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Research Article

Evaluation of fungicides against *Fusarium oxysporum ciceri* causing chickpea wilt

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Abstract

A lab experiment was conducted to evaluate six combi product fungicides, four contact fungicides and four systemic fungicides at three concentrations against *Fusarium oxysporum ciceri* causing wilt of chickpea. Among combi products, carbendazim 12% + mancozeb 63% (Saaf) was effective in all concentrations (0.1, 0.2 and 0.3%) with cent per cent inhibition and least inhibition (21.85%) was recorded in zineb 68% + hexaconazole 4%WP (Avatar) @ 0.1% concentration. In contact fungicides, copper oxychloride was effective with 90.0 % inhibition @ 0.3% concentration and minimum inhibition (44.58%) was in zineb @ 0.1% concentration. Among systemic fungicides carbendazim, tebuconazole recorded cent per cent inhibition at all concentrations, (0.015, 0.075 and 0.1%) where as less inhibition (82.08%) was in the difenconazole @ 0.1%.

Keywords: Chickpea, wilt, Inhibition, Fungicides, Per cent and *Fusarium oxysporum ciceri*

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Introduction

Chickpea (*Cicer arietinum* L), also known as Gram or Bengal gram, is the third most important pulse crop after bean (*Phaseolus vulgaris* L) and pea (*Pisum sativum* L) on world basis, but is of prime importance in the Mediterranean basin and South Asia. The crop is vulnerable to a number of air-borne and soil-borne diseases, some of which are devastating. Chickpea suffers from 172 pathogens consisting of fungi, bacteria, viruses and nematodes. The soil borne diseases, which severely damage the chickpea under favourable conditions are wilt caused by *Fusarium oxysporum ciceri*, dry root rot caused by *Rhizoctonia bataticola* and collar rot caused by *Sclerotium rolfsii*. In the present study fungicides were tested under lab condition, to know relative efficacy against the management of wilt disease.

In recent years, wilt complex is becoming the major threat in cultivation of chickpea in Karnataka. Pathogens responsible for causing wilt complex were *Fusarium oxysporum ciceri, Rhizoctonia bataticola* and *Sclerotium rolfsii* [1] and same pathogens were reported in coleus wilt [2]

Material and methods

Experiment was conducted in order to find out the suitable fungicide in inhibiting the pathogen by poison food technique [3]. The details of the fungicides are presented below.

Combi products were evaluated at 0.1, 0.2 and 0.3 per cent.

Common name	Chemical name	Trade name
Zineb 68% + Hexaconazole 4%WP	(RS)-2-(2,4-dicholoro phenyl)-1-(1H-1,2,4-triazole-1-yl)-hexan-2-01 ($C_{14}H_{17}Cl_2N_3O$) +zinc ethylene-1,2-bisdithiocarbamate	Avtar 72%WP
Tricyclazole 18%WP + Mancozeb 62%WP	5-methyl-1, 2, 4-triazole (3, 4b) Benzothiazole 18 + Manganese ethylene bis dithiocarbonate plus zinc 62	Merger 80% WP
Carbendazim 12% + Mancozeb 63%	Methyl benzimidazole carbonate + Manganese zinc ethylene bis dithiocarbomate + zinc	Saaf 75% WP
Carbendazim 25% + Mancozeb 50% WP	Methyl 2 Benzimidazole carbomate 25 + Manganese ethylene bis dithiocarbonate + zinc50	Sprint 75% WS
Captan70%+Hexaconazole 5% WP	N-trichloromethyl mercapta 4-cyclohexene-1,2-dis carboximide N-trichloromethyl thiotetra hydro othalamide + RS) -2- (2,4-dichloro phenyl) -1- (14-1,2,4-triazole-1 yl) hexane-2-1	Taqat 75% WP
Carboxin 37.5% + Thiram 37.5%	3-(3-5-dichlorophenyl) –N-(1-methylethyl)-2-4-dioxo-1-lemadazolidine carboximide + tetramethyl thirum disulphide	Vitavax power 75% WP

