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Evaluation of fungicides and antibiotics against soil borne pathogens of brinjal

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Most of the fungicides and antibiotics tested were found effective against soil borne pathogens of brinjal such as *Pythium aphanidermatum*, *Fusarium oxysporum* f. sp. *melongenae*, *Rhizoctonia solani* and *Ralstonia solanacearum*, under *in vitro* conditions. Carbendazim was found most effective against *F. oxysporum* f. sp. *melongenae* and *R. solani* at all the concentrations tested, whereas, metalaxyl + mancozeb was found effective against *P. aphanidermatum* at all the concentrations with cent per cent inhibition. However, combination of streptomycin sulphate + tetracycline was effective against *R. solanacearum.*

Key words: Antibiotics, brinjal, fungicides, soil borne pathogens

INTRODUCTION

Brinjal (*Solanum melongena* L.) is a common vegetable crop grown all over the world and India is considered to be the centre of its origin (Zeven and Zhukovsky, 1975). In Jammu region of the state of Jammu and Kashmir, the brinjal is cultivated in an area of 950 ha with total production of 13,775 MT (Anonymous, 2009). Brinjal crop suffers from many biotic stresses, out of which soil borne diseases are of great economic importance. Prevalence of warm temperature and high humidity during rainy season is congenial for the active growth of the crop, however, it also favours the development of many diseases. During field surveys in the recent past, soil borne diseases of solanaceous vegetables have been observed in an increasing proportion in all the climatic zones of Jammu region, sometimes leading to total crop failure. In spite of being non-selective, killing non-target, beneficial soil micro flora, chemical management is usually the most feasible and economic mean of managing a plant disease than any other measure. Pathogens which are mainly soil and/or seed borne, disinfection of seeds and soil with chemicals/fungicides has yielded encouraging results. Seed treatment with fungicides is regarded as the most economical and convenient method of chemical control of a particular seed borne plant disease.

MATERIALS AND METHODS

During surveys, plants showing disease symptoms such as damping off, leaf chlorosis, drooping of leaves, inward curling, disintegration of stem and stunting were collected, bagged separately in perforated polythene bags and brought to the laboratory for isolation of pathogens associated with the diseased plant samples. In order to prove the Koch's postulates, pathogenicity tests were performed on brinjal cultivar Pusa Purple Long (PPL), for which the garden soil was sterilized by autoclaving at 121^{0}C for 1 hr. consequently for two days. Pots of 15 inches diameter, filled with the sterilized soil were inoculated separately with *Fusarium oxysporum* f. sp. *melongenae* and *Rhizoctonia solani* each @ 5 g/ kg soil. The inoculations were done seven days before transplanting of the seedlings into the pots. In case of *Pythium aphanidermatum*, the pathogenicity was tested by sowing surface sterilized (0.1% mercuric chloride) brinjal seeds in trays containing sterilized soil, the pathogen was inoculated seven days before sowing. To test the pathogenicity of isolated bacterium five week old

seedlings of brinjal cv. Pusa Purple Long were raised from sterilized seeds in autoclaved soil. Roots of the seedlings were washed under running water to remove adhering soil particles, rinsed with sterilized distilled water and planted singly in 250 ml Erlenmeyer conical flasks containing 200 ml soil extract. Each flask was dispensed with 10 ml of two day old bacterial culture grown in nutrient broth (Das and Chattopadhyay, 1955). Appropriate controls for each set of treatments with three replications were maintained. These flasks were incubated at room temperature and observations on per cent wilt disease were made after 15 days.

In vitro evaluation of chemicals against the fungal pathogens

The efficacy of chemicals viz., propiconazole, tebuconazole, hexaconazole, and difenoconazole were used at 10, 25 and 50 ppm concentrations, whereas, carbendazim, carbendazim + mancozeb, metalaxyl + mancozeb, triademifon and carboxin + thiram were evaluated at 50, 100 and 250 ppm against each isolated pathogen using poisoned food technique (Schmitz, 1930). Petriplates containing PDA amended with the desired concentrations of fungicides were inoculated with 5 mm discs of individual pathogen and incubated at 25±2°C; Petriplates without any fungicide served as check. The experiment was conducted under completely randomized design with three replications. The radial growth of mycelium was recorded in each treatment and per cent inhibition over check was calculated using the following formula (Vincent, 1927) : I = 100 (C-T)/C; where, I = Inhibition per cent; C = Colony diameter in control (mm); T = Colony diameter in fungicide amended medium (mm)

In vitro evaluation of antibiotics against the bacterial pathogen (R. solanacearum)

The efficacy of antibiotics viz., Streptomycin sulphate (Rickimycin), Tetracycline hydrochloride (Hostacycline), Ampicillin (Ampicillin), Azithromycin (Azithromycin), Amoxycillin (Amoxycillin trihydrate), Nalidixic acid (Gramoneg), Chloramphenicol (Ranphenicol), Streptromycin sulphate + Tetracycline (Plantomycin), Erythromycin (Erythrocin) and Penicillin G potassium (Pentids) was evaluated at 100, 250 and 500 ppm against *Ralstonia solanacareum* adopting the methodology given by Skinner (1955).

