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BIOLOGICAL SEED TREATMENT FOR MANAGEMENT OF ZONATE LEAF SPOT OF SORGHUM

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ABSTRACT
Zonate spot caused by *Gloeocercospora sorghi* is one of the most important and destructive diseases of sorghum. Biological seed treatment is a new technique that integrates biological (treatment of seed with biocontrol agents to protect seed) and physical aspects (seed hydration) of disease control. It may provide an alternative to chemical control. The present investigation was carried out to test the efficacy of bio-control agents namely Pant bioagent-1 (*T. harizanum*), Pant bioagent-2 (*Pseudomonas fluorescence*), Pant bioagent-3 (*T. harizanum + Pseudomonas fluorescence*), *Trichoderma viridae* for their antagonistic potential against *G. sorghi* under field conditions. In the year 2016, maximum reduction in Per cent disease index at 75DAS was observed in T3 (*T.hazianum + P.fluorescence* 51.80%) and maximum increase in plant height (285.20cm) was followed by T4 (*T. viridae* 51.87%) at 75 DAS and height (283.10cm) was recorded. While in the year 2015, maximum reduction in Per cent disease index at 75 DAS was in found in T3 (*T.hazianum + P.fluorescence* (54.25%) and maximum increase in the plant height (280.33cm) followed by T4, (*T. viridae*) maximum reduction in Per cent disease index (54.32%) and increased plant height (276.13cm) was recorded under field conditions. Therefore biological seed treatment used to improve the rate and uniform emergence of seed and reduce the severity of disease.

INTRODUCTION

Sorghum [*Sorghum bicolor* (L.) Moench] is an indigenous crop to Africa, and though commercial needs and uses may change over time, sorghum will remain a basic staple food for many rural communities. It is known as king of millets and is one of the important food and fodder crops in drier parts of India, tropical Africa and China (Rooney and Waniska, 2000). Being cultivated in a variety of environments, sorghum is constantly challenged by rays of plant pathogens, especially the foliar pathogens. Numerous diseases have been reported in sorghum such as charcoal rot, stalk rot, rough leaf spot, downy mildew, red rust and anthracnose (Tarr, 1962). The foliar diseases of fungal origin prevalent in India are rust, downy mildew, anthracnose, zonate leaf spot, leaf blight, grey leaf spot, sooty stripe and tar spot (Sharma *et al*., 1978). Losses in sorghum due to foliar diseases ranged from 32 to 60 per cent (Frederiksen, 2000). The overall estimated losses due to foliar diseases except sorghum downy mildew were around 30 per cent (Anahosur, 1986). Among them, zonate leaf spot (*Gloeocercospora sorghi*) is one of the emerging and destructive foliar pathogen which causes several damages which accounts up to 85 per cent of photosynthetic area under humid and cloudy weather conditions (Agnihotri and Pandey, 1977). The characteristic symptoms of the disease appear as roughly irregular, semi-circular with altering bands of dark purple or red color and tan or straw color, to give a concentric or zonate appearance (Palakshappa and Hiremath, 2003). Biological seed treatment for managing plant disease has been considered as a novel approach, as it requires low amounts of chemical, reducing the cost of control and environmental hazardous while causing minimum interference with biological equilibrium (Papavizas, 1973). Seed treatment with biocontrol agents may acts as an important tools of preventing many soil and seed borne diseases, the process often known as biological seed treatment'. Considering the seriousness of problem, the present investigation was carried out to test the efficacy of biocontrol agents (BCAs) viz., *T. harzianum, T. viridae* and *P. fluorescens* against zonate leaf spot of sorghum as an alternative ecofriendly strategy. *Trichoderma* spp. and *Pseudomonas* spp. have been reported to secrete diverse antimicrobial secondary metabolites, which help it in host recognition and pathogen control (Jeyalakshmi *et al*., 2010; Srivastava *et al*., 2010; Shanmugaiah *et al*., 2009; Koche *et al*., 2013; Singh *et al*., 2013). Biological seed treatment often results in more rapid and uniform seedling emergence and may be useful under adverse soil conditions (Mathre *et al*., 1994). Accordingly, the following study was undertaken to see the efficacy of biological seed treatment options for management of zonate leaf spot of sorghum.

