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Eco Friendly Management of Sorghum Turcicum Leaf Blight in Field Conditions

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ABSTRACT

A field experiment was conducted at Agricultural college farm, Bapatla during *rabi*, 2018-19 to study the efficacy of botanicals, cow based natural products and bioagents on leaf blight pathogen of sorghum. T5 -*Trichoderma* (ST+ FS) + Panchagavya @15% (ST+FS) treatment was found most effective in controlling the disease even two weeks after second spray with the lowest PDI (18.89%) however, was found to be on par with all the other treatments except with T1 -*Trichoderma* (ST+ FS) and unsprayed check. Maximum inhibition of 47.78% over control was observed in *Trichoderma* (ST+ FS) + Panchagavya @15% (ST+FS) with yield of 2388 kg ha^{-1} with an increased yield (68.46%) and benefit cost ratio of 1.40.

Key words: *E. turcicum, Panchagavya, Sorghum, Trichoderma.*

Sorghum [*Sorghum bicolour* (L.) Moench], a C4 grass belonging to the family Poaceae, is one of the most important staple food crops of the poor particularly for those in the semi-arid tropics. It is the fifth most important cereal grown globally after wheat, rice, maize and barley (Dogget, 1988). Due to erratic changes in the present climatic conditions, sorghum cultivation became an alternative to cope with the contingent situation. Farmers are shifting from rice-pulse to rice-sorghum system in *rabi.*

Both abiotic and biotic factors have been reported to affect sorghum production (Ogeto *et al*., 2013). Among the biotic factors, fungal diseases are important for reduced productivity of sorghum. The important diseases include leaf blight (*Exserohilum turcicum*), anthracnose (*Colletotrichum graminicola*), rust (*Puccinia purpurea*), downy mildew (*Peronosclerospora sorghi*) and stalk rots (*Macrophomina phaseolina*). Of them, turcicum leaf blight is becoming endemic and appearing in severe form mostly in the areas where sorghum is cultivated.

In view of the lack of resistant cultivar, sorghum leaf blight can become a potentially destructive disease and fungicide sprays are inevitable for its management. However due to their expensiveness, residual problems and evolving resistance in pathogen cost effective management strategies that are in harmony with ecology should be envisaged. Therefore, plant extracts, cow based natural products and bioagents against phytopathogens were tested as an alternative for fungicide management.

MATERIAL AND METHODS

The experiment was conducted during *rabi* 2018-19 at the Agricultural College Farm, Bapatla, Guntur, Andhra Pradesh, under field conditions in randomized block design to determine the efficacy of botanicals, cow based natural products and bioagents on leaf blight pathogen of sorghum. The variety M 35-1 was sown with common spacing of 45x15cm and experiment was replicated for thrice.

Preparation of leaf extracts

Fresh henna leaves were washed well with tap water and dried. The plant tissue was ground with tap water at the rate of 1 ml/g of plant tissue using mixer grinder, and the macerate was filtered through a muslin cloth to get the crude extract (Kumari *et al.,* 2017). The henna leaf extract @ 15 per cent was tested in field against the *E. turcicum.*

Mass multiplication of *Trichoderma* sp.

Trichoderma sp. was mass multiplied on sorghum grains for 12 days and the spores on the grains were harvested by stirring the seeded grains with sterile distilled water. The spore concentration of biocontrol agent was adjusted to 10^9 using a haemocytometer (Whitehead, 1957).

Two prophylactic sprays were given at 15 day interval with the first spray initiated at 35 DAS. Disease severity of Turcicum leaf blight was assessed on the day before spraying, 7, 14 days after each spraying by following the scale given by Thakur *et al*. (2007) in Table 1. and the PDI was calculated.

$$PDI = \frac{\text{Sum of all the numerical ratings}}{\text{Number of observations} \times \text{maximum disease grade}} \times 100$$

The following treatments were imposed under field conditions.

Treatments	Seed treatment	Foliar spray
T_1	*Trichoderma* sp.	*Trichoderma* sp.
T_2	-	*Henna* leaf extract @15%
T_3	Panchagavya @ 15%	Panchagavya @ 15%
T_4	*Trichoderma* sp.	*Trichoderma* sp. + *Henna* leaf extract @15%
T_5	Trichoderma sp. + Panchagavya @ 15%	*Trichoderma* sp. + Panchagavya @ 15%
T_6	Panchagavya @ 15%	*Henna* leaf extract @15% + Panchagavya @ 15%
T_7	Trichoderma sp. + Panchagavya @ 15%	*Trichoderma* sp. + *Henna* leaf extract @15% + Panchagavya @ 15%)
T_8	----------Untreated check----------	
T_9	-	Mancozeb @ 0.25% (Fungicide check)

