Efficacy of some fungicides and oil cake extracts against basal rot of onion caused by *Fusarium oxysporum*

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ABSTRACT

Onion (*Allium cepa* L) is one of the most important vegetable cum condiment crops of family Alliaceae grown in all parts of India. *Fusarium* wilt, an economically significant disease caused by *Fusarium oxysporum* has been causing major yield loss in the most onion cultivating regions of the world. The main objective of the present study was to assess the efficacy of ten different fungicides viz carbendazim, benomyl, tebuconazole, hexaconazole, mancozeb (63%) + carbendazim (12%), mancozeb, captan, copper oxychloride, zineb (64%) + (hexaconzole 4%) and trifloxystrobin (25%) + tebuconazole (50%) each at four different concentrations (500, 1000, 1500 and 2000 ppm) and oil cake extracts of neem, mahua, groundnut, mustard, pungam, castor and gingelly at 10 per cent concentration against linear colony of the fungus *F oxysporum*. Carbendazim, mancozeb (63%) + carbendazim (12%) and mancozeb were found to be the most effective with complete inhibition of mycelial growth of the fungus at 500, 1000, 1500 and 2000 ppm followed by trifloxystrobin (25%) + tebuconazole (50%). Among the oil cake extracts neem was found the most effective in inhibiting the mycelial growth of *F oxysporum* followed by mustard.

Keywords: Onion basal rot; fungicides; oil cake extracts; inhibition; mycelial growth

INTRODUCTION

Onion (*Allium cepa* L) is a unique vegetable among the vegetables grown in India which is consumed by almost all the sections of the society throughout the year not only at maturity but also at different stages of growth. The underground bulbous vegetable has been grown on commercial high production potentiality and also it has great economic importance because of its nutritional and medicinal values (Nasri et al 2012) including anti-inflammatory, anti-cholesterol, anti-cancer and anti-oxidant properties.

Various foliar, bulb and root pathogens attack this crop and reduce production. Most important soil-borne fungal pathogens of this crop include *Fusarium* spp, *Rhizoctonia* spp, *Pythium* spp, *Sclerotium* spp, *Sclerotinia sclerotiorum*, *Pyrenochaeta terrestris* and *Macrophomina phaseolina*. All over the world these pathogens lead to severe production losses (Schwartz and Mohan 1995). One of these pathogens, *Fusarium oxysporum* f sp *cepae* causes basal rot of onion (Cramer 2000) and is considered as one of the most important soil-borne diseases of onion, causing severe yield losses in the productivity both in field and storage conditions (Coskuntuna and Ozer 2008). Infected seeds and soil have been the main source of dispersal. The fungus causes infection at the basal stem plate of the onion bulb and degrades it. Finally the whole plant is destroyed and the infection in dormant bulbs during storage allows secondary infections to occur (Cramer 2000). Despite many attempts to control this disease the problem has been still important throughout the world. The management practices generally employed for its control include resistant cultivars, chemical applications, cultural practices and biotechnological approaches. However incorporation of integrated management provides a better opportunity to manage the disease (Chandel and Deepika 2010). The chemical control based on the use of fungicides is the most

effective and reliable method. New fungicides with novel chemistry are being introduced and evaluated for plant disease control. Their application in farmers' fields can only be recommended against the causal pathogens after a successful laboratory evaluation. It needs a constant watch and effort to evolve new fungicides along with some important non-chemical methods for controlling the diseases.

MATERIAL and METHODS

The experiment was conducted in 2016-17 using completely randomized design with three replications to ascertain the effect of different fungicides and oil cake extracts at different concentrations on mycelial growth and sporulation of *F oxysporum* in vitro.

Efficacy of fungicides: Efficacy of five systemic and non-systemic fungicides was tested against mycelial growth of *F oxysporum* by poisoned food technique suggested by Nene and Thapliyal (1979). Four different concentrations viz 500, 1000, 1500 and 2000 ppm of each fungicide were tested. Required quantity of each fungicide was added separately to the sterilized medium, mixed thoroughly and poured into sterilized 10 cm diameter glass Petri plates and allowed to solidify for an hour. Each plate was inoculated with 9 mm disc of 7 days old culture of *F oxysporum* with the help of sterilized cork borer and incubated at 25 + 1°C for 7 days. A control was also maintained where medium was not supplemented with any fungicide. The mycelial growth of the test fungus was recorded and per cent growth inhibition was calculated by Vincent (1947) formula given below. The experiment was conducted in completely randomized design with three replications.

$$\text{Per cent growth inhibition (PGI)} = \frac{C - T}{C} \times 100$$

where C is diameter of colony in check (average of both diagonals) and T is diameter of colony in treatment (average of both diagonals)

Efficacy of organic amendments: The effect of each oil cake extract was tested at 10 per cent concentration. The required quantity of oil cake extract was sterilized in autoclave at 1.045 kg/cm^2 for 20 min, grinded separately and thoroughly washed with sterilized distilled water. The mixture was squeezed with double-layered sterilized cheese cloth. The amendments thus obtained were considered as of 100 per cent concentration. Required amount of stock solution was added to potato dextrose agar to get the desired concentration.

The effect of oil cake extracts against the the mycelial growth of *F oxysporum* was tested by poisoned food technique. Required quantity of each organic amendment was mixed thoroughly in melted oat meal agar to get the desired concentration just before pouring into sterilized 10 cm diameter glass Petri plates and was allowed to solidify for an hour. Each plate was inoculated with 9 mm disc of 7 days old culture of *F oxysporum* with the help of sterilized cork borer. The inoculated Petri plates were incubated at 25 + 1°C for 7 days. A control was also maintained where medium was not supplemented with any oil cake extract. The experiment was conducted in completely randomized design with three replications. Colony diameter (two diagonals) was measured after 7 days of incubation. The per cent growth inhibition was calculated as per Vincent (1947).