MATERIALS AND METHODS

A field experiments were conducted during Kharif season of 2015 and 2016 at Livestock Research Centre, Pantnagar, Uttarakhand, India to see the efficacy of seed treatment with bioagents [0.8%] namely Pant bioagent-1 (*T. harizanum*), Pant bioagent-2(*Pseudomonas fluorescence*), Pant bioagent-3 (*T. harizanum + Pseudomonas fluorescence*), *T. viridae* and carbendazim [0.3%] for the management of zonate leaf spot

Table 1.1: Field evaluation of biological seed treatment for management of zonate leaf spot of sorghum in the year 2015

Tr.No.	Treatment	30DAS	45DAS	60DAS	75DAS	Plant height(cm)
1	*T. hazianum*	13.74	34.65	50.57	54.39	272.20
2	*P. fluorescence*	13.82	34.72	50.97	54.46	265.06
3	*T.hazianum* + *P.fluorescence*	13.60	34.50	48.10	54.25	280.33
4	*T. viridae*	13.67	34.58	48.17	54.32	276.13
5	Carbendazim	13.91	34.79	51.68	54.51	258.90
6	Control	14.00	35.79	60.96	74.91	260.00
	S.Em ±	0.12	0.25	0 .16	0.15	
	CD@5%	0.38	0.78	0.50	0.47	
	CV	0.61	0 .83	0.48	0.18	

Table. 1.2: Field evaluation of biological seed treatment for management of zonate leaf spot of sorghum in the year 2016

Tr. No.	Treatment	30DAS%	45DAS%	60DAS%	75DAS%	Plant height (cm)$_1$
T. hazianum	9.52	30.49	45.72	51.93	280.00	
2	*P. fluorescence*	9.59	30.89	45.79	54.65	278.93
3	*T.hazianum* + *P.fluorescence*	9.40	29.70	45.60	51.80	285.20
4	*T. viridae*	9.46	29.77	45.66	51.87	283.10
5	Carbendazim	9.64	32.61	45.84	61.37	277.75
6	Control	9.88	35.95	64.15	75.92	273.80
	S.Em ±	0.29	0.11	0.48	0.40	
	CD@5%	0.91	0.35	1.52	0.12	
	CV	1.60	0.40	1.44	0.72	

in sorghum.

In biological seed treatment one hundred grams of sorghum seeds (cultivar Pant chari-4) were treated with bio-agents using priming agents like gur or jaggery. After pre-soaking of seeds in sterile distilled water, seeds were coated with powder formulation of bioagents and carbendazim were mixed thoroughly to provide uniform coating. The seeds were dried in shade and stored at 25 ± 2^0 C for 24 h in a self-sealing plastic bag before being tested under field conditions. The experiment was laid out in a randomized block design with 3 replications. The treatments were randomly allotted to the plots. A plot size of 3.0 × 1.8 m ^{2} was maintained and intra-row spacing of 45 cm. Observations on disease incidence at 30, 45, 60 and 75 days after sowing were recorded by scoring five plants in each treatment on a 1-9 scale as proposed by All India Coordinated Sorghum Improvement Project, as follows: (1) Highly resistant (No symptom); (2) Resistant (up to 5% leaf area covered with zonate); (3) Resistant (6-10% leaf area covered with zonate); (4) Moderately Resistant (11-20% leaf area covered with zonate); (5) Moderately Resistant (21-30% leaf area covered with zonate); (6) Susceptible (31-40% leaf area covered with zonate); (7) Susceptible (41-50% leaf area covered with zonate); (8) Highly Susceptible (51-75% leaf area covered with zonate); (9) Highly Susceptible (above75% leaf area covered with zonate) and per cent disease index (PDI) was calculated using a formula given by McKinney (1923);

$$PDI(\%) = \frac{\text{Sum of all the disease ratings}}{\text{No.of leaves observed} \times \text{Maximum disease grade}} \times 100$$

The plant height (cm) was also recorded for each treatment.

RESULTS AND DISCUSSION

Results of this study (Table 1.2) indicated that in the year 2016, maximum reduction in Per cent disease index at 75DAS was observed in T3 (*T.hazianum* + *P.fluorescence* 51.80%) and maximum increase in plant height (285.20cm) was followed by T4 (*T. viridae* 51.87%) at 75 DAS and height (283.10cm) was recorded. While, (Table 1.1) indicated that in the year 2015, maximum reduction in Percent disease indesx at 75 DAS was in found in T3 (*T.hazianum* + *P.fluorescence* 54.25%) and maximum increase in the plant height (280.33cm) followed by T4, (*T. viridae*) maximum reduction in disease severity (54.32%) and increased plant height (276.13cm) was recorded under field conditions. The observed improvements due to biological seed treatment of sorghum seeds may be due to priming-induced quantitative changes in biochemical content of the seeds and improved membrane integrity. This may be also due to secretion of diverse antimicrobial secondary metabolites, which help it in host recognition and pathogen control.The results are in accordance with the different authors [Callan *et al*., 1990; Mathre *et al*., 1999; Kharayat and Singh 2012; Purohit *et al*., 2013]

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