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Evaluation of fungicides against *Colletotrichum truncatum* (Schw.) Andrus and Moore, causing anthracnose of greengramm

Sunil Kulkarni and Raja

Abstract
Eight fungicides were evaluated *in vitro* against anthracnose of greengram caused by *Colletotrichum truncatum* (Schw.) Andrus and Moore. fungicides tested, Propiconazole, carbendazim thiophonate methyl and benomyl were best in inhibiting (100%) the growth of fungus at all the three concentrations tested (0.05, 0.1, and 0.15%) and next best was hexaconazole (100%) at 0.1 and 0.15 per cent.

Keywords: Greengram, *Colletotrichum truncatum*, Fungicides and *in vitro*

Introduction
Greengram *(Vigna radiata* L.*)* is one of the important pulse crops of India. It is quite versatile crop grown for seeds, green manure and forage and it is also considered as "Golden Bean" presently in India greengram is cultivated over an area of 32.99 lakh hectares with a production of 13.74 lakh tones. Greengram is a rich source of protein (23-24%), carbohydrate (54-56%), minerals and vitamines. It has high digestibility due to which it is fed to babies, convalescents and elders. Unlike other pulses, it is free from flatulent effects in stomach. It is consumed in many forms including boiled dhal, sprouts, bean cakes, noodles and pudding. Presently, the per capita share of pulses in nutrition supply in India with respect to energy, protein and fat is 117.4 K cal, 6.9 g and 1.0 g per day respectively. An adult male and female requires 80 and 70 g per capita per day, respectively for balanced diet (Anon., 2004). Greengram crop covers a total world area of 5 m ha with a total production of 3 mt (John, 1991) [2]. It is widely cultivated throughout the South Asia including India, Pakistan, Bangladesh, Sri Lanka, Thailand, Cambodia, Vietnam, Indonesia, Malaysia and South China. India is an important pulse growing country contributing 28 per cent to the global pulse basket from an area of about 37 per cent (Masood Ali and Shivkumar, 2000) [8]. Among the major diseases of greengram, anthracnose caused by *Colletotrichum truncatum* (Schw.) Andrus and Moore is a major disease. It causes both qualitative as well as quantitative losses (Sharma *et al.*, 1971) [12]. The disease severing varies from 18.20 to 86.57 per cent have been reported in northern Karnataka (Laxman. 2006) [6]. Hence an attempt was made to evaluate different botanicals, bioagents and fungicides against the pathogen to manage the disease.

Materials and Methods
In vitro evaluation of Fungicides
Eight systemic and five non-systemic fungicides were tested against *C. truncatum* on the potato dextrose agar media using poison food technique under *in vitro* condition. The systemic fungicides were tried at 0.05, 0.1 and 0.15 per cent concentrations, whereas non-systemic fungicides were evaluated at 0.1, 0.2 and 0.25 per cent concentrations. The list of fungicides used along with their chemical and trade names are given below.

Fungicides used for *in vitro* evaluation

Sl. No.	Common Name	Chemical Name	Trade Name
Systemic fungicides			
1.	Carbendazim	Methyl 2 Benzimidazole carbomate	Bavistin 50 WP
2.	Propiconazole	1-(2-(2, 4-D)-4-Propyl-1,3 diozolan- 2yl methyl) IH-1, 2, 4 Triazole	Tilt 25% EC
3.	Hexaconazole	RS-2-(2, 4-D)-1-(1H-1, 2, 4 Trizole-1-yl) hezan 2-ol	Contaf 5% EC
4.	Tricyclazole	5-methyl-1, 2, 4-triazole (3, 4b) benzothiazole	Beam 75% WP
5.	Benomyl	Methyl-N (1 Butyl carbonyl)2- Benzimidazole carbonate	Benlate 50 WP
6.	Thiophanate methyl	1, 2, bis (3-metoxy carboxyl-1-2-thiouredo) benzene	Roko 70 WP
7.	Difenconazole	Cis, trans-3-chloro-4(4-methyl-2-(1H-1, 2, 4-Traizole-1-y1, methyl)-1, 3-dioxolan-2-y1) phenyl 4-chlorophenyl ether	Score 25 EC
8.	Penconazole	1-[2-(2,4-dichlorophenyl) pentyl]-1H-1, 2, 4-triazole	Topaz 10 EC
Non-systemic fungicides			
9	Mancozeb	Manganese ethylene bis dithiocarbonate plus zinc	Indofil M-45 75 WP
10	Propineb	Zinc propylene is thiocarbamate	Antracol 75 WP
11	Copper oxychloride	Copper oxychloride	Fytolon 50 WP
12	Chlorothalonil	Tetrachloro isopthalo nitrate	Kavach 75 WP
13	Carbendazim 12% + Mancozeb 63%	Methyl 1H-benzimidazole-2yl- carbomate + manganesethyl lene bis – dithiocarbmate plus zinc	Saaf 75 WP

Poison food technique

The poison food technique (Shravelle, 1961) [14] was followed to evaluate the efficacy of fungicides in inhibiting the mycelial growth of *C. truncatum*. The fungus was grown on PDA medium for eight days prior to setting up the experiment. The PDA medium was prepared and melted. The fungicidal suspension was added to the melted media to obtain the required concentrations. About 20 ml of poisoned medium was poured in each sterilized petriplates. Suitable check was maintained without addition of fungicides. Five mm mycelial disc was taken from the periphery of eight days old colony was placed in the centre of petriplate and incubated at 28 $\pm$ 1^0C for 15 days. Three replications were maintained for each treatment. The diameter of the colony was measured when maximum growth in control plates were occurred. The per cent inhibition was calculated by using the formula of Vincent (1947) [17].

