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Management of stem and root rot of sesame caused by *Macrophomina phaseolina*

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Abstract
One of the principal diseases, *Macrophomina phaseolina* caused sesame stem and root rot, is responsible for 25–30% production losses each year, particularly in the turmeric fallows of Northern Telangana Zone. It is also one of the most prevalent illnesses in every Indian state that grows sesame. In sesame, the pathogen results in seedling death as well as root and stem rot. The disease can affect crops at any stage of growth and is made more likely by dry conditions and moisture stress. The main worry is secondary infection by Pycnidia, which completely kills plants from pod formation to maturity stage, resulting in significant yield losses. The experiment's objective was to assess fungicide molecules for field-based control of *Macrophomina phaseolina* secondary spread. The minimum root rot incidence (13.2) was recorded in T2 -Seed treatment with *Trichoderma viride* @ 10 g/kg + furrow application of *T. viride* (2.5 kg/ha enriched in 100 kg of FYM) @ 250 kg/ha and foliar application of Trifloxystrobin + Tebuconozole @ 0.5 g/l at capsule initiation and second spray after 15 days interval) followed by T3 -Seed treatment with *T. viride* @ 10 g/kg + furrow application of *T. viride* (2.5 kg/ha enriched in 100 kg of FYM) @ 250 kg/ha and foliar application of Azoxystrobin @ 1 ml/l at capsule initiation and second spray after 15 days interval) with 14.1 per cent disease root rot incidence, whereas the maximum root rot incidence (27.5 %) was recorded in control and maximum (685.3 kg ha^{-1}) yield was recorded in T_2 treatment when compared to inoculated control (343.9 kg ha^{-1}).

Keywords: *Macrophomina phaseolina, Trichoderma viride***,** trifloxystrobin + Tebuconozole Azoxystrobin and sesame

Introduction

One of the most significant ancient edible oilseed crops grown in India is sesame (*Sesamum indicum* L.). The highest oil content among the oilseed crops is found in sesame, which has 6335 kcal kg-1 of nutritional energy in its seeds (Kumar and Goel, 1994) [2]. Sesame seeds contain about 47% oleic acid and 39% linolenic acid, and they are a good source of protein (20%) and edible oil (50%) as well (Shyu and Hwang, 2002) [9]. Due to the presence of the naturally occurring antioxidants sesamoline, sesamin, and sesamol, sesame oil has good stability. One of the oldest oil seed crops still grown today is sesame (*Sesamum indicum* L.), which is grown in tropical and subtropical regions. Sesame crop production and growing less in its traditional growing regions. Despite the potential to increase sesame production and productivity, a variety of obstacles prevent this from happening. The primary cause of this crop's low yield is the invasion of numerous bacterial, viral, and fungal diseases. There have been reports of 72 fungus, 7 bacteria, 1 phytoplasmal, and 1 viral illness from India (Vyas *et al*., 1984) [11]. In India 32 diseases their (14 major and 18 minor). Numerous fungal diseases, including Powdery mildew (*Erysiphe cichoracearum*), Cercospora leaf spot, Alternaria leaf spot, Charcoal rot of sesame *M. phaseolina* and Alternaria leaf spot, can affect the crop (*Cercospora sesami*). Among all the fungal diseases, stem and root rot was caused by *M. phaseolina* affects severely at all stages of the crop. According to reports, During the growing season, high temperatures and water stress favor the pathogen's occurrence. According to Vyas (1981) [10], *M. phaseolina* is a very dangerous and destructive pathogen in all places where sesame is grown, and it results in a 5-100% yield loss. In 1988, Maiti *et al.* predicted that yield loss would be roughly 57% at a disease incidence of 40%. Chemical fungicides are currently the first line of defense against infections due to their versatility and speed of treatment. It is deemed appropriate to use chemical fungicides sparingly because of the risks to human health and environmental contamination they pose. Sesame oil and seeds are highly sought after for export due to their high levels of unsaturated fat and methionine, therefore in recent years, attention has switched to safer alternatives to conventional fungicides.

Modern agriculture had begun to emphasize biological management in order to reduce the risks associated with the extensive use of chemicals for disease control. Since biocontrol agents' effectiveness in disease attenuation has proven ineffective because Biocontrol with antagonistic microorganisms alone could not completely replace the management techniques now in use due to their failure to maintain the crucial threshold population required for prolonged biocontrol activity. The addition of certain substrates that are utilized only when the introduced microbe acting as a biocontrol agent is present will improve and prolong the intended response (Paulitz, 2000) [8]. Therefore, integrated management that includes biocontrol agents and organic amendments will lower the amount of fungicide used each season as well as combat diseases in a ratio that is both financially feasible and environmentally safe. Biopesticides are more affordable, environmentally benign, and do not run the danger of causing the pathogen to become resistant. Biological control agents do not thrive in the rhizoplane and rhizosphere, despite the fact that some of them may shield seeds from soil-borne diseases (Papavizas, 1985) [7]. In order to determine the impact of integrated disease management with various therapies on the incidence of the disease and sesame yield, an assessment was made.

