Original Research Article

Evaluation of Different Fungicides Against Fusarium Wilt Pathogen ofBottle Gourd

Abstract

Bottle gourd (Lagenaria siceraria Mol.Standl.) is one of the major vegetable crops belonging to the family cucurbitaceae. Among fungal diseases, wilt of bottle gourd caused by Fusarium oxysporumf. sp. lagenariae, is a major disease. It has been observed in moderate to severe form and as an epidemic results in to complete failure of the crop and elimination from nature is problematic and challenging. The research was conducted on evaluation of fungicides against F. oxysporum of bottle gourd at department of plant pathology, S. D. Agricultural University during 2018-2020. Four systemic, four non-systemic and four combined fungicides at different concentration were tested against F. oxysporum through poison food technique.Among systemic fungicides, carbendazim found much effective and it recorded the highest growth inhibition (99%) at higher concentration, followed by propiconazole (98%) at 500 ppm. Among non systemic fungicides, propineb recorded the highest growth inhibition (99.50%) at higher concentration, followed by chlorothalonil (73.83%) at 2000 ppm. Among combined fungicides, carboxin + thiram recorded the highest growth inhibition (99.50%) at higher growth inhibition at 1000 ppm.

Keywords

Fusarium, Fungicides, Poisoned food, Systemic, Non systemic, Combined

1. Introduction

Bottle gourd (*Lagenaria siceraria* Mol.Standl.) is one of the major vegetable crops belonging to the family *cucurbitaceae.* It is known by many names *viz*., birdhouse gourd, trumpet gourd, calabash gourd, white flowered gourd and dudhi in India. It is a climbing or trailing herb with bottle, oval or dumb-bell shaped fruits.

The production of bottle gourd is affected by a many diseases caused byfungi, bacteria and viruses. Some of the fungi reported from seeds of bottle gourd are*Alternaria alternata*, *Aspergillus flavus*, *A. niger*, *Botryodiplodia theobromae* and*Fusarium* spp. Among fungal diseases, wilt of bottle gourd caused by *Fusarium oxysporum*f. sp. *lagenariae*, is an economically important disease especially under protected cultivation as is responsible for heavy fruit yield losses. The disease also affects other crops of the *cucurbitaceae* family *viz.*, melon, squash, cucumber and pumpkin.

The symptoms of wilt are dependent on several factors, including the amount of inoculum in the soil, environmental conditions, nutrients and susceptibility of the host. Wilting is followed by a yellowing of the leaves and finally necrosis. The wilting generally starts with the older leaves and progresses to the younger foliage. Under conditions of sufficiently high inoculum density or a highly susceptible host, the entire plant may wilt and die within a short time. Therefore, with a view to generate scientific information related to this pathogen, the present investigation was proposed.

2. Material and methods

The *in vitro* efficacy of different fungicides was studied by using poisoned food technique (Nene and Thapliyal, 2000).The measured quantities of different fungicides were incorporated separately in conical flasks containing 100 ml of melted sterilized PDA medium aseptically to obtain desired concentrations of the fungicides at the time of pouring the medium. The medium was shaken well to give uniform dispersal of the fungicides and then poured into sterilized Petri-plates under aseptic condition. The Petri-plates were inoculated in the centre by placing 5 mm seven days old mycelial disc and then incubated at 27 ± 2°C temperatures for seven days. Simultaneously, the control was also maintained by growing the fungus on fungicide free PDA medium. Three Petri-plates were maintained for each treatment.

The observations on radial growth in each Petri-plates were measured periodically and final observations were recorded when the control plate was fully covered with the growth of test pathogen.

The per cent growth inhibition of the fungus in each treatment in comparison to control was calculated by the following equation (Bliss, 1934).

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

Where,

PGI = Per cent growth inhibition
C = Colony diameter in control (mm)
T = Colony diameter in treatment (mm)

3. Results and discussion

The experiment was conducted under *in vitro* conditions through the randomized complete block design.