Table 1. Disease severity scale for turcicum leaf blight in sorghum

Severity rating	Symptom and lesion types (on top four leaves)
1	0 to <1% leaf area with mild yellow flecks
2	1-5% leaf area covered with hypersensitive small lesions
3	6-10% leaf area covered with hypersensitive small lesions
4	11-20% leaf area covered with small necrotic lesions
5	21-30% area covered with small necrotic coalescing lesions
6	31-40% area covered with large coalescing necrotic lesions
7	41-50% leaf area covered with large coalescing necrotic lesions
8	51-75% leaf area covered with large coalescing necrotic lesions
9	76-100% leaf area covered with large coalescing necrotic lesions

RESULTS AND DISCUSSION

Prior to spray schedule (34 DAS), non significant differences between treatments were observed indicating presence of inoculum uniformly in the experimental field. One week after first spray all the treatments performed well over the control (19.88%) except in two treatments T1 where, *Trichoderma* (ST+FS) (17.53%) and T2 where, Henna @ 15% FS (17.65%) were used. The PDI among the effective treatments varied between 13.95% and 16.05%. Among all the treatments a combination of T5- *Trichoderma* (ST+FS) + Panchagavya @15% (ST+FS) (T5) was recorded with the lowest PDI (13.95%).

After two weeks of first spray the lowest PDI was recorded in treatment 5 where, *Trichoderma* (ST+FS) + Panchagavya @15% (ST+FS) (15.80%) was applied and was on a par with other treatments except with T_1 and T_2. However, all treatments showed significant difference over the control (PDI 25.31%) in reducing the disease severity.

When PDI was checked, a week after second spray all the treatments were significantly better over the untreated check (31.23%) in controlling the disease. There was no significant differences among the treatments T_5 - *Trichoderma* (ST+ FS) + Panchagavya @15% (ST+FS) (PDI-17.16%), T7 - (T_1 + T_2 + T_3) (PDI- 17.78%), T6 - (T_2 + T_3) (PDI- 18.52%), T3 - Panchagavya @15% (PDI- 18.89%), T9- FS of mancozeb 75% WP @ 0.25% (PDI- 19.38%) and T_4 (T_1 + T_2) (PDI- 20.37%) (Table 2).

T5-*Trichoderma* (ST+ FS) + Panchagavya @15% (ST+FS) treatment was found most effective in controlling the disease even two weeks after second spray with the lowest PDI (18.89%) however, was found to be on par with all the other treatments except with T1 -*Trichoderma* (ST+ FS) and unsprayed check. Maximum inhibition of 47.78% over control was observed in *Trichoderma* (ST+ FS) + Panchagavya @15% (ST+FS) and minimum inhibition over control was recorded in *Trichoderma* (ST+ FS) 30.38% after 64 DAS.

Table 2. *In vivo* evaluation of leaf extract, cow based natural product, biocontrol agent and their combinations against *E. turcicum*

Tr. No.	Treatments	PDI (%)					% Inhibition over control		Area Under Disease Progress Curve
		Day before first spray (34 DAS)	7 days after first spray (42 DAS)	14 days after first spray (49 DAS)	7 days after second spray (57 DAS)	14 days after second spray (64 DAS)	After 1st spray (49 DAS)	After 2nd spray (64 DAS)	
T1	*Trichoderma* (ST+ FS)	14.2 *(22.12)	17.53 (24.70)^{bcd}	20.49 (26.87)^{c}	23.21 (28.76)^{c}	25.19 (30.09)^{b}	19.02	30.38	604.2
T2	Henna @ 15% FS	15.19 (22.91)	17.65 (24.82)^{cd}	19.63 (26.26)^{bc}	21.85 (27.82)^{bc}	22.1 (28.02)^{ab}	22.44	38.91	581.6
T3	Panchagavya @15% (ST+FS)	14.44 (22.27)	14.94 (22.72)^{abc}	17.04 (24.36)^{ab}	18.89 (25.73)^{ab}	21.23 (27.41)^{a}	32.68	41.3	513.58
T4	$T_1 + T_2$	14.32 (22.22)	16.05 (23.60)^{abc}	18.52 (25.46)^{abc}	20.37 (26.81)^{abc}	22.22 (28.11)^{ab}	26.83	38.57	547.1
T5	$T_1 + T_3$	14.07 (22.01)	13.95 (21.92)^{a}	15.8 (23.41)^{a}	17.16 (24.45)^{a}	18.89 (25.74)^{a}	37.56	47.78	474.26
T6	$T_2 + T_3$	13.33 (21.40)	14.81 (22.61)^{ab}	16.67 (24.08)^{ab}	18.52 (25.46)^{ab}	20.49 (26.89)^{a}	34.15	43.35	500.06
T7	$T_1 + T_2 + T_3$	13.58 (21.60)	14.2 (22.12)^{a}	16.17 (23.70)^{a}	17.78 (24.92)^{a}	19.63 (26.27)^{a}	36.1	45.73	484.14
T8	Unsprayed check	15.19 (22.92)	19.88 (26.44)^{d}	25.31 (30.17)^{d}	31.23 (33.95)^{d}	36.17 (36.95)^{c}	0	0	760.49
T9	Fungicide check (FS of mancozeb 75% WP @ 0.25%)	15.06 (22.81)	16.42. (23.85)^{abc}	18.15 (25.17)^{abc}	19.38 (26.08)^{ab}	20.99 (27.21)^{a}	28.29	41.98	538.35
	SEm ±	0.69	0.7	0.78	0.83	0.87			
	CD ($P \leq 0.05$)	NS	2.11	2.33	2.5	2.62			
	CV (%)	5.38	5.15	5.28	5.33	5.3			