Contact fungicides were used at 0.1, 0.2 and 0.3 per cent

Common name	Chemical name	Trade name
Captan	N-trichloromethyl mercapta 4-cyclohexene-1,2-dis carboximide N-trichloromethyl thiotetra hydro othalamide	Captaf 50WP
Chlorothalonil	Tetrachloroisophthalonitrate	Kavach 75% WP
COC	Copper oxy chloride	Blitox 50 WP
Zineb	Zinc ethylene bis dithiocarbomate	Dithane Z-78

Systemic fungicides were used at 0.05, 0.075 and 0.1 per cent.

common name	Chemical name	Trade name
Carbendazim	2-(methoxy-carbomyl)-benzimidazole	Bavistin 50%WP
Difenconazole	1-(2-(4-(4-chlorophenoxy)-2-chlorophenyl)-4-methyl-1,3-dioxol-2yimethyl-1)-14-1,2,4-triazole	Score 25%EC
Hexaconazole	(RS)-2-(2,4-dichloro phenyl)-1-(14-1,2,4-triazole-1 yl) hexane-2-1	Contaf 5%EC
Tebuconazole	1-(2,4 di chlorophenyl) -4-ropyl-1,3-dioxolan-2-methyl) –H-1,4-triozole	Tilt 25EC

Required quantity of individual fungicide was added separately into sterilized molten and cooled potato dextrose agar so as to get the desired concentration of the fungicides. Later, 20 ml of the poisoned medium was poured into sterilised Petriplate. Mycelial disc of five mm size from actively growing zone of seven days old culture was cut by a sterile cork borer and one such disc was placed at the centre of each agar plate. Control treatment was maintained without adding any fungicide to the medium. Four replications were maintained for each treatment. Then such plates were incubated at room temperature and radial growth was measured when fungus attained maximum growth in control plates. Per cent inhibition of mycelial growth over control was calculated. [4]

Observations recorded

Per cent inhibition of mycelial growth

The per cent inhibition of the growth of the pathogen was calculated by using the formula given by [4].

$$I = \frac{C - T}{C} \times 100$$

I = Per cent inhibition
C = Radial growth in control
T = Radial growth in treatment

Results and discussion

Among the six combiproducts evaluated, carbendazim 12% + mancozeb 63% (Saaf) was found to be most effective and significantly superior to all other fungicides, which inhibited cent per cent growth of *Fusarium oxysporum ciceri*. This was followed by carboxin 37.5% + thiram 37.5% (Vitavax power 75% WP) with 85.86 per cent inhibition and the least inhibition of mycelial growth (49.94 %) was observed in zineb 68% + hexaconazole 4%WP (Avtar 72%WP) and at different concentrations tested carbendazim 12% + mancozeb 63% (Saaf) @ 0.1per cent inhibited cent per cent which was significantly superior all other treatments and least inhibition was recorded in zineb 68% + hexaconazole 4%WP (Avtar 72%WP) (21.85% @ 0.1%) (**Table 1**). Similar findings were recorded by [5] that carbendazim + mancozeb was more effective in inhibiting the mycelial growth of three pathogens *viz., Sclerotium rolfsii*, *Rhizoctonia bataicola* and *Fusarium* sp. causing root rot/wilt complex of soybean.

Table 1 *In vitro* evaluation of combi product fungicides against *Fusarium oxysporum ciceri*

Common name	**Chemicals**	**Inhibition of mycelial growth (%)**			**Mean**
		Concentrations (%)			
		0.1	**0.2**	**0.3**	
Avatar	Zineb 68% + Hexaconazole 4%WP	21.85 (27.88) *	61.67 (51.77)	66.30 (54.54)	**49.94** (44.73)
Merger	Tricyclazole 18%WP + Mancozeb 62%WP	60.74 (51.23)	81.67 (64.69)	89.81 (71.47)	**77.41** (62.46)
Saaf	Carbendazim 12% + Mancozeb 63%	100.00 (90.05)	100.00 (90.05)	100.00 (90.05)	**100.0** (90.05)
Sprint	Carbendazim 25% + Mancozeb 50% WP	72.59 (58.46)	72.96 (58.70)	78.33 (62.29)	**74.63** (59.82)
Taquat	Captan70%+Hexaconazole 5% WP	65.00 (53.76)	67.59 (55.33)	83.70 (66.23)	**72.10** (58.44)
Vitavax power	Carboxin 37.5% + Thiram 37.5%	79.07 (62.81)	78.52 (62.42)	100.00 (90.05)	**85.86** (71.76)
Mean	Zineb 68% + Hexaconazole 4%WP	**66.54** (**57.36**)	**77.07** (**63.83**)	**86.36** (**72.44**)	**76.66** (**64.54**)
		S.Em ±		**CD at 1%**	
Fungicides(F)		**0.22**		1.80	
Concentrations(C)		**0.15**		1.51	
FXC		**0.38**		2.37	