The systemic, non-systemic and combined fungicides (four each) at different concentrations were tested *in vitro* for their comparative efficacy against *F. oxysporum* through poisoned food technique.(Table 1, 2 and 3).

Among all the four systemic fungicides, the carbendazim was found more effective, it recorded 99.00 per cent growth inhibition at the highest concentration (500 ppm) and 96.00 per cent growth inhibition at the lowest concentration (50 ppm), followed by propiconazole which recorded 98.00 per cent growth inhibition at the highest concentration (500 ppm) and 70.92 per cent growth inhibition at the lowest concentration (50 ppm).

Table 1 : Per cent growth inhibition of *F. oxysporum* by systemic fungicides *in vitro*

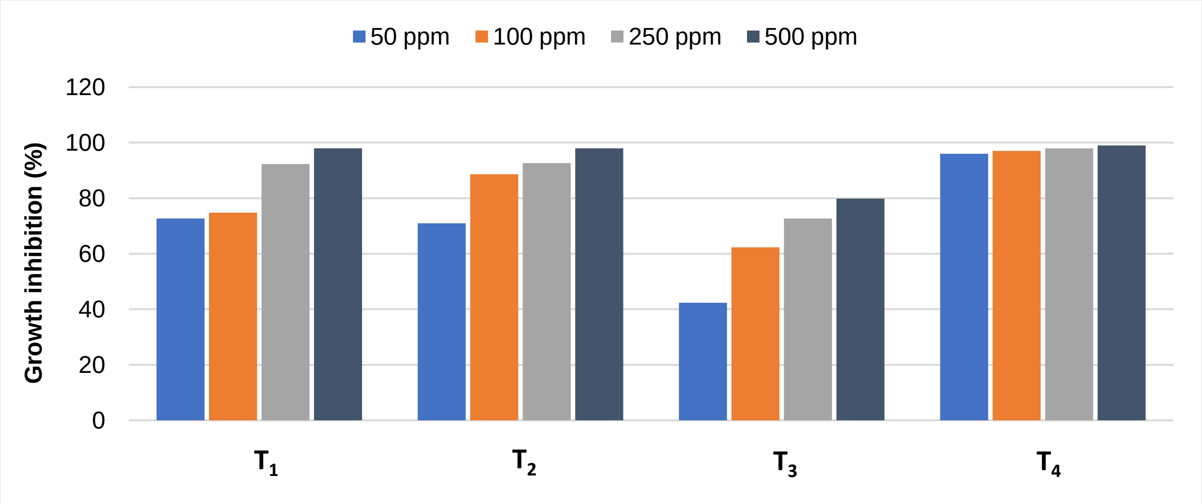
Sr. No.	Systemic fungicides	Per cent growth inhibition* Concentration (ppm)				Mean
		50	100	250	500	
1	Difenoconazole 25 EC	58.49**^{fg} (72.66)*	59.85^{f} (74.75)	73.94^{c} (92.31)	81.87^{a} (98.00)	68.54^{c} (84.43)
2	Propiconazole 25 EC	57.38^{g} (70.92)	70.43^{d} (88.64)	74.27^{bc} (92.62)	81.87^{a} (98.00)	70.99^{b} (87.54)
3	Azoxystrobin 23 SC	40.57^{i} (42.33)	52.11^{h} (62.36)	58.52^{fg} (72.71)	63.38^{e} (79.90)	53.65^{d} (64.32)
4	Carbendazim 50 WP	78.46^{ab} (96.00)	80.02^{a} (97.00)	81.87^{a} (98.00)	84.26^{a} (99.00)	81.15^{a} (97.50)
Mean		47.04^{d} (70.48)	52.54^{c} (80.69)	57.78^{b} (88.91)	62.33^{a} (93.72)	-.
		Fungicide		**Concentration**		**Fungicide × Concentration**
S. Em. ±		0.39		0.35		0.78
C.D. at 5 %		1.15		1.03		2.30
C.V. %		2.54				

*Average of three replications.

** Arc-sin transformed values

*Figures in parentheses are original values.

