper oxychloride), Kocide (copper hydroxide), Mancozeb (dithane M-45) and Bordeaux mixture (1%), and four systemic fungicides, Baycor (bitertanol), Calixin tridemorph), Contaf (hexaconazole) and Bavistin (carbendazim),
(tridemorph), Contaf (hexaconazole) and Bavistin (carbendazim), were used for the study.

Spore masses produced on solid media were used for the conidial germination studies. The spore masses were suspended in fungicide solutions of different concentration. A drop of this solution was placed in cavity slides and incubated in a humidity cabinet at 20°C and 100% relative humidity. The percent germination was recorded at 24 h interval.

The effect of various fungicides on the radial growth of the pathogen was studied by poisoned food technique (Adams and Wong, 1991). Required quantity of fungicide solutions were mixed with autoclaved and cooled PDA just before pouring into Petri plates, so as to obtain the required concentrations. The medium is then dispensed uniformly into 90 mm diameter Petri plates and inoculated with 5 mm mycelial disc of the pathogen from 5 day old culture with their mycelial side down. Pathogen inoculated in unamended medium served as control.

The growth of the fungus was monitored by measuring the radial growth in mm every 24 h till the fungus covers the plate ompletely in control plate. The per cent inhibition (PI) of the fungus over control was calculated using the following formula:

$$PI = (A - B)/A \times 100$$

Where, A is colony diameter of the fungus in control plates (mm) and B is colony diameter of the fungus in treated plates (mm).

*Corresponding authors E-mail: drponmurugan@rediffmail.com.

Table 1. Effect of various fungicides on conidial germination of *P. theae.*

Treatment	Conidial Germination* Concentration (ppm)			
	0.1	**0.5**	**1.0**	**2.0**
Blitox	12.33	8.33	3.67	0.00
Kocide	24.67	20.67	16.33	5.33
Dithane M-45	12.33	3.00	0.00	0.00
Bordeaux Mixture	30.33	20.33	14.33	8.33
Baycor	26.67	18.33	14.00	4.00
Calixin	25.00	17.67	12.67	4.67
Contaf	18.33	10.67	4.33	0.00
Carbendazim	3.00	0.00	0.00	0.00
Control	36.33	-	-	-
SE ±	1.15	2.66	1.73	0.52
CD at P=0.05	2.44	5.63	3.67	1.09

* On 5th day.

Table 2. Effect of various fungicides on in *vitro* growth of *P. theae.*

Treatment	Radial growth (mm)*Concentration (ppm)					
	0.5	**1.0**	**2.0**	**4.0**	**8.0**	**10.0**
Blitox	24.8(34.2)	23.3(38.2)	20.0(46.8)	8.6(77.1)	5.0 (86.8)	3.6(90.4)
Kocide	35.3(6.4)	35.2(6.6)	24.3(35.5)	20.1(46.7)	18.7(50.3)	16.4(56.4)
Dithane M-45	24.5(34.6)	21.7(42.3)	15.3(59.4)	8.0(78.8)	0.0(100)	0.0(100)
Bordeaux Mixture	29.7(21.2)	27.9(25.9)	21.3(43.5)	6.7(82.3)	2.5(93.4)	0.0(100)
Baycor	30.8(16.0)	28.9(21.1)	20.2(44.9)	13.0(64.6)	8.1(78.0)	5.3(85.6)
Calixin	28.8(21.4)	26.9(26.8)	20.8(43.3)	6.0(83.7)	2.2(94.1)	0.0(100)
Contaf	34.2(6.8)	33.4(9.0)	23.2(36.7)	19.4(47.0)	18.2(50.3)	16.0(56.5)
Carbendazim	23.4(36.2)	20.7(43.6)	13.4(63.5)	0.0(100)	0.0(100)	0.0(100)
Control	36.7	-	-	-	-	-
SE± CD at P=0.05	2.27 4.87	2.87 4.07	1.94 3.32	1.32 2.47	1.84 3.87	0.88 2.02

- On 5th day. Values in the parentheses indicate percent inhibition of the pathogen.

Table 3. *In vitro* efficacy of different fungicides on *P. theae.*

Fungicides	Fungicide Concentration (ppm)	Mean radial growth (mm)	% inhibition of growth (%)	Coefficient of variance	Regression equation	ED_{50} – Value (ppm)
Blitox (50 WP)	10	3.60	90.44	11.21	Y=0.15x – 4.80 (R^2 = 0.886)**	3.16
Kocide (50 WP)	10	16.43	56.38	5.56	Y=0.15x – 0.92 (R^2 = 0.752)*	9.82
Dithane M45 (75 WP)	8	0.00	100	3.27	Y=0.13x – 4.92 (R^2 = 0.911)**	1.53
Bordeux Mixture (1%)	10	0.00	100	3.27	Y=0.11x – 2.14 (R^2 = 0.875)**	3.26
Baycor (25 WP)	10	5.30	85.55	4.90	Y=0.13x – 2.29 (R^2 = 0.886)**	3.02
Calixin (80 EC)	10	0.00	1000	4.10	Y=0.10x – 2.15 (R^2 = 0.868)**	3.13
Contaf (5 E)	10	15.97	56.45	5.72	Y=0.16x – 1.17 (R^2 = 0.747)*	9.34
Carbendazim (50 WP)	4	0.00	100	5.28	Y=0.117 – 4.05 (R^2 = 0.738)*	1.24

** Significant at 1% level.
* Significant at 5% level.

RESULTS AND DISCUSSION

In vitro studies indicated the suppressive effect of various fungicides on germination of conidia as well as radial growth of mycelium of *P. theae*. The inhibitory effect varied with various fungicides. Among the test fungicides, carbendazim was found to be the most effective in suppressing conidial germination followed by Dithane M-45 (Table 1). Inhibition in spore germination was cent percent with 0.5 ppm of carbendazim and 1.0 ppm of Dithane M-45, while it was 2.0 ppm with Blitox and Contaf.

A progressive increase in percent inhibition on the radial growth of the pathogen was observed with increase in concentration of the fungicides (Table 2). Among the systemic fungicides, carbendazim was highly effective in inhibiting the pathogen growth at the lowest concentration of 4 ppm followed by Calixin (10 ppm). Similarly Dithane M-45 and Bordeaux mixture were found superior among contact fungicides where complete inhibition was observed at 8 and 10 ppm concentrations, respectively (Table 2). Further, the ED50 value was the lowest with carbendazim (1.24 ppm) followed by dithane M-45 (1.53 ppm) (Table 3). Similar results were obtained with other tea pathogen like *Hypoxylon serpens* (Onsando, 1986), *Colletotrichum gloeosporoides* (Ali et al.,1993) and *Pestalotia theae* (Dutta and Begum, 1989). Chandra Mouli and Baby (2000) screened various fungicides and found that carbendazim was the best in controlling thorny stem blight disease of tea. Choompookaew (1990) observed that the ED50 value of carbendazim to *P. asparagi* was less than 1 ppm. The superior efficacy of carbendazim in suppressing the pathogen *in vitro* may be attributed to its ability in inhibiting the mitosis (Kalim et al., 2000) and other biosynthetic processes (Vyas, 1993).

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