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# Efficacy of Different Fungicides Against *Macrophomina phaseolina* causing Root Rot of Fenugreek

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**ABSTRACT: Fenugreek (*Trigonella foenum-graecum* L.) is an important vegetable, spices, fodder and green manure. India is rightly known as the land of spices. Different non systemic, systemic and ready mix fungicides were evaluated *in vitro* against *Macrophomina phaseolina* causing root rot in fenugreek. Among non systemic fungicides evaluated maximum inhibition in mycelial growth was observed in mancozeb (100%) and metiram (100%). Among the different concentrations tried, Mancozeb and Metiram gave 100 per cent inhibition at all concentration. Out of seven systemic fungicides, propiconazole found best with 95.15 per cent mycelial growth inhibition followed by carbendazim (90.14%). Propiconazole and carbendazim showed complete inhibition of mycelial growth of the test fungus at 250 and 500 ppm concentration. Among the ready mix fungicides, carbendazim + mancozeb, penflufen + trifloxystrobin and metalaxyl + mancozeb gave 100 per cent growth inhibition at all concentration.**

**Keywords:** Fenugreek, *Macrophomina phaseolina*, root rot, non systemic fungicides, systemic fungicides and ready mix fungicides.

## INTRODUCTION

Fenugreek (*Trigonella foenum-graecum* L.) is an important vegetable, spices, fodder and green manure. India is rightly known as the land of spices. It is the largest producer, consumer and exporter of spices in the world. Fenugreek is native to India and southern Europe. Fenugreek is rich in minerals, proteins, vitamin A and C (Bose and Som 1986). Fenugreek is attacked by a number of fungal diseases like as; root rot, powdery mildew, downy mildew, wilt, rust and leaf spot. Among these, root rot of fenugreek caused by *Macrophomina phaseolina* is one of the most important diseases which reduce the yield of the plant significantly. The main symptom of this disease is damping off. The freshly emerged seedlings fall over and die and most of the seedlings die at pre or post-emergence in severely infected areas. The symptoms initially characterized by in root, the secondary root shows sign of drying and root bark shreds-off easily. Rotting spreads partly above the ground. Girdling of the collar region of the affected seedlings due to the fungi when the lower most leaves turned chlorotic and wilting of the affected seedlings. The affected collar region became shredded with lapse of time and there appeared reddish-brown discoloration of the vascular elements of roots with black sclerotia characteristic of *M. phaseolina.* Plants show stunted growth and can easily be pulled out. Heavy losses are incurred due to root rot (Rettinasababady and Ramadoss 2000). Several workers have attempted to control *M. phaseolina* by use of different non systemic fungicides (Khalikar *et al.*, 2011; Kumar and Chaudhary 2020; Bedana and Kelaiya 2020), systemic fungicides (Fagodia *et al.*, 2017; Moradia, 2011 ; Prashanthi *et al.*, 2000) and ready mix fungicides (Tandel *et al.*, 2010; Swamy *et al.*, 2018).

The main objective of this study was to evaluate the different fungicides at different concentration for their efficacy against mycelial growth inhibition of *M. phaseolina* under *in vitro* condition.

## MATERIALS AND METHODS

Efficacy of different non systemic, systemic and ready mix fungicides at different concentrations was evaluated on radial growth of test fungus by Poisoned Food Technique (Bagchi and Das 1968).

Seven non systemic fungicides *viz.,* metiram, chlorothalonil, mancozeb, thiram, copper Oxychloride, zineb and propineb were tested at concentration of 1000, 1500 and 2000 ppm. Seven systemic fungicides *viz.,* picoxystrobin, difenconazole, fosetyl–Al, metalaxyl-M, carbendazim, fluxapyroxad and propiconazole were tested at concentration of 100, 250 and 500 ppm. Seven ready mix fungicides *viz.,* penflufen + trifloxystrobin, prochloraz + tebuconazole, carbendazim + mancozeb, azoxystrobin + difenoconazole, carboxin + thiram, metalaxyl + mancozeb and fluxapyroxad + pyraclostrobin were tested at concentration of 500, 750 and 1000 ppm against test fungus.

