RESEARCH ARTICLE

EVALUATION OF SOME ADVANCE AND ELITE LINES OF WHEAT TO *BLUMERIA GRAMINISF*. SP. *TRITICI* IN NORTH WEST PLAIN ZONE OF INDIA

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Abstract: Wheat (*Triticum aestivum*) powdery mildew, caused by the biotrophic fungus *Blumeria graminis* f. sp. *tritici*, is one of the most severe foliar diseases attacking this crop, reducing grain yields by 10% to 62% in India. The disease can be controlled by genetic resistance of the host, but the pathogen has physiological specialization, which enables it to infect wheat cultivars that have remained resistant for years. The objective of this work was to evaluate the variability of pathogenic strains of *B. graminis* f. sp. *Tritici* collected in northen part of India and the effectiveness of wheat resistant varieties/ lines to powdery mildew in the 2012-13 and 2013-14 crop season. It is an important disease of wheat (*Triticum aestivum* L.) in the plains north eastern region of Haryana and adjoining areas of states of Punjab and Himachal Pradesh. Studies was carried out at IIWBR, Karnal and Regional Research Station, Dhaula kuan during *rabi* 2012-13 and 2013-14. Out of 203 entries evaluated, 67 were found tolerant and 37 were found resistant at both the location. Among all lines/varieties 27 were found susceptible and only seven were found highly susceptible at Karnal and 36 were found highly susceptible, whereas 43 were susceptible at Dhaula kuan, H.P. The resistant genotypes evaluated in the study can be utilized by the breeder while conducting the breeding programme.

Keywords: Foliar diseases, Fungus, Variety, Wheat

INTRODUCTION

Wheat is the most important winter cereal crop in India and serves as the staple food for more than 1 billion population. It contributes approximately 14% to the world wheat basket and holds the global share of 11% area under cultivation of wheat. For sustaining and realizing future goals, wheat crop will have to be protected against biotic stresses. Among biotic stresses, the powdery mildew in cereals challenges wheat production globally with highly virulent and diverse races. In India too, wheat crop is subjected to severe attack of this disease to India.

The disease had earlier been considered to be of great significance only on hills and foot hills, but in recent years, the widespread occurrence of powdery mildew has been reported from other non-host areas as well. Being the chronic pathogen, theaverage infection ranges between 5-8 % every year. During severe epidemics, the loss reaches to the tune of 30% which is far from negligible (Johnson *et al*. 1979, *Anon.*, 2017).The cultivation of resistant varieties is of great importance in preventing the spread of the disease, in maintaining satisfactory yield, reducing the damage extent and in protecting the environment. Abiotic factors play the key role in initiation and further spread of disease. The dry conditions, above 25°C particularly, are not conducive for its development.

The life cycle of powdery mildew includes sexual (between seasons) and asexual (within season) stages, a strategy that combines the benefits of both new allelic combinations and often-effective off-season survival mechanisms (through sexual reproduction) with the advantages of rapidly multiplying individual clonal lines (through asexual reproduction) that are particularly adapted to specific host habitats (McDonald and Linde, 2002).

The investigations on conductive epidemiological factors responsive for the disease development and disease resistance have been made globally, but the systematic and detailed study is still meager. Therefore, an investigation was needed to explain the disease appearance along with the factors influencing the disease development,so that the importance of breeding for disease resistance and the economic value of disease control methods could be determined. To achieve the purpose, the variability of lines/varieties wereundertaken for further study.

MATERIALS AND METHODS

Experimental details

Collection and evaluation of genotypes/lines

The experimental material (advance lines of bread wheat and allied species) was procured from Indian Institute of Wheat and Barley Research, Karnal (IIWBR). Two hundred and three wheat entries comprising of varieties/lines and accessions were evaluated against the local isolate of *Erysiphegraminis*f. sp. *tritici*and the screening was done at IIWBR and regional Research StationDhaulakuan, in Himachal Pradesh.

