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Efficacy of Fungicide against *Colletotrichum lagenarium* inciting anthracnose of bitter gourd

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Abstract

In vitro efficacy of fungicides were assessed against *Colletotrichum lagenarium* causing anthracnose of bitter gourd using Poison Food Techniques. All seven systemic fungicides tested at 500 and 1000 ppm were significant in recording minimum mycelial growth and maximum inhibition of *C. lagenarium* over the control. Among systemic fungicide, Carbendazim 50% WP showed no mycelial growth. Propiconazole was second best treatment and recorded least mycelial growth and as compared to control followed by Tebuconazole, Thiophanate methyl, Difenoconazole, Dimethomorph and Azoxystrobin at all tested concentration. Seven contact and combi fungicides were also found effective over control recording least mycelial growth and maximum inhibition. Carboxin 37.5% + Thiram 37.5% and Tebuconazole 50% + Trifloxystrobin 25% WG completely inhibited the growth of pathogen. whereas Azoxystrobin 11% + Tebuconazole 18.3% SC was next best treatment in recording least mycelial growth and highest per cent inhibition of growth followed by Tebuconazole 67% + Captan 26.9% SC and Chlorothalonil 75% WP over control.

Keywords: Bitter gourd, anthracnose, *Colletotrichum lagenarium*, fungicides, *in vitro*

Introduction

Bitter gourd (*Momordica charantia* L.), a vegetable from the Indo-Burma region, is renowned for its bitter taste and health benefits and belongs to the Cucurbitaceae family. Bitter gourd is prone to various fungal and viral diseases. Among various diseases, anthracnose is most common and widely occurred disease caused by the fungus *Colletotrichum lagenarium* (Pass.) Ell. and Halst (syn. *C. orbiculare*). It affects the leaves, stems, and fruits, leading to significant yield and quality losses. Hence experiment to find out effective fungicide against *Colletotrichum lagenarium* were conducted under *in vitro* condition.

Materials and Methods

The efficacy of seven systemic and seven contact/combi- product fungicides were assessed using the "Poisoned Food" method, as described by Nene and Thapliyal (1993)^[6] by utilizing Potato Dextrose Agar (PDA) as a base culture medium. Systemic fungicide (Table 1) was tested at 500 ppm and 1000 ppm concentration, whereas contact and combi- product fungicides listed in Table 2 were tested at 2000 ppm and 2500 ppm. The PDA medium containing appropriate quantity of fungicide were poured aseptically into Petri dishes (90 mm in diameter), where it solidifies at room temperature. All of the plates were inoculated aseptically with a 5 mm culture disc made from an actively growing pure culture of a pathogen. The disc was positioned in the middle of the petri plate on PDA, and the plates then be incubated at a temperature of 27 ± 2 °C. Three copies of each test fungicide's concentration were made. Petri plates with basic PDA (without fungicides) containing the pathogen's culture disc were continued to be used as the untreated control.

Table 1: List of systemic fungicides

Tr. No.	Treatments	Tr. No.	Treatments
T ₁	Carbendazim 50% WP	T ₅	Difenconazole 25% EC
T ₂	Dimethomorph 50% WP	T ₆	Azoxystrobin 23% SC
T ₃	Thiophanate methyl 70% WP	T ₇	Tebuconazole 25.9% EC
T ₄	Propiconazole 25% EC	T ₈	Control (untreated)

Table 2: List of Contact and combi-product fungicides

Tr. No.	Treatments	Tr. No.	Treatments
T ₁	Mancozeb 75% WP	T ₅	Tebuconazole 50% + Trifloroxystrobin 25% WG
T ₂	Propineb 76% WP	T ₆	Tebuconazole 67% + Captan 26.9% SC
T ₃	Chlorothalonil 75% WP	T ₇	Azoxystrobin 11% + Tebuconazole 18.3% SC
T ₄	Carboxyl 37.5% + Thiram 37.5% DS	T ₈	Control (untreated)

Observations on radial mycelial growth was recorded after seven days of incubation in all the replicated treatments. Percent inhibition of the test pathogen was calculated by applying the formula given by Arora and Upadhyay (1978)^[1] as follows,

$$\text{Percent growth inhibition (I)} = \frac{C - T}{C} \times 100$$

Where,

C = Growth (mm) of test fungus in untreated control plate.

T = Growth (mm) of test fungus in treated plates.

Results and Discussion

Effect of systemic fungicides on mycelial growth

Results reveals that all the treatments of systemic fungicides at all concentration were significant over the control in recording minimum mycelial growth of *C. lagenarium*.