Treatment means with the letter/letters in common are not significant by Duncan's New Multiple Range Test.



Treatments

T_1 – Difenoconazole

T_2 – Propiconazole

T_3 - Azoxystrobin

T_4 – Carbendazim

Fig.: 1 Growth inhibition of *F. oxysporum* by systemic fungicides *in vitro*

Among all the four non systemic fungicides, the propineb was found more effective, it showed 99.50 per cent growth inhibition at the highest concentration (2000 ppm) and 55.31 per cent growth inhibition at the lowest concentration (500 ppm), followed by chlorothalonil which showed 73.83 per cent growth inhibition at the highest concentration (2000 ppm) and 37.51 per cent growth inhibition at the lowest concentration (500 ppm).

Sr. No.	Non systemic fungicides	Per cent growth inhibition* Concentration (ppm)				Mean
		500	1000	1500	2000	
1	Mancozeb 75WP	31.58**[ij] (27.44)*	33.20[hi] (30.02)	39.64[g] (40.70)	46.65[e] (52.88)	37.77[d] (37.76)
2	Chlorothalonil 75WP	37.76[g] (37.51)	53.94[d] (65.34)	56.04[cd] (68.77)	59.25[b] (73.83)	51.75[b] (61.36)
3	Propineb 70WP	48.05[e] (55.31)	54.84[d] (66.84)	57.93[bc] (71.79)	85.94[a] (99.50)	61.69[a] (73.36)
4	Copper Oxychloride 50WP	29.34[j] (24.05)	35.25[h] (33.33)	42.98[f] (46.48)	85.94[a] (99.50)	48.38[c] (50.84)
Mean		29.40[d] (36.08)	35.50[c] (48.88)	39.37[b] (56.93)	55.61[a] (81.43)	-
		Fungicide		Concentration		Fungicide × Concentration
S. Em. ±		0.38		0.34		0.75
C.D. at 5 %		1.12		1.00		2.25
C.V. %		3.40				

*Average of three replications.
** Arc-sin transformed values
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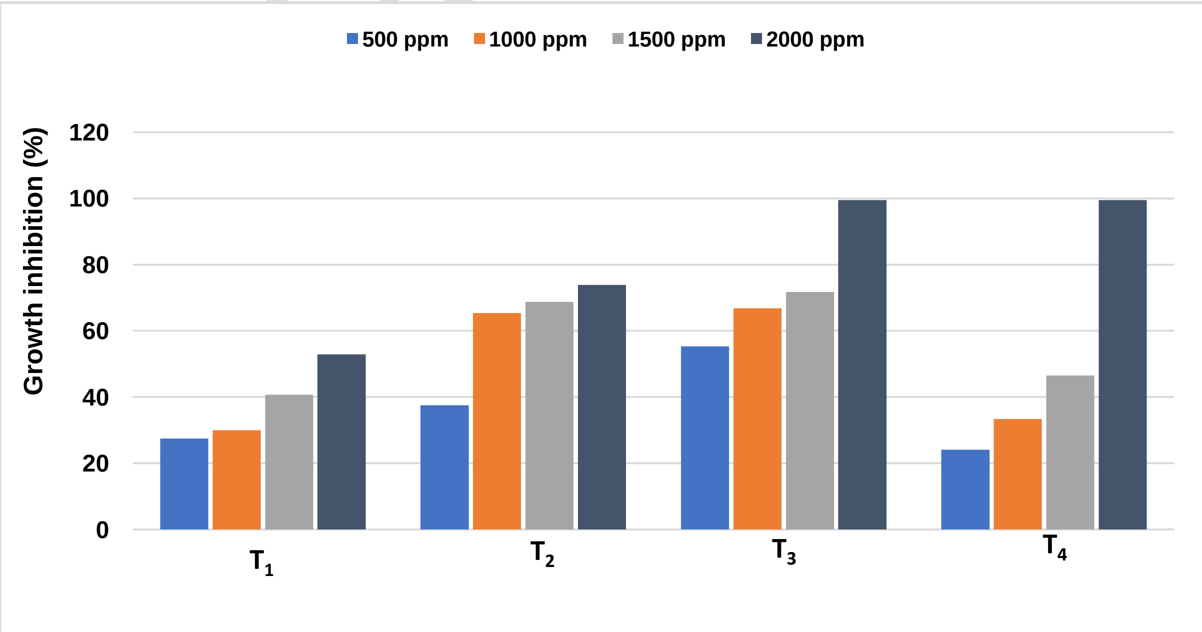
Treatment means with the letter/letters in common are not significant by Duncan's New Multiple Range Test.