The lines were sown during first week of December and maintained in two rows at 23 cm spacing. The infector row consisting of susceptible check cultivar (PBW 343) was planted after every five rows of the test genotypes. The recommended dose of fertilizers (N:P:K 50:25:25 kg/acre) were applied before sowing and the crop was raised by following all other

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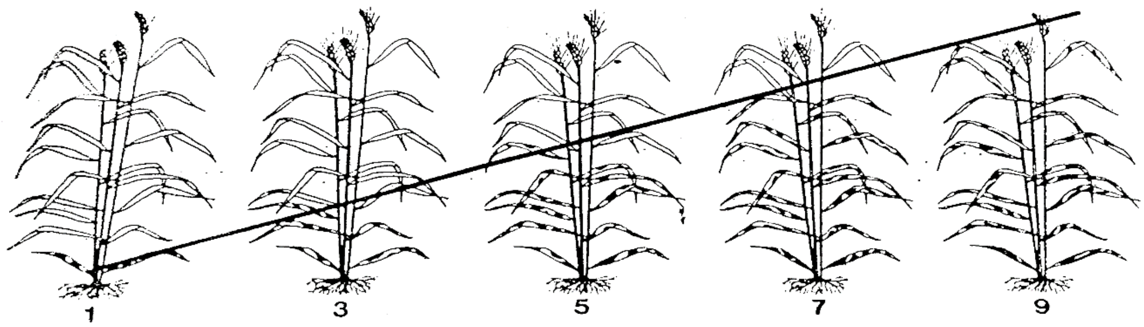
agronomic practices (Anon., 2001). The data on disease reaction was recorded when the susceptible check showed the maximum disease reaction till the senescence or drying of leaves. The disease assessment was done in accordance of scale proposed by Saari and Prescott (1975) for appraising the foliar disease intensity on wheat.

Disease severity scale

0	No disease
1	Up to 10 per cent leaf area affected
2	11-20 per cent leaf area affected
3	21-30 per cent leaf area affected
4	31-40 per cent leaf area affected
5	41-50 per cent leaf area affected
6	51-60 per cent leaf area affected
7	61-70 per cent leaf area affected
8	71-80 per cent leaf area affected
9	>81 per cent leaf area affected

Scaling for appraising the intensity of foliar disease in wheat



RESULTS

Evaluation of genotypes/lines against powdery mildew of wheat

Two hundred and three wheat entries comprising of varieties/lines and accessions obtained from different sources were evaluated for their resistance against powdery mildew disease under natural field conditions at two locations *i.e.* Indian Institute of Wheat and Barley research, Karnal (Haryana) and Regional Research Station , HPKVV, Palampur; Dhaulakuan (H.P) durind*rabi* 2012-13 and 2013-14 crop seasons. Powdery mildew severity was recorded according to 0-9 scale and the entries were categorized according to 0-5 scale *i.e.* 0 (Resistant), 1-2 (Moderately resistant), 3-4 (Moderately susceptible), 5-6 (Susceptible) and >6 (Highly susceptible).

The observations on disease incidence at various locations inferred higher incidence at Dhaulakuan followed byKarnal. Among 203 tested lines, 61 were found tolerant (0 grade) at Karnal, whereas at Dhaulakuan, 37 were recorded tolerant including A-9-30-1, DDK 1042, GW 440, HI 1588, HI 8742, HPW 251, HPW 349, HPW 368, HPW 376, HPW 380, HPW 387, HPW 388, HPW 399, HS 277, HS 536, HS 542, HS 574, HS 578, HW 1095, HW 1099, HW 2733, KRL 330, KRL 347, KRL 348, MACS 2971, MACS 3915, MACS 5022, MACS 5032, NIAW 1951, NW 2036, PBW 661, TL 2942, TL 2943, UAS 348, UAS 446, UP 2871 and WH 1098.

Table 1. Reaction of genotypes/lines against powdery mildew under field conditions at Karnal during 2012-13 and 2013-14

Sr. No.	Disease Grade	Reaction	Genotypes/Lines
1.	0	T	A-9-30-1, DDK 1042, GW 432, GW 440, GW 446, HD 3110, HD 3114, HI 1563, HI 1588, HI 8727, HI 8731, HI 8742, HPW 251, HPW 368, HPW 376, HPW 380, HPW 387, HPW 388, HPW 399, HS 536, HS 542, HS 574, HS 578, HUW 666, HW1095,HW 1099, HW 2733,

