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Searching of wheat genotypes for resistance against *Bipolaris sorokiniana*

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Abstract
A field study was conducted during *Rabi*, 2014-15 and 2015-16 crop seasons at Main Experiment Station, NDUA & T, Kumarganj, Faizabad to test the resistance of 176 genotypes against *Bipolaris sorokiniana* under artificial epiphytotic conditions. Each genotype was sown in last week of November in single row of one meter length. Variety Raj 4015 was used as check and was sown after every 20 genotypes. Pure culture of pathogen was inoculated on genotypes by using cleaned sprayer, at evening. Disease data was recorded using double digit scale based on per cent blighted area on flag leaf and one leaf just below. Out of 176 genotypes, one namely KARAWANI/4NIF3/SOTY/NAD63/CHRIS was found immune, 31 genotypes were found resistant, 75 were moderately resistant, 52 were moderately susceptible and 17 were found susceptible against spot blotch disease of wheat.

Keywords: Wheat, Spot blotch, *B. sorokiniana*, Screening

Introduction
Wheat (*Triticum aestivum* L.) is one of the most important and strategic cereal crops for the majority of world's population. According to latest report of DWR, Karnal wheat was grown in 29.9 million ha. area and production was 93.9 million tonnes in 2014-15, in India (Anonymous, 2015), whereas in U. P. 9.7 lakh ha. area was under wheat cultivation in 2014-15 and production was 31.66 lakh mt. (Anonymous, 2015). It has good nutritional value than other food grains comprising 71.2g carbohydrates, 11.8g proteins, 1.5g fat, 1.2 g crude fiber, 306 mg phosphorus and 41 mg calcium per 100g grains (Rai and Mauria, 1999) [6]. Spot blotch caused by *Bipolaris sorokiniana* (Sacc.) Shoem. (syn. *Helminthosporium sativum*, teleomorph *Cochliobolous sativus*) is an important wheat disease in warmer and humid growing regions ofthe world such as Eastern India, South East Asia (Joshi *et al*., 2007) [3]. Yield losses were estimated to be 18-22 per cent in India (Saari, 1998) [7]. The control strategy for the diseases caused by *B. sorokiniana* is based on an integrated approach where genetic resistance is a major element, because economic returns have not always resulted in commercial grain production from fungicide inputs (Duveiller and Sharma, 2009). Hence, search of effective non-fungicidal control of spotblotch disease is of utmost importance. The best, long term, economically and environmentally safe method for sustainable disease control is the use of resistant varieties.

Material and methods
The experiment was conducted at main experiment station of Narendra Deva University of Agriculture andTechnology, Kumarganj, Faizabad (U.P.) during crop season Rabi, 2013-14. Seeds of 250 genotypes were collected from All India Co-ordinated Wheat and Barley Improvement Project, Department of Genetics and Plant Breeding, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad (U.P.). Each genotype was sown (fourth week of November) in single row of one meter length at a distance of 25 cm row to row and 5 cm plant to plant. Two rows of susceptible varieties (A-9-30-1 and Raj 4015) to foliar blight were sown as border rows around all the sites of experiment. The ten days old pure culture of Biopolaris sorokiniana multiplied on potato dextrose Agar and sorghum seeds were used for inoculating on entries. The spore suspension was prepared in sterilized distilled water having a spore load of 50-75 per microscopic field (10x). This suspension was sprayed at 3-4 leaf stage by using hand atomizer. The second field inoculation was made again in the same manner after the 15 days of the first inoculation. After inoculation, the entries were regularly watched for recording the observations of disease severity. The first observations were made after ten days of inoculation on ten plants selected randomly.

The disease score of each selected plants were recorded by using Kumar *et al*. (1998) [5] double digit scale (Table A) based on per cent blighted area on the flag and one leaf just below. The maximum disease score of each genotype was recorded finally.

Table A: Kumar *et al.* (1998) [8] double digit scale, based on per cent blighted area on the flag leaf and one leaf just below.

