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J Krishi Vigyan 2025, 13(2) : 435-438

DOI: 10.5958/2349-4433.2025.00078.X

ISSN 2319-6432 (Print)
ISSN 2349-4433 (Online)

Integrated Management of Stem and Root Rot of Sesame caused by *Macrophomina phaseolina* (Tassi) Goid

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ABSTRACT

Sesame (*Sesamum indicum* L.) is an important oilseed crop known for its high-quality oil (48-55%) and nutritional value, making it a key agricultural commodity globally. However, its production is constrained by various biotic stresses, including fungal, bacterial and phytoplasmal diseases like Alternaria leaf spot, stem and root rot, powdery mildew, Cercospora leaf spot, bacterial blight and phyllody. Among these stem and root rot caused by *Macrophomina phaseolina* attributes significant yield losses. This soil-borne, saprophytic pathogen affects all parts of the plant and is challenging to manage due to its ability to survive in the soil as sclerotia. Hence, the current investigation examined the effects of using botanicals, bioagents and fungicides to assess their effectiveness in disease management. Field experiments during *Kharif* 2024 demonstrated that soil application of *T.harzianum* enriched with Neem cake and FYM @ 1:20:250 kg/ha + seed treatment with *T. harzianum* @ 10g/kg of seeds followed by spray of (Tebuconazole 50% + Trifloxystrobin 25 %) 75% WG @ 0.5g/l at 45, 60 and 90 DAS resulted in the lowest stem and root rot incidence (14.94 %) and highest yield (8.74q/ha) which was significantly superior to other scheduled combinations. The lowest yield of 3.42 q/ha and maximum stem and root rot incidence of 38.82 per cent was recorded in untreated control. Thus explore the integrated approaches for the management of diseases an experiment was conducted with different treatments against the control of *M. phaseolina* causing stem and root rot in sesame.

Keywords: *Macrophomina,* Oilseed, Sesame**,** Stem and root rot, *Trichoderma harzianum*

INTRODUCTION

Sesame (*Sesamum indicum* L.) often referred to as the Queen of Oilseeds due to its high content of polyunsaturated fatty acids, which help prevent rancidity. The seeds contain 48-55 per cent oil and 20-28 per cent protein, along with essential amino acids, niacin and various minerals. Additionally, they are rich in sesamin and sesamolin, which contribute to the formation of sesamol—an antioxidant that enhances shelf life. This remarkable longevity has also earned sesame the title of seeds of immortality (Bashir, 2017). In Karnataka, sesame is primarily cultivated under rainfed conditions, covering 0.20 lakh ha with an annual production of 0.13 lakh tonnes and an average productivity of 650 kg/ha (Anonymous, 2023).

The decline in sesame cultivation across traditional growing regions is attributed to various yield-limiting factors, particularly biotic and abiotic stresses. Among these, diseases pose a major threat, with sesame being highly susceptible to fungal, bacterial, and phytoplasmal infections such as Alternaria leaf spot, stem and root rot, powdery mildew, Cercospora leaf spot, bacterial blight, and phyllody. Among these, stem and root rot, caused by *Macrophomina phaseolina*, is one of the most severe. It begins with black lesions at the plant's base, gradually spreading upward along the stem, while the roots darken and secondary rootlets decline. As the infection worsens, capsules turn brown, dry out and open prematurely, eventually causing the entire plant to blacken, wilt and shed its leaves (Khamari and Patra, 2018).

The pathogen persists in soil and plant debris by producing an asexual structure called microsclerotia, which can remain viable in infected root debris for over 5–12 years. These hard resting structures, including sclerotia and microsclerotia, are dispersed throughout the soil. The drying and decomposition of host tissue further support the pathogen's survival under unfavorable environmental conditions. Additionally, pycnidial growth develops

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*Part of M.Sc. (Agri.) Thesis submitted by the first author to the University of Agricultural Sciences, Dharwad - 580 005 (Karnataka)