			HW 4013, HW 5224, KRL 330, KRL 347, KRL 348, MACS 2496, MACS 2971, MACS 3915, MACS 5022, MACS 5031, MACS 5032, MACS 6478, MACS 6583, MP 1270, MP 3379, MP 3382, NI 5439, NIAW 1951, NIDW 295, NW 2036, NW 2036, NW 5064, PBW 661, RAJ 4250, TL 2942, TL 2943, UAS 342, UAS 348, UAS 446, UP 2485, UP 2871, WH 1098, WHD 948
2.	1-2	R	AKDW 2997-16, BRW 3723, DBW 110, DBW 131, DBW14, DBW 74, DBW 93, DDK 1029, GW292, HD 2888, HD 2932, HD 3043, HD 3076, HD 3086, HD 3090, HD 3091,HD 3093, HD 3095, HD 3109, HD 3111, HD 3117, HD 3118, HD 3120, HD 3123, HI 1544, HI 8498, HI 8735, HI 8736, HI 8737, HPW 349, HPW 398, HS 277, HS 507, HS 575,HS 577, HUW 662, HUW 664, HUW 667, HUW 668, HUW 669, HW 1021, HW 1900, HW 3059, HW 4042, HW 5235, HW 5237, K 8027, KLP 1006, K0307, KRL 345, KRL 346, MACS 3929, MACS 6222, MACS 6568, NIAW 34, NIDW 699, NW 5054, PBW 175, PBW 644, PBW 660, PBW 674, PBW 675, PBW 688, RAJ 4229, RAJ 4295, UAS 334, UAS 447, UP 2843, UP 2872, VL 3001, VL 3002, VL 804, VL 892, WH 1126, WH 1128, WH 1130, WH 1142, WH 1145
3.	3-4	MR	DBW 88, DBW 90, DPW 621-50, GW 322, HD 2864, HD 2967, HD 3122, HI 8627, HI 8627, HI 8724, HPW 397, HS 490, HS 557, HS 576, HW 2044, K 1105, K 1114, KRL 210, MP 3336, MPO 1215, NIAW 1415, NIAW 1885, PBW 590, PDW 291, RAJ 4083, RAJ 4238, RAJ 4324, UA 428, VL 829, WH 1080, WH 1129
4.	5-6	S	C 306, DBW 71, HI 1500, HI 8713, Hi 8725, HI 8739, HPW 381, HW 1105, 1006, kharchia 65, MP 3288, MP 3392, MP 4010, PDW 314, RAJ 4294, UAS 347, UP 2847, UP2848, UPD 94, VL 1001, VL 1002, VL 3003, VL 907, VL 967, WH 1120, WH 1124,WH 1136
5.	>6	HS	COW(W)1, DBW 107, DBW 17, PBW 343, PBW 373, WH 1137, WH 1138

Table 2. Reaction of genotypes/lines against powdery mildew under field conditions at Dhaulakuan during 2012-13 and 2013-14

Sr. No.	Disease Grade	Reaction	Genotypes/Lines
1.	0	T	A-9-30-1, DDK 1042, GW 440, HI 1588, HI 8742, HPW 349, HPW 368, HPW 376, HPW 380, HPW 387 HPW 388, HPW 399, HS 536, HS 542, HS 574, HS 578, HW 1099, HW 2733, KRL 330, KRL 347, KRL 348, MACS 2971, MACS 3915, MACS 5022, MACS 5031, MACS 5032, NIAW 1951, NW 2036, NW 5064, PBW 661, TL 2942, TL 2943, UAS 348, UAS 446, UP 2485, UP 2871, WH 1098
2.	1-2	R	AKDW 2997-16, DBW 131, DBW 74, DDK 1029, DDK 1044, GW 432, HD 3109, HD 3110, HD 3114, HD 3118, HI 1563, HI 8727, HI 8731, HI 8736, HPW 251, HS 542 ,HS 577, HUW 664, HW 4013, HW 5224, KRL 346, MACS 2496, MACS 3929, MACS 6478, MACS 6583, MP 1270, MP 3379, MP 3382, NI5439, NIAW 1994, NIAW 34, NIDW 295, NW 5064, PBW 175, RAJ 4250, RAJ 4324, UAS 342, UP 2843, VL 3002, WH 1128, WH 1145, WHD 948
3.	3-4	MR	DBW 110, DBW 114, DBW 93, DPW 621-50, GW 292, GW 322, GW 446, HD 2932, HD 3086, HD 3090, HD 3091, HD 3095, HD 3117, HD 3123, HI 8498, HI 8735, HI 8737, HPW 398, HS 490, HS 507, HS 575, HS 576, HUW 662, HUW 666, HUW 668, HUW 669, HW 1900, HW 3059, HW 5235 KLP 1006, KRL 345 MACS 6222, MACS 6568, NIDW 699, NW 5054, PBW 660, PBW 674, PBW 675, PBW 688, RAJ 4295, UAS 334, UAS 428, UAS 447, UP 2845, UP 2872, VL 3001, VL 804, VL 892, WH1126, WH 1130, WH 1142
4.	5-6	S	BRW 3723, C 306, DBW 71, DBW 88, DBW 90, HD 2864, HD 2888, HD 2967, HD 3043, HD 3076, HD 3111, HD 3120, HD 3122, HI 1500, HI 8627, HI 8724, HPW 397, HS 557, HUW 667, HW 1021, HW 4042, HW 5237, K 1105, K 1114, K 8027, K0307, PBW 590, PBW 644, PDW 291, PDW 314, VL 907, WH 1080, WH 1124,WH 1129
5.	>6	HS	COW(W)1, DBW 107, DBW 17, HD 3093, HI 1544, HI 8713, Hi 8725, HI 8739, HPW 381, HW 1105, K 1006, Kharchia 65, KRL 210, MP 3288, MP 3336, MP 3392, MP 4010, MPO 1215, NIAW 1415, NIAW 1885, PBW 343, PBW 373, RAJ 4083, RAJ 4238, RAJ 4294, UAS 347, UP 2847, UP 2848, UPD 94, VL 1001, VL 3003, VL 829, VL 967, WH 1120, WH 1136, WH 1137, WH 1138