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

Where,

I : Per cent inhibition
C : Mycelial growth in control
T : Mycelial growth in treatment

Result and Discussion

***In vitro* evaluation of fungicides:** Eight systemic and five non-systemic fungicides were evaluated at three concentrations in the laboratory for their efficacy against *C. truncatum* through poison food technique. The data are presented in Table 1 and 2

The results presented in Table 1 revealed that, there was a significant difference between the systemic fungicides, concentrations and interactions. Propiconazole, carbendazim, thiophanate methyl and benomyl inhibited cent per cent of mycelial growth of *C. truncatum* at all the three concentrations (0.05, 0.1 and 0.15%). Hexaconazole and tricyclazole also showed cent per cent inhibition at 0.1 and 0.15 per cent concentrations, while penconazole and Difenconazole showed cent per cent inhibition at 0.15 per cent concentration. The least inhibition of mycelial growth among the systemic fungicides was observed in penconazole (59.45%) at 0.05 per cent concentration (Plate 1).

Among the non-systemic fungicides tested, it is evident form the Table 2 that the maximum mycelial growth inhibition was obtained by carbendazim + mancozeb (100%) at all the three concentrations (0.1, 0.2 and 0.25%), followed by chlorothalonil (100%) at 0.25 per cent. The least inhibition of mycelial growth was observed in copper oxychloride (35.82%) at 0.1 per cent concentration (Plate 2).

In vitro evaluation of fungicides**:** *In vitro* evaluation of fungicides provides useful and preliminary information regarding efficacy of fungicides against pathogen within a shortest period of time and therefore, serves as a guide for field testing. In the present investigation, eight systemic fungicides and five non-systemic fungicides were tested at three concentrations. Among the eight systemic fungicides propiconazole, carbendazim, thiophanate methyl and benomyl were the best in inhibiting (100%) the growth of *C. truncatum* at all the three concentrations (0.05, 0.1 and 0.15%) and next best were hexaconazole and tricyclazole (100%) at 0.1 and 0.15 per cent. Efficacy of these fungicides was previously reported by Varaprasad (2000) [16], Madhusudhan (2002) [7] and Laxman (2006) [6]. Among the five non-systemic fungicides tested carbendazim + mancozeb (SAAF) was found to be effective in inhibiting the growth of mycelium upto 100 per cent at all three concentrations (0.1, 0.2 and 0.25%). The next best was chlorothalonil (100%) at 0.25 per cent. These results are in accordance with Mesta (1996), Hegde (1998) and Madhusudhan (2002) [7].

Table 1: *In vitro* evaluation of systemic fungicides against *Colletotrichum truncatum*

Sl. No	Chemicals	Per cent inhibition of radial growth over control			
		0.05%	0.1%	0.15%	Mean
1.	Propiconazole 25%	100.00 (90.05) *	100.00 (90.05)	100.00 (90.05)	100.00 (90.05)
2.	Hexaconazole 5%	96.20 (78.85)	100.00 (90.05)	100.00 (90.05)	98.73 (86.31)
3.	Carbendazim 50 WP	100.00 (90.05)	100.00 (90.05)	100.00 (90.05)	100.00 (90.05)
4.	Thiophanate methyl 70 WP	100.00 (90.05)	100.00 (90.05)	100.00 (90.05)	100.00 (90.05)
5.	Penconazole 10 EC	59.45 (50.47)	69.60 (56.56)	100.00 (90.05)	76.35 (65.69)

