Fungicides and bioagents are used to manage downy mildew on pearl millet

Abstract

Pennisetum glaucum (L.), pearl millet Known by most as bajra, it is a significant warm-season grain that is mostly farmed in India under rainfed circumstances. In India, downy mildew caused by *Sclerosporagraminicola* (Sacc.) Schroet is the most common and deadly disease affecting pearl millet. Two weeks after seeding, the illness was visible as chlorotic stripes on the leaf surface advanced from the base to the top. Most infected plants were unable to develop typical, healthy earheads. The bioagents that were examined as seed dressers were *Trichoderma harzianum* (6 g/kg seed), *Pseudomonas fluorescens* (8 g/kg seed), *Trichoderma viride* (6 g/kg seed), and neem oil and water.The downy mildew disease incidence was significantly reduced (2.83%) by the fungicides Mancozeb at 0.2%, Neem oil, Metalaxyl at 0.25%, and Carbendazim at 0.25%, as compared to the control, which had a documented disease incidence of 40.33%. Neem oil considerably outperformed all evaluated bioagent seed dressings for downy mildew prevention, including the seed dressing containing *Pseudomonas fluorescens* seed treatment at 8 g/kg seed was statistically comparable to *Trichoderma harzianum* seed treatment at 6 g/kg seed and Metalaxyl application at 0.25%. The downy mildew was also greatly reduced by 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%; these two methods outperformed the seed dressing with all evaluated bioagents. The positive outcome of using neem oil topically suggests that, when it comes to managing downy mildew in pearl millet in an environmentally benign manner, it might replace fungicides.

Keywords: pearl millet, bio-agents, fungicides.

Introduction

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). Although they are now required, pesticides are not a sustainable answer for crop health. In addition to their non-target effects, cost, and potential harm to the environment, some of them are becoming less effective due to the emergence of resistant strains. Assaying resistance in terms of biogenetic factors that are less impacted by the environment would be more reliable for rapid screening against downy mildew. Murthy (1983). The modern era demands the use of biocontrol agents in integrated management of pearl millet downy mildew in order to prevent all inherent negative effects, such as environmental pollution, residual toxicity, pathogen resistance, cost ineffectiveness, etc., brought on by the ongoing use of chemicals.

Material and Methods

The current investigation was carried out 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.

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

Downy mildew incidence (%):

The total number of plants was counted at the time of thinning, or fifteen days after sowing; the number of plants afflicted with downy mildew was counted 30, and 60 days after sowing.The following formula was used to determine the downy mildew incidence percentage:

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

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 notably successful in bringing down the occurrence of pearl millet downy mildew to at least 1.52% in contrastto 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 seedtreatment 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%). The incidence of downy mildew at 30 and 60 days after planting was dramatically reduced by pearl millet seed dressing using Apron 35 SD at 6 g/kg seed, Bacillus pumulis (INR 7), and chitosan (Rajput, 2009). In a similar vein, Pooja and Kushal (2016) managed downy mildew through field experiments. When Bacillus pumulis and chitosan were used together, a minimum illness incidence of 9.3% and a maximum germination percentage of 53.5% were noted.

Conclusion

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.

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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 +	149.77	51.53 (7.21)	8.42 (2.99)	16.1 (4.07)

Spray of Propiconazole 25% EC @ 0.25%				
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

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

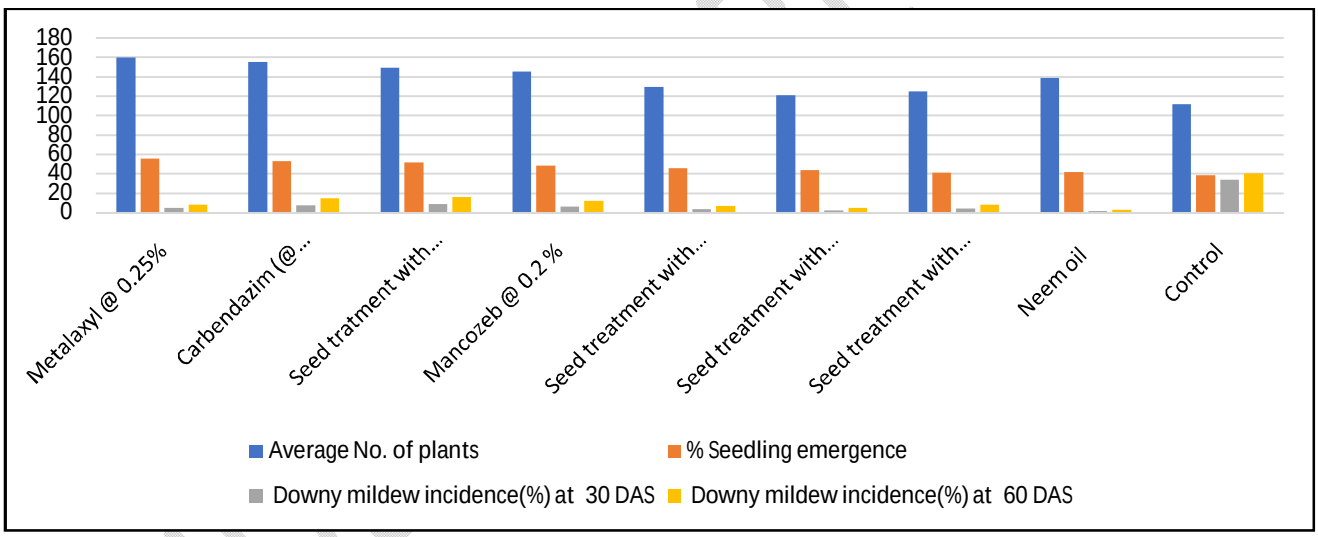

Fig: - 1 Evaluation of various biocontrol agents against downy mildew of pearl millet during kharif 2023 under field conditions.