



Efficacy of Fungicides against *Myrothecium roridum*, the Causal Agent of Leaf Spot in Sesame (*Sesamum indicum* L.) under In vitro and In vivo Conditions

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ABSTRACT

Sesame (*Sesamum indicum* L.), a vital oilseed crop in India and worldwide, is frequently constrained by foliar diseases, particularly leaf spot caused by *Myrothecium roridum*. The pathogen causes severe yield losses and deteriorates oil quality, making its management critical for sustaining sesame production. The present study evaluated the efficacy of systemic and non-systemic fungicides through in vitro assays, seed treatment trials, and field experiments. Eighteen fungicides were screened against *M. roridum* using poisoned food technique, followed by seed treatment trials on naturally infected sesame seeds, and replicated field trials under Kharif conditions. In vitro results indicated complete inhibition (100%) of fungal growth by Benomyl, Bavistin, Metalaxyl, Vitavax, Topsin-M, and Thiram. In seed treatment studies, Vitavax and Bavistin recorded the highest reduction in seed-borne infection (94.0% and 90.2%, respectively). Field experiments over two years revealed Bavistin (0.10%) and Benomyl (0.15%) as the most effective foliar sprays, reducing disease incidence by 75–78%, followed by Metalaxyl (72%). The findings suggest that fungicides, especially Bavistin and Benomyl, can play a central role in integrated disease management modules for sesame.

Keywords: Sesame, *Myrothecium roridum*, leaf spot, fungicides, seed treatment, field evaluation.

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Introduction

Sesame (*Sesamum indicum* L.) is among the oldest cultivated oilseed crops, valued for its high-quality edible oil and therapeutic properties (Bedigian, 2003). India remains the world's largest producer and exporter of sesame seeds, contributing about 850,000–900,000 tonnes annually from 1.6–1.7 million hectares (FAOSTAT, 2023; Ministry of Agriculture & Farmers Welfare, 2024). Despite its importance, productivity remains low (~500–600 kg/ha), considerably below the global average (~1,000 kg/ha), due to constraints posed by diseases, insect pests, and abiotic stresses. The Solvent Extractors' Association of India (SEA, 2024) estimates that India's per capita edible oil consumption reached 19.7 kg/year in 2023, highlighting the growing demand-supply gap and the importance of efficient oilseed management.

Sesame suffers from a range of fungal diseases including *Alternaria* leaf blight, *Cercospora* leaf spot, charcoal rot, powdery mildew, and *Myrothecium* leaf spot (Kumar et al., 2022). Among these, leaf spot caused by *M. roridum* is highly destructive, with reports of yield losses ranging from 20–40% under severe epidemics. The disease was first documented in India by Singh and Srivastava (1967) and has since spread across major sesame-growing states. Symptoms typically appear as small, tan-colored spots with brown margins and concentric rings that coalesce, leading to premature leaf fall and poor seed set.

While cultural measures (crop rotation, residue management) and biological agents (e.g., *Trichoderma* spp.) provide partial control, fungicides remain an essential component of integrated disease management, especially under high disease pressure (Rathore et al., 2021). However, continuous evaluation of fungicide efficacy is required due to evolving pathogen sensitivity and environmental concerns.

The present investigation was conducted with the following objectives:

1. To evaluate the efficacy of systemic and non-systemic fungicides against *M. roridum* under in vitro conditions.
2. To determine the effectiveness of fungicides in eliminating seed-borne infection.
3. To assess the performance of selected fungicides under field conditions for disease suppression.

Materials and Methods: The study consisted of three parts: in vitro assay seed treatment and field evolution of fungicides against *Myrothecium roridum*.