T: Tolerant; R: Resistant, MR: Moderately Resistant; S: Susceptible; HS: Highly Susceptible

On the other hand, thirty seven entries *viz.*, A-9-30-1, DDK 1042, GW 440, HI 1588, HI 8742, HPW 251, HPW 349, HPW 368, HPW 376, HPW 380, HPW 387, HPW 388, HPW 399, HS 277, HS 536, HS 542, HS 574, HS 578, HW 1095, HW 1099, HW 2733, KRL 330, KRL 347, KRL 348, MACS 2971, MACS 3915, MACS 5022, MACS 5032, NIAW 1951, NW 2036, PBW 661, TL 2942, TL 2943, UAS 348, UAS 446, UP 2871 and WH 1098 were found tolerant at Dhaulakuan and Karnal, during both observational years. The results are in agreement with the earlier observations by few workers (Basandrai and

Sharma., 1990; Chung and Griffey., 1995; Pathania*et al*., 1997, Ilker E.*et al.*,2009 and Alam A. 2011). Similarly, in other study genotypes viz.,Chilero, HD 2643, PBW 343, PBW 373, PBW 487, UP 2456, W 4677 were observed (*Pm8*)susceptible at Ludhiana and Keylong. While Chilero, PBW 487, UP 2456, W 4677 exhibited resistanceat Ludhiana (Rani *et al*.,2004a).

Multi location testing of varieties should be done in areas considered to be the hot spots for powdery mildew and to ensure the escape of infection at different locations (Menzies&Macneill, 1989).Moreover, the adult plant resistance might be utilized for breeding horizontal resistance as witnessed a resistant gene (Pm4a) in Khaplivariety of *Triticumdicoccum*Interestingly, the genotypes, Fd/Kav, Kavkaz and Veerywere observed susceptible at Keylonghowever, exhibited resistance at Ludhiana, indicated the absence of matching virulence. Similarly, The Plains population differed in that it was avirulent to several Pm genes long defeated in the soft-wheat-growing areas. Virulence complexity was greatest east of the Mississippi River, and diminished toward the west studied by Cowger *et al*. 2018.

CONCLUSION

The screening of breeding material is a continuous process to achieve the objective of finding the sources of resistance against the biotrophic pathogens, so that the resistant donors may be utilized in development of varieties exhibiting resistanceagainst powdery mildew. Control of powdery mildew is more difficult when infection is strong and has established in crop canopies. Therefore,the growers are needed to encourage the monitoringof crop regularly since tillering to harvesting stag.The early seeded varieties with dense canopies, high nitrogen status and a good soil moisture profile in particular, are needed to inspect at regular intervals. Furthermore, the resistant genotypes evaluated in the study can be utilized by the breeder while conducting the breeding programme.

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