The fungus treated with Carbendazim 50% WP showed no mycelial growth. Propiconazole 25% EC was second best treatment and recorded least mycelial growth as compared to control followed by Tebuconazole 25.9% EC, Thiophanate methyl 70% WP, Difenconazole 25% EC, Dimethomorph 50% WP and Azoxystrobin 23% SC. Similar trends of mycelium growth were observed at 1000 ppm concentration of all tested systemic fungicides. Results (Table 3, Fig 1) shows that all the treatments at all concentration were significant over the control in inhibiting the growth of test pathogen. At all concentration same trend of systemic fungicide were recorded in inhibition of mycelial growth. Carbendazim showed maximum inhibition of mycelial growth to the tune of 100% followed by Propiconazole, Tebuconazole, Thiophanate methyl, Difenconazole, Dimethomorph and Azoxystrobin. These results are in consonance with those of Dubale (2018)^[3] and Joshi *et al.* (2019)^[4] who also tested four systemic fungicides against pathogen and observed that Propiconazole, Carbendazim and Thiophanate methyl were effective in inhibition of mycelial growth and sporulation of test fungus. These results were also supported by the observations of Potphode (2011)^[7], Begum *et al.* (2015)^[2] and Kumar *et al.* (2018)^[5].

Table 3: *In vitro* efficacy of systemic fungicides against *Colletotrichum lagenarium* causing anthracnose of bitter gourd

Tr. No.	Treatments	Colony Dia. (mm)* at ppm		Avg. (mm)	% Inhibition* at ppm		Avg.% Inhibition
		500	1000		500	1000	
T ₁	Carbendazim 50% WP	00.00	00.00	00.00	100.00 (90.00)**	100.00 (90.00)	100.00 (90.00)
T ₂	Dimethomorph 50% WP	32.00	24.00	28.00	64.44 (53.39)	73.33 (58.90)	68.88 (56.09)
T ₃	Thiophanate methyl 70% WP	8.00	6.50	7.25	91.11 (72.65)	92.77 (74.40)	91.94 (91.94)
T ₄	Propiconazole 25% EC	6.00	0.00	3.00	93.00 (74.65)	100.00 (90.00)	96.50 (79.21)
T ₅	Difenconazole 25% EC	12.00	5.00	8.50	86.66 (68.57)	94.44 (76.36)	90.55 (72.09)
T ₆	Azoxystrobin 23% SC	52.00	35.00	43.50	42.22 (40.52)	61.11 (51.41)	51.66 (45.95)
T ₇	Tebuconazole 25.9% EC	8.00	4.00	6.50	91.11 (72.65)	95.55 (77.82)	93.33 (75.03)
T ₈	Control (untreated)	90.00	90.00	90.00	00.00 (00.00)	00.00 (00.00)	00.00 (00.00)
	S.E. ±	0.5	0.67	-	0.61	0.68	-
	C.D. at 1%	2.06	2.79	-	2.55	2.82	-

*: Mean of three replications. **: Values in parenthesis are arcsin transformed values. Dia.: Diameter, Avg.: Average

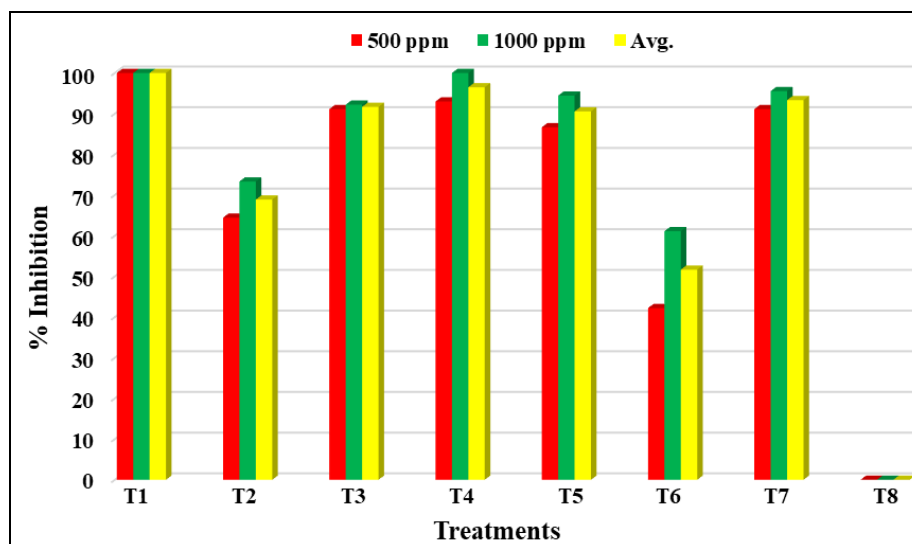


Fig 1: *In vitro* efficacy of systemic fungicides against *Colletotrichum lagenarium* causing anthracnose of bitter gourd

In vitro evaluation of non-systemic and combi fungicides against *C. lagenarium*

Results (Table 4, Fig 2) shows that all the treatments were significant over the control and showed similar trend at all concentration in recording minimum mycelial growth and maximum inhibition. Carboxin 37.5% + Thiram 37.5% and Tebuconazole 50% + Trifloroxystrobin 25% WG completely inhibited the growth of pathogen. whereas Mancozeb 75% WP was next best treatment in recording least mycelial growth and per cent inhibition of growth followed by Propineb 76% WP, Azoxystrobin 11% + Tebuconazole 18.3% SC, Tebuconazole 67% + Captan 26.9% SC and Chlorothalonil 75% WP over control (untreated). Joshi *et al.* (2019) [4] tested nine fungicides

in vitro against *Colletotrichum lagenarium*, which causes bottle gourd anthracnose, for combi fungicides they stated, Carbendazim 12% + Mancozeb 63% @ 0.25%, completely inhibited the mycelial growth of *C. lagenarium* also, Tebuconazole 50% + Trifloxystrobin 25% WG showed 40.44% of mycelial growth inhibition. The results were also supported by Begum *et al.* (2018) [2] who observed the *in vitro* effectiveness of eight fungicides, among which Tebuconazole 25.9% EC, Mancozeb 75% WP, and Trifloxystrobin 25% + Tebuconazole 50% WG each at 150 µg / ml and Carbendazim 12%+ Mancozeb 63% WP at 200 µg / ml were significantly better than all other treatments.

