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Evaluation of Ready-Mix Fungicides Against Okra Root Rot [*Macrophomina phaseolina* (Tassi) Goid.] Under *In Vitro* Condition

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ABSTRACT

Okra [*Abelmoschus esculentus* (L.) Moench] is the only vegetable crop of significance in the *Malvaceae* family and is very popular in the Indo-Pak subcontinent. In India, it ranks first in its consumption. The crop was found to suffer from stem and root rot disease in severe form in many regions of Gujarat state during *Kharif*, 2021. So, for its management ready mix fungicides evaluated under *in vitro* condition, among the different tested fungicides carboxin 37.5% + thiram 37.5% found effective treatment with 93.40 per cent mycelial growth at 1000 ppm concentration and it found statistically at par with carbendazim 25%+ mancozeb 50% gave 92.92 per cent mycelial growth inhibition at 1000 ppm. Next best was carboxin 37.5% + thiram 37.5%with 90.66 per cent mycelial growth inhibition at 500 ppm and it found statistically at par with metiram 55% + pyraclostrobin 5% gave 89.51 per cent mycelial growth inhibition at 1000 ppm.

Key words: Okra, Root rot, Ready mix fungicide, *Macrophomina phaseolina*

INTRODUCTION

Okra [*Abelmoschus esculentus* (L.) Moench] is the only vegetable crop of significance in the *Malvaceae* family and is very popular in the Indo-Pak subcontinent. In India, it ranks number one in its consumption. Okra is attacked by several fungal pathogens, which not only reduces the potency of seed, but also degrades the health beneficial and nutritional quality components. The most serious fungal diseases of okra are damping-off and root rot (*Macrophomina phaseolina*, *Pythium aphanidermatum* and *Rhizoctonia solani*), vascular wilt (*Fusarium oxysporum*), Cercospora blight (*Cercospora abelmoschus, Cercospora malayensis*) and powdery mildew (*Erysiphe cichoracearum, Oidium abelmoschi*) (Anonymous, 2013). *M. phaseolina* is a necrotrophic plant pathogen, with heterogeneous host specificity (Mayek *et al.,* 2001). Rangaswami (1993) described the pathogen *Macrophomina phaseolina* affects the fibrovascular system of the roots and basal stem of its host, impeding the transport of water and nutrients to the upper parts of the plant. Roots of infected plants rot, plants wilt, and ultimately die when the disease reach at advance stages. The disease symptom starts initially with yellowing and drooping of the leaves and later infected leaves fall off pre-maturely and the plant dies within a short period. The infected plant shows dark brown lesions on the stem at ground level and bark shows shredding symptom. The affected plants can be easily pulled out leaving dried, rotten root portions in the ground. Hence, different ready-mix fungicides tested against *Macrophomina phaseolina.*

MATERIALS AND METHODS

Different fungicides *viz.*, ready mix at three concentrations mentioned in (**Table 1**) were tested for the growth inhibition of *M. phaseolina* by using poisoned food technique (Grover and Moore, 1962). The experiment was laid down in randomized completely block design with three replications.

Table 1: List of different ready-mix fungicides tested and their concentration

S. No.	Mix fungicides	Concentration in ppm		
		1	2	3
1.	Carbendazim 25% + mancozeb 50% WS	250	500	1000
2.	Carboxin 37.5% + thiram 37.5% WS	250	500	1000
3.	Fluxapyroxad 167 g/l + pyraclostrobin 333 g/L SC	250	500	1000
4.	Hexaconazole 4% + zineb 68% WP	250	500	1000
5.	Penflufen 13.28% + trifloxystrobin 13.28% FS	250	500	1000
6.	Metiram 55% + pyraclostrobin 5% WG	250	500	1000
7.	Thiophanate methyl 45% + pyraclostrobin 5% FS	250	500	1000

The required quantity of each fungicide was incorporated aseptically in 100 ml of PDA in 250 ml flasks to make various concentrations. The medium was shaken well to give uniform dispersal of the chemical and then 20 ml of medium was poured aseptically to each plate with three replications. After solidification, the plates were inoculated with mycelial discs of 4 mm diameter of seven days old culture. The mycelial disc, which was placed in the center of the plates, in an inverted position to make a direct contact with the poisoned medium, was incubated at 28 ± 2 °C for seven days.

The per cent inhibition of growth of the fungus in each treatment was calculated by using the following formula described by (Vincent, 1947).

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

Where,

PGI = Per cent growth inhibition index

C = Area of test fungus in control (mm^2)

T = Area of test fungus in respective treatment (mm^2)

RESULT AND DISCUSSION

The relative efficacies of different six combination fungicides were tested at the concentration of 250, 500 and 1000 ppm using poison food technique. The data on per cent inhibition of mycelial growth are presented in **Table 2**.