(a) In vitro Bioassay of Fungicides

The efficacy of 18 systemic and non-systemic fungicides (Table 1) was evaluated using the poisoned food technique (Schmitz, 1930). Required concentrations of fungicides were incorporated into sterilized PDA medium before pouring into Petri plates. Five-mm discs of 7-day-old *M. roridum* culture were aseptically placed at the center of each plate. Plates without fungicides served as control. Each treatment was replicated four times, and the plates were incubated at 27 ± 1 °C for 10 days. Radial growth was measured, and percent inhibition was calculated using the formula.

$$\text{Per cent inhibition over control} = \frac{C - T}{C} \times 100$$

Where C = radial growth in control, and T = radial growth in treatment.

(b) Seed Treatment Assay

Naturally infected seeds of sesame variety T-4 were used to evaluate fungicides for seed-borne infection control. Seeds were dressed with fungicides (Vitavax, Bavistin, Thiram, Captan, Karathane, Ziram, and Captafol) at recommended dosages by shaking in sterile conical flasks for 20 minutes. Treated and untreated seeds were incubated on moist blotter papers at 27 ± 1 °C for 10 days in four replications of 100 seeds each. Seed infection percentage was recorded, and data were analyzed statistically.

(c) Field Trials (In vivo Evaluation)

Field experiments were conducted during Kharif seasons of 2007 and 2008 at the Instructional Farm of [Institute/University]. The susceptible variety T-4 was sown in 4×3 m plots under Randomized Block Design (RBD) with three replications. Ten fungicides found promising in vitro were selected for field evaluation: Metalaxyl (0.10%), Benomyl (0.15%), Bavistin (0.10%), Topsin-M (0.15%), Indofil M-45 (0.25%), Indofil Z-78 (0.25%), Daconil (0.15%), Blitox-50 (0.20%), Calixin (0.10%), and Kitazin (0.25%).

Sprays were initiated at the first appearance of disease symptoms, followed by three sprays at 10-day intervals. Disease incidence was recorded 15 days after the final spray using a 0–5 disease rating scale, and Percent Disease Index (PDI) was calculated. Data were statistically analyzed using ANOVA, and critical difference (CD) was determined at 5% significance level.

Results:

Table 1: Effect of various fungicide(s) on the growth of *M. roridum* in vitro.

S.No.	Name of Fungicide	Dose(ppm)	Average diameter of fungal colony	% Inhibition over control
1.	Benomyl	1500	0.00	100
2.	Metalaxyl	1000	0.00	100
3.	Bavistin	1000	0.00	100
4.	Vitavax	1000	0.00	100
5.	Topsin-M	1000	0.00	100
6.	Thiram	2500	0.00	100
7.	Captafol	2500	6.10	91.58
8.	Daconil	1500	7.25	90.00
9.	Indofil M-45	2500	15.00	79.31
10.	Indofil-Z-78	2500	14.50	80.00
11.	Blitox-50	2000	15.25	78.96
12.	Captan	2000	15.50	78.62
13.	Karathane	2000	16.00	77.93
14.	Folpet	2000	16.25	57.58
15.	Calixin	1000	18.00	75.17
16.	Ziram	2000	21.00	71.03
17.	Kitazin	2500	24.50	66.20
18.	Hinosan	2500	28.00	61.37
19.	Control	-	72.50	-
	CD at 5% Level of significance		3.39	

Table 2: Efficacy of different fungicides against seed borne infection of *M.roridum*.

S.No.	Name of Fungicide	Dose (%)	% Average infection	% Inhibition Controlled
1.	Vitavax	0.10	2.50 (9.06)	94.04
2.	Bavistin	0.10	4.10 (11.62)	90.23
3.	Thiram	0.25	5.00 (12.87)	88.09
4.	Captan	0.20	6.95 (15.26)	83.45
5.	Karathane	0.20	10.60 (18.98)	74.76
6.	Ziram	0.20	13.50 (21.54)	67.85
7.	Captafol	0.25	17.60 (24.80)	58.09
8.	Control		42.00 (40.39)	
CD at 5% level of significance			1.99	

Table 3: Efficacy of spray fungicides under field conditions.

