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Evaluation of Fungicides Against *Macrophomina Phaseolina* (Tassi) Goid. causing *Macrophomina* Blight of Mungbean

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ABSTRACT: The disease commonly referred to as *Macrophomina* blight has emerged as a noteworthy hindrance to the profitable and prosperous mungbean farming in Madhya Pradesh in recent times. *In vitro* conditions were used to evaluate the efficacy of eight different single and combination fungicides against *Macrophomina phaseolina*. The findings showed that the most effective fungicides were Tebuconazole 25.9EC, Mancozeb 75% WP and Carbendazim 50% WP. These fungicides completely inhibited mycelia growth of *M. phaseolina* at all concentrations (300, 600, and 900 ppm). All combination fungicides were found effective for mycelia growth inhibition of *M. phaseolina under in vitro condition*. Vitavax (Carboxin37.5% + Thiram 37.5%WS), Saaf (Carbendazim 12% + Mencozeb 63%WP) and two new generation fungicide combination trade name as Xelora (Thiophenate Methyl 450 + Pyrachlostrobin 50) and Juniper (Mencozeb 64% + Thiophenate Methyl 12%WP) were found to be most effective at all concentrations used and shows 100% inhibition of the fungus.

Keywords: Fungicides, *Macrophomina* blight, *Macrophomina Phaseolina*, Mungbean.

INTRODUCTION

The mungbean (*Vigna radiata* (L.) Wilczek, *Phaseolus radiatata* L.), after chickpea and pigeonpea, is the third most important pulse crop among the thirteen edible legumes grown in India. Madhya Pradesh ranks among India's top producers of mungbean, accounting for 14% of the country's overall production and 9% of the state's total geographical area (Anonymous, 2023). In addition to adapting well to many climatic conditions, this crop faces ongoing challenges from a variety of biotic and abiotic causes. The mungbean crop is thought to be effected by three bacterial, five viral, and over sixty fungal diseases. One of the main diseases that might reduce mung bean yields is *Macrophomina* blight, which is caused by *Macrophomina phaseolina* (Tassi) Goid. *Rhizoctonia bataticola* (*Macrophomina phaseolina*) has been found to infect numerous areas of mungbean plants, including the leaves (leaf blight), stems (stem blight), stalks (stalk rot), roots (root rot), collar region (collar rot), blossoms, and fruits.

When the mungbean crop is developing and getting close to maturity, the pathogen mostly causes leaf and stem blight. *M. phaseolina* pycnidia, which resemble black specks, grow on withered leaves and stems. Furthermore, the disease reduces grain yield by making the grains and pods shrink (Pal, 1998). Microsclerotia aid in the survival of *M. phaseolina* in the soil, and these microsclerotia also attach themselves to mungbean seeds, resulting in the development of disease symptoms. Test weight and grain yield losses were recorded as being between 23.12% to 28.6% and 33.4 to 37.8%, respectively, (Gupta *et al*., 2010). The infected seeds constitute an important source of primary inoculum for new locations. Effective disease control is hampered by the pathogen's soil, seed, and airborne forms. Because *M. phaseolina* is a soil saprophyte with a broad host range and lengthy lifespan, management of this organism is challenging (Khaire *et al.,* 2018). Several management techniques are available into the literature but the use of fungicides are very efficient and fast as it is very useful for the farmers also. A number of researchers have experimented with managing *Macrophomina phaseolina* with fungicides, including carbendazim, hexaconazole, and mancozeb (Rathore 2012; Khan *et al*., 2004; Lakhran and Ahir 2018). However, in Madhya Pradesh, not much effort has been done in this area. As a result, an effort has been made to assess chemical fungicide against *Macrophomina phaseolina* (Tassi) Goid *in vitro*.

