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Received: 20 May 2026

Revision: 18 June 2026

Accepted: 31 July 2026

Citation

Sharma, Y.K., Meena, R.D., and Kant, K. 2025. Optimization of fungicide application for effective management of Alternaria blight disease in cumin. *Int J Seed Spice*. 15 (2): 42-45

DOI

<https://doi.org/10.56093/IJSS.v15i2.5>

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Optimization of fungicide application for effective management of Alternaria blight disease in cumin

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Abstract

Cumin (*Cuminum cyminum* L.) is an important seed spices crop widely cultivated in arid and semi-arid regions. Among the diseases affecting cumin, Alternaria blight caused by *Alternaria burnsii* is one of the most destructive, leading to significant yield losses. Field experiments were conducted over two consecutive years using different fungicide combinations and spray sequences. Results revealed that application of 3–4 foliar sprays of recommended fungicides, namely Mancozeb (2 g/l), Azoxystrobin (1 ml/l) and Difenconazole (0.5 ml/l), starting at 45 days after sowing and repeated at 15-day intervals, significantly reduced disease severity by 53–66 per cent over control. Evaluation of new fungicide molecules (combination fungicides) indicated that foliar application of Azoxystrobin + Difenconazole (0.5 ml/l) was most effective, recording a 79 per cent reduction in disease intensity along with significant yield improvement. The study concludes that strategic fungicide scheduling and use of combination fungicides with multiple modes of action are highly effective in managing Alternaria blight of cumin and enhancing crop yield.

Keywords: Alternaria blight, *Alternaria burnsii*, bioefficacy, cumin, disease management, fungicide

Introduction

Cumin (*Cuminum cyminum* L.) is one of the most important seed spices crop cultivated extensively in arid and semi-arid regions, particularly in Rajasthan and Gujarat states of India. It accounts for a major share of global production and export and holds significant economic value due to its aromatic seeds, widely used in culinary preparations, traditional medicine, and the food processing industry (Meena *et al.*, 2010). Despite its economic significance, cumin productivity remains relatively low due to several biotic and abiotic constraints, among which fungal diseases play a dominant role (Dange, 1995; Sharma *et al.* 2010; Khare *et al.* 2014). Alternaria blight, caused by *Alternaria burnsii*, is among the most destructive

diseases affecting Cumin cultivation, particularly under favourable environmental conditions. The disease has been reported with severity levels reaching up to 80 percent disease intensity (PDI) in major cumin-growing region of Rajasthan, including Ajmer, Nagaur, Jodhpur, Barmer, Jaisalmer, and Pali, as well as in Banaskantha district in Gujarat (Sharma *et al.* 2013a). This widespread occurrence highlights the serious threat caused by the disease to cumin production in arid and semi-arid regions of India. The disease can appear at any stage of crop growth, but it is particularly severe during flowering and seed formation stages. Typical symptoms include small, dark brown to black necrotic lesions on leaves, stems, and umbels, which coalesce under favorable environmental conditions, leading to blighting, drying of plant parts, and ultimately significant yield losses (Sharma *et al.* 2024). In severe epidemics, yield reductions may range from 40 to 60 per cent or even higher, depending on environmental conditions and crop management practices. Management of *Alternaria* blight has traditionally depend on repeated applications of contact fungicides such as Mancozeb, copper oxychloride, zineb, chlorothalonil (Gemawat and Prasad 1972; Akbhari and Dhruj 1995; Sharma *et al.* 2013b). In recent years, new fungicidal molecules with systemic activity, such as strobilurins and triazoles, have shown promising results against foliar pathogens of cumin (Amin *et al.* 2018; Verma *et al.* 2020). However, indiscriminate or improper use of fungicides without proper scheduling may lead to suboptimal disease control and increased production costs. Therefore, the present study was undertaken with the objectives to develop an effective fungicide spray schedule and evaluate new fungicide molecules for efficient management of *Alternaria* blight of cumin.

Materials and Methods

Field experiments were conducted during two consecutive *rabi* seasons at ICAR-NRC on Seed Spices, Ajmer to evaluate the bioefficacy of different fungicide spray schedules and new fungicide molecules against *Alternaria* blight of cumin caused by *Alternaria burnsii*. The experiments were laid out in a randomized block design (RBD) with three replications under natural field conditions. A popular cultivar of cumin (GC-4) was sown following recommended agronomic practices and all standard cultural practices