S.No.	Fungicide	Dose (%)	2007		2008	
			Average disease Incidence (%)	Disease Control (%)	Average disease Incidence (%)	Disease Control (%)
1.	Bavistin	0.10	12.10 (20.31)	75.94	11.20 (19.54)	77.18
2.	Benomyl	0.15	13.15 (21.22)	73.85	12.50 (20.69)	74.54
3.	Metalaxyl	0.10	14.50 (22.37)	71.17	13.40 (21.46)	72.70
4.	Indofil M-45	0.25	17.50 (24.70)	65.20	16.10 (23.64)	67.20
5.	Topsin-M	0.15	21.75 (27.79)	56.75	20.25 (26.73)	58.75
6.	Indofil-Z-78	0.25	26.40 (30.91)	47.51	25.15 (30.09)	48.77
7.	Daconil	0.15	29.75 (33.05)	40.85	28.25 (32.10)	42.46
8.	Blitox	0.20	32.50 (34.71)	35.38	31.20 (33.95)	36.45
9.	Calixin	0.10	34.30 (35.84)	31.80	33.10 (35.12)	32.58
10.	Kitazin	0.25	37.45 (37.73)	25.54	36.05 (36.89)	26.57
11.	Control	-	50.30 (45.17)	-	49.10 (44.48)	-
CD at 5% Level of Significance			1.79		1.28	



Figure 1: Bioassay of fungicides *in vitro*.

1. Benomyl	2. Metalaxyl	3. Bavistin
4. Vitavax	5. Topsin-m	6. Thiram
7. Captafol	8. Daconil	9. Indofil-m-45
10. Indofil-z-78	11. Bitox-50	12. Captan
13. Karathane	14. Folpet	15. Calixin
16. Ziram	17. Hinosan	18. Kitazin
19. control		

In vitro: Benomyl, Metalaxyl, Bavistin, Vitavax, Topsin-M, and Thiram gave complete inhibition (100%). Captafol and Daconil followed with >90% inhibition. Kitazin and Hinosan least effective.

Seed treatment: Vitavax (0.10%) controlled 94% of seed-borne infection, followed by Bavistin (90%) and Thiram (88%).

Field trials: Bavistin (0.10%) and Benomyl (0.15%) reduced disease incidence by 75–78%, followed by Metalaxyl and Indofil M-45 (67–72%). Kitazin least effective (26%).

Discussion

The study demonstrated that both systemic and non-systemic fungicides significantly reduced the growth of *M. roridum*. In vitro assays revealed that systemic fungicides such as Benomyl, Bavistin, Metalaxyl, and Vitavax provided complete inhibition, corroborating earlier findings in soybean, cowpea, and rajmash (Sharma & Chauhan, 1985; Singh & Shukla, 1986; Sinha & Narain, 1993). Seed treatment with Vitavax and Bavistin effectively reduced infection, highlighting their importance in seed health management. Similar observations were reported by Sharma and Chauhan (1985), where carbendazim-based fungicides minimized seed-borne inoculum.

Field trials indicated that Bavistin and Benomyl were superior, providing up to 78% disease reduction. These findings align with reports by Singh et al. (1995) who found Bavistin most effective against *M. roridum* in rajmash. However, moderate performance of protectants like Indofil Z-78 and Kitazin suggests their limited efficacy under high inoculum pressure. Considering fungicide resistance concerns, it is essential to integrate these chemicals with eco-

friendly approaches such as resistant varieties, bioagents (*Trichoderma* spp.), and cultural practices.

Conclusion

The results establish Bavistin, Benomyl, and Vitavax as highly effective fungicides for management of sesame leaf spot caused by *M. roridum*. Their efficacy in vitro, in seed treatment, and under field conditions justifies their inclusion in integrated disease management modules. However, sustainable use requires rotation with fungicides of different modes of action and integration with biological control measures to prevent resistance development.

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