



## Screening and Evaluation of Wheat Varieties against Powdery Mildew (*Blumeria graminis* f. sp. *tritici*) under field Conditions

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Wheat is attacked by a large number of fungal diseases in India, but only some of them are usually responsible for major economic losses. The important fungal diseases occurring in Uttar Pradesh are loose smut, flag smut, karnal bunt, rusts and powdery mildew. The powdery mildew fungi (*Blumeria graminis* f. sp. *tritici*) continues to rank among the most harmful pathogens on wheat (*Triticum aestivum* L.) in the world (Opalski *et. al.*, 2006). It is becoming a disease of concern in the North Western Plains Zone, Northern Hills Zone and Southern Hills Zone of the country. In subtropical regions, powdery mildew damage ranges from 13% to 35% when low infection while 50% to 100% damage under severe infection of disease could be recorded in field (Alam *et. al.* 2013; Li *et. al.*, 2011) when chemical control is neglected. In Uttar Pradesh, it regularly appears on wheat crop resulting in losses in isolated fields. Indeed, powdery mildew has a number of characteristics, which support rapid adaptation, such as its relatively short generation time with potential sexual recombination throughout the year, and the nature of its air-borne spread. Indian germplasms lack variability for powdery mildew resistance as evident from the susceptibility of wheat varieties developed recently in India (Singh *et. al.* 2009). However, sporadic incidence of powdery mildew has been reported from Rajasthan, Maharashtra and Karnataka (Arya and Ghemawat, 1953; Gadore and Patwardhan, 1965; Patil *et. al.*, 1969). Not much work on powdery mildew resistance has been done so far, therefore identification and evaluation of wheat

varieties for powdery mildew resistance should be done. Hence, the present study was undertaken to evaluate the effect of powdery mildew severity and to identify the powdery mildew resistant varieties for direct use in breeding programmes.

The experiment was carried out during *Rabi* season (2018-19) at Section of Rabi Cereals, Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, India under field conditions. Twenty six varieties of wheat (Table 1) were tested against powdery mildew pathogen for screening resistant, moderately susceptible and susceptible reactions. The experiment was conducted in randomized complete block design with three replications. This study was done to select resistant donors to incorporate their resistance in the breeding of wheat, to evolve high yielding and disease resistant genotypes for general cultivation. Each entry was planted in 1.0 m row length and 30 cm apart. The pathogenic inoculum was obtained from wheat plants that were naturally infected by *Blumeria graminis* f. sp. *tritici* at the New Dairy research farm of Chandra Shekhar Azad University of Agriculture & Technology, Kanpur, Uttar Pradesh during the early crop season. The inoculum was multiplied on susceptible wheat variety PBW 343 grown in poly house according to the inoculation method of Leath and Heun (1990). Accordingly, the conidia collected from infected plants were mixed in water to make a suspension and sprayed all over the leaves of 25-30 days after planting of all



26 experimental lines. The inoculated seedlings were maintained in the field and 70–90 % relative humidity was maintained through sprinkler. Normal agricultural practices including recommended fertilizer dose and irrigation schedule were followed.

Data was recorded when the infection on susceptible check PBW 343 was at its maximum following the scale 0-9 given by Leath and Heun (1990). The scale is based on infection

types where 0 = immune (no visible sign of infection); 1-3 = resistant (1= flecks with no necrosis, 2 = necrosis and 3 = chlorosis, while amount of mycelium went from none to detectable amount); 4-6 = moderately susceptible (chlorotic area decreasing in amount but mycelium and conidia production increases); 7-9 = Highly susceptible (increasing amount, size and density of mycelium and conidia to a compatible reaction).



Figure 1. Symptoms of powdery mildew on wheat crop after disease development

Table 1. Powdery mildew reaction of wheat varieties of bread wheat (*T. aestivum* L).

