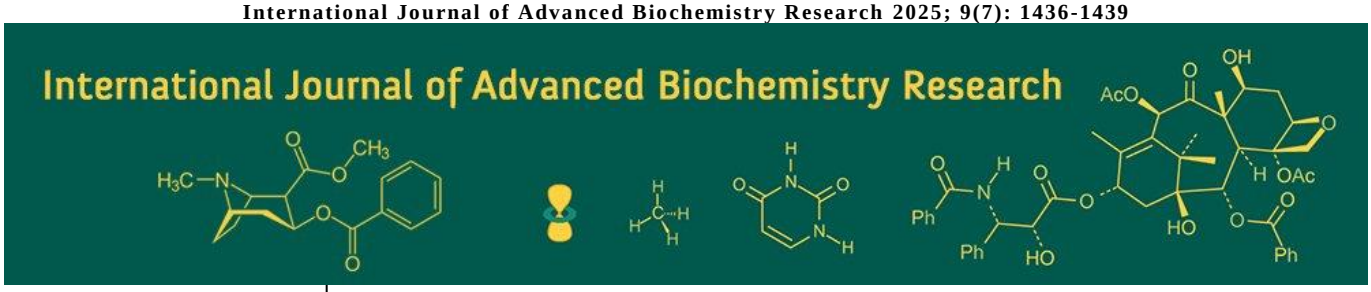

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2025): 5.29
IJABR 2025; 9(7): 1436-1439
www.biochemjournal.com
Received: 18-04-2025
Accepted: 21-05-2025

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Effectiveness of systemic fungicides against mustard powdery mildew caused by *Erysiphe cruciferarum* (Opiz ex. Junell) under screen house conditions

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DOI: https://www.doi.org/10.33545/26174693.2025.v9.i7r.4932

Abstract
Powdery mildew of Mustard incited by *Erysiphe cruciferarum* is considered to be the most devastating disease occurring all over the world. The present investigation on "Management of Mustard Powdery Mildew caused by *Erysiphe cruciferarum* Opiz ex. Junell." was undertaken during 2024-2025. Mustard yield is affected by several diseses like powdery mildew, alternaria blight, sclerotiana stem rot, white rust, downy mildew and damping off. India yield losses due to Mustard powdery mildew are ranging between 10-90%. Powdery mildew is predominantly observed on the adaxial (upper) leaf surface.
Present study is under taken on different systemic fungicides to find out effectiveness against Mustard powdery mildew. Among six systemic fungicides Propiconazole 25% EC was most effective against powdery mildew, followed by Difenconazole 25% EC and Azoxystrobin 23% SC, Hexaconazole 5% EC, Carbendazim 50% WP and Kresoxim-methyl 44.3% SC. Water spray is superior over the Kresoxim-methyl 44.3% SC in systemic fungicides.

Keywords: *Erysiphe cruciferarum*, powdery mildew, severity, systemic fungicides

Introduction
Mustard is hardy crop grown in arid region mainly, it required sandy loam soil with rainfall 400-600 mm and temperature range between 5-35 °C with low relative humidity. Rapeseed-Mustard is one of the major oil seed crop grown in India. It is the second most important oil seed crop grown after Groundnut. It contributes nearly 30% of total oil seed production in India. Mustard yield is severely affected, due to occurrence of diseases likes Powdery mildew caused by *Erysiphe cruciferarum*, Alternaria blight (*Alternaria brassicae*), Sclerotiana stem rot (*Sclerotinia sclerotiorum*), White rust (*Albugo candida*), Downy mildew (*Hyaloperonospora parasitica*), Seedling blight (*Rhizoctonia solani*) and Damping off (*Pythium spp*.) (Sharma *et al.*, 2022) [2]. Powdery mildew is one of the most widespread fungal plant diseases, affecting a diverse range of crop species, with over 400 different species, it has the potentials to infect nearly 10,000 host plants, making it major concern in plant disease management (Glawe, 2008) [4]. In the world, up to 17% Mustard yield losses were reported only due to powdery mildew and in India yield losses due to Mustard powdery mildew is ranging between 10-90% (Verma *et al.*, 2023) [3].
Powdery mildew is predominantly observed on the adaxial (upper) leaf surfaces and can affect not only the foliage but also the developing green siliquae and mature Mustard plants. Infected floral buds may fail to open, resulting in significant yield losses. The disease tends to be more severe under warm climatic conditions, as the pathogen does not require free water on the leaf surface for successful infection. However, high relative humidity is essential for spore germination. Powdery mildew is commonly prevalent in densely planted crops with poor air circulation and in damp, shaded micro-environments (Enright and Cipollini, 2007) [1].

