

Management studies of okra powdery mildew (*Erysiphe Cichoracearum* DC) using bio-agents and chemical fungicides

ABSTRACT:

Okra (*Abelmoschus esculentus* (L.) Moench) occupies a prominent place in the horticultural wealth and economy of the country. Powdery mildew disease on okra (*Abelmoschus esculentus* (L.) Moench) incited by fungus, *Erysiphe cichoracearum* is a limiting factor in the successful cultivation in Bundelkhand region of Uttar Pradesh. Studies were carried out to find out disease management strategies against okra powdery mildew using bioagents and chemical fungicides. Disease incidence declined after first, second and third sprays. The fungicide Hexaconazole (Contaf 5% EC) @ 0.1%, showed significantly lowest disease incidence (19.53 %) with maximum (68.40 %) disease control. On the basis of effectiveness in controlling the powdery mildew disease of okra the most effective fungicides recorded in the order of merit were Carbendazim (Bavistin 50WP) @ 0.1%, Propiconazole (Tilt 25EC) @ 0.1%, *Trichoderma viride* (3 %), Sulphur (Sulfex 80% WP) @ 0.3%, *Pseudomonas flouresens* (4 %) and *Trichoderma harizum* (4 %).

Key words: Powdery mildew, *Erysiphe cichoracearum* DC, and okra.

INTRODUCTION

Okra commonly known as lady's finger or 'bhendi' is most delicious vegetable relished world over. It belongs to the family Malvaceae. India occupies an area of 547.7 thousand hectares with a production of 6889.4 thousand tones and productivity of 12.6 mt/ha. (Anonymous, 2022a). In Maharashtra, it was cultivated on an area of 24.92 thousand hectares with annual production of 338.84 thousand tones and productivity of 13.60 mt/ha (Anonymous, 2022b). A number of fungal, bacterial, viral diseases have been reported in India. Amongst the fungal diseases, powdery mildew caused by *Erysiphe cichoracearum* DC. is one of the important and of common occurrence wherever this crop is grown. The occurrence of the disease has been reported from Mexico (Diaz-Franco, 1999). In India, the disease has been reported to occur in Delhi (Prabhu et al., 1971), Karnataka (Sohi and Sokhi, 1974), Himachal Pradesh (Raj et al., 1992) and Maharashtra (Jambhale and Nerkar, 1983). Disease initiates as white minute patches, first on the upper surface of lower leaves or older leaves and then spread to younger ones. While grayish powdery coating is visible on severely affected leaves. Leaves finally show necrosis resulting in withering, drying and defoliation. The powdery mildew affects all growth stages and responsible for yield to the tune of

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17 to 86.6 per cent (Sridhar et al., 1989). Considering the economic importance of the disease the present studies were undertaken with the objectives to manage the disease with the help of bioagents and chemical fungicides.

MATERIAL AND METHODS

A field experiment was carried out at the field of Rainfed Organic Agriculture Research Farm Narayan Bagh, Institute of Agricultural Sciences, Department of plant pathology, Bundelkhand University, Jhansi (Uttar Pradesh) during *kharif Season* of 2023. to study the efficacy of different fungicides, bioagents and plant extracts against powdery mildew of okra (*Erysiphe cichoracearum* DC) with nine treatments Sulphur (Sulfex 80% WP) @ 0.3%, Hexaconazole (Contaf 5% EC) @ 0.1%, Propiconazole (Tilt 25 EC) @ 0.1%, Carbendazim (Bavistin 50 WP) @ 0.1%, Neem oil (Azadiractin EC 1 %), *Trichoderma Viride* @ 4 g/ lit of water, *Trichoderma harizium* 4 g/ lit of water, *Pseudomonas fluorescens* 4 g/ lit of water, Control (Untreated). In Randomized Block Design, plot size: 2.40 X 2 m., Spacing (R×P): 60 cm x 45 cm. Three sprayings of fungicides were given at ten days interval. First spraying was done immediately after first appearance of powdery mildew disease symptoms and subsequent second and third sprayings were given at an interval of 10 days. The observations on disease incidence were recorded at first appearance of the disease and subsequent three observations were taken after each spraying and per cent incidence was calculated, applying following formula.

$$\text{Per cent disease incidence} = \frac{\text{No. of plant affected}}{\text{Total number of plants observed}} \times 100$$

$$\text{Per cent disease control} = \frac{\text{Control plot} - \text{Treatment plot}}{\text{Control plot}} \times 100$$

Observations on powdery mildew disease severity were recorded on five randomly selected plants. The first observation was taken at first appearance of the disease and subsequent three observations were taken after each spraying. The powdery mildew disease was graded on the basis of disease severity observed on leaves by applying 0-5 disease rating scale developed by Mckineey (1923).

RESULTS AND DISCUSSION

Efficacy of fungicides against okra powdery mildew

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Total nine fungicides were evaluated under field condition against powdery mildew of okra using susceptible variety “Aprana” during *Kharif*, 2023. Results obtained in respect of disease incidence, per cent disease control are presented here in following paragraphs.