RESULTS AND DISCUSSION

In vitro evaluation of chemicals against the fungal pathogens

The perusal of the data presented in Table 1 revealed that Mancozeb + Metalaxyl was highly effective against *Pythium aphanidermatum* at all the concentrations tested (50, 100 and 250 ppm), resulting in 100 per cent inhibition over control, followed by Mancozeb + Carbendazim, exhibiting 17.33, 27.80 and 38.47 mm mycelial growth with 80.74, 69.11 and 57.26% growth inhibition over control at 250, 100 and 50 ppm, respectively, though they were significantly different from each other. They were followed by Triademifon (45.67 mm mycelial growth with 49.26% inhibition) at 250 ppm, whereas, Carbendazim was least effective at 50, 100 and 250 ppm, exhibiting growth of 85.67, 85.00 and 81.00 mm, thereby causing inhibition of 4.81, 5.56 and 10.00%, respectively, over check. The data further revealed that all the fungicides were effective against *R. solani*, though complete inhibition (100 %) of the mycelial growth was observed with Carbendazim at 50, 100 and 250 ppm, Tebuconazole at 25 and 50 ppm and Mancozeb + Carbendazim at 250 ppm. This was followed by Tebuconazole (10 ppm) and Carboxin + Thiram (250 ppm) which resulted in 8.20 and 9.00 mm mycelial growth with 90.89 and 90.00% inhibition over control. The complete inhibition of the mycelial growth of *F. oxysporum* f. sp. *melongenae* was observed with Carbendazim at all the concentration tested and Tebuconazole at 50 ppm, followed by Mancozeb + Carbendazim at 250 ppm resulting in 9.60 mm mycelial growth with 89.33% inhibition. Carboxin + Thiram at 50 ppm was found least effective against the fungus exhibiting 63.07 mm growth with 29.93% inhibition. Our results are in accordance with Hundoo and Dwivedi (1997) who tested Captan, Emison-6, Foltaf, JKstein, Kavach, Shield-75 and Vitavax against *R. solani*, the causal agent of damping off in eggplant under *in vitro* conditions and concluded that JKstein and Vitavax were the most effective, whereas, Shield-75 was least effective in checking the linear growth of the fungus. Singh *et al.* (1995), who reported that Carbendazim and Benomyl were the most effective *in vitro* fungitoxicants against *Fusarium* spp. compared to Captafol, Thiram, Thiophenate methyl and Captan. The efficacy of Carbendazim and carboxin against *R. solani* under *in vitro* conditions had also been

Table.1: *In vitro* evaluation of fungicides against soil borne fungal pathogens of brinjal

Chemical	Conc. (ppm)	Radial growth (mm)			Per cent inhibition		
		Pa	*Rs*	*Fo*	*Pa*	*Rs*	*Fo*
Propiconazole (Tilt)	10	80.73	21.80	26.00	10.30	75.78	71.11
	25	71.40	17.00	21.40	20.67	81.11	76.22
	50	60.40	12.20	15.40	32.89	86.44	82.89
Tebuconazole (Folicur)	10	77.47	8.20	18.20	13.93	90.89	79.78
	25	69.07	0.00	11.00	23.26	100.00	87.78
	50	60.13	0.00	0.00	33.19	100.00	100.00
Hexaconazole (Malconda)	10	70.60	26.40	28.40	21.56	70.67	68.44
	25	60.60	21.00	22.20	32.67	76.67	75.33
	50	47.27	16.00	15.80	47.48	82.22	82.44
Difenoconazole (Score)	10	83.80	68.00	49.80	6.89	24.44	44.67
	25	76.87	58.00	36.20	14.59	35.56	59.78
	50	67.27	41.00	31.80	25.26	54.44	64.67
Carbendazim (Bavistin)	50	85.67	0.00	0.00	4.81	100.00	100.00
	100	85.00	0.00	0.00	5.56	100.00	100.00
	250	81.00	0.00	0.00	10.00	100.00	100.00
Triademifon (Bayleton)	50	71.00	68.20	59.00	21.11	24.22	34.44
	100	61.00	59.60	48.40	32.22	33.78	46.22
	250	45.67	41.00	36.60	49.26	54.44	59.33
Mancozeb + Carbendazim (SAAF)	50	38.47	14.60	19.00	57.26	83.78	78.89
	100	27.80	24.80	14.80	69.11	72.44	83.56
	250	17.33	0.00	9.60	80.74	100.00	89.33
Mancozeb + Metalaxyl (Ridomil-MZ)	50	0.00	26.80	22.13	100.00	70.22	75.41
	100	0.00	21.00	18.13	100.00	76.67	79.85
	250	0.00	11.40	12.13	100.00	87.33	86.52
Carboxin + Thiram (Vitavax power)	50	75.80	23.00	63.07	15.78	74.44	29.93
	100	65.00	17.20	53.93	27.78	80.89	40.07
	250	57.73	9.00	42.20	35.85	90.00	53.11
Control		90.00	90.00	90.00	0.00	75.78	0.00
CD (P=0.05)		2.32	1.52	1.14			
$S.E_m(\pm)$		0.81	0.53	0.40			

