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Control of leaf blight of taro (*Colocasia esculenta* (L) Schott) Caused by *Phytophthora colocasiae* Racib. through fungicides and selection of variety

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Control of *Phytophthora* leaf blight of Taro *(C. esculenta* (L) Schott) was attempted through application of fungicides and selection of vari ty. *In vivo* application of fungicides was followed through *'in vivo'* screening under controlled conditions. Ridomil MZ 72 WP (@ 3.0 Kg/hac at 15 days interval) was found to be highly effective in controlling the disease under field conditions with maximum net financial return (Rs. 33, 254.04 / hac). The fungicide was equally effective against the pathogen (ED_{50} : 1.13 ppm) under *in vitro* conditions. Of the eleven Taro cultivars screened against the pathogen and disease under natural epiphytotics, variety Burdwan local was best for commercial cultivation for this agroclimatic zone in particular.

Key words : Leaf blight, *Colocosia esculenta*, *Phytophthora colocasiae*, Control, Fungicides, Variety.

INTRODUCTION

Taro (*Colocasia esculenta* Schott), the poor mens' staple food, is known to suffer from a number of diseases in the field, of which leaf blight caused by *Phytophthora colocasiae* Racib. has been considered as a major constrain of the crop. Racibroski (1900) was the first to report the disease from Java. It was reported from India by Butler and Kulkarni (1973), by Gomez (1925) from Philippines, from China by Teug (1932) and from different *Colocasia* growing countries by others. The characteristic symptoms of the disease are development of small dark coloured round spots on the upper surface of the infected leaves with dark lesions on the under side and becoming irregularly necrotic with purplish to brownish colouration. Drops of yellowish to amber coloured liquid ooze out from the margin of the lesions (Parris, 1941). Under conducive environments the entire field may be blighted within 7-10 days (Trujillo, 1965). About 25-50%

reduction in tuber yield has been frequently reported (Parris, 1941 ; Johnston, 1960 ; and Kay, 1973). Under dry weather, infected tissue become necrotic, dry and fall off leaving short holes.

Chemical control has been tried by several workers. Although copper fungicides are known to control the desease very successfully (Parris, 1941 ; Parham, 1949 ; Mundkur, 1949 ; Trujillo and Aragaki, 1964 ; Bergquist, 1972 ; and Jackson *et al.*, 1980) yet other fungicides like Dithane M-45, Difolatan, Polyram, Benlate, Perenox, Dyrene are also known to play differential role in combating the disease under natural epiphytotics (Bergquist, 1972 ; 1974).

In addition varieties like 'Ahina' (Deshmuk and Chibber, 1960) and 'Poonam Pat' (Paharia and Mathur, 1964) are known to show a fairly high degree of field resistance against the disease.

The present study envisaged to evaluate further the efficacy of different fungicides including some new ones as well as to screen some newly recommended cultivars against the disease and pathogen under natural epiphytotic condition of West Bengal in particular.

MATERIALS AND METHODS

Screening of fungicides under in vitro *condition*

The fungicides belonging to several groups were assayed under *in vitro* condition by modified 'Poisoned food technique' (Pan and Sen, 1976) using oat agar medium fortified with 1% yeast extract as food base at 28°C. To determine the ED_{50} value, the data were statistically analysed on a log-probit scale. Each treatment including control (without fungicide) was suitably replicated to satisfy the statistical need.

The fungicides screened in the experiment were Bavistin 50 WP (Methyl-IH-benzimidazole - z - yl carbanate) ; Alleiate 80 WP (80% Aluminium ethyl phosphide) ; Blitox 50 W (50% Copper oxychloride) ; Captaf 75 W (75 N-tri chloromethylthio - 4 - cyclohexene - 1, 2 - dicarboximide) ; Foltaf 80 W (80% cis-N- (1, 1, 2, 2 - tetrachloroethylthio) - 4 - cyclohexene - 1, 2 - dicarboximide); Vitavax 75 WP (75% carboxin, 5, 6 dihydro 2 - methyl - 1, 4 - oxathin - 3 - carboxanilide) ; Rhizolex 50 WP (50% 0-0- dimethyl 1-0 (2, 6 - diohloro - 4 - methyl-phenyl) - phosphorothionate ; Dithane M-45 (Zinc - manganese ethylene bisdithiocarbomate) ; Ziride 80 WDP (80% zinc dimethyl dithiocarbomate) ; Benomyl (methyl - butyl - carbamamoyl - 2 - benzimidazole carbonate) ; Ridomil MZ 72 WP (methyl DL - N 2, 6 dimethyl phenyl) - N - (2, methoxyacetyl) alaninate ; Kitazin 48% EC (0, 0 - diisopropyl - S - benzylthio-phosphate); Sulfex (Sulphur 80 WP), and Delan WP 75 (4 - dithiquar-thraquinone).

