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Occurrence and Management of Blast and Leaf Blight in Browntop Millet [*Brachiaria ramosa* (L.) Stapf]

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Brown top millet is an underutilized millet crop and grown in Southern Peninsular region of India. Blast as well as leaf blight diseases are frequently noticed in Browntop millet. A study was carried to find out the seasonal occurrence and management of major diseases of the crop at Centre of Excellence in Millets, Athiyandal during 2022-23 and 2023-24. The crop was sown during Second week of July of both years and the blast symptom noticed from 10 days after sowing (DAS) and shows increasing trend upto 40 DAS and later shows decreasing trend till the maturity of the crop. However, the leaf blight noticed from 20 DAS and reached maximum level at 60 DAS in both years. Field experiments were conducted to study the effect of biocontrol agents and fungicides on incidence of blast as well as leaf blight in browntop millet. The results show significant variation

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observed between the treatments on the disease incidences in both the years. Seed treatment with *B. subtilis* @10g/kg of seed +Foliar spray of Azoxystrobin 23% SC @ 1ml/l at 20 and 40 DASrecorded the lower incidence of blast as well as leaf blight disease incidence and produced more grain yield when compared to other treatments.

Keywords: Browntop millet; blast; leaf blight; occurrence; management.

1. INTRODUCTION

Brown top millet (*Brachiaria ramosa* (L.) Stapf), which is native to the United States, was recently introduced into India as one of the small millet crops. The crop is drought hardy and heat tolerant, but can also be planted in low lying areas. The crop is cultivated especially in rainfed tracts of Karnataka and Andhra Pradesh and is part of major diet of economically weaker section. The crop is a hardy crop and well suited for dry land condition and matures approximately 60 days but still is an underutilized crop in India. Diseases such as Blast and leaf blight are major and frequently observed [1,2]. No reports on management of the diseases in browntop millet are available till now. Hence,a study was undertaken during 2022-23 and 2023-24 on the seasonal occurrence and management of these diseases.

2. MATERIALS AND METHODS

2.1 Survey on the Occurrence of Diseases of Browntop Millet

The study was undertaken to assess the level of disease incidence in browntop millet at CEM, Athiyandal under North East Region of Tamil Nadu. Browntop millet crop was raised during 2022-23 and 2023-24 without any plant protection measures in order to study the natural occurrence of the diseases of the crop variety GBUBT2. The incidence of blast as well as leaf blight was recorded from 20 days after sowing to the period of the crop maturity using standard scale and per cent disease index were calculated using formula. The leaf blast incidence was recorded using standard evaluation system [3]. The score 1: Small brown specks of pinhead size without sporulating centre, 2: Small roundish to slightly elongated, necrotic grey spots, about 1–2 mm in diameter with a distinct brown margin and lesions are mostly found on the lower leaves, 3: Lesion type is the same as in scale 2, but significant numbers of 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 infection in 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 and 9: More than 75% leaf area affected. Per cent disease index was calculated as PDI (%) = [sum (class frequency × score of rating class)]/[(total number of plants) × (maximal disease index)] × 100.

2.2 Correlation between Weather Factors and Disease Incidence of Browntop Millet

The data on disease incidence and weather factors recorded in the field were subjected to analysis of correlation to study of influence of weather factors on the disease incidence. Data on the daily weather factors *viz*., maximum temperature, minimum temperature, relative humidity, rainfall, sunshine hours and leaf wetness hours were recorded for the study.

2.3 Effect of Biocontrol Agents and Chemicals on Major Diseases of Browntop Millet

Field trials were conducted to find out the effect of biocontrol agent and fungicides on the diseases of browntop millet at Centre of Excellence in Millets, Athiyandal, Tamil Nadu during 2022-23 and 2023-24. There were nine treatments imposed in the trials. The biocontrol agent's viz., *Bacillus subtilis* and *Trichoderma viride* were included in the study. The crop was maintained by following necessary crop management practices. The incidence of blast and leaf blight recorded using scale 1-9 and per cent disease index were calculated using formula.

2.4 Statistical Analysis

The field experiment was conducted in a randomized block design with three replications. The data was analysed by analysis of variance (ANOVA) of randomized block design (RBD). Data for correlation studies from each experiment were analysed by one-way analysis of variance using IBM SPSS (v. 28.0).