Effect on powdery mildew incidence

To study the effect of fungicides on powdery mildew incidence an experiment was carried out and results obtained are presented in (Table: 1) and graphically depicted in 28 (Fig: 1). Results revealed that, all the fungicides were found effective and reduced the powdery mildew incidence over control.

The powdery mildew disease incidence at first appearance was ranged from 9.66% to 12.30%. The disease incidence was found to be increased steadily up to second spraying (20.90 to 38.31%). There after in different treatments it was reduced after third spraying which ranged from 19.53 to 31.07 per cent, as against highest incidence (68.40%) in untreated control.

The results revealed that, after second and third sprayings, plot sprayed with hexaconazole recorded disease incidence of 20.90 and 19.53%, respectively, and it was at par with propiconazole, which recorded disease incidence of 26.39% and 24.34% after second and third sprayings, respectively. Rest of the treatments exhibited comparatively maximum disease incidence in the range of 20.90 to 38.31 per cent and 19.53 to 31.07 per cent, respectively, after second and third sprayings.

Thus, data indicated that all the treatments significantly and gradually reduced the powdery mildew incidence after second and third sprayings over control. Mean disease incidence was ranged from 19.53 to 37.07%. However, it was least in hexaconazole (19.53%) followed by propiconazole (24.34%), carbendazim (22.34%), *Tricoderma viride* (25.21%) and Sulphur (27.34%).

Table: 1 Effect of fungicides on powdery mildew incidence in okra.

| S. No. | Treatment | Conc. (%) | PDI at first appearance | Per cent disease incidence after spraying | | | Mean PDI |
|----------------|-------------------------------|-----------|-------------------------|---|-----------------|-----------------|-----------------|
| | | | | First | Second | Third | |
| T ₁ | Sulphur | 0.3% | 11.49 (3.46) | 16.69 (4.15) | 29.43 (5.43) | 27.34 (5.28) | 27.34 (4.96) |
| T ₂ | Hexaconazole | 0.1% | 12.27 (3.57) | 15.41 (3.99) | 20.90 (4.64) | 19.53 (4.48) | 19.53 (4.36) |
| T ₃ | Propiconazole | 0.1 % | 11.52 (3.47) | 16.85 (4.17) | 26.39 (5.19) | 24.34 (4.98) | 24.34 (4.78) |
| T ₄ | Carbendazim | 0.1 % | 12.57 (3.62) | 14.21 (3.84) | 23.27 (4.88) | 22.34 (4.78) | 22.34 (4.5) |
| T ₅ | Neem oil | 4 % | 9.66 (3.19) | 23.37 (4.89) | 38.31 (6.23) | 31.07 (5.62) | 31.07 (5.58) |
| T ₆ | <i>Tricoderma viride</i> | 3 % | 13.41 (3.73) | 15.35 (3.98) | 27.42 (5.28) | 25.21 (5.07) | 25.21 (4.78) |
| T ₇ | <i>Trichoderma harizum</i> | 4 % | 11.59 (3.48) | 17.22 (4.21) | 31.52 (5.66) | 28.27 (5.36) | 28.27 (5.08) |
| T ₈ | <i>Pseudomonas flouresens</i> | 4 % | 12.3 (3.58) | 14.14 (3.83) | 28.59 (5.39) | 27.71 (5.31) | 27.71 (4.84) |
| T ₉ | Control (water spray) | - | 11.56 (3.47) | 29.93 (5.52) | 42.41 (6.55) | 68.40 (8.30) | 68.4 (6.79) |
| | S.Em. ± | - | 0.04 | 0.03 | 0.02 | 0.02 | - |
| | C.D | - | 0.11 | 0.08 | 0.05 | 0.05 | - |

*Mean of three replications; PI- Per cent Incidence.

**Figures in parentheses are arcsine transformed values.

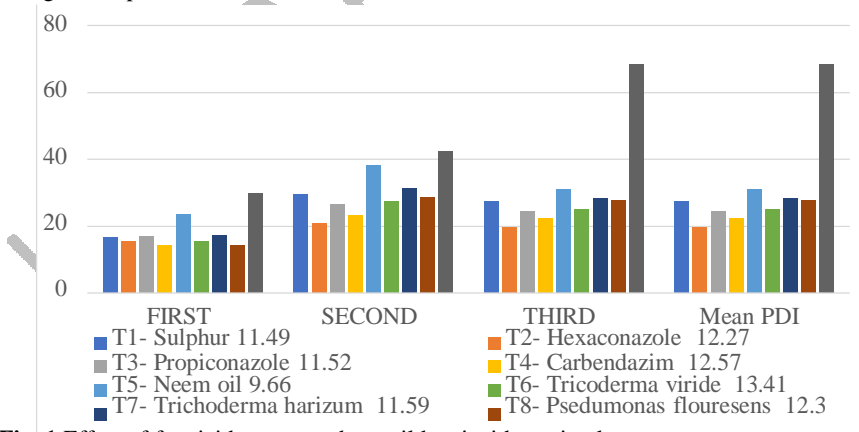


Fig. 1 Effect of fungicides on powdery mildew incidence in okra.