Screening of fungicides under in vivo *conditions*

The healthy cormels of a susceptible Taro cultivar (cv. Kovvur local) were sown during the 2nd week of March in a completely randomized block design in 2 m x 3 m plots in two consequetive years (1989 and 1990). The spray operation of different fungicides was initiated in the 4th week of June, just before appearance of leaf blight symptoms in the field and was followed subsequently by two more sprays at 15 days interval. The disease intensity (as per cent leaf area damage) was estimated visually after each spray on a 0-7 scale. Corm yield per plot (2 x 3 m^2) was also recorded after harvesting the crop. The scale used (0-7) for estimation of the disease was as follow :

0 = No infection, 1=1.0%, 2 = 10%, 3 = 25%, 4 = 50%, 5 = 75%, 6 = 85% and 7 = 100% (complete destruction of foliage).

Screening of Taro cultivars for disease resistance

Eleven Taro cultivars were sown in replicated tretments in random block design in plots measuring 2 m x 3 m during the 2nd week of March in 1989 and 1990 with recommended agronomic practices (Thompson and Kelly, 1949). The disease severity was recorded during the period of peak disease incidence by method described earlier. The yield of individual cultivar was also recorded. The cultivars included in the experiment were Kovvur local, C-135, C-149, C-266, Kaka Kachu, Pancha Mukhi, White Goria, Purulia local, Nadia local, Burdwan local and Birbhum local collected from different sources.

RESULTS AND DISCUSSION

The results of the *in vitro* screening of fungicides (Table 1) showed that Ridomil MZ 72WP was highly effective in inhibiting the mycelial growth under *in vitro* condition (ED_{50} : 1.13 ppm) and this was subsequently followed by Dithane M45 (ED_{50} : 31.38 ppm), Foltaf 80 WP (ED_{50} : 35.55 ppm), Kitazin 48% EC (ED_{50} : 72.88), Blitox 50 WP (ED_{50} : 77.66) and Captaf 75W (ED_{50} : 207.91) in a descending order. The pathogen was less sensitive to Sulfex, Delan WP 75, Vitavax 75 WP, Bavistin 50 WP, Ziram, Rhizolex 50 WP and Benomyl (ED_{50} >250 ppm). Further it was interesting to note that Alleiate 80 WP had hardly any effect on the mycelial growth of *P. colocasiae* inspite of its known activity towards the members of Pythiaceae.

The results of the present investigation were at per with the earlier observations made by Clarkson and Moles (1985) who obtained complete inhibition of mycelial growth of *P. palmivora* with Ridomil 25 WP (metalaxyl) on the contrary Alleiate showed poor inhibitory property against the same pathogen.

Table 1. Effect of different concentrations of fungitoxicants on mycelial growth (radial) of *Phytophthora colocasiae* Racib.

Fungicides	Percent inhibition of growth over control*				ED_{50} ppm
	31.25 ppm	62.5 ppm	125 ppm	250 ppm	
Dithane M-45	45.00	79.36	100.00	100.00	31.38
Vitavax 75 WP	6.75	72.11	25.43	36.08	72.50
Blitox 50 W	10.00	26.62	72.16	100.00	77.66
Ziram (Ziride 80 WDP)	5.75	13.73	15.33	17.57	>250
Alleiate 80 WP	5.90	13.87	15.47	17.70	>250
Benomyl	3.85	4.36	7.71	8.22	>250
Foltaf 80 WP	38.90	65.75	100.00	100.00	35.50
Rhizolex 50 WP	9.30	13.88	15.80	16.66	>250
Captaf 75 W	15.30	31.74	34.97	53.65	207.91
Bavistin 50 WP	8.10	8.10	15.81	22.16	>250
Kitazin 48% EC	35.55	48.80	50.44	77.11	72.88
Sulfex	22.56	25.00	29.26	39.93	>250
Delan WP 75	22.25	30.09	35.73	38.55	>250
	0.97 ppm	1.95 ppm	3.90 ppm	7.81 ppm	
Ridomil MZ 72 WP	30.81	100.00	100.00	100.00	1.13