Fo = Fusarium oxysporum f. sp. *melongenae; Pa = Pythium aphanidermatum; Rs = Rhizoctonia solani*

Table. 2: *In vitro* evaluation of antibiotics against *Ralstonia solanacearum* causing bacterial wilt in brinjal

Antibiotic	Concentration (ppm)	Mean Zone of inhibition
Tetracycline	100	1.73
	250	3.60
	500	7.77
Penicillin	100	8.43
	250	12.73
	500	21.00
Nalidxic acid	100	00.00
	250	1.27
	500	3.70
Amoxycillin	100	00.00
	250	1.53
	500	4.10
Chloramphenicol	100	5.97
	250	10.73
	500	18.00
Streptomycin sulphate	100	5.97
	250	11.33
	500	18.47
Plantomycin (Streptomycin sulphate + Tetracycline)	100	10.83
	250	18.63
	500	28.77
Azithromycin	100	00.00
	250	00.00
	500	00.00
Erythromycin	100	00.00
	250	00.00
	500	00.00
Ampicillin	100	00.00
	250	00.00
	500	00.00
Control	-	00.00
$S.E_m(\pm)$		0.18
CD (P=0.05)		0.50

advocated by other researchers (Dubey and Patel, 2001; Upmanyu *et al.*, 2002). Abdel and Abu (1991) tested nine fungicides (Bavistin, Benlate, Topsin-M, Miltox special, Dithane M-45, Dithane S-60, Ridomil 5-G, Rovral and Captan-50) against *P. debarynum* and found that Ridomil 5-G (Metalaxyl) gave best control on Potato Dextrose Agar medium. Sawant and Mukhopadhyay (1992) reported that the best control of sugarbeat damping-off was with Metalaxyl which was followed by Mancozeb + Metalaxyl (Ridomil-MZ).

In vitro evaluation of antibiotics against the bacterial pathogen (*R. solanacearum*)

Efficacy of ten antibiotics viz., Tetracycline hydrochloride, Penicillin, Nalidixic acid, Amoxicillin, Chloramphenicol, Streptomycin sulphate, Ampicillin, Azithromycin, Erythromycin and combination antibiotic Streptomycin sulphate + Tetracycline (Plantomycin) were tested against *R. solanacearum* at 100, 250 and 500 ppm concentrations. All the antibiotics inhibited the growth of test pathogen, except Ampicillin, Azithromycin and Erythromycin. The results presented in Table 2 revealed that plantomycin (Streptomycin sulphate + Tetracycline) was most effective antibiotic, resulted in mean inhibition zone of 28.77 mm, followed by Penicillin showing 21.00 mm zone of inhibition at 500 ppm concentrations, though they were significantly different from each other. The data also exhibited that Plantomycin at 250 ppm restricted the bacterium with mean inhibition zone of 18.63 mm, which was followed by Streptomycin sulphate exhibiting 18.47 mm inhibition zone and this treatment was at par with Chloramphenicol which resulted in 18.00 mm mean zone of inhibition. The least effective antibiotics tested were Azithromycin, Erythromycin and Ampicillin which did not show any inhibition zone at any of the tested concentrations. Our findings are in conformity with Hidaka and Murano (1956) who showed that *in vitro* Streptomycin at 0.3 to 0.5 µg/ml of water was effective in inhibiting *P. solanacearum*. Sitaramaiah and Sinha (1983) evaluated five antibiotics viz., Penicillin-G sodium, Streptomycin sulphate, Agrimycin-100, Oxytetracycline and Chloramphenicol in glass house at 250, 500 and 1000 ppm against *P. solanacearum* in brinjal.

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