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Prevalence of Spot Blotch (*Bipolaris sorokiniana*) of Wheat and its Management through Host Resistance

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A B S T R A C T

Survey was conducted at dough stage to assess the spot blotch disease of wheat in different locations of Jammu sub-tropics during 2015 cropping seasons. The disease was reported in all the wheat growing areas of Jammu subtropics with the maximum AIDX observed in Kathua district with the range of 29.55-48.15 per cent, followed by Samba ranging from 29.28-45.82 per cent. However, minimum disease was observed in Jammu district (30.06-40.61%). Out of sixty two wheat genotypes evaluated against spot blotch under natural epiphytotic conditions, 8 (HD-2967, HD-3043, HP-1102, HS-277, JAUW-598, PBW-660, PBW-692 and VL-907) were observed as resistant having disease severity of 34.26 to 35.0 per cent and AUDPC value of 330.90-402.80. While as, 24 genotypes were observed as moderately resistant having disease severity of 39.45 to 57.0 per cent and AUDPC value of 429.60-742.10. The rest of wheat genotypes belong to moderately susceptible and susceptible groups and having high disease severity and AUDPC value.

Introduction

Spot blotch, caused by *Bipolaris sorokiniana* (Sacc.) Shoemaker is a major disease of wheat (*Triticum aestivum* L.), in all the six agroclimatic zones of India. During past two decades, substantial economic loss in wheat production has occurred due to the severity of spot blotch, adversely affecting the livelihood of millions of small scale farmers (Krishnendu *et al.*, 2011). The losses in grain yield are estimated from 6.3 to 50% (Chenulu *et al.*, 1972 and Singh *et al.*, 2002), depending on cultivars grown. The disease also causes serious damage in seed quality and market value of the produce (Singh and Kumar, 2008). Although chemical control of the disease has been worked out (Singh *et al.*, 2014), yet deployment of resistant cultivars remains a top priority. The status of the

disease varied year to year and season to season. Therefore, an extensive survey were conducted in different wheat growing areas of Jammu subtropics to know the present status of spot blotch disease. Moreover, screening of popular varieties and elite germplasm of wheat was also evaluated against spot blotch under natural epiphytotic conditions, to identify the sources of resistance against the disease in order to manage it and also to use the resistant germplasm in breeding for resistance.

Materials and Methods

Status of spot blotch disease in Jammu subtropics

Survey was conducted to record the severity of spot blotch in wheat fields located in subtropical zones of Jammu Division comprising of Jammu, Samba and Kathua districts, during of Jammu the month of March, 2015. Five fields at each location were selected randomly in each district and data were collected at weekly intervals by random sampling method. Disease intensity/average infection index (AIDX) was calculated on the bases of 0-4 scale proposed by Chenulu and Singh (1964).

$$\text{AIDX} = \frac{\text{Class rating} \quad \text{x Class frequency}}{\text{Total number of leaves x Maximum Class frequency}}$$

The scale used for calculating Average Infection Index (AIDX) was as follows:

0 = no infection
1 = 1-25 per cent leaf area infected
2 = 26-50 per cent leaf area infected
3 = 51-75 per cent leaf area infected
4 = > 75 per cent leaf area infected

Sixty two wheat genotypes *viz*. Agra Local, AKW-1071, DBW-14, DBW-39, DBW-88, DBW-90, DL-784-3, DPW-621-50, Durgapur-65, G-W-40, HD-2733, HD-2851, HD-2888, HD-2967, HD-2985, HD-3043, HD-3059, HD-3086, HI-1563, HP-1102, HS-1138, HS-207, HS-277, HS-375, HS-490, HS-507, HS-542, JAUW-584, JAUW-595, JAUW-598, K-0307, K-1006, K-8027, Kharchia 65, MP-3382, Narmada -112, PBW-175, PBW-343, PBW-550, PBW-590, PBW-644, PBW-660, PBW-692, PDW-233, PDW-291, PDW-314, RAJ-3077, RAJ-3765, RAJ-4015, RAJ-4037, RAJ-4083, RSP-561, Sarbati Sonara, Sonalika, VL-804, VL-829, VL-892, VL-907, WH-1021, WH-1080, WH-1105 and WH-1124, procured from different sources were screened for spot blotch under natural epiphytotic conditions during 2014-2015 *Rabi* seasons at University Research Farm, Chatha. The experiment was laid out in randomized block design with three replications. Each genotype was sown in 2m rows spaced 22.5cm apart in 4th week of December.