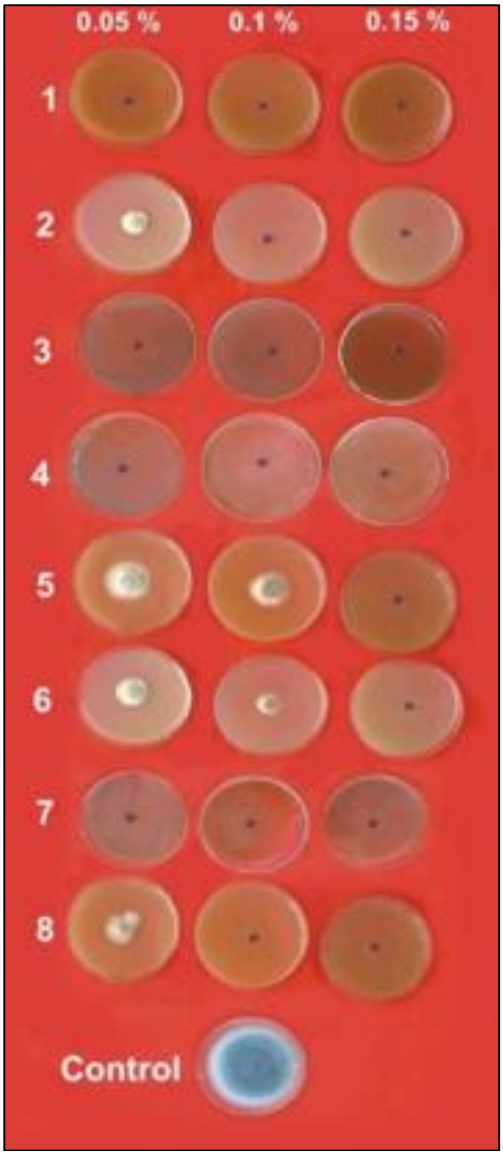
6.	Difenconazole 25 EC	60.17 (50.89)	70.43 (57.09)	100.00 (90.05)	76.86 (66.01)
7.	Benomyl 50 WP	100.00 (90.05)	100.00 (90.05)	100.00 (90.05)	100.00 (90.05)
8.	Tricyclazole 75 WP	72.51 (58.41)	100.00 (90.05)	100.00 (90.05)	90.83 (79.50)
	Mean	86.04 (74.85)	92.50 (81.74)	100.00 (90.05)	
		S.E m ±		C.D at 1%	
	Fungicide(F)	0.12		0.45	
	Concentration (C)	0.07		0.26	
	F × C	0.20		0.75	

* Values in parenthesis are arcsine transformed values

Table 2: *In vitro* evaluation of non-systemic fungicides against *Colletotrichum truncatum*

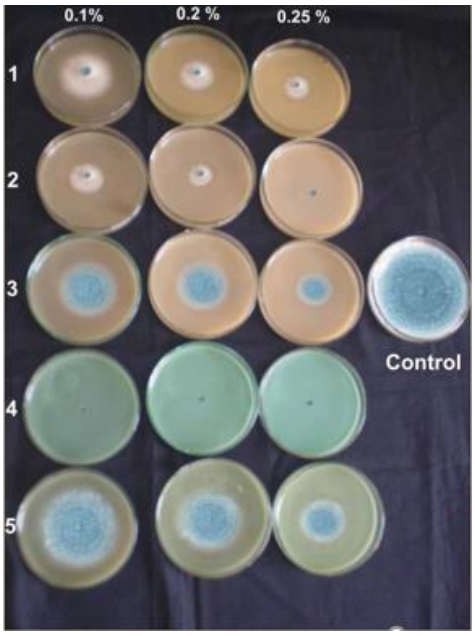
S. No	Chemicals	Per cent inhibition of radial growth over control			
		0.1%	0.2%	0.25%	Mean
1.	Mancozeb 75 WP	60.36 (51. 00)*	66.52 (54.67)	85.55 (67.70)	70.81(57.80)
2.	Chlorothalonil 75 WP	84.39 (66.76)	87.81 (69.60)	100.00 (90.05)	90.73 (75.47)
3.	Propineb 75 WP	46.52 (43.02)	55.48 (48.17)	61.46 (51.65)	54.49 (47.61)
4.	Carbendazim 12% + Mancozeb 63%	100.00 (90.05)	100.00 (90.05)	100.00 (90.05)	100.00 (90.05)
5	Copper oxy chloride 50 WP	35.82 (36.78)	45.47 (42.42)	53.61 (47.09)	44.97 (42.10)
	Mean	65.42 (57.52)	71.06 (60.98)	80.12 (69.30)	
		S.E m±		C.D at 1%	
	Fungicide(F)	0.11		0.42	
	Concentration (C)	0.09		0.34	
	F × C	0.21		0.80	

* Values in parenthesis are arcsine transformed values



1. Propiconazole 2. Hexaconazole 3. Carbendazim 4. Thiophanate methyl 5. Penconazole 6. Difenconazole 7. Benomyl 8. Tricyclazole

Plate 1: *In vitro* evaluation of systemic fungicides against *Colletotrichum truncatum*



1. Mancozeb 2. Chlorothalonil 3. Propineb 4. Carbendazim + Mancozeb 5. Copper oxy chloride

Plate 2: *In vitro* evaluation of non-systemic fungicides against *Colletotrichum truncatum*

Conclusion

Out of eight systemic fungicides tested *in vitro* against *C. truncatum*, propiconazole, carbendazim, thiophanate methyl and benomyl were best in inhibiting (100%), the growth of fungus at all the three concentrations tested (0.05, 0.1 and 0.15%) and next best was hexaconazole (100%) at 0.1 and 0.15 per cent. Carbendazim + mancozeb (Saaf) was found to be superior among the non-systemic fungicides by inhibiting 100 per cent at all three concentrations (0.1, 0.2 and 0.25%).

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