Fungicides were added aseptically to sterilized PDA medium to get the required concentrations and then poured into petriplates. The plates prepared without any fungicides served as control. These plates were inoculated with 7 mm disc of seven day old culture of the test fungus and incubated at 28 ± 1°C for 7 days after seven days of incubation the radial growth was measured. The percent inhibition in growth was determined with help of mean colony diameter and calculated by using the formula given by McKinney (1923).

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

Where,

I = Per cent inhibition of mycelial growth

C = Average radial growth of fungus in control plate (mm)

T = Average radial growth of fungus in treated plate (mm)

## RESULT AND DISCUSSION

The growth inhibition of *M. phaseolina* causing root rot in fenugreek has been tested at various concentration of contact, systemic and combination of fungicides *in vitro* recorded in Table 1-3. The results showed that (Table 1) all non systemic fungicides, mancozeb 75 WP and metiram 70 WG were found the most effective fungicide with 100 per cent mean mycelium growth inhibition and significantly superior over rest of the treatments. Whereas, propineb 70 WP and thiram 75 WS was the next the best fungicide showed 90.31 and 75.06 per cent mean mycelial growth inhibition, respectively. Chlorothalonil 75 WP found moderately effective fungicide with mean mycelial growth inhibition of 37.81 per cent. The next effective fungicides were copper oxychloride 50 WP with mean mycelial growth inhibition of 15.51. Zineb 75 WP was found the least effective fungicide with mean mycelium growth inhibition of 8.52 per cent. These results are supported by finding of Khalikar *et al.* (2011); Kumar and Chaudhary (2020); Bedana and Kelaiya (2020).

Similarly, systemic fungicides (Table 2), propiconazole 25 EC was found significantly superior over rest of the treatments with 95.15 per cent mean mycelial growth inhibition. But, it was remained statistically at par with carbendazim 50 WP with 90.14 per cent mean mycelial growth inhibition. Whereas, fluxapyroxad 333 g/L was the next the best fungicide showed 78.94 per cent mean mycelial growth inhibition followed by difenoconazole 25 EC showed 46.52 per cent mean mycelial growth inhibition. Fosetyl - AI 80 WP found moderately effective fungicide with mean mycelial growth inhibition of 31.37 per cent. The least effective fungicides were picoxystrobin 22.52 EC statistically at par with metalaxyl-M 35 WS with mean mycelial growth inhibition of 19.04 and 14.56 per cent, respectively. This finding is also in consonance with the results of Fagodia *et al.*, (2017); Moradia (2011); Prashanthi *et al.* (2000).

The results of ready mix fungicides presented in Table 3 revealed that penflufen 13.28 + trifloxystrobin 13.28 w/w FS, carbendazim 25 + mancozeb 50 WS and metalaxyl 8 + mancozeb 64 WP recorded maximum mean mycelial growth inhibition with 100 per cent. The next effective treatment was carboxin 37.5 + thiram 37.5 WS with 86.10 per cent mean mycelial growth inhibition. Azoxystrobin 18.2 + difenoconazole 11.4 SC found moderately effective fungicides with 79.81 per cent mean mycelial growth inhibition followed by fluxapyroxad 250 g/L + pyraclostrobin 250 g/L SC with mean mycelial growth inhibition 76.42 per cent. While minimum mean mycelial growth inhibition was recorded in prochloraz 5.7 + tebuconazole 1.4 w/w ES with 69.06 per cent. Similar result was recorded by Tandel *et al.* (2010); Swamy *et al.* (2018). The effectiveness of metalaxyl 8 + mancozeb 64 WP recorded by Choudhary *et al.* (2004) while working with *M. phaseolina.*

**Table 1: Effect of different non systemic fungicides on mycelial growth inhibition of *M. phaseolina* under *in vitro* condition.**