Materials and Methods
Present investigation on Mustard powdery mildew caused by *Erysiphe cruciferarum* Opiz ex. Junnel was conducted at screen house of the Department of Plant Pathology, College of

Agriculture, Parbhani during 2024-2025. The experiment was carried out under controlled condition, to study the efficacy of different agrochemicals against powdery mildew of Mustard (*Erysiphe cruciferarum*). Completely Randomized Design (CRD) with eight treatments (six systemic fungicides, one water spray and one untreated control) at 0.1% concentration and three replications were adopted.

Six systemic, water spray and one untreated control were undertaken during application. The agrochemicals such as (T_1) Propiconazole 25% EC, (T_2) Hexaconazole 5% EC, (T_3) Difenconazole 25% EC, (T_4) Azoxystrobin 23% SC, (T_5) Carbendazim 50% WP, (T_6) Tebuconazole 10% + Sulphur 65% WG @ 0.15%, (T_7) Kresoxim-methyl 44.3% SC, (T_8) Water spray and (T_9) untreated control were used for the experiment**.**

Symptoms of the disease on the host plants were observed and studied directly from the plants sown in pots at screen house of Department of Plant Pathology, VNMKV, Parbhani. Before recording first observation of powdery mildew disease symptoms, five plants per treatment per replication in the pot culture were randomly selected and tagged for recording observations. When the powdery mildew disease was noticed, on the same day first observation on disease severity was recorded. The first spraying was taken immediately after appearance of the disease. Subsequent second and third spraying was taken at ten days interval and final observations were recorded one week after third spraying. An observation on powdery mildew disease severity was recorded on randomly selected and tagged plants. The powdery mildew disease was graded on the basis of disease severity observed on leaves by applying 0-9 disease rating scale (Mayee and Datar, 1986) [5].

Scale	Description
0	No symptoms on the leaf.
1	Small powdery specks on the leaves covering <1% leaf area.
3	Powdery lesions small, scattered, covering 1-10% leaf area.
5	Powdery patches big, scattered, covering 11-25% leaf area.
7	Powdery patches big, coalescing and covering 25-50% leaf area, leaves shedding.
9	Powdery growth covering >51% leaf area, leaves turn yellow, dry up and shed off.

The percent disease control over untreated control (PDC) was calculated by using following formula given by Mathur *et al.*, (1971) [5].

$$\text{Percent disease control (PDC)} = \frac{\text{PDI in control plot-PDI in treatment plot}}{\text{PDI in control plot}} \times 100$$

Results and Discussion

The mean percent disease severity recorded in all the treatments was ranged from (0.14%) (T_1) to (0.26%) (T_6) as compared to untreated control (T_8) with mean percent disease severity of (1.40%). From the mean disease severity (Table 1) it was found that treatments significantly reduced powdery mildew severity after second and third spray over the untreated control. However, fungicide Propiconazole 25% EC (T_1) was found to be most effective with lowest mean disease severity of (0.14%). The second best fungicide observed were Difenconazole 25% EC and Azoxystrobin 23% SC which recorded comparatively lesser mean disease severity of (0.18%) each. Other fungicides in order to merit of effectivity were Hexaconazole 5% EC (0.20%), Carbendazim 50% WP (0.22%) and Kresoxim-methyl 44.3% SC (0.26%).

The simple water spray (T_7) was found equally effective as carbendazim spray (0.22%) and more effective than the Kresoxin-methyl (0.26%) but statistically all these treatments were at par with each other except (T_8) (untreated control).

Results indicated that all the treatments were found effective and significantly reduced the powdery mildew disease severity over untreated control in local Mustard cultivar.

Table 1: Effect systemic fungicides on severity of Mustard powdery mildew:

Treatments		Disease severity after spraying				Mean Disease Severity (%)
Tr. No.	Details	Conc.	First	Second	Third	
T_1	Propiconazole 25% EC	0.1%	0.27 (2.98)*	0.07 (1.52)	0.07 (1.52)	0.14 (2.14)
T_2	Hexaconazole 5% EC	0.1%	0.33 (3.29)	0.20 (2.56)	0.07 (1.52)	0.20 (2.56)
T_3	Difenconazole 25% EC	0.1%	0.27 (2.98)	0.20 (2.56)	0.07 (1.52)	0.18 (2.43)
T_4	Azoxystrobin 23% SC	0.1%	0.33 (3.29)	0.13 (2.07)	0.07 (1.52)	0.18 (2.43)
T_5	Carbendazim 50% WP	0.1%	0.33 (3.29)	0.20 (2.56)	0.13 (2.07)	0.22 (2.69)
T_6	Kresoxim-methyl 44.3% SC	0.1%	0.53 (4.17)	0.13 (2.07)	0.13 (2.07)	0.26 (2.92)
T_7	Water spray	-	0.40 (3.63)	0.13 (2.07)	0.13 (2.07)	0.22 (2.69)
T_8	Untreated control	-	0.87 (5.35)	1.33 (6.62)	2.00 (8.13)	1.40 (6.80)
SE ±		-	-	0.17	0.20	-
CD @ 1%		-	NS	0.69	0.81	-

* Figures in parenthesis are arcsine transformed values.

