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Epidemiological Studies on Leaf Blight of Sweet Sorghum caused by *Exserohilum turcicum* (Pass.) Leonard and Suggs

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A B S T R A C T

Sweet sorghum is an important fodder crop, besides which can be used for the multiple purposes like grain, jaggery making and ethanol production. Leaf blight caused by the *Exserohilum turcicum* is an important disease affecting the sorghum. Studies on epidemiology of the disease were conducted at Main Agricultural Research station, UAS, Dharwad during *kharif* 2017. Study indicated that, significantly positive correlation was observed with morning and evening relative humidity, rainfall and number of rainy days without any association with maximum and minimum temperature at 0.01 level. Whereas, host range studies indicate that, grain sorghum, bajra, foxtail millet and Johnson grass expressed the symptoms under artificial inoculations with *E. turcicum*. However, grain sorghum and Johnson grass showed the symptoms under natural conditions also.

Introduction

Sorghum [*Sorghum bicolour* (L.) Moench] is a self-pollinated crop belongs to the family poaceae, subfamily panicoidae and tribe andropogoneae. It is one of the main staples for the world's poorest and most food-insecure people. Among the different types of sorghum like grain and grass sorghum, sweet sorghum [*Sorghum bicolour* (L.) Moench] is the one which can be used for multi-purpose. It produces food (grain from its ear head), sugary juice and leaves make excellent fodder for animals. Among the foliar diseases affecting the sorghum, anthracnose, leaf blight and grey leaf spot are rampant over in all the humid regions when high rainfall occurs while rust and the sorghum downy mildew are next in importance.

Leaf blight caused by *E. turcicum* is commonly or generally found on sorghum grown in the sub-tropics and tropical lowlands during summer (Frederiksen, 1982). Occurrence of this pathogen was less consistent in the cooler temperate and tropical

environments. The pathogen is easily wind disseminated and apparently most consistent in their occurrence and severity across the diverse sorghum growing environments. In India, the disease was first reported by Butler (1918) on the leaves of cultivated sorghum and later by Mitra (1923) from Punjab. The symptoms of leaf blight may vary according to geographical area, host cultivar and pathogen. Yield losses attributed due to this disease will usually vary with sorghum growing region and with environment (Frederiksen, 1982). The sweet sorghum variety SSV 74 was released by University of Agricultural Sciences, Dharwad for *kharif* season mainly for fodder purpose. This variety is also good for ethanol production and jaggery making. However for the last several years this variety was showing it's susceptibility to the leaf blight caused by *E. turcicum* and causes heavy losses both in fodder and its quality. Even though there are reports of the presence of leaf blight caused by *E. turcicum* on the grain sorghum, no precise information is available on presence of the leaf blight on sweet sorghum and how the epidemiology is influencing disease development in India as well as the world. Keeping this in view, epidemiological study was undertaken to find out how the different weather parameters are influencing the disease and also to find out the host range for the disease.

Materials and Methods

Correlation of disease with weather parameters

Experiment was conducted during *kharif* 2017 at Main Agricultural Research Station, Dharwad under field condition to study correlation of the disease with weather parameters. The highly susceptible sweet sorghum variety SSV 74 was sown in a plot size of 10 m x 10 m. All the agronomic practices were followed to raise the crop. Observations on leaf blight severity was taken at weekly interval starting from the onset of disease till harvesting of the crop following 0-9 scale of Mayee and Datar (1986) and further per cent disease index (PDI) was calculated using the formula of Wheeler (1969)and it was used to correlated with weather parameters. Weather parameters were collected from farm section of Main Agricultural Research Station, UAS, Dharwad.

Host range studies of *E. turcicum*

The weeds and grasses found in fields in and around the Main Agricultural Research Station, UAS, Dharwad and few cultivated crops were included in this study. The weeds and grasses were identified according to Hosmani (1995), Krishnashastry *et al.,* (1984) and Narashimachar (1976).

Above listed hosts (except sugarcane) were raised in 15 cm diameter pots by using seed or propagating materials. The pots were filled with sterilized soil-sand-FYM mix (2:1:1 by volume) and placed in a greenhouse at 30±1^{o}C. One month old seedlings were sprayed with spore suspension of *E. turcicum* and covered with polythene bag for 24 hrs. Further the inoculated plants were sprayed with water during evening hours to achieve favourable conditions for disease development. Regular monitoring was done to record the observations on symptoms.