Material & methods

During the summer of 2019–20, a field experiment was carried out at the Regional Agricultural Research Station in Polasa, Jagtial, to investigate the effectiveness of fungicides, *Trichoderma viride*, and *Pseudomonas flourescens* as biocontrol agents for the treatment of stem and root rot disease in sesame. The susceptible variety VRI-1 was used in the field trial to cure the stem and root rot disease of sesame in a plot measuring 2.4 x 3.0 m, with eight treatments and three replications. Eight treatments in integrated manner, T1 - Seed treatment with *Trichoderma viride* @ 10 g/kg + furrow application of *T. viride* (2.5 kg/ha enriched in 100 kg of FYM) @ 250 kg/ha + Spraying of *Pseudomonas flourescens* @ 5 g/l at 45 and 60 DAS; T2: Seed treatment with *Trichoderma viride* @ 10 g/kg + furrow application of *T. viride* (2.5 kg/ha enriched in 100 kg of FYM) @ 250 kg/ha + Spraying of Trifloxystrobin + Tebuconozole @ 0.5 g/l at capsule initiation and second spray after 15 days interval; T3: Seed treatment with *Trichoderma viride* @ 10 g/kg + furrow application of *T. viride* (2.5 kg/ha enriched in 100 kg of FYM) @ 250 kg/ha + Spraying of Azoxystrobin @ 1 ml/l at capsule initiation and second spray after 15 days interval; T4: Seed treatment with *Trichoderma viride* @ 10 g/kg + furrow application of *T. viride* (2.5 kg/ha enriched in 100 kg of FYM) @ 250 kg/ha + Spraying of Pyraclostrobin + Metiram @ 3 g/l at capsule initiation and second spray after 15 days interval; T5: Seed treatment with *Trichoderma viride* @ 10 g/kg + furrow application of *T. viride* (2.5 kg/ha enriched in 100 kg of FYM) @ 250 kg/ha + Spraying of Cymoxanil + Mancozeb @ 2 g/l at capsule initiation and second spray after 15 days interval; T6: Seed treatment with *Trichoderma viride* @ 10 g/kg + furrow application of *T. viride* (2.5 kg/ha enriched in 100 kg of FYM) @ 250 kg/ha + Spraying of Captan + Hexaconozole @ 2 g/l at capsule initiation and second spray after 15 days interval, T7: Seed treatment with *Trichoderma viride* @ 10 g/kg + furrow application of *T. viride* (2.5 kg/ha enriched in 100 kg of FYM) @ 250 kg/ha + Spraying of Carbendazim + Mancozeb @ 2.5 g/l at capsule initiation and second spray after 15 days interval, T8- Water spray (Untreated check). The incidence of Macrophomina stem and root rot and yield was recorded.

$$\text{Percent Disease Incidence (PDI)-} = \frac{\text{Number of infected plants}}{\text{Total number of plants}} \times 100$$

Results and Discussion

Effect of seed treatment with biocontrol agents and spraying of fungicides on per cent stem and root rot incidence were studied on sesame cv. VRI-1 under field conditions. The results of experiments presented in table 1 showed that the per cent root rot disease incidence of sesame in all the treatments (13.2 to 19.4 %) was significantly higher as against 27.5 per cent in the untreated check. Among all the treatments, T2 - Spraying of Trifloxystrobin + Tebuconozole @ 0.5 g/l at capsule initiation and second spray after 15 days interval recorded minimum root rot incidence (13.2 %) followed by T3 Spraying of Azoxystrobin @ 1 ml/l at capsule initiation and second spray after 15 days interval, T5 Spraying of Cymoxanil + Mancozeb @ 2 g/l at capsule initiation and second spray after 15 days interval, T4 Spraying of Pyraclostrobin + Metiram @ 3 g/l at capsule initiation and second spray after 15 days interval and T1 Spraying of *Pseudomonas flourescens* @ 5 g/l at 45 and 60 DAS, with 14.1, 15.7, 16.6, 17.3 and 18.5 per cent respectively, the treatments T3, T5 and T4 were statistically on par with T2. However treatment T7 Spraying of Carbendazim + Mancozeb @ 2.5 g/l at capsule initiation and second spray after 15 days interval recorded maximum (19.4 %) root rot incidence was observed.