Treatment details

T_1	Soil application of *Trichoderma harzianum* enriched with Neem cake and FYM @1:20: 250kg/ha + Seed treatment with *T.*harzianum @10g/kg of seeds followed by spray of *T.harzianum* @ 10g/l at 45,60 and 90 DAS
T_2	Seed treatment with Azadirachtin (10000ppm) @2ml/l followed by Spray of Azadirachtin (10000ppm) @2ml/l at 45,60 and 90 DAS
T_3	ST with Carbendazim 50 WP @2g/kg of s eeds followed by spray of (Tebuconazole 50 % + Trifloxystrobin 25 %) @ 0.5g/l at 45,60 and 90 DAS
T_4	ST with (Carboxin 37.5% + Thiram 37.7 %) @ 3g/kg of seeds followed by spray of *T.harzianum* @ 10g/l at 45,60 and 90 DAS
T_5	ST with (Carbendazim 12%+ Mancozeb 63 %) @ 2g/kg of seeds followed by spray of Azadirachtin (10000 ppm) @2ml/l at 45,60 and 90 DAS
T_6	Soil application of *T.harzianum* enriched with Neem cake and FYM @1:20250kg/ha + ST with *T.harzianum* @10g/kg of seeds followed by spray of Azadirachtin (10000 ppm) @2ml/l at 45,60 and 90 DAS.
T_7	Soil application of *T.harzianum* enrichedwith Neem cake and FYM @1:20:250kg/ha + ST with *T.harzianum* @10g/kg of seeds followed by spray of (Tebuconazole 50 % + Trifloxystrobin 25 %) @ 0.5g/l at 45,60 and 90 DAS
T_8	Seed treatment with *T.harzianum* @10g/kg of seed (RC)
T_9	Seed treatment with Captan 70% WP @3g/kg of seed (RC)
T_{10}	Untreated control

on plant tissues, eventually rupturing to release aseptate, ellipsoid to ovoid conidia, facilitating successive infections in the field (Marquez *et al,* 2021).

MATERIALS AND METHODS

A field trial was conducted on integrated management of stem and root rot of sesame during *kharif* 2024 at AICRP on sesame and Niger, Main Agricultural Research Station, University of Agricultural Sciences, Dharwad by following Randomized block design . There were 10 treatments with three replications each. The variety of sesame used was DSS 9 which was sown at 30X 10 cm spacing in a plot size of 2.4mX 3 m. The detail of treatments is given as under

The observations like seed germination was done after 15 days of sowing, disease incidence was calculate by the given by Wheeler (1969). The yield of the plot was recorded and converted into per hectare basis. Observations on stem and root rot incidence were recorded at different intervals, beginning 45 days after sowing and continuing until crop maturity.

RESULTS AND DISCUSSION

A field investigation was conducted during *Kharif* 2024 at the Main Agricultural Research Station, UAS, Dharwad, using a randomized block design with three replications and the DSS-9 variety of sesame. The study evaluated the efficacy of the fungicide (Tebuconazole 50% + Trifloxystrobin 25%), which had shown the highest effectiveness in *in vitro* studies, along with the best biocontrol agent, *Trichoderma harzianum* IOF strain from UAS Dharwad. A total of ten treatment combinations were evaluated against stem and root rot, all of which showed a significant reduction in disease incidence and performed better than the control treatment.

After 15 days of sowing, the percentage of germination was calculated and result indicated that there were no significant differences among the treatments, highest germination percentage of sesame plants of 92.63 per cent was recorded (T_7) and least in treatment T_{10} (Untreated control), 62.04 per cent respectively.

Among the ten treatments evaluated during *kharif* 2024, results revealed that all the treatments significantly reduced the stem and root rot incidence as compared to the control. The treatment T_7 (Soil application of *T.harzianum* enrichedwith Neem cake and FYM @1:20:250kg/ha + Seed treatment with *T.harzianum* @10g/kg of seeds followed by spray of (Tebuconazole 50 % + Trifloxystrobin 25 %) @ 0.5g/l at 45, 60 and 90 DAS) recorded least disease incidence of 14.94 per cent during *kharif* 2024, which was significantly superior to other scheduled combinations. Next best treatment was T_3 (ST with Carbendazim 50 WP @2g/kg of seeds followed by spray of (Tebuconazole 50 % + Trifloxystrobin 25%) @ 0.5g/l at 45,60 & 90 DAS) which had recorded disease incidence of 18.51 per cent during *kharif* 2024. Untreated control (T_{10}) recorded a maximum stem and root rot incidence of 38.82 per cent and it is significantly highest over all other treatments (Table 1)