3. RESULTS AND DISCUSSION

The disease incidences recorded during 2022-23 and 2023-24 are presented in Table 1. The results revealed that blast symptoms were noticed from 10 DAS and showed an increasing trend upto 40 DAS which declined thereafter. However, the leaf blight was noticed from 20 DAS and reached maximum level at 60 DAS in both years. [4] reported about *H. setariae* causing leaf spot on browntop millet but no further work on the pathogen has been done till now. The first report on leaf blight caused by *Bipolaris setariae* on browntop millet in Peninsular India as well as its the molecular characterization was byRamesh et al. [5]. The prevalence of leaf blast in Uttrakhand region has been summarized byLaxmi et al. [6]. Correlation between weather variables and disease incidence also carried out to find out influence of weathers on disease incidence and the results are presented in Table 2. The results indicated the negative influence of minimum temperature and positive influence of rainfall on the incidence of both diseases. Earlier, weather parameters *viz*., average minimum and maximum temperatures of 21^0C and 29^0C respectively and a relative humidity of 70-81% were found to favour blast disease development [7].

The results of the field experiments carried out to study the effect of biocontrol agents and fungicides on incidence of blast as well as leaf blight in browntop millet showed significant variations among the treatments on the disease incidences in both years (Tables 3 and 4). The Seed treatment with *B. subtilis* @10g/kg of seed +Foliar spray of Azoxystrobin 23% SC @ 1ml/l at 20 and 40 DASrecorded the lower incidence of blast as well as leaf blight disease incidence and produced more grain yield (1241.0 kg /ha) followed by Seed treatment with *B. subtilis* @10g/kg of seed + Foliar spray of Propiconazole 25 % EC @ 1ml/l at 20 and 40 DAS. Seed treatment with biocontrol agents also performed better compared to untreated control. Biocontrol agents such as *T. viride* and *B. velezensis* and chemicals *viz*., propiconazole and mancozeb exhibited the maximum inhibition of mycelia growth of the leaf blight pathogen under *in vitro* conditions [8]. The fungicide azoxystrobin had been reported to be more effective than propiconazole in controlling rice blast disease [9]. Chemicals such astricyclazole, azoxystrobin + difenoconazole, and azoxystrobin + tebuconazole showed the highest levels of blast reductions in rice [10]. The endophytes viz., *Curtobacterium, Microbacterium, Methylobacterium* and *Bacillus amyloliquefaciens* inoculated onto seeds proved very effective against the pathogens which attack seeds as well as seedlings in Browntop millet [11]. A combination of seed treatment with 0.6% suspension of *Pseudomonas fluorescens* followed by two foliar sprays of 0.6% *P. fluorescens* and two sprays of hinosan @ 0.1% was most significantly effective in reducing blast disease in finger millet [12].

Table 1. Occurrence of blast incidence in browntop millet at CEM, Athiyandal (North east of Tamil Nadu)

Sl.No	Days after sowing	Blast incidence (PDI)		Leaf blight incidence (PDI)	
		2022-23	2023-24	2022-23	2023-24
1	10	1.02	0.86	0.0	0.0
2	20	6.85	6.32	1.32	1.94
3	30	19.24	14.84	11.20	12.94
4	40	21.24	20.62	16.52	18.31
5	50	20.31	21.06	29.63	30.47
6	60	18.20	16.32	33.41	35.36
	CD (0.05% level)	1.02	0.86	3.52	3.96

Mean of four replications, each replication contains of PDI of 100 leaves.

Table 2. Correlation coefficient between significant weather variables and disease incidence

Correlation Coefficient value	Blast incidence (PDI)		Leaf blight incidence (PDI)	
	2022-23	2023-24	2022-23	2023-24
Min Temperature	-0.802*	-0.832**	-0.702*	-0.729*
Rainfall	0.724*	0.831**	0.802*	0.812**

*Significant level *=p<0.001, **= p<0.01*

Table 3. Effect of biocontrol agents and fungicides on blast and leaf blight of browntop millet during 2022-23