Table 2 : Per cent growth inhibition of *F. oxysporum* by non systemic fungicides*in vitro*



Treatments

T_1 - Mancozeb
T_2 - Chlorothalonil
T_3 - Propineb
T_4 - Copper oxychloride

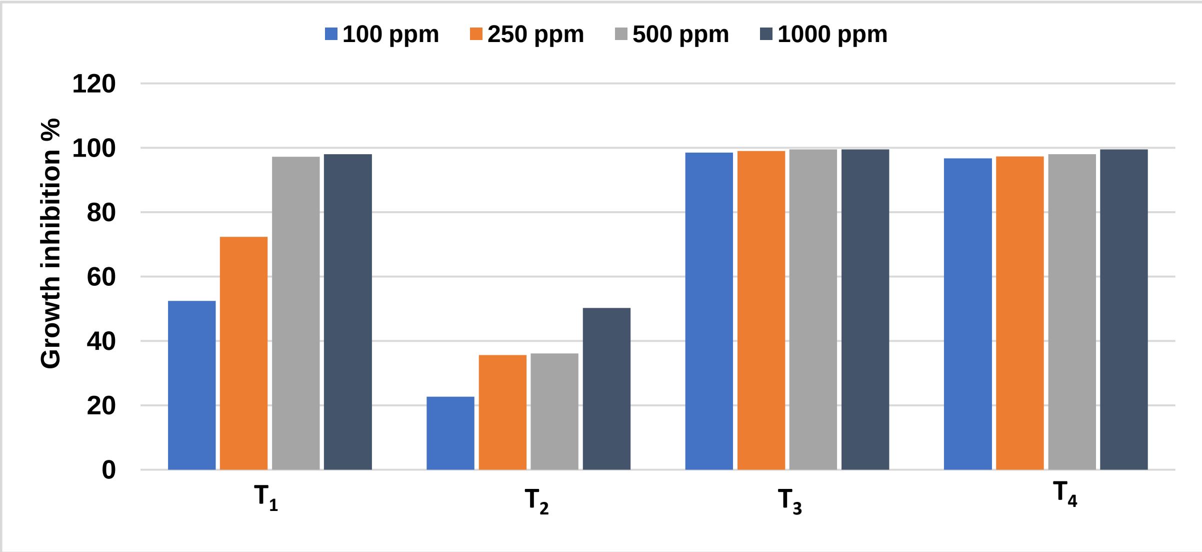
Fig. : 2 Growth inhibition of *F. oxysporum* by non systemic fungicides*in vitro*

Among all the four combined fungicides, the carboxin + thiram was found more effective, it obtained 99.50 per cent growth inhibition at the highest concentration (1000 ppm) and 98.50 per cent growth inhibition at the lowest concentration (100 ppm), followed by azoxystrobin + tebuconazole which obtained 99.50 per cent growth inhibition at the highest concentration(1000 ppm) and 96.67 per cent growth inhibition at the lowest concentration (100 ppm).