Table 1: Management of stem and root rot of sesame caused by *Macrophomina phaseolina*

Treatment	Macrophomina stem and root rot PDI (%)	Yield (kg ha^{-1})
T1: Spraying of *Pseudomonas flourescens* @ 5 g/l at 45 and 60 DAS	17.3	552.0
T2: Spraying of Trifloxystrobin + Tebuconozole @ 0.5 g/l at capsule initiation and second spray after 15 days interval	13.2	685.3
T3: Spraying of Azoxystrobin @ 1 ml/l at capsule initiation and second spray after 15 days interval.	14.1	629.2
T4: Spraying of Pyraclostrobin + Metiram @ 3 g/l at capsule initiation and second spray after 15 days interval.	16.6	564.5
T5: Spraying of Cymoxanil + Mancozeb @ 2 g/l at capsule initiation and second spray after 15 days interval.	15.7	577.1
T6: Spraying of Captan + hexaconozole @ 2 g/l at capsule initiation and second spray after 15 days interval.	19.4	531.5
T7: Spraying of Carbendazim + Mancozeb @ 2.5 g/l at capsule initiation and second spray after 15 days interval.	18.5	539.4
T8: Water spray (Untreated check)	27.5	343.9
S.Em ± 2	0.96	45.2
CD @ 5%	3.54	138.7

The influence of biocontrol agents and fungicides on the yield parameters were studied under filed conditions and the results are presented in (table-1). There was significant increase in yields in various treatments compared to check. The yields ranged from 343.9 to 685.3 kg ha-^{1} in various treatments. The maximum (685.3kg ha-^{1}) yield was recorded in T2 treatment (Spraying of Trifloxystrobin + Tebuconozole @ 0.5 g/l at capsule initiation and second spray after 15 days interval) when compared to Uninoculated control (343.9 kg ha-^{1}). Among all the treatments T3 (Spraying of Azoxystrobin @ 1 ml/l at capsule initiation and second spray after 15 days interval) followed by T5- Spraying of Cymoxanil + Mancozeb @ 2 g/l at capsule initiation and second spray after 15 days interval, T4- Spraying of Pyraclostrobin + Metiram @ 3 g/l at capsule initiation and second spray after 15 days interval, T1- Spraying of *Pseudomonas flourescens* @ 5 g/l at 45 and 60 DAS, T7 -Spraying of Carbendazim + Mancozeb @ 2.5 g/l at capsule initiation and second spray after 15 days interval and T6- Spraying of Captan + Hexaconozole @ 2 g/l at capsule initiation and second spray after 15 days interval with 629.2, 577.1, 564.5, 552.0, 539.4 and 531.5 kg ha-1 respectively.

Similar findings were made by Nayan Kishor *et al.* (2019) [6] among the fungal diseases, stem and root rot of sesame caused by *Macrophomina phaseolina* affects severely at all stages of crop growth. *Macrophomina phaseolina* is a diverse, omnipresent soil borne pathogen. The pathogen survives as sclerotia in the soil and in host tissue for varying periods. Two consecutive summer season trials of 2017 and 2018 were conducted at Agricultural Experimental Farm, Institute of Agricultural Science, University of Calcutta, Baruipur, South 24 Parganas. Integrated management of stem and root rot disease (*M. phaseolina*) of sesame was conducted with seven treatments. The results revealed that minimum stem and root rot incidence (9.5%) and maximum yield (557 kg/ha) with C:B ratio 2.40 in 2017, stem and root rot incidence (10.5%) and Maximum yield (545 kg/ha) with C:B ratio 2.33 in 2018 were recorded in the treatment of T6 (Seed treatment with carbendazim @ 2 g/kg + soil drenching with carbendazim @ 1 g/ l).

Similar results were reported by Meena. B (2020) [5] that effect of bioagents and newer molecules of fungicides were evaluated in managing the stem and root rot disease of sesame under sick plot conditions during 2018 and 2019. Seed treatment was done with bioagent *Trichoderma asperellum* at the rate of 4 g/kg of seed. Furrow application of *T. asperellum* (2.5 kg/ha enriched in 100 kg of FYM) at the rate of 250 kg/ha was also made uniformly in all the treatments. Foliar application of fungicides was done twice one at capsule initiation stage and another at 15 days interval. From the results, it could be inferred that seed treatment with *T. asperellum* at the rate of 4g/kg seed, furrow application of *T. asperellum* (2.5 kg/ha enriched in 100 kg of FYM) at the rate of 250 kg/ha followed by foliar application of Trifloxystrobin + Tebuconazole at the rate of 0.5 g/l at capsule initiation and second spray after 15 days interval was highly effective in managing the stem and root rot disease of sesame as well increased the seed yield also.

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