The spore suspension *B. sorokiniana* was prepared from 21-day old culture of pathogen grown on sorghum seeds. Inoculation with the test pathogen was made by spraying spore suspension ($4.3x10^4$spores/ml of water) on wheat genotypes including spreader rows at tillering stage and subsequent two sprays were made to create artificial epiphytotic conditions in the field to screen wheat varieties. The field was irrigated after inoculation to maintain proper humidity. Disease observations were started when the first lesion appeared (March 21st) on the lower leaves and repeated at 10-day intervals till the leaves were green. The observations on per cent blighted area as per 0-9 scale (Saari and Prescott, 1975) were recorded. The terminal disease severity, used to classify the wheat genotypes into different groups as reported by Singh *et al.*, (2015). The categorization of genotypes for resistance to spot blotch was done as, HR: average disease score range 00-13, R: average score 14-35, MR: average score 36-57, MS: average score 58-69 and S: average score >69.

Results and Discussion

A perusal of the data (Table 1) revealed that the disease occurred in all the fifteen locations surveyed and AIDX varied from 29.28 to 48.15 per cent during 2014-15 crop season. The maximum AIDX (48.15%) was recorded at Barnoti in district Kathua, whereas minimum AIDX (29.28%) was recorded at Rajpura in district Samba. In Jammu district, the AIDX ranged from 30.06 to 40.61 per cent with mean intensity of 33.89±1.63 per cent. The maximum AIDX was recorded at Akalpur (40.61%) followed by R. S. Pura (35.40%) and the lowest in Marh (30.06%). In Samba district, the AIDX ranged from 29.28 to 45.82 per cent with mean intensity of 33.99±1.68 per cent. The maximum AIDX was recorded at Sapwal (45.82%) followed by Ghagwal (34.09%) and the lowest in Rajpura (29.28%). In Kathua district, the AIDX ranged from 29.55 to 48.15 per cent with mean intensity of 35.25±1.26 per cent. The maximum AIDX was observed at Barnoti (48.15%) followed by Rajbag (35.80%) and the lowest in Hiranagar (29.55%).

The predominance of spot blotch of wheat has been reported from Bihar, Delhi, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamilnadu, Uttar Pradesh and West Bengal states of India (Singh *et al.*, 2001). Krishnendu *et al.*, (2011) observed that great yield losses occurred by the disease, when flag leaf and the leaf below the flag leaf were infected before the emergence of ear head. Our findings are in complete agreement with Mahto *et al*., (2002) and Singh *et al.*, (2004) who also reported similar findings. Joshi *et al.*, (2002) also observed that spot blotch or foliar blight was most concerning disease in warm and humid regions of India and other South Asian countries due to its wide spread prevalence and increasing severity.

Screening of 62 wheat genotypes under field conditions against spot blotch disease on 0-9 scale showed that the infection varied from 5.10 to 29.12 per cent and all the genotypes were infected on 20th March, 2015 (Table 2), whereas, 13.41 to 59.62 per cent infection was recorded on 30th of March, 2015. At the end of the crop season the terminal disease severity of different genotypes was highest and varied from 34.26 to 90.00 per cent. The Area Under Disease Progress Curve (AUDPC) varied from 330.90 to 1191.80, showing the fast progress of disease in all genotypes. It was observed that different wheat genotypes expressed varied type of disease response against *B. sorokiniana* under artificial epiphytotic conditions in the field.

A perusal of data (Table 3) revealed that no wheat genotype under the study appeared to be the highly resistant to the *B. sorokiniana* (spot blotch disease). However, under natural epiphytotic conditions, wheat germplasm, HD-2967, HD-3043, HP-1102, HS-277, JAUW-598, PBW-660, PBW-692, PDW-291 and VL-907 were observed as resistant, with AUDPC ranging between 330.90-402.80, and DBW-88, DL-784-3, DPW-621-50, HD-2733, HD-3059, HD-3086, HI-1563, HS-1138, HS-207, HS-375, HS-490, HS-507, HS-542, JAUW-584, JAUW-595, Narmada-112, PDW-291, PDW-314, RAJ-4037, RSP-561, WH-1021, WH-1080, WH-1105 and WH-1124 were ranked as moderately resistant with AUDPC ranging from 429.60-742.10. Whereas, AKW-1071, DBW-14, DBW-39, DBW-90, Durgapur-65, G-W-40, HD-2851, HD-2888, HD-2985, K-1006, K-8027, MP-3382, PBW-175, PBW-550, PBW-590, PBW-644, PDW-233, RAJ-3077, RAJ-3765, RAJ-4083, Sarbati Sonara, VL-804, VL-829 and VL-892 were graded as moderately susceptible and Agra Local, K-0307, Kharchia 65, PBW-343, RAJ-4015 and Sonalika as susceptible.

