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Management of pearl millet blast through fungicides and biocontrol agents

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Abstract

The *in vivo* experiment was conducted at Agricultural Research Station, Vizianagaram against pearl millet blast revealed that all the treatments showed significant reduction in blast disease incidence in pearl millet. Among all the treatments T₃ i.e., foliar application of *Pseudomonas fluorescens* at 20 DAS and Trifloxystrobin + Tebuconazole at 35 DAS was found effective with least disease intensity of blast (14.1%), highest grain (26.0 q/ha) and fodder yield (60.9 q/ha). While the highest disease intensity (94.8) was noticed in the treatment T₆ i.e., control with lowest grain (9.3 q/ha) and fodder yield (26.3 q/ha). The highest cost benefit ratio (2.5) was obtained in treatment T₃.

Keywords: Biocontrol agents, fungicides, pearl millet, *Pseudomonas fluorescens*, *Pyricularia grisea*, Trifloxystrobin + Tebuconazole

Introduction

Pearl millet (*Pennisetum glaucum* (L.) R. Br.) is one of the important cereal and drought tolerant crop grown in arid and semi arid tropics of Asia and Africa. It is highly nutritious which high amounts of iron and zinc (Rai *et al.*, 2008) [12]. It is grown as dual purpose crop for grain and fodder purpose. In India, pearl millet is popular as bajra and is cultivated under rainfed conditions with an annual production of about 86.60 lakh tonnes (India stat 2019).

As, pearl millet crop is prone to number of diseases which is a major constraint in production causing low yield and economic losses. The fungal diseases that affect pearl millet such as, downy mildew or green ear disease (*Sclerosporagraminicola*), rust (*Puccinia substriata* var. *indica*), smut (*Tolyposporium penicillariae*) and sugary disease or ergot of bajra (*Claviceps fusiformis*) which bothers both the farmers and researchers. On the other hand, leaf spots which are caused by pathogens like, *Pyricularia grisea*, *Bipolaris setariae*, *Cercospora penniseti*, *Curvularia penniseti*, *Drechslera dematioidea* and *Exserohilum rostratum* destroys the foliage and thus reducing yield. Among the leaf spots, blast disease caused by *Pyricularia grisea* which is considered as a minor problem during the past but now emerged as a serious problem affecting both forage and grain production of pearl millet in India (Lukose *et al.*, 2007) [6].

Although, host plant resistance is considered as the most economical and ecofriendly method of management of plant diseases. Hence, efforts are being made to understand inheritance of resistance to *P. grisea* and pathogenic variation in the pathogen so as to develop pearl millet parental lines and hybrids resistant to blast (Gupta *et al.*, 2012) [2]. As, the blast disease in rice is primarily managed through host plant resistance, the pathogen has the ability to develop new pathogenic races leading to breakdown of resistance within few years (Ahn, 1994). Hence, extensive research is being carried out to manage blast disease in different crops using fungicides (Lukose *et al.*, 2007; Narayana Swamy *et al.*, 2009; Netam *et al.*, 2014; Pagani *et al.*, 2014) [6, 7, 9, 10]. Hence, a research was executed to know the efficacy of fungicides and biocontrol agents.

Materials and Methods

The field experiment was conducted at Agricultural Research Station, Vizianagaram for the management of blast disease in pearl millet by using fungicides and potential biocontrol agents like *Bacillus subtilis*, *Pseudomonas fluorescens* and chitosan.

These isolates were collected from Department of Biological control, Vizianagaram. The experiment was laid out in randomized block design (RBD) with three replications at spacing of 45×15 cm with 3×2.7 m gross plot size. Standard agronomic practices of NPK-50kg, 40kg, 25kg were followed at the time of crop growth period. The crop was sown in the second week of July 2019. A susceptible variety ICMV 155 was used in this experiment by imposing the following treatments: (Table 1).

