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Screening of bioagents for control of downy mildew of pearl millet

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ABSTRACT

The bioagents *viz*., *Trichoderma viride, T. harzianum, T. hamatum ,Pseudomonas fluorescens* and effective micro-organisms (EM) along with fungicide Ridomil MZ-72 were screened in sick plot for their effectiveness in controlling downy mildew disease of pearl millet. Seed treatment followed by spraying at 20 days after sowing was done. Among the bioagents, *T. harzianum* and *P.fluorescens* were found most promising in reducing the disease incidence with increase in emergence of crop and grain yield. However, the chemical treatment of Ridomil MZ-72 was most significant in respect of all the parameters under study.

Key words : Downy mildew, Bioagents , *T. harzianum, P.fluorescens*

INTRODUCTION

Pearl millet production is affected by various biotic and abiotic stresses. Among the biotic factors diseases *viz.*, ergot and downy mildew are important. Downy mildew caused by *Sclerospora graminicola* (Sacc.) Schoret, is one of the major factor that restrict the production potential of pearl millet. It has become occasional setback to pearl millet hybrid programme in India. The pathogen *S. graminicola* is biotrophic in nature, seed and soil borne with profusely branched mycelium that systematically colonizes stem, leaves and apical meristem producing symptom starting from first leaf stage to flowering. The crop is mainly grown by poor farmers and managing downy mildew is very difficult due to its biotrophic nature. Recent research into the control of soil borne diseases has mostly concentrated on chemical methods that offer considerable cost effective and pollution free control. Various biocontrol agents including fungi and bacteria have been reported as antagonist to soil borne pathogens of graminaceous downy mildews. The present study was, therefore, undertaken to determine the effect of different biocontrol agents *viz.* ,four fungus species, one bacterial and the effective microorganisms (EM) which are both aerobic and anaerobic (lactic acid bacteria, photosynthetic bacteria, yeast and fungi) on downy mildew pathogen and to compare their effectiveness with fungicide Ridomil MZ-72 (Metalaxyl+Mancozeb)in controlling the disease under field conditions along with effect on crop emergence, tiller production etc.

MATERIALS AND METHODS

A field experiment was carried out with downy mildew susceptible pearl millet hybrid HB-3 in the well-developed downy mildew sick plot of Plant Pathology Section, College of Agriculture, Pune during *Kharif* 2004. The experiment was laid out in randomized block design with four replications and seven treatments. Seed treatment followed by spraying at 20 days after sowing was done.

Seed Treatment:

For the seed treatment with fungal and bacterial biocontrol agents, procedure given by Agrwal *et. al.*(1977) was followed. Potato dextrose broth was inoculated with each fungal antagonist and incubated at 26±2^{0}C for 7 days. After incubation seeds of pearl millet (HB-3) were immersed in broth for five minutes and dried in shade before sowing. While for bacterial antagonist Kings 'B' medium was used. Seeds were immersed in EM solution poured in petriplates for five minutes, removed, dried in shade and used for sowing. The fungicide Ridomil MZ-72 WP was applied to the seed @4 gm a.i./kg.

Spraying:

Spraying with all biocontrol agents and fungicide was done 20 days after sowing of the crop. The fungal antagonist cultures were multiplied on potato dextrose broth for 7 days under 12 hrs. light cycle without shaking. The cultures were harvested and blended in sterile distilled water (spore count 5 x 10^{-7} spore ml^{-1}) and used for spraying (Haware *et al*. 1999). Similarly, bacterial suspension (10^{-8} CFU ml^{-1}) was prepared with Kings 'B' broth and used for spraying. EM solution was sprayed @ 1 % while fungicide Ridomil MZ-72 WP @ 0.4 %.

Observations recorded:

The downy mildew disease affects the emergence

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of crop as well as tillers and earhead formation. The killing of tillers and green ear formation ultimately results into low yield. Therefore, the observations on emergence count seven days after planting of the crop, disease incidence at 30 and 60 days after planting, green ear and number of tillers per hill at maturity and grain yield were recorded. The infection index was also calculated.