Results and Discussion

Correlation of disease with weather parameters

Influence of weather parameters on development of the disease

The effect of weather parameters on the severity of leaf blight development was assessed using the susceptible variety SSV 74

during *kharif* 2017 at Main Agricultural Research Station, UAS, Dharwad. The intensity of disease was recorded at weekly interval as described in "Material and Methods" and the data were analysed by simple correlation analysis and presented in Table 1a, 1b and 1c.

The data reveals that, the first appearance of leaf blight disease was observed between 23rd July to 29th July with the PDI of 6.91 per cent (30th meteorological standard week).

The PDI was increased from 6.91 to 67.41 per cent as the age of the crop increases. There was sudden increase in PDI from 22.10 to 36.42 per cent between 34th and 35th standard meteorological week because of increase in rainfall, morning and evening relative humidity. It is evident that highest PDI was observed when there is a good rainfall and high relative humidity (morning relative humidity between 95-96 %, evening relative humidity between 80- 88 %). Temperature has not much influenced the disease development since it was almost uniform throughout the cropping season (Table 1a).

Correlation between per cent disease index of leaf blight in relation to weather parameters

Analysis was made to establish relationship between weather parameters *viz.*, maximum and minimum temperature, morning and evening relative humidity, rainfall and number of rainy days with per cent disease index in susceptible cultivar SSV 74 through correlation.

The relationship between leaf blight severity and weather factors during *kharif* 2017 (Table 1b and 1c) indicated that, negative correlation was observed between minimum temperature (-0.319) and maximum temperature (-0.074) whereas, positive correlation was noticed with morning and evening relative humidity, rainfall and number of rainy days. Significantly positive correlation was observed with rainfall (0.709) at 0.05 level. At 0.01 level significantly positive correlation was observed with number of rainy days (0.838), morning (0.778) and evening (0.888) relative humidity. These results are in accordance with Nwanosike *et al.,* (2015) from Tanzania reported that, severity of turcicum leaf blight of maize was significantly positively correlated with the relative humidity, whereas negative correlation was observed with the minimum temperature.

Host range studies of *E. turcicum*

The possibility of existence of alternative hosts was studied. Twenty two host plants as mentioned in the "Material and Methods" under both artificially inoculated with *E. turcicum* and also natural conditions were examined for their reaction to the pathogen.

The results regarding reaction on different test hosts by the pathogen are presented in Table 2 and it was confirmed that out of 22 hosts, four hosts, *viz.*, grain sorghum (*Sorghum bicolour*), johnson grass(*Sorghum halepense*), bajra (*Pennisetum glaucum)*, foxtail millet (*Setaria italic*) were found to be infected by *E. turcicum* under challenge inoculations. However, under natural conditions, only two hosts, *viz.*, *Sorghum halepense* and *Sorghum bicolor* showed infection. The pathogen could perpetuate during off-season on these alternative hosts and serve as source of secondary infection.

These findings were in accordance with Ullstrup (1966) and Mazzani *et al.,* (1997) who reported that maize leaf blight pathogen *E. turcicum* also attacked sorghum, sudan grass, johnson grass and teosinte.

Table.1a Influence of weather parameters on the development of leaf blight

Standard week No.	Month and date	Age of the crop	Per cent disease index	Temperature (ºC)		Relative humidity (%)		Rainfall (mm)	No. of rainy days
				Maximum	Minimum	Morning	Evening		
30	Jul 23-Jul 29	21	6.91	28.1	21.2	92	66	4.60	0
31	Jul 30-Aug 5	28	11.36	28.9	20.9	91	72	7.00	1
32	Aug 6-Aug 12	35	14.32	29.1	20.6	91	65	1.00	0
33	Aug 13-Aug 19	42	16.17	28.6	20.5	92	71	8.00	1
34	Aug 20-Aug 26	47	22.10	28.1	20.9	96	81	8.60	2
35	Aug 27-Sep 2	54	36.42	28.3	20.8	96	80	9.20	1
36	Sep 3-Sep 9	61	42.32	29.7	21.4	95	82	73.00	3
37	Sep 10-Sep 16	67	55.59	29.7	21.4	96	81	40.20	2
38	Sep 17-Sep 23	74	59.17	27.0	19.8	95	85	12.60	3
39	Sep 24-Sep 30	81	67.41	28.4	20.2	96	88	82.20	6

Table.1b Correlation between per cent disease index of leaf blight in relation to weather parameters