MATERIALS AND METHODS

The experiment was carried out during 2023–24 at Plant Pathology Laboratory in department of plant Pathology, College of Agriculture, Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur, Madhya Pradesh. The specific materials and methodology used during this experiment are:

A. Collection of disease sample

Diseased plant samples of Mungbean infected with *Macrophomin aphaseolina* were collected from the field of College of Agriculture, JNKVV, Jabalpur, India in year 2023. The samples were kept in pre-sterilized polyethylene bags separately and brought to the lab for further processing. The usual methodology was performed according to Pandey *et al*. (2020) for isolation and purification of the fungus. Small portion of diseased parts of plants showing small sclerotia were cut into 5 to 10 mm size and these portions were then surface sterilized using 1% NaOCl. After 60s these bits are taken out and washed into sterilized water to remove all the traces of the chemicals. Then these bits were placed on the petri plates containing solidified PDA medium for 25±1°C into BOD for 48 to 72 hours. As soon as the growth of fungus was observed in plates, small portion of mycelial growth was transferred on potato dextrose agar slants. Number of slants were prepared for further investigation.

B. In vitro evaluation of fungicides

Different concentrations of eight single fungicides, Carbendazim (50% WP), Pyraclostrobin (20%WG), Tebuconazole (25.9EC), Thiophenate Methyl (70% WP), Mancozeb (75% WP), Difenconazole (25% EC), Trifloxystrobin (25%WG) and Propineb (70%WP) and eight combination fungicides *viz.,* Vitavax (Carboxin 37.5% + Thiram 37.5%WS), Saaf (Carbendazim 12% + Mencozeb 63%WP), Nativo (Tebuconazole50%+ Trifloxystrobin 25%WG), Priaxor (Fluxapyroxad 167 + Pyraclostrobin 333 SC), Xelora (Thiophenate Methyl 450+ Pyrachlostrobin 50 g/l), Juniper (Mencozeb 64% + Thiophenate Methyl 12% WP), Tebusulf (Tebuconazole 10%+ Sulphur 65%WG) and Taqat (Captan 70%+ Hexaconazole5% WP) were tested for the growth inhibition and sclerotial formation of *M. phaseolina* by using poisoned food technique (Bagchi & Das 1968).

The required quantity of each fungicides were incorporated into autoclaved measured PDA medium before solidification and then medium were poured into sterilized Petri dishes (90 mm dia.) in equal quantity (20 ml per Petri dish) to form a uniform layer. These plates were then allowed to solidify. After solidification the plates were inoculated with an actively growing fungal mycelial bit of 5 mm diameter which were transferred under aseptic conditions over the solidified PDA medium. The mycelial disc were placed in the center of plates in an inverted position to make a direct contact with the poisoned medium. Then Petri dishes were incubated at 28± 2°C for 168 hours and observations were recorded on radial growth of mycelium in treated and control plates. Inoculated Petri dishes containing PDA medium without fungicides were served as control. The radial growth of the fungal colonies were measured from two different angles in millimeter (mm) and the average values were calculated. The per cent growth inhibition of the fungus in each treatment was calculated by using following formula (Vincent, 1947)

$$\text{Inhibition Per Cent (I)} = \frac{C - T}{C} \times 100$$

Where as

C = Diameter of fungus colony (mm) in control plate

T = Diameter of fungus colony (mm) in treated plate.

RESULT AND DISCUSSION

The findings showed that the most effective fungicides were Tebuconazole 25.9 EC, Mancozeb 75% WP, and Carbendazim 50% WP. These fungicides completely inhibited mycelia growth of *M. phaseolina* at all concentrations (300, 600, and 900 ppm) when tested *in vitro*. Thiophenate methyl came in second, with an average inhibition of 86.29% at 168 hours (Fig. 1 and Table 1). Trifloxystrobin (25%WG), which exhibits 42.40% of the inhibition over control, exhibited the least amount of inhibition. Upon analyzing the result it was evident that the inhibition of growth was found to be directly proportional to the concentration of fungicides that means per cent mycelial inhibition was increased with increase in concentrations of the fungicides tested.

Maruti *et al*. (2017) reported that Mancozeb and Tebuconazole shows full inhibition at all concentrations tested under *in vitro* condition which support the present findings. Kumar and Kelaiya (2020) also reported that Mancozeb 75% WP and Carbendizim 50% WP was most effective against *Macrophomina phaseolina in vitro* condition. The results is also in agreement to the findings of Iqbal and Mukhtar (2020) who reported that maximum individual inhibition of growth of the fungus was recorded with Benomyl (83.89%) followed by Carbendazim (79.11%).

Treatment	T1	T2	T3	T4	T5	T6	T7	T8	T9
300 ppm									
600 ppm									
900 ppm									

Fig. 1. *In vitro* evaluation of *M. phaseolina* against single fungicides.