Table.1 Average Infection Index (AIDX) of spot blotch of wheat in different locations of Jammu sub-tropics

District	Location	AIDX *
Jammu	Marh	30.06
	Bishnah	31.03
	Akalpur	40.61
	R.S. Pura	35.40
	Kotli	32.37
	Mean±SE(m)	**33.89±1.63**
	Range	**30.06-40.61**
Samba	Vijaypur	30.56
	Sapwal	45.82
	Ghagwal	34.09
	Rajpura	29.28
	Jatwal	30.22
	Mean±SE(m)	**33.99±1.68**
	Range	**29.28-45.82**
Kathua	Hiranagar	29.55
	Chadwal	31.67
	Rajbag	35.80
	Barnoti	48.15
	Laget Moh	31.11
	Mean±SE(m)	**35.25±1.26**
	Range	**29.55-48.15**

*AIDX = Average infection index

Table.2 Evaluation of wheat genotypes against spot blotch disease caused by *Bipolaris sorokiniana*

S.No	Genotype	Per cent disease severity			Disease reaction	*AUDPC
		20th March	30th March	9th April		
1	Agra Local	22.50	56.21	84.12	S	1095.2
2	AKW-1071	12.33	34.12	68.10	MS	743.30
3	DBW-14	12.20	35.60	58.20	MS	708.00
4	DBW-39	13.21	35.42	65.23	MS	746.40
5	DBW-88	12.30	34.00	55.41	MR	678.50
6	DBW-90	12.60	36.21	66.21	MS	756.15
7	DL-784-3	13.35	34.56	56.30	MR	693.80
8	DPW-621-50	13.00	24.45	45.50	MR	537.00
9	Durgapur-65	12.50	35.12	58.41	MS	705.70
10	G-W-40	22.10	36.10	58.16	MS	762.30
11	HD-2733	13.11	35.41	54.67	MR	693.00
12	HD-2851	22.21	35.45	59.61	MS	763.60
13	HD-2888	13.52	36.41	64.70	MS	752.70
14	HD-2967	5.10	13.41	34.26	R	330.90
15	HD-2985	12.48	36.45	66.21	MS	757.90
16	HD-3043	4.56	15.26	35.00	R	350.40
17	HD-3059	12.42	25.45	48.21	MR	557.60
18	HD-3086	12.00	35.21	44.52	MR	634.70
19	HI-1563	18.52	34.53	48.12	MR	678.50
20	HP-1102	6.20	14.23	34.85	R	347.50
21	HS-1138	12.86	26.16	46.53	MR	558.50
22	HS-207	18.52	36.45	57.00	MR	742.10
23	HS-277	4.50	16.24	34.82	R	359.00
24	HS-375	12.62	25.45	46.52	MR	550.20
25	HS-490	12.58	25.00	47.23	MR	549.00
26	HS-507	13.25	25.45	46.25	MR	552.00
27	HS-542	12.25	24.15	46.52	MR	535.30
28	JAUW-584	12.14	23.46	45.85	MR	524.50
29	JAUW-595	12.45	24.47	56.00	MR	586.90
30	JAUW-598	8.14	16.25	35.00	R	378.20