Parameters	Y	X1	X2	X3	X4	X5	X6
Y–PDI	1	- 0.074	- 0.319	0.709*	0.838**	0.778**	0.888**
X_1- Maximum temperature (°C)	- 0.074	1	0.722*	0.381	- 0.100	- 0.105	- 0.171
X_2- Minimum temperature (°C)	- 0.319	0.722*	1	0.102	- 0.365	- 0.010	- 0.256
X_3–Rainfall	0.709*	0.381	0.102	1	0.835**	0.531	0.659
X_4- Rainy days	0.838**	- 0.100	-0.365	0.835**	1	0.645*	0.860**
X_5- Relative humidity (Morning)	0.778**	- 0.105	- 0.010	0.531	0.645*	1	0.891**
X_6- Relative humidity (Evening)	0.888**	- 0.171	- 0.256	0.659*	0.860**	0.891**	1

*Correlation significant at the 0.05 level
** Correlation significant at the 0.01 level

Table.1c Correlation coefficient (r) for leaf blight severity with weather variables

Parameters	Correlation coefficient
Maximum temperature (ºC)	- 0.074
Minimum temperature (ºC)	- 0.319
Rainfall (mm)	0.709
Rainy days (days)	0.838
Relative humidity (morning) (%)	0.778
Relative humidity (evening) (%)	0.888

Table.2 Reactions of different weed hosts and cultivated field crops under natural and artificial inoculations of *E. turcicum*

Sl. No.	Weed/cultivated field crops	Scientific name	Appearance of symptoms	
			Natural condition	Artificially Inoculated condition
1	Gini grass (Cv. Samruddhi)	*Panicum maximum* Jacq.	-	-
2	Rhodes grass	*Chloris gayan* Kunth	-	-
3	Anjan grass (Cv. Bundel Anjan 1)	*Cenchrus ciliaris* L.	-	-
4	Deenanath grass (Cv. Bundel 2)	*Pennisetum pedicellatum* Trinn	-	-
5	Fodder maize (Cv. South African tall)	*Zea mays* L.	-	-
6	Bajra (Cv. ICTP -8203)	*Pennisetum glaucum* (*L.*)R. Br.	-	+
7	Sugarcane (Cv. COM 265)	*Saccharum officinarum* L.	-	-
8	Grain sorghum (Cv. M-35-1)	*Sorghum bicolor* (L.) Moench	+	+
9	Wheat (Cv. Amruth)	*Triticum* sp.L.	-	-
10	Grain maize(Cv. CM 202)	*Zea mays* L.	-	-
11	Ragi (Cv. GPU-28)	*Eleusine coracana* Gaertn.	-	-
12	Navane(Cv. HMT-100-1)	*Setaria italica*(L.) P. Beauvois	-	+
13	Save (Little millet) (Cv. Sukshema)	*Panicum sumatrense* Roth ex Roem. & Schult.	-	-
14	Baragu (Prosomillet) (Cv. GPUP 8)	*Panicum miliaceum* L.	-	-
15	Udalu (Barnyard millet) (Cv. Sushrutha)	Echinocloa crus-galli (L.) Beauv	-	-
16	Barley (Cv. Jyoti)	*Hordeum volgare* L.	-	-
17	Rice(Cv. MTU 1001)	*Oryza sativa* L.	-	-
18	Elephant grass (Napier Grass)	*Pennisetum purpureum* Schumach.	-	-
19	Johnson grass	*Sorghum halepense* (L.) Pers.	+	+
20	Canary grass	*Phalaris minor* Retz.	-	-
21	Nut Grass (Jeku)	*Cyperus rotundus* (L.)	-	-
22	Bermuda grass (Karake)	*Cynodon dactylon* (L.) Pers.	-	-

+: Symptoms appeared, -: No symptoms

Whathaneeyaweech *et al.*, (2016) reported that, *E. turcicum* causing leaf blight of maize has shown the three different kinds of symptoms on twenty two different hosts belonging to the poaceae family including johnson grass, grain sorghum, rice *etc.*

In conclusion, present investigation revealed that, morning and evening relative humidity, number of rainy days were significantly influencing the disease development and from the host range studies we came to know that, grain sorghum, johnson grass, bajra, foxtail millet were found to be infected by *E. turcicum* under *in vitro* conditions, whereas Johnson grass and grain sorghum shown the infection under both natural as well as *in vitro* conditions, so these host may act as secondary source inoculum and alternative hosts during the off season.

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