Severity			Rating	
Sr. No.	**Top (flag) leaf**	**Second top leaf**	**Disease response**	**Range**
1.	0	0-1	Immune (I)	00-01
2.	1-2	2-4	Resistant (R)	12-24
3.	3-4	4-6	Moderately resistant (MR)	34-46
4.	5-6	6-8	Moderately susceptible (MS)	56-68
5.	7-8	8-9	Susceptible (S)	78-89
6.	9	9	Highly susceptible (HS)	99

Results and Discussion

Use of resistant variety is a cheapest and most economical method of disease control. Two hundred fifty varieties (Table 1) were screened under field conditions by double digit scale based on per cent blighted area on the flag and flag-1 leaf at hard dough stages. Out of which, only one genotype (KARAWANI/4NIF-3/SOTY/ AD63/CHRIS) was rated as immune, 31 genotypes viz., VL 892, MP 1277, HD 3043, PBW 644, K8027, WH 592, HS 583, HS 590, HS 596, HS 597, HS 598, UP 2917, VL 1006, VL 4001, DBW 147, DBW 150, HI 1605, HUW 688, K 1313, NW 6024, PBW 707, PBW 716, UP2883, WH 1179, HD 3171, GW 463, DBW 181, KB 2012, HPBW 02, HPBW 07, HPBW 08, HUW 711, WB 1, VL 829, PBW 660, K 8027 were rated as resistant, 75 genotypes viz., HS 562, HS 375, HS 542, HD 4530, WH 1164, DBW 88, DBW 90, DPW 621, HD 2967, HD 3059, PDW 314, WH 1021, GW 322, HD 2864, HD 2932, HI 8498, HI 8737, MACS 3927, NIAW 2030, MACS 6222, MACS 6478, NI 5439, NIAW 1415, UAS 347, PBW 723, HW 1098, PBW 343, TL 2942, TL 2969, HPW 394,HPW 413, HPW 422, HS 580, HS 599, HS 600, HS 601, UP 2918, VL 1005, VL 3009, DBW 148, DDW 31, DDW 32, HD 3159, HD 3165, HD 3174, HI 1604, K 1312, K 1314, MACS 4024, PBW 709, PBW 718, UP 2883, K 1317, CG 1015, HI 8765, K 1315, PBW 721, UAS 360, UAS 361, DBW 182, DBW 184, DBW 185, DDK 1049, KRL 350, KRL 351, MACS 5043, TL 3001, TL 3004, DWR-NIL 01, DWR-NIL 02, HD 3209, HPBW 01, HPBW 05, HPBW 09, HUW 695, WB 2, WB 5, HUW 712, MACS 6507 were rated as genotypes moderately resistant, 52 genotypes viz., HPW 251, HPW 349, HS 490, HS 507, VL 804, VL 892, VL 907, HD 3086, PDW 233, PDW 291, WH 1021, WH 1105, WH 1124, WH 1142, C 306, HD 2888,HD 4728, HI 4730, HI 1544, MP 3336, PM 4010, MPO 1215, DBW 93, UAS 428, UAS 446, HD 2932 + Lr19/Sr25, MMBL 283, DBW 14, HD 2985, HI 1563, K 0307, Kharchia 65, KRL 210, RAJ 4883, HPW 393, HPW 421,VL 3002, VL 3008, MACS 3949, HI 8759, HD 3164, MACS 3970, MACS 3972, TL 3005, DBW 183, DDK 1048, MACS 5041, WH 1309, TL 3002, UAS 453, UAS 455, USA-316 genotypes were rated as moderately susceptible and 17 genotypes viz., AKDW 2997, DDK 1029, HUW 234, KRL 19, VL 1006, VL 3007, NE - LS - 0 5, NE -R F - 0 1, C Z - TS - 0 2, CZ-TS-03, CZ-TS-04, CZTS-07, CZ-TS-08,GW 1315,DWS 712, MACS 4020, TL 3003 genotypes were rated as susceptible for spot blotch disease under field conditions. Similar observations were recorded by other workers. Kenganal *et al*. (2008) [4] screened wheat cultivars against Helminthosporium sativum [*Cochliobolus sativus*] occurring on wheat. Out of 15 wheat cultivars screened, NIDW-295 and MACS-2496 were found immune; DDK-1013, DWR-185, DWR-225, RAJ-4037 and MACS-2846 were highly resistant; GW-344 and DWR-195 were resistant; GW-322, DDK-1001 and DWR-162 were moderately resistant, DWR-2006 and DWR-1006 were susceptible and DDK-1009 was highly susceptible. Singh *et al*. (1995) [10] In field inoculation trials only 15 of 257 genotypes were consistently resistant to H. sativum (*Cochliobolus sativus*). A further 47 were moderately resistant and 158 moderately susceptible, with 33 rated susceptible and 4 highly susceptible. No genotype was free from infection during the 3 test years. Singh *et al* (2016) [8] tested 250 genotypes against *Bipolaris sorokiniana* under artificial epiphytotic conditions. Each genotype was sown in last week of November in single row of one meter length. Variety Raj 4015 was used as check and was sown after every 20 genotypes. Pure culture of pathogen was inoculated on genotypes by using cleaned sprayer, at evening. Disease data was recorded using double digit scale based on per cent blighted area on flag leaf and one leaf just below. Out of 250 genotypes, one namely Karawani/4NIF-3/SOTY/NAD63/CHRIS was found immune, 20 genotypes were found resistant, 146 were moderately resistant, 75 were moderately susceptible and 8 were found susceptible against spot blotch disease of wheat. Singh *et al.* (2016) [9] tested 300 genotypes against *B. sorokiniana* under artificial epiphytotic conditions. Each genotype was sown in last week of November in single row of one meter length. Variety Raj 4015 was used as check and was sown after every 20 genotypes. Pure culture of pathogen was inoculated on genotypes by using cleaned sprayer, at evening. Disease data was recorded using double digit scale based on per cent blighted area on flag and flag-1 leaf. Out of 300 genotypes, 3 genotypes were found resistant, 145 were moderately resistant, 118 were moderately susceptible and 34 were found susceptible against spot blotch disease of wheat.

