Management of pearl millet downy mildew by theapplication of bio-agents and fungicides

Comment [AK1]: Write in a effective way

Abstract

Pearl millet (*Pennisetum glaucum* (L.) R.Br.) Popularly known as bajra, it is a major warm-season cereal, largely grown under rainfed conditions in India. Downy mildew incited by *Sclerospora graminicola* (Sacc.) Schroet is the most widespread and destructive disease of pearl millet in India. The disease was observed two weeks after sowing as chlorotic strips on the upper surface of the leaves progressed from base to top. The majority of infected plants failed to form normal, healthy earheads. The bioagents, viz., seed treatment with *Trichoderma harzianum* (6 g/kg seed), treatment with *Pseudomonas fluorescens* (8 g/kg seed), treatment with *Trichoderma viride* (6 g/kg seed) and Neem oil and water, were also evaluated as seed dressers. The fungicides, viz., Mancozeb at 0.2%, Neem oil, Metalaxyl at 0.25%, and Carbendazim at 0.25%, were effective in terms of a significant reduction of downy mildew (2.83%) as compared to the control, in which 40.33% disease incidence was recorded, respectively. For the control of downy mildew, neem oil was significantly superior over all the tested bioagent seed dressings, as well as the seed dressing with Seed treatment with *Pseudomonas fluorescens* at 8 g/kg seed was statistically at par with seed treatment with *Trichoderma harzianum* at 6 g/kg seed and application of Metalaxyl at 0.25%. Foliar application of Mancozeb at 0.2 % and seed treatment with Metalaxyl (6 g/kg seed) + spray of Propiconazole at 25% EC at 0.25% also significantly checked the downy mildew, and these two were significantly superior over the seed dressing with all the tested bioagents. The encouraging result of neem oil as foliar application gives a sign that it may act as an alternative to fungicides in the light of eco-friendly management of pearl millet downy mildew.

Keywords: pearl millet, bio-agents, fungicides.

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Introduction

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The world's poorest and most food-insecure societies are found in Asia and Africa's dry, semi-arid, tropical, and subtropical regions, where pearl millet [*Pennisetum glaucum* (L) R. Br] is a special crop that serves as a staple food, suitable for cattle, and an important grain. Other names for it include Bajra, Bulrush, and Spiked Millet. It is a C_4 cereal plant that is diploid, with chromosomal number 2n = 14, and is native to central Africa (Wilson et al., 1989). In Africa and India, 90% of the world's pearl millet is produced. Approximately 10% of all food grain production is contributed by pearl millet. With an annual area of 684.1 thousand hectares, India has a production of 978.1 thousand tons and a productivity of 14.30 mt/ha. (Anonymous, 2022). Pesticides are necessary at present but are not a long-term solution for crop health. Besides their non-target effects, being hazardous to nature, and being expensive, some of them are losing their effectiveness because of the development of resistant strains. For quick screening against downy mildew, assaying resistance in terms of biogenetic parameters that are less influenced by the environment would be more reliable. Murthy (1983). The use of biocontrol agents in integrated management of pearl millet downy mildew is the requirement of the current era to avoid all inherent ill effects, viz., environmental pollution, residual toxicity, development of resistance by the pathogen, cost ineffectiveness, etc., caused by the continuous use of chemicals. Apart from

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this use of botanicals and bio-agents, management approaches may also serve as an alternate line for the eco-friendly management of the disease under field conditions.

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Material and Methods

The present study was conducted at Research Farm Rainfed Organic Agriculture Research Farm Narayan Bagh, Institute of Agricultural Sciences, Department of Plant Pathology, Bundelkhand University, Jhansi (Utter Pradesh) during the *Kharif* season of 2023. It is situated at $78^0$36 E Longitude and $25^0$27 N Latitude and is about 178.37 m above mean sea level. The climate is subtropical and semi-arid. The details of the experiment are as follows: Design: RBD, Variety: Leo-7601, Replications: 3, Treatments: 9, Spicing: row: 40cm x plant: 10cm, Plot size: 2 m x 2 m.

Comment [AK6]: Which software you used to analyse the dataset?

T_1: Metalaxyl @ 0.25%
T_2: Carbendazim @ 0.25%
T_3: Seed treatment with Metalaxyl @6g/kg seed + Spray of Propiconazole 25% EC @ 0.25%
T_4: Mancozeb @ 0.2 %
T_5: Seed treatment with *Trichoderma harzianum* @ 6g/kg seed
T_6: Seed treatment with *Pseudomonas fluorescens* @ 8g/kg seed
T_7: Seed treatment with *Trichoderma viride*@ 6g/kg seed
T_8: Neem oil
T_9: Control

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Comment [AK8]: Kindly write the Source of these bioagents.