Table 1. Evaluation of different treatment against stem and root rot of sesame (*Kharif*-2024)

Treatment		Germination (%)	Disease incidence (%)			Yield (q/ha)
			45 DAS	60 DAS	90 DAS	
T1	Soil application of *Trichoderma harzianum* enriched with Neem cake and FYM @1:20:250kg/ha + Seed treatment with *T.*harzianum @10g/kg of seeds followed by spray of *T.harzianum* @ 10g/l at 45,60 and 90 DAS	90.01 (71.87) *	9.6 (14.5) *	13.25 (18.27) *	26.77 (29.78) *	5.33
T2	Seed treatment with Azadirachtin (10000ppm) @2ml/l followed by spray of Azadirachtin (10000ppm) @2ml/l at 45,60 and 90 DAS	74.2 (59.57)	10.76 (15.74)	18.05 (22.67)	33.42 (34.73)	4.18
T3	ST with Carbendazim 50 WP @2g/kg of seeds followed by spray of (Tebuconazole 50 % + Trif loxystrobin 25%) @ 0.5g/l at 45,60 & 90 DAS	82.1 (65.06)	8.06 (12.74)	10.63 (15.6)	18.51 (23.07)	8.32
T4	ST with (Carboxin 37.5% + Thiram 37.7 %) @ 3g/kg of seeds followed by spray of *T.harzianum* @ 10g/l at 45,60 and 90 DAS	83.5 (66.03)	8.55 (13.3)	12.16 (17.18)	22.91 (26.75)	5.79
T5	ST with (Carbendazim 12%+ Mancozeb 63 %) @ 2g/kg of seeds followed by spray of Azadirachtin (10000 ppm) @2ml/l at 45,60 and 90 DAS	84.5 (66.86)	8.88 (13.69)	13.61 (18.62)	21.15 (25.32)	4.57
T6	Soil application of *T.harzianum* enriched with Neem cake & FYM @1:20:250kg/ha + ST with *T.harzianum* @10g/kg of seeds followed by spray of Azadirachtin (10000 ppm) @2ml/l at 45,60 & 90 DAS.	91.1 (72.7)	9.81 (14.72)	12.02 (17.05)	22.52 (26.45)	6.01
T7	Soil application of *T.harzianum* enrichedwith Neem cake and FYM @1:20:250kg/ha + ST with *T.harzianum* @10g/kg of seeds followed by spray of (Tebuconazole 50 % + Trifloxystrobin 25 %) @ 0.5g/l at 45,60 and 90 DAS	92.63 (74.26)	6.49 (10.83)	10.36 (15.3)	14.94 (19.89)	8.74
T8	Seed treatment with *T.harzianum* @10g/kg of seed (RC)	87.83 (69.7)	9.64 (14.53)	14.65 (19.6)	28.60 (31.17)	4.85
T9	Seed treatment with Captan 70% WP @3g/kg of seed (RC)	81.8 (64.78)	9.10 (13.93)	13.29 (18.3)	24.79 (28.24)	5.11
T10	Untreated control	62.04 (51.95)	13.98 (18.96)	19.84 (24.22)	38.82 (38.58)	3.42
	S.Em±	1.58	0.80	1.09	1.43	0.35
	CD at 5%	4.69	2.39	3.25	4.26	1.03
	C. V.	4.12	9.76	10.16	8.75	10.75

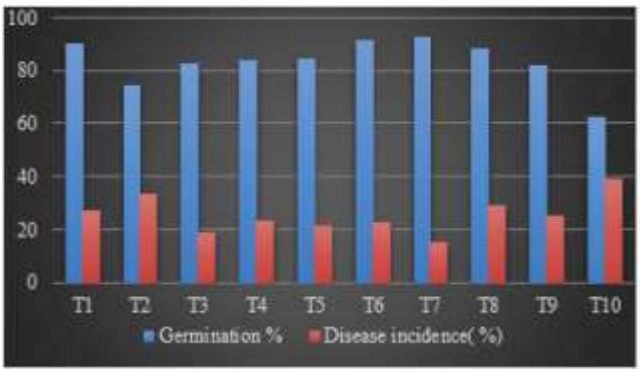
**Arcsine transformed values ST: Seed treatment DAS: Days after sowing*