Seed treatment was done with chitosan at the time of sowing with 3.75 g of chitosan for one kg seed. For foliar spray both the biocontrol agents *ie.*, *Pseudomonas fluorescens* and *Bacillus subtilis* were applied @ 10 g/l. For foliar spray Trifloxystrobin + Tebuconazole was applied @ 0.4 g/l Two foliar sprays with biocontrol agents and fungicides were done

at 20 days after sowing as first spray and at 35 days after sowing as second spray. The intensity of blast was recorded after seven days of each spray. Ten plants were selected randomly and labeled from each plot for scoring the disease intensity. These labeled plants were observed for disease intensity from upper, middle and lower leaves using disease rating scale of 0-9 (IRRI, 1988) [4]. The grain and fodder yield per ha were recorded. Standard Evaluation System (SES) for blast (IRRI, 1988) [4].

The per cent disease intensity (PDI) was calculated by using the following formula

$$PDI = \frac{\text{Sum of individual disease ratings}}{\text{No. of observations assessed} \times \text{maximum disease rating}} \times 100$$

Table 1: Details of the Treatments

S. No.	Treatments
1	Seed treatment with Chitosan @3.75g/kg seed + 2 sprays of <i>Pseudomonas fluorescens</i> @10g/l after 20 DAS and 35 DAS
2	Seed treatment with Chitosan @3.75g/kg seed + 2 sprays of <i>Bacillus subtilis</i> @10g/l after 20 DAS and 35 DAS
3	Spray treatment with <i>Pseudomonas fluorescens</i> @10g/l 20 DAS and Trifloxystrobin + Tebuconazole @ 0.04% after 35 DAS
4	Spray treatment with Trifloxystrobin + Tebuconazole @0.04% 20 DAS and <i>Bacillus subtilis</i> @ 10g/l after 35 DAS
5	Trifloxystrobin + Tebuconazole @ 0.04% 2 sprays after 20 DAS and 35 DAS
6	Control

Table 2: Blast disease rating scale

Scale	Description
0	No lesions
1	Small brown specks of pinhead size without sporulating center
2	Small roundish to slightly elongated, necrotic grey spots, about 1-2 mm in diameter with a distinct brown margin, lesions are mostly found on the lower leaves
3	Lesion type is the same as in scale 2, but significant number lesions are on the upper leaves
4	Typical sporulating blast lesions, 3 mm or longer, infecting less than 2% of the leaf area
5	Typical blast lesions infecting 2-10% of the leaf area
6	Blast lesions infecting 11-25% leaf area
7	Blast lesions infecting 26-50% leaf area
8	Blast lesions infecting 51-75% leaf area
9	More than 75% leaf area affected

Results and Discussion

The findings of the present study from Table 3 reveals that all the treatments showed significant reduction in blast incidence when compared to control. Among all the treatments T_3 *ie.*, Foliar spray with *Pseudomonas fluorescens* at 20 DAS as first spray and Trifloxystrobin + Tebuconazole at 35 DAS as second spray proved to be best with least disease intensity 14.1%. The next best treatment was T_4 *ie.*, spray treatment with Trifloxystrobin + Tebuconazole 20 DAS as first spray and *Bacillus subtilis* after 35 DAS as second spray with 29.6% disease intensity. Foliar sprays with Trifloxystrobin + Tebuconazole at 20 as first spray and at 35 DAS as second spray showed 38.5% disease intensity. 40.7 and 44.4 percent disease intensity was recorded in treatments T_1 *ie.*, seed treatment with chitosan and 2 foliar spray of *Pseudomonas fluorescens* and T_2 *ie.*, seed treatment with chitosan and 2 foliar spray of *Bacillus subtilis*, respectively. The highest disease intensity was recorded in control with 94.8%.