Downy mildew incidence (%):

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The total number of plants were recorded at the time of thinning, *i.e.*, fifteen days after sowing, while the number of downy mildew-infected plants was recorded at 30 and 60 days after sowing. The downy mildew incidence per cent was calculated with the help of the following formula:

$$Downy\ mildew\ incidence\ (\%) = \frac{Downy\ mildew\ infected\ plants}{Total\ number\ of\ plants} \times 100$$

Seedling emergence

$$Percent\ seedling\ emergence = \frac{Number\ of\ seeds\ germinates}{Total\ number\ of\ seeds\ sown} \times 100$$

Result and Discussion

The bioagents and fungicides when evaluated against downy mildew and were compared with the recommended chemicals and controls. The average number of plants were maximum with seed treatments of Metalaxyl at 0.25% (160.14) and Carbendazim at 0.25% (155.3), followed by seed treatment with Metalaxyl at 6 g/kg seed + Spray of Propiconazole 25% EC at 0.25% (149.77), Mancozeb at 0.2% (145.88), Neem oil (138.8), seed treatment with *Trichoderma harzianum* at 6 g/kg seed (129.83), seed treatment with *Trichoderma viride at 6 g*/kg seed (125.27) and seed treatment with *Pseudomonas fluorescens* @ 8 g/kg seed (121.43) in comparison to control where minimum number of plants (111.8).

Accordingly, seed treatment with Metalaxyl at 0.25% (55.38) and Carbendazim at 0.25% (52.95) was followed by seed treatment with Metalaxyl at 6 g/kg seed + Spray of Propiconazole at 25% EC at 0.25% (51.53), Mancozeb at 0.2% (48.58), seed treatment with *Trichoderma harzianum* at 6 g/kg seed (45.62), seed treatment with *Pseudomonas fluorescens* at 8 g/kg (43.52), neem oil (41.57), and seed treatment with *Trichoderma viride* at 6 g/kg (40.9), in comparison to the control where the minimum number of plants (38.47).

Amongst different treatments, neem oil was significantly effective in reducing the incidence of pearl millet downy mildew to a minimum of 1.52% in comparison to 33.97 per cent in control at 30 days after sowing. Seed treatment with *Pseudomonas fluorescens* at 8 g/kg seed ranked next (2.25%), followed by seed treatment with *Trichoderma harzianum* at 6 g/kg seed (3.37%), seed treatment with *Trichoderma viride* at 6 g/kg seed (4.11%), Metalaxyl at 0.25% (4.63%), mancozeb at 0.2% (6.1%), carbendazim at 0.25% (7.53%), seed treatment with Metalaxyl (@ 6 g/kg seed + Spray of Propiconazole 25% EC @ 0.25% (8.42%) Pandya et al. (2000) reported that the seed treatment with Metalaxyl 2 g/kg seed controlled downy mildew up to 20–22 days after sowing (DAS). Similar findings are also given by Gupta et al. (2014). Similar findings are also given by Sasode et al. (2017).

At 60 days after sowing, neem oil was significantly superior in reducing the incidence of pearl millet downy mildew to a minimum of 2.83% in comparison to 40.33 per cent in the control. Seed treatment with *Pseudomonas fluorescens* at 8 g/kg seed ranked next (4.43%), followed by seed treatment with *Trichoderma harzianum* at 6 g/kg seed (6.5%), seed treatment with *Trichoderma viride* at 6 g/kg seed (7.72%), metalaxyl at 0.25% (8.09%), mancozeb at 0.25% (12.13%), carbendazim at 0.25% (14.23%), and seed treatment with metalaxyl at 6 g/kg seed + spray of Propiconazole at 25% EC at 0.25% (16.1%). Pearl millet seed dressing with Apron 35 SD at 6 g/kg seed, Bacillus pumulis (INR 7) and chitosan significantly checked the incidence of downy mildew at 30 and 60 days after sowing (Rajput, 2009). Similarly, Pooja and Kushal (2016) conducted field trials to manage downy mildew. A minimum disease incidence of 9.3% was observed in the treatment of Chitosan and Bacillus pumulis, with a maximum germination percentage of 53.5%.