*An average of five applications

Six fungicides (whose ED_{50} were below 250 ppm) were tried against the disease under field conditions at two concentrations. The results (Table 2) showed that the crop sprayed with Ridomil MZ 72 WP @ 0.4% had low disease incidence (20.87% and 22.74% in 1989 and 1990 respectively) followed by Dithane M-45 (@ 0.4%) and Ridomil MZ 72 WP (@ 0.2%). Both Blitox 50W and Captaf 75 W were moderately effective. However, Foltaf 80 WP (@ 0.4% & 0.2%) was severe to moderate phytotoxic towards the crop. Cox and Kasimani (1989) obtained excellent control of this disease with Ridomil 72 WP @ 0.3% under field conditions. Bergquist (1974) claimed that Dithane M-45 @ of 2.24 or 4.48 kg/hac was highly effective in controlling the disease. A negative correlation with disease severity severity and corm yield (Table 2) indicated that the incidence of the disease had significant effect on the corm yield. The corm yield in plots treated with fungicides was significantly higher over non-treated plots but with Captafol and Kitazin a reduction in yield over control was recorded. Foltaf, (@ 0.4%) although, was phytotoxic to taro leaves gave slight increase of yield over control.

Table 2. Effect of different fungicides on *Phytophthora* leaf blight and yield of Taro

Fungicides	Conc. of Fungicides (%)	Mean disease severity (%) 1989	1990	Pooled	Mean yield (Kg/6 Sq.m) 1989	1990	Pooled
Ridomil MZ 75 WP (T_1)	0 2	42.76* (40.80)	39.06* (38.65)	40.91 (39.76)	16.00	16.10	16.03
Ridomil MZ 75 WP (T_2)	0.4	20 87 (27.20)	22.74 (28.45)	21.81 (27.83)	17.29	17.70	17.50
Blitex 50 W (T_3)	0.4	44.77 (41.96)	42.20 (40 51)	43.49 (41.27)	13.66	13.12	13.39
Blitex 50 W (T_4)	0.6	43.70 (41.38)	40.13 (39.29)	41 92 (39.99)	15.50	15.90	15.70
Dithane M-45 (T_5)	0.2	45.45 (42.36)	43.36 (41.21)	44.41 (41.78)	15.50	14.28	14.89
Dithane M-45 (T_6)	0.4	41.32 (39.99)	40.23 (39.35)	40.78 (39.70)	16.50	15.80	16.15
Captaf 50 W (T_7)	0.2	53.77 (47.18)	54.14 (47.35)	53.96 (47.24)	11.20	12.58	11.89
Captaf 50 W (T_8)	0.4	51.53 (45.86)	50.24 (45 11)	50.89 (45.52)	13.60	13.00	13.26
Foltaf 80 WP (T_9)	0.2	55.70 (48.27)	51 82 (46.03)	53 76 (47.12)	8.70	9.00	8.85
Foltaf 80 WP (T_{10})	0.4	46.47 (42.94)	44.28 (41.73)	45.38 (42.36)	9.70	10.00	9.85
Kitazin 48% E.C. (T_{11})	0.2	49.43 (44.66)	49 76 (44.89)	49.60 (44.77)	9.00	8.22	8.61
Kitazin 48% E.C. (T_{12})	0.4	47.67 (43.74)	48.46 (44.14)	48.07 (43.91)	9.20	9.00	9 10
Control (T_{13})	—	60.30 (50.94)	61.90 (51.88)	61.10 (51.41)	9.50	10.00	9.75
SEM ± =					0.558	0.398	0.378
C. D. (P ⩾ 0.05) =					1.286	1.163	1.105
r=					—0.717	—0.745	—0.739

* Mean disease severity of 1st, 2nd & 3rd spray

Cost : benefit ratio of fungicidal spraying against *P.colocasiae* (Table 3) showed that maximum net return of Rs. 33,254.04/hac was obtained from the spraying with Ridomil MZ 72WP (0.4%) followed by Dithane M-45 (0.4%), Ridomil (0.2%), Blitox 50W (0.4%), Dithane M-45 (0.2%), Blitox 50W (0.2%), Captaf 50W (0.4%) and Captaf 50W (0.2%) in order of merit.

It was evident from the present study that the foliar spray with Ridomil MZ 72WP @ 0.4% at an interval of 15 days before the on set of diseaee may be recommended for effective control of leaf blight of Taro caused by *Phytophthora colocasiae* Racib.