RESULTS AND DISCUSSION

Emergence percentage:

The effect of different treatments on seed emergence was observed to be significant. Maximum emergence (87.36 %) was observed in the treatment of *Pseudomonas fluorescens* . It was followed by the treatments of fungal bioagents *i.e Trichoderma harzianum, T. hamatum* and *T. viride* respectively. Enhancement in seed germination due to *P. fluorescens* had been reported earlier in pearl millet by Umesh *et al.*, (1998). Also, increase in emergence, seed germination and vigour due to bio-control agents in pearl millet had been reported by Shetty *et al.*, (2000) thus confirming the present results. Emergence percentage was low in treatment of Ridomil MZ-72 WP (70.50 %) and was at par with the treatment of EM (68.00 %). The fungicidal treatment of Ridomil MZ-72 WP was not observed to influence emergence significantly. Similar results were obtained by Singh (1983) in different cultivars of pearl millet. Though so, all the treatments were significantly superior over uninoculated control showing increase in emergence percentage.

Number of tillers per hill at maturity:

Number of tillers per hill at maturity were recorded to know the effect of different treatments on tillering of plant and ultimately disease control. From the data, it was indicated that, maximum tillers were recorded in the treatment of *T. harzianum* (4.87) followed by *T. hamatum* (4.82) and *T. viride* (4.30). All these treatments were also found to be significantly superior over control. However, the treatment of fungicide Ridomil MZ-72 WP not showed any significant effect on tillering. Amrutesh (2002), had also recorded significant tillering in pearl millet by seed treatment with different bio-control agents *viz., T. harzianum, Bacillus subtilis, P. fluorescens* and their combinations. The increase in emergence percent and number of tillers due to different bio-control agents may be attributed to their capacity of fixing various elements *viz.,* nitrogen and phosphorus.

Table 1 : Emergence per cent, number of tillers per hill at maturity and green ear per plot.

Treatments	Treatment details	Emergence %	% increase over control	Tillers / hill	Green ear / plot	% decrease over control
T_1	*Trichoderma viride*	72.00 (58.05)	11.73	4.30	8.00	41.81
T_2	*Trichoderma harzianum*	77.33 (61.55)	20.03	4.87	4.95	64.00
T_3	*Trichoderma hamatum*	76.00 (60.67)	17.90	4.62	9.50	30.90
T_4	*Pseudomonas fluorescens*	87.36 (69.21)	35.56	3.87	6.75	50.69
T_5	Effective microorganisms (EM)	68.00 (55.55)	5.52	3.31	11.25	18.18
T_6	Ridomil MZ-72 WP	70.50 (57.10)	9.40	3.45	4.00	70.90
T_7	Control	64.44 (53.37)	-	2.87	13.75	-
S.E.±		2.002	-	0.313	0.663	-
C.D. at 5 %		5.890	-	0.922	1.951	-

Effect on green ear production :

Formation of green ear is the most damaging stage of the crop, which results in lowering grain yield. Therefore, observations on green ear per plot as affected by different treatments were recorded at maturity of crop.

Minimum numbers of green ear were recorded in the treatment Ridomil MZ-72 WP that gave 70.90 % decrease over control. The next best treatments were *T. harzianum* and *P. fluorescens* (64.00 and 50.69 % decrease over control respectively). Effectiveness of

Ridomil MZ-72 WP had been also reported by Pandya *et al* (2000) in controlling the malformation of ear heads in pearl millet due to downy mildew, . From the results it is seen that no biological agent was as superior as chemical treatment, but these could significantly reduce the formation of green ears.

Disease control and grain yield:

From the data it was revealed that all the treatments were significantly superior over control in recording the disease incidence and infection index. Treatment with Ridomil MZ-72 WP recorded minimum disease incidence and infection index giving 71.51 % protection over control. Earlier Dang *et al.,* (1983), had reported seed treatment and / or foliar spray with metalaxyl to decrease disease intensity of downy mildew of Pearl Millet. Gupta and Verma (1991), had also reported 77.2 % protection by metalaxyl. Similar results were obtained during present investigation. Amongst the bio-agents, *T. harzianum* treated plants recorded minimum downy mildew incidence percentage and greater control (52.40 %) as compared to other treatments and uninoculated control. These results are in confirmatory with the findings of Amrutesh (2002). The next best treatments were *T. viride, P. fluorescens* and *T. hamatum* respectively. However, during present investigation EM solution not appeared effective in controlling the disease.