*Arcsine transformed values

Among the contact fungicides tested, copper oxychloride gave the best results by maximum inhibition of 86.76% which was significantly superior to all other fungicides and the least in inhibiting the mycelial growth was zineb (52.18%). Copper oxy chloride has given the best result at 0.3 per cent concentration in inhibiting the growth of pathogen (90.0%) and least inhibition was observed in the zineb @ 0.1% (44.58 %) (**Table 2**). Similar results were reported by [6] in *Fusarium oxysporum* infecting soybean.

Table 2 *In vitro* evaluation of contact fungicides against *Fusarium oxysporum ciceri*

Fungicides	**Inhibition of mycelial growth (%)**			**Mean**
	Concentrations(%)			
	0.1	**0.2**	**0.3**	
Copper oxy chloride	83.47 (66.05)*	86.81 (68.74)	90.00 (71.61)	**86.76** (68.80)
Chlorothalonil	54.58 (47.65)	57.64 (49.42)	61.67 (51.77)	**57.96** (49.62)
Captan	57.64 (49.42)	61.53 (51.69)	64.86 (53.68)	**61.34** (51.60)
Zineb	44.58 (41.91)	46.94 (43.27)	65.00 (53.76)	**52.18** (46.31)
Mean	**60.07** (**51.26**)	**63.23** (**53.28**)	**70.38** (**57.71**)	**64.56** (**54.08**)
	S.Em ±		**CD at 1%**	
Fungicides(F)	0.18		1.66	
Concentrations(C)	0.15		1.54	
FXC	0.31		2.18	

*Arcsine transformed values

Among the four systemic fungicides evaluated, carbendazim and tebuconazole were best with cent per cent inhibition at all concentrations (0.05, 0.075 and 0.1%) and significantly superior to all other treatments in inhibiting growth of *Fusarium oxysporum ciceri*. This was followed by Hexaconazole with 88.61 per cent inhibition. The least inhibition of mycelial growth was observed in difenconazole (83.66%) Among the concentrations carbendazim and tebuconazole were effective @ 0.05% with cent per cent inhibition and significantly superior to all fungicides the least inhibition was found in the difenconazole @ 0.05% with inhibition of 82.08% (**Table 3**). Similar results were reported by [7] in lentil and in wilt of patchouli by [8].

Table 3 *In vitro* evaluation of systemic fungicides against *Fusarium oxysporum ciceri*

Chemicals	**Inhibition of mycelial growth (%)**			**Mean**
	Concentrations			
	0.05%	**0.075%**	**0.1%**	
Carbendazim	100.00 (90.05)*	100.00 (90.05)	100.00 (90.05)	**100.00** (90.05)
Difenconazole	82.08 (64.99)	83.33 (65.94)	85.56 (67.70)	**83.66** (66.21)
Hexaconazole	88.06 (69.93)	88.33 (70.20)	89.44 (71.12)	**88.61** (70.41)
Tebuconazole	100.00 (90.05)	100.00 (90.05)	100.00 (90.05)	**100.00** (90.05)
Mean	**92.53** (**78.75**)	**92.92** (**79.06**)	**93.75** (**79.73**)	**93.07** (**79.18**)
	S.Em ±		**CD at 1%**	
Fungicides(F)	**0.39**		2.45	
Concentrations(C)	0.33		2.28	
FXC	0.68		3.23	

*Arcsine transformed values

Conclusions

Among combiproducts carbendazim 12% + mancozeb 63% (Saaf) is most effective. In contact fungicides copper oxychloride showed maximum inhibition. Among systemic fungicides carbendazim and tebuconazole were best with cent per cent inhibition. Hence these chemicals can be used for the management of the *Fusarium oxysporum ciceri* causing chickpea wilt.

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