S.N.	Name of varieties	Infection type	Host response
1	K307	6	Moderately Susceptible
2	C306	7	Highly Susceptible
3	K8027	9	Highly Susceptible
4	K1006	4	Moderately Susceptible
5	K1105	3	Resistant
6	K1114	3	Resistant
7	K1116	4	Moderately Susceptible
8	HD2733	6	Moderately Susceptible
9	HD2888	7	Highly Susceptible
10	HD3171	9	Highly Susceptible
11	K1204	1	Resistant
12	K1213	1	Resistant
13	K1215	2	Resistant
14	K1217	2	Resistant
15	DBW14	9	Highly Susceptible
16	DBW39	7	Highly Susceptible
17	DBW107	7	Highly Susceptible

18	K1312	5	Moderately Susceptible
19	K1313	5	Moderately Susceptible
20	K1314	5	Moderately Susceptible
21	K1315	3	Resistant
22	K1317	4	Moderately Susceptible
23	K1601	3	Resistant
24	NW2036	8	Highly Susceptible
25	NW5054	7	Highly Susceptible
26	PBW343 (C)	9	Highly Susceptible

All the varieties of wheat were screened for powdery mildew resistance under artificial inoculation condition. Varieties exhibited powdery mildew reaction ranging from resistant score of 1 to highly susceptible of 9 according to scale given by Leath and Heun (1990). None of the variety exhibited immune response as 0. The screened wheat varieties showed variable powdery mildew infection response and disease severity in growing season (2018-19). The varieties were differed in their reactions and have been classified into different classes based on number of pustules on flag leaf. Only 8 varieties *i.e.* K1105, K1114, K1204, K1213, K1215, K1217, K1315 and 1601 have shown resistant reaction, whereas 8 varieties showed moderately susceptible reaction (K307, K1006, K1116, HD2733, K1312, K1313, K1314, K1317) and 10 varieties (C306, K8027, HD2888, HD3171, DBW14, DBW39, DBW107, NW2036, NW5054, PBW343) showed highly susceptible reaction. A close perusal of data revealed that K1105, K1114, K1204, K1213, K1215, K1217, K1315 and K1601 varieties of wheat exhibited resistance against powdery mildew. The wheat variety K1213 showed the lowest level of powdery mildew severity *i.e.* 4.5 % whereas the wheat variety PBW 343 (75.9 %) showed the highest level of powdery mildew severity.

In the present study, adult plants of 26 wheat varieties were evaluated for artificial powdery mildew inoculation under field conditions. Infection types and powdery mildew severity were recorded for each of the tested variety. A wide range of reactions from resistant to highly susceptible were shown by wheat varieties whereas no any variety showed immune response. Wheat varieties *viz.* K1105, K1114, K1204, K1213, K1215, K1217, K1315 and K1601 were found resistant to powdery mildew showing low infection. Resistance to powdery mildew was evaluated on material collected from different sources

in fields in Israel and Netherland (Gerechter-Amita and Vansilfhout, 1984) and they observed diverse response to powdery mildew infection ranging from highly resistant to completely susceptible. Similarly commercial wheat varieties were screened for their resistance to powdery mildew in Pakistan with a variety of reactions ranging from resistant to highly susceptible (Shahzad *et al.*, 2014). The screening period for powdery mildew was tillering stage as depicted by Rani *et al.* (2008) as they found late sown crop was vulnerable to powdery mildew infection as in this study powdery mildew inoculations were made after 25-30 days after sowing. They also reported susceptibility of most widely adapted cultivar PBW 343. The varieties PBW 343, PBW 550 and DPW 621-50 have shown susceptible reactions to powdery mildew at Malan and Dhaukuan (Gupta *et al.*, 2014) signifying that the recently released varieties are not having high level of resistance against the disease.

A wide variation for powdery mildew reaction ranging from immune (score = 0) to highly susceptible (score =7-9) reaction observed in the present study indicate that powdery mildew resistance was not an integral part of the breeding programs of the country. Out of 26 wheat varieties, only 8 were found resistant and 8 were found moderately susceptible to *B. graminis*, whereas the remaining 10 varieties showed highly susceptible at adult plant stages against powdery mildew reactions. Thus, there is an urgent need to broaden the genetic base of wheat by evaluating and identifying new sources of powdery mildew resistance in the breeding lines. None of the wheat variety showed immune reaction indicating higher resistance level for powdery mildew in them. Resistant varieties identified in this study may be used in breeding programme for enhancing powdery mildew resistance through gene pyramiding. These resistant varieties can be



further used in identifying and characterizing resistance genes using molecular biology tools.

### Conflict of Interest

Authors declare that they have no conflict of interest.

### Ethical Compliance Statement

NA

### Author Contribution

Conceptualization: JBK, SS; Initial Draft: JBK, SS, CK; Critical review and finalization: PKG and JK.

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