Fungicide

The data presented in **Table 2** indicated that carboxin 37.5% + thiram 37.5% WS was significantly superior over rest of the treatments and gave mean mycelial growth inhibition 89.33 per cent.

Carbendazim 25% + mancozeb 50% WS was the next best mixed fungicide with mean mycelial growth inhibition of 86.78%, followed by metiram 55% + pyraclostrobin 5% WG, hexaconazole 4% + zineb 68% WP and fluxapyroxad 167 g/l + pyraclostrobin 333 g/l SC found effective mixed fungicide with 86.61, 83.63 and 83.12% mean mycelial growth inhibition, respectively.

Among different mix fungicides tested, penflufen 13.28% + trifloxystrobin 13.28% FS found least effective with 57.45% mycelial growth inhibition at 250 ppm.

Table 2: Growth inhibition of *Macrophomina phaseolina* at different concentrations of various ready-mix fungicides after seven days of incubation at 28 ± 2º C

S. No.	Fungicide	Per cent inhibition			Mean
		250	500	1000	(pooled)
1	Carbendazim 25% + mancozeb 50% WS	67.25 (79.03)	70.07 (88.38)	74.57 (92.92)	69.13 (86.78)
2	Carboxin 37.5% + thiram 37.5% WS	66.38 (83.95)	72.20 (90.66)	75.11 (93.40)	71.23 (89.33)
3	Fluxapyroxad 167 g/l + pyraclostrobin 333 g/l SC	63.62 (80.26)	65.56 (82.88)	68.21 (86.22)	65.80 (83.12)
4	Hexaconazole 4% + zineb 68% WP	62.30 (78.39)	66.82 (84.51)	69.74 (88.01)	66.29 (83.63)
5	Penflufen 13.28% + trifloxystrobin 13.28% FS	41.83 (44.48)	51.89 (61.90)	54.32 (65.99)	49.34 (57.45)
6	Metiram 55% + pyraclostrobin 5% WG	64.28 (81.16)	70.11 (88.42)	71.10 (89.51)	68.68 (86.61)
7	Thiophanate methyl 45% + pyraclostrobin 5% FS	51.72 (61.61)	53.77 (65.07)	59.79 (74.69)	55.09 (67.12)
	Mean	59.06 (72.80)	64.35 (80.26)	67.55 (84.39)	63.65 (79.15)
		Between fungicides	Within fungicide (conc.)	Fungicide x Concentration	
	S. Em. ±	0.57	0.37	0.99	
	CD at 5%	1.63	1.06	2.82	
	CV %		2.69		

Note: Data in parentheses are re-transformed values, whereas outside are arcsine transformed value

Concentration

Among all three concentrations 1000 ppm concentration was found significantly superior over rest of the two concentrations with 84.39% mean mycelial growth inhibition. It was followed by 500 ppm with 80.26 per cent and 250 ppm 72.80% mean mycelial growth inhibition.

Fungicide x Concentration

Among all the treatments carboxin 37.5% + thiram 37.5% WS remained most effective treatment that control 93.40% mycelial growth at 1000 ppm concentration and it found statistically at par with carbendazim 25% + mancozeb 50% WS gave 92.92% mycelial growth inhibition at 1000 ppm. Next best was carboxin 37.5% + thiram 37.5% WS with 90.66% mycelial growth inhibition at 500 ppm and it found statistically at par with metiram 55% + pyraclostrobin 5% WG gave 89.51 per cent mycelial growth inhibition at 1000 ppm.

Among different ready-mix fungicides tested, penflufen 13.28% + trifloxystrobin 13.28% FS found least effective with 44.48% inhibition of mycelial growth at 250 ppm concentration.

The present study is supported by different works also *viz.,* El-Habbaa *et al*. (2002) effectivness of carboxin + thiram against *M. phaseolina in vitro* at 25-200 ppm. Effectivness of carbendazim 25% + mancozeb 50% against *M. phaseolina in vitro* condition (Swamy *et al.*, 2018). Carbendazim 12% + mancozeb 63% WP and carboxin 37.5% + thiram 37.5% WP were found most effective with cent per cent growth inhibition of *M. phaseolina* (0.10%, 0.20% and 0.30%) (Maruti *et al*., 2017). Karibasappa *et al.* (2020) recorded maximum growth inhibition (100%) in carboxin 37.5% + thiram 37.5% WP at 2000 ppm.

SUMMARY AND CONCLUSION

All the tested ready-mix fungicides were found capable of inhibiting the mycelial growth of *M. phaseolina* at different concentrations (250, 500 and 1000 ppm) as compared to the control. The treatments carboxin 37.5% + thiram 37.5% WS remained most effective treatment that control 93.40% mycelial growth at 1000 ppm concentration. Penflufen 13.28% + trifloxystrobin 13.28% FS found least effective with 44.48% inhibition of mycelial growth at 250 ppm concentration.

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CONFLICT OF INTEREST

No conflict of interest to declare.

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