Table 1: Categorization of wheat genotypes against the response of foliar blight disease under artificial disease pressure condition during 2014-2015.

S.N.	Disease reaction	Double digit scale	Genotypes	No. of genotypes
1	Immune (I)	00-01	KARAWANI/4NIF-3/SOOTY/NAD63/CHRI	1
2	Resistant (R)	12-24	VL 892, MP 1277, HD 3043, PBW 644, K8027, WH 592, HS 583, HS 590, HS 596, HS 597, HS 598, UP 2917, VL 1006, VL 4001, DBW 147, DBW 150, HI 1605, HUW 688, K 1313, NW 6024, PBW 707, PBW 716, UP2883, WH 1179, HD 3171, GW 463, DBW 181, KB 2012, HPBW 02, HPBW 07, HPBW 08, HUW 711, WB 1, VL 829, PBW 660, K 8027	31
3	Moderately resistant (MR)	34-46	HS 562, HS 375, HS 542, HD 4530, WH 1164, DBW 88, DBW 90, DPW 621, HD 2967, HD 3059, PDW 314, WH 1021, GW 322, HD 2864, HD 2932, HI 8498, HI 8737, MACS 3927, NIAW 2030, MACS 6222, MACS 6478, NI 5439, NIAW 1415, UAS 347, PBW 723, HW 1098, PBW 343, TL 2 942,TL 2969, HPW 394,HPW 413, HPW 422, HS 580, HS 599, HS 600, HS 601, UP 2918, VL 1005, VL 3009, DBW 148, DDW 31, DDW 32, HD 3159, HD 3165, HD 3174, HI 1604, K 1312, K 1314, MACS 4024, PBW 709, PBW 718, UP 2883, K 1317, CG 1015, HI 8765, K 1315, PBW 721, UAS 360, UAS 361, DBW 182, DBW 184, DBW 185, DDK 1049, KRL 350, KRL 351, MACS 5043, TL 3001, TL 3004, DWR-NIL 01, DWR-NIL 02, HD 3209, HPBW 01, HPBW 05, HPBW 09, HUW 695, WB 2, WB 5, HUW 712, MACS 6507	75
4	Moderately susceptible	56-68	HPW 251, HPW 349, HS 490, HS 507, VL 804, VL 892, VL 907, HD 3086, PDW 233, PDW 291, WH 1021, WH 1105, WH 1124, WH 1142, C 306, HD 2888,HD 4728, HI 4730, HI 1544, MP 3336, PM 4010, MPO 1215, DBW 93, UAS 428, UAS 446, HD 2932 + Lr19/Sr25, MMBL 283, DBW 14, HD 2985, HI 1563, K 0307, Kharchia 65, KRL 210, RAJ 4883, HPW 393, HPW 421,VL 3002, VL 3008, MACS 3949, HI 8759, HD 3164, MACS 3970, MACS 3972, TL 3005, DBW 183, DDK 1048, MACS 5041, WH 1309, TL 3002, UAS 453, UAS 455, USA-316	52
5	Susceptible	78-89	AKDW 2997, DDK 1029, HUW 234, KRL 19, VL 1006, VL 3007, NE - LS - 0 5, NE -R F - 0 1, C Z - TS - 0 2, CZ-TS-03, CZ-TS-04, CZTS-07, CZ-TS-08,GW 1315,DWS 712, MACS 4020, TL 3003	17

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