Similar results regarding effectiveness of hexaconazole were reported in pea by Khunti *et al.* (2002), Banniyal and Rana (2003), Singh (2007), Surwase *et al.* (2009) and Kacchot *et al.* (2011). Effectiveness of propiconazole was reported by Nargund *et al.* (2012) in green gram, Basandrai *et al.* (2013) in black gram and Hiremath *et al.* (2013) in pea. Effectiveness of difenconazole, sulphur, carbendazim, mancozeb was reported by Vijaya (2004), Shivanna *et al.* (2006) and Bachihal *et al.* (2014) in okra crop. Singh *et al.* (1998), Naik and Nagaraja (2000), Khodke and Kakde (2004) in mustard. Similar results in pea were reported by Patel *et al.* (2008), Nargund *et al.* (2012), Hiremath *et al.* (2013) in pea and by Chavan *et al.* (2013) in cowpea.

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Effect on reduction of powdery mildew severity of okra.

Results (Table. 2, Fig. 2). indicated that, all the treatments reduced the powdery mildew disease severity, over untreated control, after first, second and third spray treatments. After first spraying, the per cent reduction in disease severity over control was ranged from 52.76% to 21.92%, which after second spraying ranged from 50.72% to 9.67% and after third spraying, ranged from 88.71.45% to 58.67%.

Mean per cent disease reduction over untreated control was ranged from 71.45% (hexaconazole) to 60.03 (water spray). However, it was highest in Hexaconazole (71.45%), followed by carbendazim (67.34%), propiconazole (64.42), *Tricoderma viride* (63.14%), *Pseudomonas flouresens* (59.49%), sulphur (60.03%), *Tricoderma viride* (63.14%) and neem oil (54.58%). The mean reduction in disease over control was observed in water spray (60.03%).

Table:2 Effect on reduction of powdery mildew severity of okra.

| S.No. | Treatment | Conc. (%) | Per cent disease control after spraying | | | Mean PDC |
|----------------|---------------|-----------|---|--------|-------|----------|
| | | | First | Second | Third | |
| T ₁ | Sulphur | 0.3% | 44.24 | 30.61 | 60.03 | 60.03 |
| T ₂ | Hexaconazole | 0.1% | 48.51 | 50.72 | 71.45 | 71.45 |
| T ₃ | Propiconazole | 0.1 % | 43.70 | 37.77 | 64.42 | 64.42 |
| T ₄ | Carbendazim | 0.1 % | 52.52 | 45.13 | 67.34 | 67.34 |
| T ₅ | Neem oil | 4 % | 21.92 | 9.67 | 54.58 | 54.58 |

| | | | | | | |
|----------------|-------------------------------|-----|-------|-------|-------|-------|
| T ₆ | <i>Tricoderma viride</i> | 3 % | 48.71 | 35.35 | 63.14 | 63.14 |
| T ₇ | <i>Trichoderma harizum</i> | 4 % | 42.47 | 25.68 | 58.67 | 58.67 |
| T ₈ | <i>Pseudomonas flouresens</i> | 4 % | 52.76 | 32.59 | 59.49 | 59.49 |
| T ₉ | Control (water spray) | - | 44.24 | 30.61 | 60.03 | 60.03 |

*PDC- Per cent disease control.

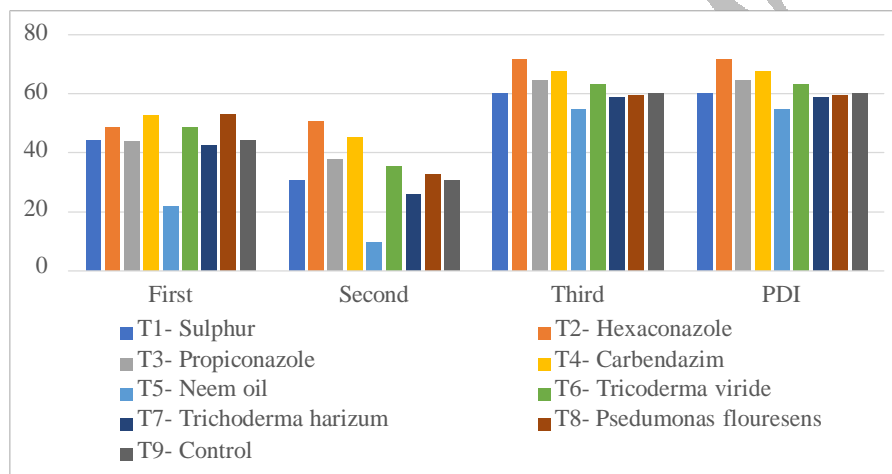


Fig: 2 Effect on reduction of powdery mildew severity of okra.

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