Table 3: Per cent growth inhibition of *F. oxysporum* by combined fungicides *in vitro*

Sr. No.	Combined fungicides	Per cent growth inhibition* Concentration (ppm)				Mean
		100	250	500	1000	
1	Carbendazim 12WP + Mancozeb 63WP	46.37**[e] (52.41)*	58.24[d] (72.29)	80.51[bc] (97.24)	81.87[abc] (98.00)	66.75[c] (79.98)
2	Metalaxyl 8WP + Mancozeb 64WP	28.44[h] (22.70)	36.66[g] (35.67)	36.93[g] (36.12)	45.12[f] (50.21)	36.79[d] (36.17)
3	Carboxin 37.5WS + Thiram 37.5WS	82.96[abc] (98.50)	84.26[ab] (99.00)	85.94[a] (99.50)	85.94[a] (99.50)	84.77[a] (99.12)
4	Azoxystrobin 11SC + Tebuconazole 18.3SC	79.60[c] (96.67)	80.64[abc] (97.35)	81.87[abc] (98.00)	85.94[a] (99.50)	82.01[b] (97.88)
Mean		47.53[d] (67.57)	52.02[c] (76.08)	57.10[b] (82.71)	59.83[a] (86.80)	-
		Fungicide	**Concentration**		**Fungicide × Concentration**	
S. Em. ±		0.25	0.21		0.48	
C.D. at 5 %		0.70	0.62		1.40	
C.V. %		1.56				

*Average of three replications.
**Arc-sin transformed values.
*Figures in parentheses are original values.
Treatment means with the letter/letters in common are not significant by Duncan's New Multiple Range Test.



Treatments

T_1 : Carbendazim 12WP + Mancozeb 63WP
T_2 : Metalaxyl 8WP + Mancozeb 64WP
T_3 : Carboxin 37.5WS + Thiram 37.5WS
T_4 : Azoxystrobin 11SC + Tebuconazole 18.3SC

Fig. : 3Growth inhibition of *F. oxysporum* by combined fungicides *in vitro*

Gurjar and Shekhawat (2012) evaluated five fungicides against Fusarium wilt of muskmelon under *in vitro* conditions and observed complete inhibition of mycelial growth of the fungus with carbendazim at all the concentrations tested and difenoconazole and propiconazole at 200 and 500 ppm concentrations.
The efficacy of three fungicides *viz*., carbendazim, carboxin + thiram and propineb were studied under *in vitro* conditions against wilt of chickpea caused by *F. oxysporum* f. sp. *ciceri*. All the test fungicides inhibited the mycelial growth of the fungus. The fungitoxicity of carbendazim was significantly superior as compared to carboxin + thiram and propineb (Kala *et al*., 2013).
Bashir *et al*., (2017) evaluated *in vitro* efficacy of different fungicides against wilt of chilli caused by *F. oxysporum* f. sp. *capsici* and found significant reduction in fungal growth with carbendazim at 700 ppm concentrations.
In vitro evaluation was conducted to test the efficacy of seven different fungicides *viz*.,azoxystrobin, propineb, thiophanate methyl, difenoconazole, mancozeb, mancozeb + thiophanate methyl, boscalid + pyraclostrobin against wilt of mungbean caused by *F. oxysporum*.Mancozeb + thiophanate methyl (0.15%) was found to be the best which

completely inhibited the growth and sporulation of the test fungus, followed by propineb, mancozeb, boscalid + pyraclostrobin and difenoconazole. The least inhibition was recorded with azoxystrobin (55.8%) (Vani *et. al.*, 2019).

The present findings are in conformity withthe findings made by earlier research workers**.** More or less they reported carbendazim as an effective fungicide. In the present study also, carbendazim among systemic fungicides and propineb among non systemic fungicides were proved to be highly effective against *F. oxysporum*. Among compound fungicides, carboxin + thiram was proved to be the most effective in inhibiting the growth of the test fungus.

The systemic, non-systemic and combined fungicides (four each) at different concentrations were tested *in vitro* for their comparative efficacy against *F. oxysporum* through poisoned food technique. In the present study, carbendazim among systemic fungicides and propineb among non systemic fungicides were proved to be highly effective against*F. oxysporum*. Among compound fungicides, carboxin + thiram was proved to be the most effective in inhibiting the growth of the test fungus. For future researchers and students, this findings will be helpful to develop the management strategies for wilt disease in field.

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