In case of grain yield highest (26.0 q/ha) was recorded in treatment T_3 *ie.*, Foliar spray with *Pseudomonas fluorescens* at 20 DAS as first spray and Trifloxystrobin + Tebuconazole at 35 DAS as second spray followed by T_4 *ie.*, spray treatment with Trifloxystrobin + Tebuconazole 20 DAS as first spray and *Bacillus subtilis* after 35 DAS as second spray with 22.0 q/ha. Foliar spray with Trifloxystrobin + Tebuconazole at 20 and 30 DAS alone recorded 19.0 q/ha. The treatments with

seed treatment with chitosan and 2 foliar spray of *Pseudomonas fluorescens* and *Bacillus subtilis* at 20 and 30 DAS with 15.0 q/ha and 12.7 q/ha, respectively. The least grain yield was recorded in control 9.3 q/ha.

Regarding fodder yield was highest was recorded in Foliar spray with *Pseudomonas fluorescens* at 20 DAS as first spray and Trifloxystrobin + Tebuconazole at 35 DAS as second spray (60.9 q/ha). Spray treatment with Trifloxystrobin + Tebuconazole 20 DAS as first spray and *Bacillus subtilis* after 35 DAS as second spray recorded 51.9 q/ha of fodder yield. The fodder yields of treatments Foliar sprays with Trifloxystrobin + Tebuconazole at 20 as first spray and at 35 DAS as second spray (46.2 q/ha) and seed treatment with chitosan and 2 foliar spray of *Pseudomonas fluorescens* at 20 and 30 DAS (40.2 q/ha) are significantly on par with each other followed by seed treatment with chitosan and 2 foliar spray of *Bacillus subtilis* at 20 and 30 DAS (39.1 q/ha). Control showed lowest fodder yield (26.3 q/ha). Foliar spray with *Pseudomonas fluorescens* at 20 DAS and Trifloxystrobin + Tebuconazole at 35 DAS was proved to be best with highest cost benefit ratio of 2.5 followed by spray treatment with Trifloxystrobin + Tebuconazole 20 DAS and *Bacillus subtilis* after 35 DAS with 2.1.

Two sprays of *P. fluorescens* was effective in controlling the blast disease in finger millet (Ramappa *et al.*, 2002) [13]. Sithther and Gananamanickan (1996) [15] reported that six

strains of *Pseudomonas fluorescens* showed their ability to inhibit the finger millet blast fungus. Seed treatment and two foliar sprays with *Pseudomonas fluorescens* most effective in reducing blast disease of finger millet (Kumar and Kumar, 2011) [5]. Netam *et al.*, (2016) [8] reported that foliar sprays of *Pseudomonas fluorescens* was effective in controlling blast incidence. Trifloxystrobin + Tebuconazole was found to be effective in managing the blast disease in pearl millet with

higher yield (Ajay *et al.*, 2018) [1]. Field experiment results of Sharma *et al.*, 2018 revealed that three sprays of Tebuconazole + Trifloxystrobin or propiconazole was superior in reducing blast incidence with higher yields in pearl millet. Parmesh *et al.*, (2016) reported that rice blast was effectively controlled with Tebuconazole + Trifloxystrobin and resulted in higher yield.

Table 3: Efficacy of treatments on blast disease, effect of treatments on grain and fodder yield and benefit cost ratio

S. No.	Treatments	Blast (PDI%)	Grain yield (q/ha)	Fodder yield (q/ha)	BCR
1	T ₁	40.7 (39.6)	15.0	40.2	1.5
2	T ₂	44.4 (41.7)	12.7	39.1	1.3
3	T ₃	14.1 (21.9)	26.0	60.9	2.5
4	T ₄	29.6 (32.9)	22.0	51.9	2.1
5	T ₅	38.5 (38.3)	19.0	46.2	1.8
6	T ₆	94.8 (77.2)	9.3	26.3	1.0
	CV(%)	7.1	5.9	9.6	
	CD at 5%	5.4	1.9	7.8	
	S.Em.±	1.7	0.6	2.5	

Conclusion

The entire study showed that all the treatments are effective in controlling pearl millet blast. Further it is concluded that initial spray of *Pseudomonas fluorescens* and Trifloxystrobin + Tebuconazole as second spray was found superior in managing the blast disease.

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