References

1. Anonymous, (2022). https://www.indiastatagri.com/table/agriculture/area-production-productivity-bajra-india-1949-1950/7267.
2. Murthy SE, Nagarajan C, Parasade MN, Ravvendran TS, Shanmugam N. Identification of the sources of resistance to pearl millet downy mildew. On Breeding Crop Plants for Resistance to Pests and Diseases, Tamil Nadu Agric. Univ. Coimbatore, Tamil Nadu, India, 1983.
3. Pandya RK, Singh Reeti, Tripathi ML. Efficacy of metalaxyl and Aliete on downy mildew of pearl millet. Crop Res. Hisar. 2000; 20(1):134-136.
4. Pooja S, Kushal R. Evaluation of bioagents for management of downy mildew of pearl millet caused by *Sclerosporagraminicola*(Sacc.) Schroet. Forage Res. 2016; 42(1):44-47.
5. Rajni Singh Sasode, RK Pandya and Pramod Kumar Fatehpuria (2017). Management of pearl millet downy mildew by the application of bio-agents, chemicals and botanical, *International Journal of Chemical Studies* 2018; 6(1): 606-608.
6. Rajput SS. Pearl millet downy mildew status in Northern Madhya Pradesh and its integrated management. M. Sc. (Ag) Thesis Plant Pathology, JNKVV, Jabalpur, 2009.
7. Wilson, J. P., and R. N. Gates, (1993). Forage yield losses in hybrid.

Comment [AK10]: Write discussion in proper way.

Comment [AK11]: All the references should be according to the guidelines of the journal.

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Table: - 1. Evaluation of various biocontrol agents against downy mildew of pearl millet during kharif2023 under field conditions.

Treatments	Average no. of plants	Per cent Seedling emergence	Downy mildew incidence Per cent at 30 DAS	Downy mildew incidence Per cent at 60 DAS
Metalaxyl @ 0.25%	160.14	55.38 (7.48)	4.63 (2.26)	8.09 (2.93)
Carbendazim @ 0.25%	155.3	52.90 (7.31)	7.53 (2.83)	14.23 (3.84)
Seed treatment with Metalaxyl (@ 6g/kg seed + Spray of Propiconazole 25% EC @ 0.25%	149.77	51.53 (7.21)	8.42 (2.99)	16.1 (4.07)
Mancozeb @ 0.2 %	145.88	48.58 (7.01)	6.1 (2.57)	12.13 (3.55)
Seed treatment with *Trichoderma harzianum* (@ 6g/kg seed	129.83	45.62 (6.79)	3.37 (1.97)	6.5 (2.65)
Seed treatment with *Pseudomonas fluorescens* @ 8g/kg seed	121.43	43.52 (6.63)	2.25 (1.66)	4.43 (2.22)
Seed treatment with *Trichoderma viride* (@ 6g/kg seed	125.27	40.9 (6.43)	4.11 (2.15)	7.72 (2.87)
Neem oil	138.8	41.57 (6.49)	1.52 (1.41)	2.83 (1.82)
Control	111.8	38.47 (6.24)	33.97 (5.87)	40.33 (6.39)
S. Em±	0.849	0.018	0.053	0.033
C.D. @ 5%	2.545	0.053	0.160	0.098

Al data are means of three replications.
*Figures in parentheses are angular transformed value.

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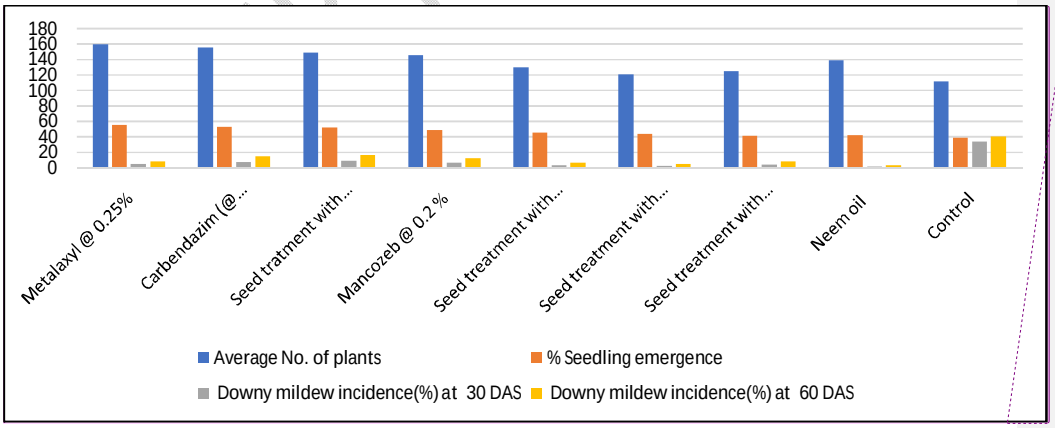

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Fig: - 1 Evaluation of various biocontrol agents against downy mildew of pearl millet during kharif 2023 under field conditions.