In case of grain yield, it was observed that all the treatments significantly increased yield (987.00 to 1335.50 kg / ha) over control (765.50 kg / ha). Maximum grain yield was obtained in the treatment of Ridomil MZ-72 WP (1335.50 kg / ha) followed by treatment with *T. harzianum* (1185.00 kg / ha) giving 74.46 and 54.80 % increase over control respectively. Similar results with metalaxyl seed treatment in pearl millet were reported Pandya *et al* (1999) and Singh (1983). Increase in grain yield due to bio-control agent *T. harzianum* in pearl millet had been reported by Amrutesh (2002), which supports the present results.

Thus, during the present investigation, Ridomil MZ-72 WP seed treatment followed by foliar spray at 20 DAP was found most significant in recording minimum disease incidence, green ear with higher grain yield, followed by the treatment of fungal bio-agent *T. harzianum* and *P. fluorescens* respectively. This indicates the possibility of exploiting bio-agents like *Trichoderma* spp. and *Pseudomonas* spp. to manage downy mildew of pearl millet.

Table 2 : Downy mildew incidence, infection index and grain yield as affected by various treatments

Treatments	Treatment details	PDI 30 DAP	PDI 60 DAP	% Protection	Infection Index	Yield kg/ha	% increase over control
T_1	*Trichoderma viride*	21.07 (27.35)	42.00 (44.40)	49.51	20.55 (6.92)	1156.25	51.80
T_2	*Trichoderma harzianum*	18.60 (25.55)	39.60 (39.00)	52.40	19.82 (26.42)	1185.00	54.80
T_3	*Trichoderma hamatum*	27.30 (31.50)	48.30 (44.03)	41.94	23.30 (28.86)	1082.50	41.41
T_4	*Pseudomonas fluorescens* (PU)	24.00 (29.33)	44.49 (41.84)	46.52	21.52 (27.63)	1127.25	47.25
T_5	Effective microorganisms (EM)	41.20 (39.93)	73.00 (58.69)	12.25	39.40 (38.88)	987.00	28.93
T_6	Ridomil MZ-72 WP	7.90 (16.32)	23.70 (22.55)	71.51	12.17 (20.44)	1335.50	74.46
T_7	Control	47.30 (43.45)	83.20 (65.80)	-	60.65 (51.12)	765.50	-
S.E.±		0.191	0.733	-	0.421	8.860	-
C.D. at 5 %		0.562	2.101	-	1.239	26.067	-

REFERENCES

Agarwal, S.C., Khare, M.N. and Agarwal, R.S. (1977). Biological control of *Sclerotium rolfsii* causing collar rot of lentil. *Indian Phtopath.*, **30:**176-179.

Amrutesh, S.A. (2002). Hypersensitive reaction in pearl millet downy mildew host pathogen interaction and different approaches for disease management. Ph.D. Thesis submitted to University of Mysore, Mysore, India.

Dang, J.K., Thakur, D.P. and Grover, R.K. (1983). Control of pearl millet downy mildew caused by *Sclerospora graminicola*

with systemic fungicide in an artificially contaminated plot. *Ann. Appl. Biol.,* **102 :** 99-100.

Gupta, G. K. and Verma, S.K. (1991). Control of downy mildew of pearl millet with Ridomil. *Indian Phytopath.* **44 (4) :** 458-461.

Pandya, R.K., Mishra, V.K., Tripathi, A.K. and Tripathi, M.L. (1999). Fungicide control of downy mildew of pearl millet. *Flora and Fauna.,* **5 (1) :** 35-36.

Pandya, R.K., Singh, Reeti, Tripathi, M.L. and Singh, R. (2000). Efficacy of metalaxyl and alliete on downy mildew of pearl millet. *Crop Research,* **20 (1) :** 134-136.

Shetty, H.S., Kumar, V.U., Upadhyay, R.K., Mukerji, K.G. and Chamola, B.P. (2000). Biological control of pearl millet downy mildew: Present Status and future prospects. Bio-control potential and its explanation in sustainable agriculture. **1 :** 251-265.

Singh, S.D. (1983). Variable cultivar response to metalaxyl treatment in pearl millet. *Plant Disease.* **67 :** 1013-1015.

Umesh, S., Dharmesh, S.M., Shetty, S.A., Krishnappa, M. and Shetty, H.S. (1998). Bio-control of downy mildew disease of pearl millet using *Pseudomonas*. *Crop Protection.* **17 (5) :** 387-392.

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