were uniformly followed throughout the treatments. For studying fungicide scheduled, with different sequences of contact and systemic fungicides were evaluated during the first and second years. Seven treatments comprising combinations of Mancozeb @ 2 g/l, Azoxystrobin @ 1 ml/l, and Difenoconazole @ 0.5 ml/l were tested in different spray sequences along with an untreated control. In a separate experiment, the efficacy of new molecules fungicides were evaluated, which included combination products such as Metiram 55% + Pyraclostrobin 5% (Cabrio Top @ 1 g/l), Cymoxanil 8% + Mancozeb 64% (Curzate @ 1 g/l), Azoxystrobin 18.2% + Difenoconazole 11.4% (Amistar Top @ 0.5 ml/l), and Tebuconazole 50% + Trifloxystrobin 25% (Nativo @ 0.5 ml/l), along with Copper hydroxide (Cocide @ 2 g/l), Hexaconazole @ 0.5 ml/l, and an untreated control. Fungicides were applied as foliar sprays using a knapsack sprayer. The first spray was initiated at 45 days after sowing (DAS), and subsequent sprays were applied at 15-day intervals, with a total of 3–4 sprays depending on disease pressure. Care was taken to ensure uniform coverage of the foliage during each application. Observations on disease intensity were recorded at regular intervals using a standard disease rating scale and the percent disease intensity (PDI) was calculated. The percent disease control over untreated control was also computed. At maturity, seed yield was recorded from each plot and converted into kilograms per hectare. The data obtained from different treatments were subjected to statistical analysis using analysis of variance (ANOVA) for randomized block design. The significance of treatment differences was tested at the 5 per cent level, and critical difference (CD) values were calculated for comparison of means.

Results and Discussion

The results indicated that application of recommended fungicides in a proper spray schedule significantly reduced *Alternaria* blight severity compared to the untreated control. Three to four foliar sprays initiated at 45 days after sowing (DAS) and repeated at 15-day intervals proved effective in managing the disease. The data (Table 1) revealed that disease intensity in treated plots ranged between 9.4 and 13.0 per cent as compared to 28.0 per cent in control. Among these treatments, the schedule involving sequential

application of Mancozeb (0.2%) followed by Difenconazole (0.05%) and Azoxystrobin (0.1%) recorded the lowest disease intensity (9.4%) and maximum disease reduction (66.2%). This indicates that integration of contact fungicides (Mancozeb) with systemic fungicides (Azoxystrobin and Difenconazole) provides better protection due to combined preventive and curative action. Seed yield was increased in all treated plots, ranging from 280 to 369 kg/ha, compared to 213 kg/ha in control.

The evaluation of new-molecule fungicides revealed that combined fungicides were highly effective in managing *Alternaria* blight disease (Table 3). Per cent disease reduction was recorded in range from 77 to 79 per cent in the best treatments. Foliar spray of Azoxystrobin + Difenconazole (Amistar Top) @ 0.5 ml/l recorded the lowest disease intensity (10.3%) and highest disease reduction (79.6%), followed by Metiram + Pyraclostrobin (Cabrio Top) @ 0.5 ml/l, which recorded disease intensity and reduction by 14.60 and 71.10 per cent, respectively. Significantly,

higher seed yield was recorded in sprayed with Azoxystrobin + Difenconazole by 416 kg^{ha} which was at par with Metiram + Pyraclostrobin (371 kg^{ha}). Whereas, least seed yield was recorded in control treatment with 167 kg^{ha}. The superior performance of Azoxystrobin + Difenconazole may be attributed to the synergistic action of strobilurin and triazole groups, while Metiram + Pyraclostrobin combines contact and systemic action, enhancing disease control efficiency.

Acknowledgements

The authors sincerely acknowledge the financial support received from the Indian Council of Agricultural Research, Department of Agricultural Research and Education, Government of India, which made this research possible. The authors are also thankful to the Director, ICAR-National Research Centre on Seed Spices, Ajmer, for providing the necessary facilities to conduct this research work.

Conflict of Interest

The authors declare that there is no conflict of interest associated with this publication

Table 1. Effect of Recommended Fungicide Scheduling on *Alternaria* Blight of Cumin

Treatment	Spray Schedule	Disease Intensity (%)	Disease Reduction (%)	Seed Yield (kg ha ⁻¹)
T1	Mancozeb → Azoxystrobin → Difenconazole	9.5	65.8	328
T2	Mancozeb → Difenconazole → Azoxystrobin	9.4	66.2	369
T3	Azoxystrobin → Mancozeb → Difenconazole	13.0	53.5	309
T4	Azoxystrobin → Difenconazole → Mancozeb	11.9	57.5	350
T5	Difenconazole → Azoxystrobin → Mancozeb	11.3	59.5	299
T6	Difenconazole → Mancozeb → Azoxystrobin	12.0	57.1	280
T7	Control	28.0	—	213
	CD (0.05)	3.04		127.12

Table 2. Bioefficacy of New Fungicides against Alternaria Blight of Cumin

Treatment	Fungicide	Disease	Disease	Seed Yield (kg ha ⁻¹)
		Intensity (%)	Reduction (%)	
T1	Azoxystrobin + Difenconazole	10.3	79.6	416
T2	Metiram + Pyraclostrobin	14.6	71.1	371
T3	Cymoxanil + Mancozeb	15.6	69.1	326
T4	Tebuconazole + Trifloxystrobin	19.6	61.2	311
T5	Hexaconazole	22.0	56.5	259
T6	Copper hydroxide	28.3	44.0	260
T7	Control	50.6	—	167
	CD (0.05)	4.14		69.64

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