RESULTS and DISCUSSION

The efficacy of different fungicides against *F oxysporum* at four concentrations viz 500, 1000, 1500 and 2000 ppm was assayed in vitro. Results presented in Tables 1 and 2 indicate that all the chemicals at various concentrations inhibited the fungal mycelial growth and all the fungicides were significantly superior over control at all the concentrations. Carbendazim, mancozeb (63%) + carbendazim (12%) and mancozeb gave complete growth inhibition of the fungus at 500 ppm concentration followed by trifloxystrobin (25%) + tebuconazole (50%) which showed complete mycelial growth inhibition at 1000, 1500 and 2000 ppm concentrations. Tebuconazole, hexaconazole and copper oxychloride were observed as moderate inhibitors of the mycelial growth at 500, 1000, 1500 and 2000 ppm. Minimum inhibition was recorded in benomyl, captan and zineb (64%) + hexaconazole (4%) at - 500, 1000, 1500 and 2000 ppm.

Similar results were observed by Behrani et al (2015) who reported that carbendazim followed by antracol appeared as the most effective fungicides. Gupta et al (1983) tested the efficacy of the fungicides against *F oxysporum* f sp *cepae* causing the basal rot of onion in vitro and found that Benlate (benomyl) performed the best (250 ppm) followed by Bavistin (carbendazim), thiram and Vitavax (carboxin) (2000

Table 1. In vitro effect of different fungicides on the growth of *Fusarium oxysporum* f sp *cepae*

Fungicide	Mycelial growth (cm) at different concentrations (ppm)			
	500	1000	1500	2000
Carbendazim (Bavistin 50 WP)	0.00	0.00	0.00	0.00
Benomyl (Benlate 50 WP)	5.86	4.83	3.54	2.83
Tebuconazole (Folicure 25.9 EC)	3.52	2.15	1.85	1.25
Hexaconazole (Contaf 5 EC)	2.84	2.24	1.86	1.63
Mancozeb 63% + carbendazim 12% (SAFF 75 WP)	0.00	0.00	0.00	0.00
Mancozeb (Dithane M-45, 75 WP)	0.00	0.00	0.00	0.00
Captan (Captaf 50 WP)	6.45	5.36	4.15	2.90
Copper oxychloride (Blitox 50 WP)	4.09	2.93	2.73	1.83
Zineb 64% + hexaconazole 4% (Avatar 68 WP)	6.56	4.02	3.83	2.74
Trifloxystrobin 25% + tebuconazole 50% (Nativo 75 WP)	3.53	0.00	0.00	0.00
Control	9.00	9.00	9.00	9.00
$CD_{0.05}$	0.03	0.05	0.03	0.05

Table 2. In vitro effect of different fungicides on inhibition of *Fusarium oxysporum* f sp *cepae*

Fungicide	Reduction (%) over control at different concentrations (ppm)			
	500	1000	1500	2000
Carbendazim (Bavistin 50 WP)	100.00	100.00	100.00	100.00
Benomyl (Benlate 50 WP)	34.88	46.33	60.66	68.55
Tebuconazole (Folicure 25.9 EC)	60.88	76.11	79.44	86.11
Hexaconazole (Contaf 5 EC)	68.44	75.11	79.33	81.88
Mancozeb 63% + carbendazim 12% (SAFF 75 WP)	100.00	100.00	100.00	100.00
Mancozeb (Dithane M-45, 75 WP)	100.00	100.00	100.00	100.00
Captan (Captaf 50 WP)	28.33	40.44	53.88	67.77
Copper oxychloride (Blitox 50 WP)	54.55	67.44	69.66	79.66
Zineb 64% + hexaconazole 4% (Avatar 68 WP)	27.11	55.33	57.44	69.55
Trifloxystrobin 25% + tebuconazole 50% (Nativo 75 WP)	60.77	100.00	100.00	100.00
Control	-	-	-	-

Table 3. Efficacy of oil cake extract on the growth of *Fusarium oxysporum* f sp *cepae*

Oil cake	Concentration (%)	Linear growth of mycelium (cm)	Reduction (%)
Neem oil cake	10	2.03	77.44
Mahua oil cake	10	2.37	73.66
Groundnut oil cake	10	3.74	58.44
Mustard oil cake	10	2.26	74.88
Pungam oil cake	10	7.94	11.77
Castor oil cake	10	3.44	61.77
Gingelly oil cake	10	4.75	47.22
Control	-	9.00	-
$CD_{0.05}$	-	0.06	-

ppm). Song et al (2004) and Rajput et al (2006) tested carbendazim and some other fungicides for their inhibitory activities against the wilt pathogen *F oxysporum*. Similarly Kyada and Parakhia (2011) tested the systemic and non-systemic fungicides in vitro and found that carbendazim and thiophanate methyl were equally effective and completely inhibited the growth of the fungus.

Efficacy of five different oil cake extracts was tested in vitro at 10 per cent concentration by poisoned food technique against the mycelial growth of *F oxysporum*. All the oil cake extracts were significantly superior in inhibiting the mycelial growth of the fungus over control. Irrespective of the concentration neem cake extract was found the most effective in inhibiting the mycelial growth closely followed by mustard and groundnut cake extracts. The maximum inhibition of mycelial growth (77.44%) was in neem cake followed by mustard cake extract (74.88%) (Table 3).

Haseeb and Kumar (2007) reported that neem oil cake was effective against the growth of *F oxysporum*. Yadav et al (2014) found neem cake extract effective in inhibiting the mycelial growth of *F oxysporum* f sp *cepae* causing basal rot of onion followed by mustard cake.

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