Fig 1: Mustard powdery mildew (0-9) disease rating scale (Mayee and Datar, 1986) [5]

The mean percent disease control (PDC) achieved with all the treatments (Table 2) ranged from 74.27% (T_6) to 87.88% (T_1). The highest mean percent disease control (87.88%) was recorded in the pots receiving spray of Propiconazole 25% EC (T_1). The second and third best fungicides were Difenconazole 25% EC (T_3) and Azoxystrobin 23% SC (T_4) with mean PDC of (84.62%) and (82.93%). These were followed by the fungicides Hexaconazole 5% EC (T_2), Carbendazim 50% WP (T_5) and Kresoxim-methyl 44.3% SC (T_6) 81.17%, 80.17% and 74.27% percent disease control over the untreated control (T_8), respectively.

The simple water spray recorded percent disease control of (79.25%) over the untreated control and was found effective over the Kresoxim-methyl 44.3% SC (T_6) sprays.

Table 2: Effect of systemic fungicides on percent disease control of Mustard powdery mildew:

Treatments		PDC after spraying				Mean
Tr. No.	Details	Conc.	First	Second	Third	PDC*
T_1	Propiconazole 25% EC	0.1%	72.41	94.73	96.5	87.88
T_2	Hexaconazole 5% EC	0.1%	62.06	84.96	96.5	81.17
T_3	Difenconazole 25% EC	0.1%	72.41	84.96	96.5	84.62
T_4	Azoxystrobin 23% SC	0.1%	62.06	90.23	96.5	82.93
T_5	Carbendazim 50% WP	0.1%	62.06	84.96	93.5	80.17
T_6	Kresoxim-methyl 44.3% SC	0.1%	39.08	90.23	93.5	74.27
T_7	Water spray	-	54.02	90.23	93.5	79.25
T_8	Untreated control	-	….	….	….	….

*PDC-Percent Disease Control.

Similar effect of fungicides on powdery mildew of various crops were earlier reported by several workers like, Goswami *et al.* (2016) [7] found that Propiconazole 0.03% was most effective fungicide which inhibited higher spore germination (84.26%), Ushamalini and Nakkeeram (2017) [8] reported that Propiconazole (0.15%) effectively control Coriander powdery mildew with 5.14% percent disease incidence.

Kanzaria and Dhruj (2018) [11] observed that water spray alone reduced the Powdery Disease Index (PDI) in Mustard from 88.25% (untreated control) to 84.14%, giving a 4.89% reduction in disease severity. Rathod (2014) [10] reported that water spray control powdery mildew disease by 61.58%. Similar result was reported by Wadulkar (2010) [9].

Conclusion

In systemic fungicides the highest percent disease control (87.88%) was recorded in Propiconazole 25% EC (T_1) followed by Difenconazole 25% EC (T_3) (84.62%), Azoxystrobin 23% SC (T_4) (82.93%), Hexaconazole 5% EC (T_2) (81.17%), Carbendazim 50% WP (T_5) (80.17%) and Kresoxim-methyl 44.3% SC (T_6) (74.27%).

Water spray (T_8) (79.25% PDC) is superior over the Kresoxim-methyl 44.3% SC (T_6) (74.27%) and the untreated control (T_7) for the management of Mustard powdery mildew under controlled conditions at screen house of Department of Plant Pathology. This can be attributed to the unique microclimatic conditions of the screen house, where the average temperature ranged between 20-28 °C and the relative humidity was maintained at approximately 60-80% during the cropping period. Powdery mildew pathogens *Erysiphe cruciferarum*, generally require high relative humidity (above 60%) for spore germination but are inhibited by the presence of free water on leaf surfaces. Under these conditions, the application of water spray increases leaf wetness duration, directly dislodging surface conidia and inhibiting their germination. Moreover, repeated water spraying reduces the inoculum potential by physically washing off spores, which is particularly effective in environments where air circulation is limited and humidity remains consistently high. Therefore, the results indicate that maintaining moderate temperatures (20-28 °C) and relatively high humidity (60-80%) in combination with periodic water spraying can provide an eco-friendly and effective strategy for managing powdery mildew under protected cultivation conditions.

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