*Figures in parenthesis are arc sine transformed values

Table 3. *In vivo* evaluation of different treatments for their impact on yield

Tr. No.	Treatments	No. of grains per panicle	Per cent increase over control (%)	Test weight (g)	Per cent increase over control (%)	Yield (kg/8.64 m2)	Yield (kg ha^{-1})	Per cent increase over control (%)	Benefit: Cost ratio
T1	*Trichoderma (*ST+ FS)	411.06^{cd}	8.92	2.91^{de}	7.63	1.43^{de}	1658.67^{de}	17.01	0.98
T2	Henna @ 15% FS	425.27^{bcd}	12.68	3.11^{cd}	14.99	1.59^{cd}	1839.48^{cd}	29.76	1.21
T3	Panchagavya @15% (ST+FS)	484.93^{ab}	28.49	3.27^{abc}	20.93	1.90^{ab}	2201.34^{ab}	55.29	1.23
T4	$T_1 + T_2$	464.27^{abc}	23.02	3.21^{bc}	18.77	1.80^{bc}	2077.77^{bc}	46.57	1.48
T5	$T_1 + T_3$	502.40^{a}	33.12	3.44^{a}	27.16	2.06^{a}	2388.00^{a}	68.46	1.4
T6	$T_2 + T_3$	488.07^{ab}	29.32	3.33^{abc}	22.9	1.95^{ab}	2251.23^{ab}	58.81	1.28
T7	$T_1 + T_2 + T_3$	490.67^{ab}	30.01	3.38^{ab}	24.78	1.99^{ab}	2301.12^{ab}	62.33	1.32
T8	Unsprayed check	377.40^{d}	-	2.71^{e}	-	1.22^{e}	1417.57^{e}	-	0.7
T9	Fungicide check (FS of mancozeb 75% WP @ 0.25%)	486.26^{ab}	28.85	3.30^{abc}	21.79	1.92^{ab}	2227.65^{ab}	57.15	1.56
SEm±		23.07		0.07		0.08	94.5		
CD ($P \leq 0.05$)		69.16		0.21		0.12	283.31		
CV (%)		8.71		3.9		8.02	8.02		

Area under disease progress curve was assessed and it was found comparatively minimum in the treatment T_5 - *Trichoderma* (ST+ FS) + Panchagavya @15% (ST+FS) (474.26) as against 760.49 in unsprayed check indicating the most effectiveness for the treatment. Among different treatments the amount of diseased area was maximum in T1 -*Trichoderma* (ST+ FS) (604.20) which indicated slow activity of the biocontrol agent.

The benefit cost ratio (BCR) of the different treatments varied from 0.70 to 1.56 with the highest BC ratio being recorded with fungicidal spray of 0.25% mancozeb (1.56). However, among non chemical treatments best BC ratio was obtained in T4 (T1+T2) with 1.48 followed by T5 (T1+T3) with a BC ratio of 1.40 treatments which represented a potential alternatives to fungicide treatments (Table 3).

Biles and Hill (1988) reported the significant reduction in the sporulation of *Bipolaris sorokiniana* when sprayed with *Trichoderma harzianum* conidial suspension. Tharmaraj *et al*. (2011) reported that the effective microorganisms, macro and micro nutrients existing in panchagavya could bring about phenotypic changes in plants resulting in enhanced growth and productivity. Devakumar *et al.* (2014) emphasized the potential role of panchagavya in supporting the growth of *Trichoderma* moderately. *T. harzianum* isolate was reported effective against *E. turcicum* both *in vitro* and *in vivo* with 77.11% and 35.59% inhibition respectively by Singh and Singh (2014).

The results obtained were in agreement with the pervious results on Panchagavya and *Trichoderma* which were reported to have potential in reducing the disease severity. Panchagavya (15%) used in the present study for disease control might have impact on the growth of *Trichoderma* providing the additional benefits of pathogen suppression and PGPR activity which finally reflected in enhanced yield as in the case with T5 (*Trichoderma* (ST + FS) + Panchagavya (ST + FS).

CONCLUSION

Turcicum leaf blight in sorghum can be managed non chemically by treating sorghum seeds with Trichoderma Sp. @ 10^9 CFU and Panchagavya @ 15% followed by two foliar sprays at 15 days interwal with Trichoderma sp. and Panchagavya @ 15% with intial spray at 35 DAS. Which was found in a par with chemical spray.

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