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Efficacy of fungicides against mycelial growth inhibition of *Macrophominaphaseolina* (Tassi) Goid. causing root rot of okra

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Abstract:
Okra [*Abelmoschus esculentus* (L.) Moench]is the only vegetable cropof 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 region of Gujarat state during *Kharif*, 2021. So for its management non systemic fungicides evaluated under *in vitro* condition, recorded hexaconazole 5% at 250 and 500 ppm and propiconazole 25% at 500 ppm concentrations found significantly superior over rest of the treatments and found at par with each other with cent per cent mycelial growth inhibition.

Key words: Okra, root rot,non systemic fungicide,*Macrophominaphaseolina*

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Introduction:

Okra [*Abelmoschus esculentus* (L.) Moench]is the only vegetable cropof 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 (*Macrophominaphaseolina, Pythium aphanidermatum* and *Rhizoctoniasolani*), vascular wilt (*Fusarium oxysporum*), Cercospora blight (*Cercosporaabelmoschus, Cercosporamalayensis*) and powdery mildew (*Erysiphecichoracearum, Oidiumabelmoschi*). (Anonymous, 2013) [1].*M. phaseolina*is a necrotrophic plant pathogen, with heterogeneous host specificity (Mayek*et al.*, 2001) [4].Rangaswami(1993) [6] describedthe pathogen *Macrophominaphaseolina* 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 non systemic fungicides tested against *Macrophominaphaseolina.*

Materials and Methods

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Different fungicides *viz*.,non systemic 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) [2]. 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) [8].

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

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 efficacy of different seven non systemic fungicides was tested at the concentration of 1000, 1500 and 2000 ppm using poison food technique. The data on per cent inhibition of mycelia growth was presented in table 2.

Fungicide

Data presented in table 2 revealed that thiram 75 % DS gave 88.69 per cent mean mycelial growth inhibition which is found significantly superior over rest of the treatments. The next best treatment found was among the all, mancozeb 75% WP gave 88.25 per cent mean mycelial growth inhibition but it remain statically at par with zineb 75 % WP which was gave 86.23 per cent mean mycelial growth inhibition. Whereas, wettablesulphur 80% WP was the least effective fungicide with mean mycelial growth inhibition of 1.02 per cent.

Concentration

Among all three concentrations, 2000 ppm concentration was found significantly superior over rest of the two concentrations with 75.64 per cent mean mycelial growth inhibition. While in case of 1000 ppm and 1500 ppm mean mycelial growth inhibition were 60.79 and 70.71 per cent, respectively.

Within fungicides, all three levels of fungicides significantly differed from each other. Higher concentration of all the fungicides gave significantly more inhibition as compared to their lower levels of concentration.

Fungicide x Concentration

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Looking to interaction effect of fungicides and various concentrations, the treatment zineb 75 % WP and mancozeb 75% WP were gave cent per cent mycelial growth inhibition at 2000 ppm concentration.

Different non systemic fungicides, thiram 75 % DS gave mycelial growth inhibition 85.08, 90.06, 90.92 per cent at concentrations (1000, 1500 and 2000 ppm) which were found best treatments for inhibiting the mycelial growth of *M. phaseolina*under *in vitro* condition.

Mancozeb 75% WP was found next best effective fungicide gave 75.45 and 89.30 per cent mycelial growth inhibition at 1000 and 1500 ppm concentrations, respectively. Next, zineb 75 % WP with 86.07 per cent and 72.64 percent mean mycelial inhibition at 1000 and 1500 ppm. In case of copper oxychloride 76.20, 79.50 and 82.82 per cent mycelial growth inhibition at 1000, 1500 and 2000 ppm concentrations recorded. The cumulative mycelial growth inhibition was increased with increase concentration of fungicides.

Wettablesulphur 80 % WP gave 0.58, 1.20 and 1.29 per cent mycelial growth inhibition of the fungus at 1500, 2000 and 2500 ppm concentration respectively, which was found as least effective nonsystemic fungicides.

Among seven non systemic fungicides mancozeb, zineb and thiram proved to be most effective in mycelial growth inhibition of *M. phaseolina*. These results are supported by finding of Swamy *et al*. (2018) [7] conducted an experiment to evaluate different fungicides *M. phaselinain vitro*. They observed that mancozeb (0.2 %) was most effective fungicide in inhibition of mycelial growth of *M. phaselina*. In another laboratory trial non systemic fungicides Mahaveer *et al*. (2021) [3] evaluated chemical control is an effective method when seed treatment and foliar spray thiram, mancozeb, copper oxychloride against root rot and leaf blight (*M. phaseolina*). Parmar (2017) [5] tested different non systemic fungicides at three different concentration under *in vitro* against root rot pathogen *M. phaseolina* among them maximum mean mycelial growth inhibition was observed in mancozeb (99.97%).

Table 1 List of different non systemic fungicides tested and their concentration

Sr. No.	Non systemic fungicides	Concentration in ppm		
		1	2	3
1.	Chlorothalonil 75% WP	1000	1500	2000
2.	Copper oxychloride 50% WP	1000	1500	2000
3.	Mancozeb 75% WP	1000	1500	2000
4.	Propineb 70% WP	1000	1500	2000
5.	Thiram 75% DS	1000	1500	2000
6.	Wettablesulphur 80% WP	1000	1500	2000
7.	Zineb 75% WP	1000	1500	2000

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Table 2Growth inhibition of *M. phaseolina*at different concentrations of various non systemic fungicides after seven days of incubation at 28 ± 2º C

Sr. No.	Fungicide	Per cent inhibition			Mean
		1000	1500	2000	(pooled)
1	Chlorothalonil 75% WP	39.52 (40.50)	51.11 (60.58)	54.47 (66.22)	48.37 (55.77)
2	Copper oxychloride 50% WP	60.80 (76.20)	63.08 (79.50)	65.52 (82.82)	63.13 (79.51)
3	Mancozeb 75% WP	60.30 (75.45)	70.91 (89.30)	90.05 (100.00)	73.75 (88.25)
4	Propineb 70% WP	60.05 (75.07)	66.81 (84.49)	69.91 (88.20)	69.91 (82.59)
5	Thiram 75% DS	67.28 (85.08)	71.62 (90.06)	72.46 (90.92)	70.45 (88.69)
6	Wettablesulphur 80% WP	4.39 (0.58)	6.29 (1.20)	6.52 (1.29)	5.73 (1.02)
7	Zineb 75% WP	58.46 (72.64)	68.07 (86.07)	90.05 (100.00)	72.19 (86.23)
	Mean	50.11 (60.79)	56.84 (70.17)	64.14 (75.64)	57.03 (68.86)
		Between fungicides	Within fungicide (conc.)		Fungicide x Concentration
	S.Em.±	0.68	0.45		1.17
	CD at 5 %	1.94	1.27		3.36
	CV %	3.58			

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

Summary and conclusion

Among different seven nonsystemic fungicides tested were found capable of inhibiting the mycelial growth of *M. phaseolina* at various concentrations (1000, 1500 and 2000 ppm) as compared to the control. Mancozeb 75% WP and zineb 75% WP gave 100.00 per cent inhibition of mycelial growth of the fungus at 2000 ppm concentration. Next, zineb 75 % WP with 86.07 per cent and 72.64 percent mean mycelial inhibition. Wettablesulphur 80 % WP gave 0.58, 1.20 and 1.29 per cent mycelial

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growth inhibition of the fungus at 1500, 2000 and 2500 ppm concentration respectively, which was found as least effective nonsystemic fungicides.

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