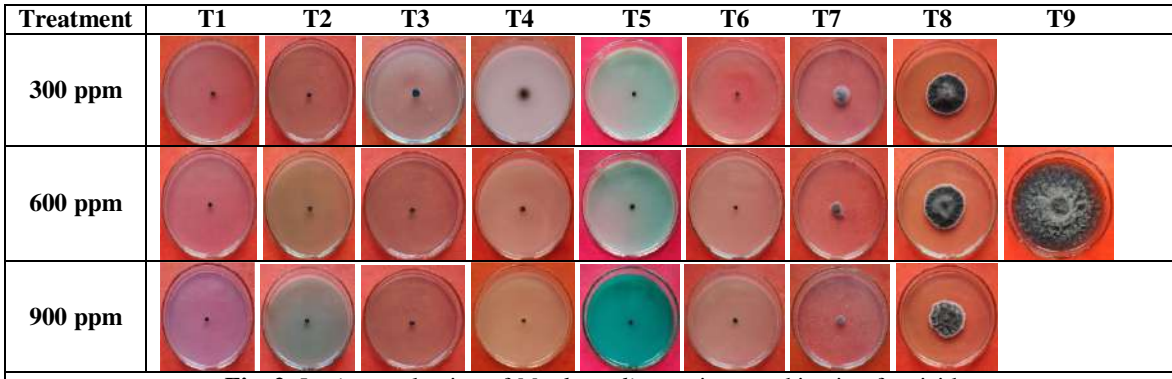

Fig. 2. *In vitro* evaluation of *M. phaseolina* against combination fungicides.

Table 1: Evaluation of single fungicides against *M. phaseolina* under *in vitro* condition.

Sr. No.	Fungicides	Radial Growth (mm) Concentration (ppm)			Average growth (mm)	Inhibition (%) Concentration (ppm)			Average Inhibition %
		300	600	900		300	600	900	
T1	Carbendazim (50% WP)	0.00	0.00	0.00	0.00	100 (90.00)*	100 (90.00)	100 (90.00)	100.00 (90.00)
T2	Pyraclostrobin (20%WG)	27.67	16.83	14.00	19.50	69.25 (56.32)	81.30 (64.38)	84.44 (66.77)	78.33 (62.49)
T3	Tebuconazole (25.9EC)	0.00	0.00	0.00	0.00	100 (90.00)	100 (90.00)	100 (90.00)	100.00 (90.00)
T4	Thiophenate Methyl (70% WP)	31.00	17.50	6.00	12.33	65.55 (54.06)	80.55 (63.83)	93.33 (75.03)	79.81 (64.31)
T5	Mancozeb(75% WP)	0.00	0.00	0.00	0.00	100 (90.00)	100 (90.00)	100 (90.00)	100.00 (90.00)
T6	Difenconazole (25% EC)	29.50	14.50	8.50	17.50	67.22 (55.07)	83.88 (66.33)	90.55 (72.10)	80.55 (64.50)
T7	Trifloxystrobin (25%WG)	77.67	49.33	28.50	51.83	13.70 (21.72)	45.18 (42.23)	68.33 (55.75)	42.40 (39.90)
T8	Propineb (70%WP)	46.83	45.05	40.00	43.96	47.96 (43.83)	49.94 (44.97)	55.55 (48.19)	51.15 (45.66)
T9	Control	90.00	90.00	90.00	90	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	
	SE(m)± CD at 5%	0.42 1.27	0.51 1.53	0.76 2.28					

***value in parenthesis are angular transformed values**

All combination fungicides were found effective for mycelia growth inhibition of *M. phaseolina under in vitro condition*, Vitavax (Carboxin37.5% + Thiram37.5%WS), Saaf (Carbendazim 12% + Mencozeb 63%WP) and two new generation fungicide combination trade name as Xelora (Thiophenate Methyl 450+ Pyraclostrobin 50) and Juniper (Mencozeb 64% + Thiophenate Methyl 12%WP) were found to be most effective at all concentrations used and shows 100% inhibition of the fungus (Fig. 2 and Table 2).

Table 2: Evaluation of combination fungicides against *M. phaseolina* under *in vitro* condition.