Table 4: *In vitro* efficacy of non-systemic and combi-product fungicides against *Colletotrichum lagenarium* causing anthracnose of bitter gourd

Tr. No.	Treatments	Colony Dia. (mm)* at ppm		Avg. (mm)	% Inhibition* at ppm		Avg.% Inhibition
		2000	2500		2000	2500	
T ₁	Mancozeb 75% WP	8.00	6.00	9.50	91.11 (72.65)**	93.33 (75.03)	92.22 (71.03)
T ₂	Propineb 76% WP	9.50	5.00	7.25	89.44 (71.03)	94.00 (75.82)	91.72 (73.27)
T ₃	Chlorothalonil 75% WP	24.00	20.00	22.00	73.33 (58.90)	77.77 (61.86)	75.55 (60.36)
T ₄	Carboxin 37.5% + Thiram 37.5% DS	00.00	00.00	00.00	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
T ₅	Tebuconazole 50% + Trifloroxystrobin 25% WG	00.00	00.00	00.00	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)
T ₆	Tebuconazole 67% + Captan 26.9% SC	16.00	14.00	15.00	82.22 (65.06)	84.44 (66.76)	83.33 (65.90)
T ₇	Azoxystrobin 11% + Tebuconazole 18.3% SC	11.00	10.00	10.50	87.77 (69.53)	88.88 (70.52)	88.32 (70.01)
T ₈	Control (untreated)	90.00	90.00	90.00	00.00 (00.00)	00.00 (00.00)	00.00 (00.00)
	S.E. ±	0.45	0.57	-	0.63	0.67	-
	C.D. at 1%	1.88	2.38	-	2.62	2.79	-

*: Mean of three replications. **: Values in parenthesis are arcsin transformed values.

Dia.: Diameter, Avg.: Average

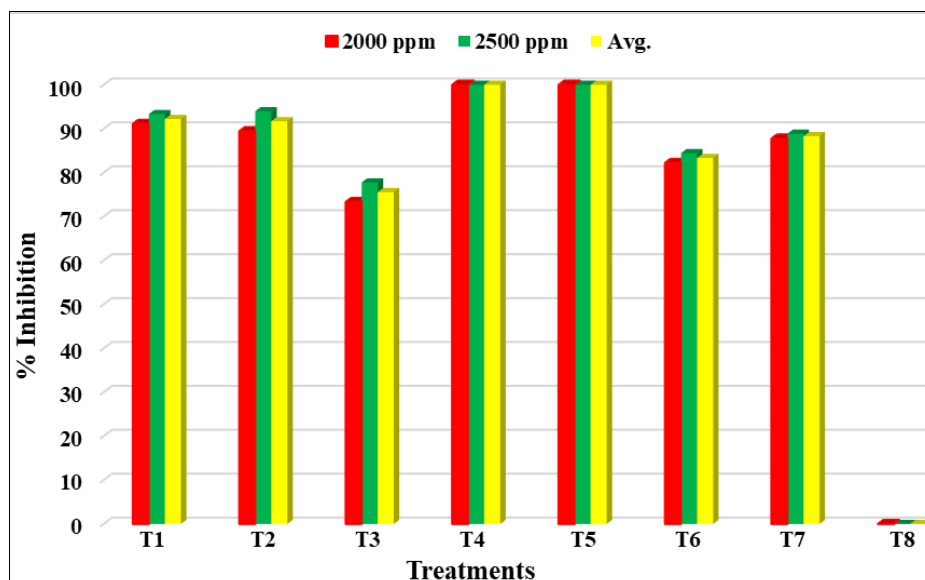


Fig 2: *In vitro* efficacy of non-systemic and combi-product fungicides against *Colletotrichum lagenarium* causing anthracnose of bitter gourd

Conclusion

The results of the conducted experiment documented that, all tested systemic, contact and combi-product fungicide significantly inhibited the growth of the test pathogen compared to the untreated control in *in vitro*. However, among the systemic fungicides, Carbendazim 50% WP, Propiconazole 25% EC and Tebuconazole 25.9% EC were most effective at both 500 ppm and 1000 ppm concentrations. In contact and combi-product fungicides *viz.*, Carboxin 37.5% + Thiram 37.5% DS and Tebuconazole 50% + Trifloxystrobin 25% WG combinations effectively inhibited the growth of *Colletotrichum lagenarium* under *in vitro* experimental conditions.

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