| Non systemic fungicides | Mycelial growth inhibition (%) and concentration (ppm) | | | Mean mycelial growth inhibition (%) |
|---|---|---|---|---|
| | 1000 | 1500 | 2000 | |
| Metiram 70 WG | 100 | 100 | 100 | 100 |
| Chlorothalonil 75 WP | 21.12 | 42.63 | 49.67 | 37.81 |
| Mancozeb 75 WP | 100 | 100 | 100 | 100 |
| Thiram 75 WS | 57.82 | 80.60 | 86.76 | 75.06 |
| Copper oxychloride 50 WP | 8.24 | 13.11 | 25.20 | 15.51 |
| Zineb 75 WP | 1.12 | 10.75 | 13.70 | 8.52 |
| Propineb 70 WP | 86.76 | 89.71 | 94.48 | 90.31 |
| Mean | 53.58 | 62.40 | 67.11 | - |
| | Fungicide (F) | Concentration (C) | | F x C |
| S. Em. ± | 0.57 | 0.37 | | 0.98 |
| C.D. at 5% | 1.62 | 1.06 | | 2.81 |
| C.V.% | 3.07 | | | |

**Table 2: Effect of different systemic fungicides on mycelial growth inhibition of *M. phaseolina* under *in vitro* condition.**

| Systemic fungicides | Mycelial growth inhibition (%) | | | Mean mycelial growth inhibition (%) |
|---|---|---|---|---|
| | 100 ppm | 250 ppm | 500 ppm | |
| Picoxystrobin 22.52 SC | 02.13 | 04.02 | 50.97 | 19.04 |
| Difenconazole 25 EC | 27.43 | 49.67 | 62.45 | 46.52 |
| Fosetyl – Al 80 WP | 02.57 | 20.94 | 70.60 | 31.37 |
| Metalaxyl-M 35 WS | 4.40 | 14.64 | 24.65 | 14.56 |
| Carbendazim 50 WP | 70.43 | 100 | 100 | 90.14 |
| Fluxapyroxad 333 g/L | 59.31 | 81.16 | 96.36 | 78.94 |
| Propiconazole 25 EC | 85.45 | 100 | 100 | 95.15 |
| Mean | 35.96 | 52.92 | 72.15 | — |
| | **Fungicide (F)** | **Concentration (C)** | | **F × C** |
| S. Em. ± | 0.81 | 0.53 | | 1.40 |
| C.D. at 5% | 2.31 | 1.52 | | 3.99 |
| C.V.% | 4.95 | | | |

**Table 3: Effect of different ready mix fungicides on mycelial growth inhibition of *M. phaseolina* under *in vitro* condition.**

| Ready mix fungicides | Mycelial growth inhibition (%) and concentration (ppm) | | | Mean mycelial growth inhibition (%) |
|---|---|---|---|---|
| | 500 | 750 | 1000 | |
| Penflufen 13.28 + Trifloxystrobin 13.28 FS | 100 | 100 | 100 | 100 |
| Prochloraz 5.7 + Tebuconazole 1.4 w/w ES | 55.23 | 68.01 | 83.93 | 69.06 |
| Carbendazim 25 + Mancozeb 50 WS | 100 | 100 | 100 | 100 |
| Azoxystrobin 18.2+Difenoconazole 11.4 SC | 69.31 | 83.19 | 86.91 | 79.81 |
| Carboxin 37.5 + Thiram 37.5 WS | 67.08 | 94.48 | 96.75 | 86.10 |
| Metalaxyl 8 + Mancozeb 64 WP | 100 | 100 | 100 | 100 |
| Fluxapyroxad 250+Pyraclostrobin 250 SC | 62.45 | 70.05 | 96.75 | 76.42 |
| Mean | 79.15 | 87.96 | 94.91 | — |
| | **Fungicide (F)** | **Concentration (C)** | | **F × C** |
| S. Em. ± | 0.25 | 0.16 | | 0.43 |
| C.D. at 5% | 0.71 | 0.46 | | 1.24 |
| C.V. % | 1.02 | | | |

## CONCLUSIONS

The present result indicates that mancozeb, metiram, carbendazim and propiconazole and ready mix of fungicides *viz.,* penflufen + trifloxystrobin, carbendazim + mancozeb and metalaxyl + mancozeb were quite effective in controlling root rot. The alternate application of these chemicals reduced the risk of development of resistance in pathogen. Such information will be helpful in formulation of schedule for management of root rot.

## FUTURE SCOPE

The fungicides remain a major phytosanitary challenge to fenugreek cultivation and a threat to fenugreek production worldwide. Our analysis suggests that fungicides will continue to play key role in root rot management, even when fenugreek cultivars with level of resistant cultivars.

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