Sr. No.	Fungicides	Radial Growth (mm) Concentration (ppm)			Average growth (mm)	Inhibition (%) Concentration (ppm)			Average Inhibition
		300	600	900		300	600	900	
1.	Vitavax (Carboxin 37.5% + Thiram37.5%WS)	0.00	0.00	0.00	0.00	100 (90.00)*	100 (90.00)	100 (90.00)	100 (90.00)
2.	Saaf (Carbendazim 12% + Mencozeb 63%WP)	0.00	0.00	0.00	0.00	100 (90.00)	100 (90.00)	100 (90.00)	100 (90.00)
3.	Nativo (Tebuconazole50%+ Trifloxystrobin 25%WG)	7.00	5.50	0.00	4.16	92.22 (73.80)	93.88 (75.68)	100.00 (90.00)	95.36 79.83
4.	Priaxor (Fluxapyroxad167+ Pyraclostrobin 333 SC)	19.17	11.33	5.33	11.94	78.70 (62.51)	87.41 (69.22)	94.07 (75.91)	86.72 69.21
5.	Xelora (Thiophenate Methyl 450+ Pyraclostrobin 50 g/l)	0.00	0.00	0.00	0.00	100 (90.00)	100 (90.00)	100 (90.00)	100 (90.00)
6.	Juniper (Mencozeb 64% + Thiophenate Methyl 12%WP)	0.00	0.00	0.00	0.00	100 (90.00)	100 (90.00)	100 (90.00)	100 (90.00)
7.	Tebusulf (Tebuconazole 10%+ Sulphur 65%WG)	16.50	11.50	7.50	11.83	81.66 (64.64)	87.22 (69.05)	91.66 (73.21)	86.85 68.97
8.	Taqat (Captan 70%+ Hexaconazole 5%WP)	36.00	34.67	11.67	24.44	60.00 (50.77)	61.47 (51.63)	87.03 (68.89)	69.50 57.10
9.	Control	90.00	90.00	90.00	90	0.00	0.00	0.00	
	SE(m)± CD at 5%	0.272 0.815	0.194 0.582	0.221 0.662					

***value in parenthesis are angular transformed values**

Least mycelia inhibition was shown by Taqat (Captan 70%+ Hexaconazole 5%WP) which shows 69.50% of mycelial inhibition. Lokesh *et al.* (2020) reported that highest per cent growth inhibition over control was recorded (82.35%) in carbendazim 12% + mancozeb 63% followed by Carboxin 37.5% + Thiram 37.5% (78.82%) against *M. phaseolina* in *in vitro* conditions. The present findings are also in agreement to experimental findings of Kumar and Kelaiya (2020a) into which vitavex (Carboxin 37.5% + Thiram 37.5% WP) shows maximum average mycelial inhibition of 80.30% followed by Saaf (Carbendazim 12% + Mancozeb 63% WP) which gave 73.17% of average mycelial inhibition. Kumari *et al*. (2022) also evaluated five fungicides containing four combination and one single fungicides under in vitro conditions against *M. phaseolina* inciting charcoal rot of cowpea. They have found that Saaf (Carbendazim 12% + Mencozeb 63%WP) gave about 97.43% of total average reduction of mycelial growth over control.

CONCLUSIONS

The disease known as *Macrophomina* blight has emerged as a significant obstacle to the lucrative and successful cultivation of mungbean in Madhya Pradesh in recent years. The effectiveness of many fungicides against *Macrophomina phaseolina* was assessed under *in vitro* condition. The most successful single fungicides that completely inhibited *M. phaseolina* radial growth were carbendazim 50% WP, mancozeb 75% WP, and tebuconazole 25.9EC. The most effective combination fungicides were found to be Vitavax (Carboxin 37.5% + Thiram 37.5%WS), Saaf (Carbendazim 12% + Mencozeb 63%WP), Xelora (Thiophenate Methyl 450+ Pyrachlostrobin 50) and Juniper (Mencozeb 64% + Thiophenate Methyl 12%WP).

FUTURE SCOPE

Madhya Pradesh produces Mungbean into summer season and at that time the disease is highly prevalent hence the promising fungicides identified in this study can be used for the management of *Macrophomina* blight of mungbean into field condition at big scale.

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