31	K-0307	23.12	46.25	78.12	S	968.70
32	K-1006	22.45	34.26	68.45	MS	797.10
33	K-8027	21.36	34.25	67.15	MS	785.00
34	Kharchia 65	23.15	46.52	78.21	S	972.00
35	MP-3382	19.51	35.26	67.45	MS	787.40
36	Narmada -112	13.26	24.86	46.79	MR	548.80
37	PBW-175	23.25	42.21	60.52	MS	840.90
38	PBW-343	19.12	45.23	83.50	S	965.50
39	PBW-550	23.52	36.41	58.75	MS	775.40
40	PBW-590	17.45	35.42	67.23	MS	777.60
41	PBW-644	24.00	45.26	77.90	MS	962.10
42	PBW-660	5.30	15.41	34.62	R	353.70
43	PBW-692	8.52	18.52	35.00	R	402.80
44	PDW-233	14.52	36.51	68.45	MS	779.90
45	PDW-291	10.00	18.24	39.45	MR	429.60
46	PDW-314	11.36	20.45	40.35	MR	463.00
47	RAJ-3077	23.10	46.53	68.45	MS	923.00
48	RAJ-3765	25.21	45.12	67.15	MS	913.00
49	RAJ-4015	27.26	56.12	84.24	S	1118.70
50	RAJ-4037	11.23	25.12	50.13	MR	558.00
51	RAJ-4083	15.23	36.45	62.30	MS	752.15
52	RSP-561	13.52	29.53	50.14	MR	613.60
53	Sarbati Sonara	23.52	38.12	68.16	MS	839.60
54	Sonalika	29.12	59.62	90.00	S	1191.80
55	VL-804	16.23	38.15	60.23	MS	763.80
56	VL-829	20.42	38.42	63.42	MS	803.40
57	VL-892	13.26	36.12	58.12	MS	718.10
58	VL-907	6.20	17.26	35.00	R	378.60
59	WH-1021	12.41	34.36	47.52	MR	643.20
60	WH-1080	13.25	25.41	45.32	MR	546.90
61	WH-1105	12.42	35.46	47.95	MR	656.40
62	WH-1124	13.25	33.25	49.52	MR	646.30

Table.3 Reaction of different wheat genotypes against spot blotch (*B. sorokiniana*) disease of wheat

Disease reaction	Category	*AUDPC value	Wheat genotype
Highly resistance (HR)	00 -13	-	Nil
Resistant (R)	14 -35	330.90- 402.80	HD-2967, HD-3043, HP-1102, HS-277, JAUW-598, PBW-660, PBW-692, VL-907
Moderately resistant (MR)	36 - 57	429.60-742.10	DBW-88 , DL-784-3, DPW-621-50, HD-2733, HD-3059, HD-3086, HI-1563, HS-1138, HS-207, HS-375, HS-490, HS- 507, HS-542, JAUW-584, JAUW-595, Narmada-112, PDW-291, PDW-314, RAJ-4037, RSP-561, WH-1021, WH-1080, WH-1105, WH-1124
Moderately susceptible (MS)	58 - 78	746.40-962.10	AKW-1071, DBW-14, DBW-39, DBW-90, Durgapur-65, G-W-40, HD-2851, HD-2888, HD-2985, K-1006, K-8027, MP-3382, PBW-175, PBW-550, PBW-590, PBW-644, PDW-233, RAJ-3077, RAJ-3765, RAJ-4083, Sarbati Sonara, VL-804, VL-829,VL-892.
Susceptible (S)	< 78	965.50- 1191.80	Agra Local, K-0307, Kharchia 65, PBW-343, RAJ-4015, Sonalika.

*****Area Under Disease Progress Curve (AUDPC)

The present result was found to be in conformation with findings of Khan and Chowdhury (2011) who evaluated 422 spring wheat germplasm from India, CIMMYT and China against *B. sorokiniana*, under natural epiphytotic conditions and reported 52 as resistant, 180 as moderately susceptible, 171 as susceptible and rest as highly susceptible. Ibeagha *et al.,* (2005) reported higher levels of resistance in Yangmai 6, M 3 (W7976), Shanghai 4 and Chiriya 7 when compared with Sonalika. Chaurasia *et al.,* (1999) and Dubin *et al.,* (1998) reported low to moderate levels of resistance to spot blotch in international wheat germplasm.

Sources of resistance against *B. sorokiniana* were also identified by Aggarwal (2011) under natural and artificial epiphytotic conditions. Our results are in accordance with the findings of Singh *et al.,* (2005), who reported that wheat genotypes namely, CB (BW)-351, CB (BW)-355, MRANG ALD/AN'S' MON's'/ALD's', UHU, BAU 4, K 9204, BW 14989, HW 2012 and HW 2014 were resistant to spot blotch (*B. sorokiniana*). Mexican varieties Alovdra, Cocoraine, Cugap; Chinese genotypes, Ning 8201, Longmai 10, Yangmai 6 and Brazilian cultivars, BH 1146, CNT 2, PAT 7219, Ocepar 7 have been noted as best resistance (Mehta, 1985; Singh *et al*., 2007). The genotypes identified as resistant may be useful in breeding programme against spot blotch disease and also useful for deployed in the areas getting high disease pressure over years to contain losses in yield.

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