Sl.No	Treatments	Blastincidence (PDI)			Leaf blight (PDI)			Yield (kg/ha)	B:C ratio
		15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS		
1	T1: Seed treatment with *Bacillus subtilis* @10g/kg of seed	1.62	10.21	14.32	0.85	8.25	17.32	1125.0	1.74
2	T2: Seed treatment with *Trichoderma viride* @ 4g/ kg of seed	2.05	15.32	17.64	0.61	11.62	24.32	1025.3	1.59
3	T3: T1+ foliar spray of *B. subtilis* at 1g/lit at 20 and 40 DAS	1.57	6.20	10.02	0.49	6.02	14.32	1195.2	1.83
4	T4: T1+ Foliar spray of Azoxystrobin 23% SC @ 1ml/l at 20 and 40 DAS	1.81	2.68	4.12	0.73	3.68	7.24	1205.0	1.84
5	T5: T1+ Foliar spray of Propiconazole 25 % EC @ 1ml/l at 20 and 40 DAS	1.62	2.02	3.08	0.68	3.20	6.25	1241.0	1.90
6	T6: T2 + Foliar spray of Propiconazole 25 % EC @ 1ml/l at 20 and 40 DAS	1.65	3.06	4.63	0.59	4.12	8.62	1185.6	1.81
7	T7: T2 + Foliar spray of Azoxystrobin 23% SC @ 1ml/l at 20 and 40 DAS	1.94	2.84	4.31	0.81	5.02	11.32	1174.5	1.79
8	T8: Foliar spray of Mancozeb 75 % WP @ 2.5g/L at 20 and 40 DAS	3.25	4.25	6.12	0.64	5.21	12.61	1162.3	1.80
9	T9: Control	3.61	18.32	22.15	0.81	12.52	28.96	985.0	1.55
	CD (0.05% level)	0.15	0.85	0.91	0.024	0.87	1.05	32.5	

Mean of three replications.

Table 4. Effect of biocontrol agents and fungicides on blast and leaf blight of browntop millet during 2023-24

Sl.No	Treatments	Blast incidence (PDI)			Leaf blight (PDI)			Yield (kg/ha)	B:C ratio
		15 DAS	30 DAS	45 DAS	15 DAS	30 DAS	45 DAS		
1	T1: Seed treatment with *Bacillus subtilis* @10g/kg of seed	1.21	11.32	15.24	0.34	10.42	19.32	1025.62	1.59
2	T2: Seed treatment with *Trichoderma viride* @ 4g/ kg of seed	2.08	13.62	18.30	0.42	13.60	25.16	984.5	1.53
3	T3: T1+ foliar spray of *B. subtilis* at 1g/lit at 20 and 40 DAS	1.41	5.05	11.26	0.61	8.24	15.27	1145.3	1.75
4	T4: T1+ Foliar spray of Azoxystrobin 23% SC @ 1ml/l at 20 and 40 DAS	1.25	1.93	4.01	0.48	4.62	7.02	1189.6	1.82
5	T5: T1+ Foliar spray of Propiconazole 25 % EC @ 1ml/l at 20 and 40 DAS	1.30	2.04	4.63	0.52	5.17	8.32	1175.0	1.80
6	T6: T2 + Foliar spray of Propiconazole 25 % EC @ 1ml/l at 20 and 40 DAS	1.62	2.68	5.27	0.61	6.31	8.67	1085.3	1.66
7	T7: T2 + Foliar spray of Azoxystrobin 23% SC @ 1ml/l at 20 and 40 DAS	2.01	3.06	5.30	0.47	7.02	8.49	1052.5	1.61
8	T8: Foliar spray of Mancozeb 75 % WP @ 2.5g/L at 20 and 40 DAS	2.60	4.92	7.02	0.53	8.32	13.08	1046.3	1.62
9	T9: Control	4.02	14.62	22.67	0.71	15.23	27.62	915.0	1.44
	CD (0.05% level)	0.19	0.74	0.86	0.018	1.08	1.04	36.4	

Mean of three replications.

4. CONCLUSION

Both blast and leaf blast symptoms were observed in browntop millet. Blast occurred from 10 DAS showing an increasing trend upto 40 DAS which declined thereafter. However, the leaf blight was noticed from 20 DAS reaching the maximum level at 60 DAS. A combination of seed treatment with *B. subtilis* @10g/kg of seed +foliar spray of Azoxystrobin 23% SC @ 1ml/l at 20 and 40 DAS was effective in managing the two major diseases in browntop millet under field conditions.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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