Table 3. Cost : Benifit analysis of fungicidal spraying against *Phytophthora* leaf blight of Taro

Fungicides	Dose (Kg/ha.)	Total Yield (qt/ha.)	Increase in yield over control (qt/ha.)	Value of increased yield (qt/ha.)	Cost fungicides + Labour charge for 3 spray (qt/ha.)	Net return (Rs/ha.)
Ridomil MZ 75 WP	1.5	267.16	105.50	31650.00	2985.48	28664.52
Ridomil MZ 75 WP	3.0	291.66	130.00	39000.00	5745.96	33254.04
Biltox 50 W	3.0	223.25	61.58	18474.99	1002.60	17472.39
Biltox 50 W	4.5	261.66	100.00	30000.00	1391.40	28608.60
Dithane M-45	1.5	248.16	86.49	25949.99	710.50	25239.49
Dithane M-45	3.0	269.16	107.50	32250.00	1196.00	31054.00
Captaf 50 W	1.5	198.16	36.49	10949.90	783.90	10166.09
Captaf 50 W	3.0	221.10	59 43	17829.99	1348 00	16481.99
Foltaf 80 W	1.5	147.50	—		1138.68	—
Foltaf 80 W	3.0	164.16	2.49	749.99	2052.36	—
Kitazin 48% E.C.	1.5*	143.50	—			—
Kitazin 48% E.C.	3.0*	151 66	—			—
Control (Untreated)		161.66				—

* litre / ha (—) loss

An overview of the results (Table 4) clearly indicated that all the varieties screened showed leaf blight symptoms due to *Phytophthora colocosiae* but the intensity of disease index (PDI) varied between 5.0-79.5% in 1989 and 7.0-84.5% in 1990. The PDI slightly increased in 1990 than 1989 may be due to vriations in prevailing environmental conditions in these two years. From the results (Table 4) it was further clear that among the different caltivars screened variety Birbhum local showed maximum resistance towards the pathogen and disease development (PDI : 6 0). Burdwan local (PDI : 10.0) was next to best. Variety Kovvur local suffered from maximum disease severity (PDI-82.0).

The highest yield was obtained from Nadia local (15.0 kg 6 sq. m). Burdwan local (12.5 kg/6 sq. m) was next to best. Variety Kaka Kachu gave poor yield (6.85 kg/6 sq. m). It was interesting to note that statistically there was no significant difference between yield of most susceptible variety Kovvur local and Birbhum local. However, from an overall perusal of results, (disease tolerance and yield potential) variety Burdwan local may be recommended for commercial cultivation with reference to the environmental conditions of this locality duriug the taro growing season in particular.

Table 4. Screening of different Taro cultivars *(C. esculenta)* against *P. colocasiae* under natural epiphytotics

Variety	Percentage of disease index (PDI)			Mean yield (Kg/6 Sq.m)		
	1989	1990	Pooled	1989	1990	Pooled
Kavvur	79.5*	84.5*	82.0	10.0	9.5	9.7
Local	(64.01)	(67.10)	(65.56)			
C-135	72.5	75 0	73.75	13.0	11.0	12.0
	(59.24)	(59.90)	(59.57)			
C-149	52.0	61.0	56.5	12.0	10.0	11.0
	(46 26)	(51 16)	(48.71)			
C-266	72.0	73.0	72.5	10.0	8.9	9.5
	(58.30)	(58.71)	(58.51)			
Kaka	75.0	77.0	76.0	7.0	6.7	6.8
Kachu	(59 63)	(61.36)	(60.50)			
Pancha	11.0	17.0	14.0	9.0	8.0	8.5
Mukhi	(18 48)	(24.45)	(21.47)			
White	22 0	41.0	31.5	8.5	7.0	7.7
Goria	(27.50)	(40.01)	(33.76)			
Purulia	10.0	18.0	14.0	9.0	8.5	8.7
Local	(18.65)	(25 34)	(21.99)			
Nadia	12.0	20.0	16.0	16.0	14.0	15.0
Local	(20.35)	(26.66)	(23.1)			
Burdwan	9.0	11.0	10.0	13.0	12.0	12.5
Local	(17.08)	(19.58)	(18.33)			
Birbhum	5 0	7.0	6.0	10.0	9.0	9.5
Local	(12.91)	(15.32)	(14.11)			
SEM ±	0.942	0.853	0.482	0.400	0.498	0.354
CD ($P \geq 0.05$)	2 769	2.516	1.424	1.180	1.470	1.047
CD ($P \geq 0.01$)	2.777	3.432	1.943	1.609	2.005	1.427

* Average of three replications.

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