Highest yield of 8.74 q/ha was obtained in T_7 [Soil application of *T.harzianum* enrichedwith Neem cake and FYM @1:20:250kg/ha + Seed treatment with *T.harzianum* @10g/kg of seeds followed by spray of (Tebuconazole 50 % + Trifloxystrobin 25 %) @ 0.5g/l at 45,60 and 90 DAS] followed by 8.32 q/ ha in T_3 [ST with Carbendazim 50 WP @2g/kg of seeds followed by spray of (Tebuconazole 50 % + Trifloxystrobin 25%) @ 0.5g/l at 45,60 & 90 DAS]. However, lowest yield of 3.42 q/ha was noticed in T_{10} (Untreated control).

Results of the present studywere in line with findings of Prasad *et al* (2022) reported that treatment involving Tebuconozole 50 %+ Trifloxystrobin 25 % @ 0.5 g/l resulted in least mean disease incidence (13.2 %) and highest mean yield (685 kg/ha) compared to (27.5 % and 343.9kg/ha) control against stem and root rot of sesame (*Macrophomina phaseolina*). In addition, Geat *et al* (2023) found that the seed treatment with *Trichoderma viride* @ 10 g/kg, furrow application of enriched *Trichoderma* (2.5kg *Trichoderma viride* + 100 kg vermicompost) @ 250 kg/ha and spray of combi-product (Tebuconazole 50 % + Trifloxystrobin 25%) @ 0.5 g/l at 30-35 DAS and second spray at 50-60 DAS. This treatment resulted in the lowest disease incidence (13.66 %), with a maximum yield of 405kg/ha, compared to untreated control was 38.99 per cent of disease incidence and yield about 301 kg/ha.

CONCLUSION

Field experiments during *kharif* 2024 demonstrated that Soil application of *T.harzianum* enrichedwith Neem cake and FYM @1:20:250kg/ha + Seed treatment with *T.harzianum* @10g/kg of seeds followed by spray of (Tebuconazole 50 % + Trifloxystrobin 25 %) @ 0.5g/l at 45,60 and 90 DAS



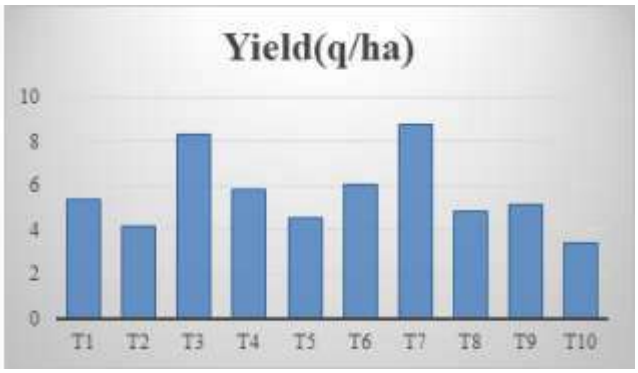


Fig. 1. Effect of different treatments on disease incidence and yield

Fig 1. Performance of crop under T_7 (Soil application of *T.harzianum* enrichedwith Neem cake and FYM @1:20:250kg/ha + ST with *T.harzianum* @10g/kg of seeds followed by spray of (Tebuconazole 50 % + Trifloxystrobin 25 %) @ 0.5g/l at 45,60 and 90 DAS)

Fig 2. Performance of crop under T_{10} (Untreated control)

recorded least disease incidence of 14.94 per cent and highest yield of 8.74 q/ha. These studies collectively suggested that an integrated approach, involving the use of (Tebuconazole 50 % + Trifloxystrobin 25%) and *T. harzianum*, supplemented with organic amendments like FYM or vermicompost, offers a highly effective strategy for managing sesame diseases, leading to significant reductions in disease incidence and substantial increases in sesame yield.

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Received on 1/3/2025 Accepted on 17/5/2025