RESEARCH ARTICLE

SURVEY AND SURVEILLANCE OF WHEAT POWDERY MILDEW IN MAJOR GROWING AREAS OF NORTHERN HILLS AND PLAINS, INDIA

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Abstrct: Powdery mildew is very important foliar disease of wheat among major wheat growing areas of northen hills and plains in India which results in huge economic loss. Disease first appear on the lower leaves,varied in appearence depends on the location and continue to produce white mycelial growth on all plant parts up to the maturity of crop. Survey results revealed that the disease severity of powdery mildew in all the wheat growing areas of northern part of India is low to moderate (0 to 7). The disease severity was varied among different stage of the crop and places to grown but there was no significant difference among the cultivation practices. Maximum disease severity grade was recorded in Dhaulakuan district *i.e* 6 in 2012-13 and 7 in 2013-14, whereas minimum disease severity was recorded in Ludhiana, Ambala and Kaul i.e. 3 and 2 during the year 2012-13 and 2013-14, respectively.

Keywords: Powdery mildew, Northern hills, Survey, Wheat

INTRODUCTION

Wheat (Triticum aestivum L.) is the earliest domesticated crop with >10000- year-old of world agriculture [Zohary, D].Spread and complexity of pest and disease problems under climate change such as elevated atmospheric temperature have led farmers to apply intensive chemical compounds, which result in increase the resistance of pests and pathogens [Coakley, S.M]. Moreover, plant disease reduces global food production by at least 10% up to 30% [Strange, R.N]. Specifically, powdery mildews are obligate parasitic fungi which infect a wide range of crops (about 700 species of powdery mildews existing in about 7600 plant species) including cereals, cucurbits, fruit trees and ornamental crops [Braun, U], thereby causing significant losses of crop yields when compared to other plant diseases. Powdery mildew caused by *Blumeria graminis* (formerly named as *Erysiphe graminis* f.sp. *tritici*), is one of the most deleterious diseases threaten wheat production worldwide, resulting in a huge damage and yield losses [Zhang, J.C].Surveillance is apre-requisite for the adoption of integrated approach of disease management as it is an effective tool as an information system and renders control methods more effective (Rajak and Diwakar, 1995)

MATERIALS AND METHODS

The present investigations for powdery mildew in wheat were carried out at the Indian Institute of Wheat & Barley Research, Karnal and Regional Research station, Dhaulakuan, HPKV, H.P, during the wheat crop seasons of 2012-13 and 2013-14. Karnal is situated at 29° 23' N and 76° 58' E at an elevation of 245 meters above mean sea level. Dhaulakuan, is situated on 30° 04’ N and 75° 05’ E at an elevation of 468 m above mean sea level. A trap nursery consisting of six cultivars viz. PBW343, DBW17, PBW550, WH542, DPW621-50, PBW644, was raised during 2012-13 and 2013-14 crop seasons at different locations of North West Plain Zone (NWPZ) based on different height from sea level. The infector row consisting of susceptible check cultivar (PBW 343) was planted after every five rows of the test genotypes. Normal doses of fertilizers (N:P:K 50:25:25 kg/acre) were applied and other recommended agronomic practices were followed (Anonymous., 2001).

The locations were Dhaulakuan in Himachal Pradesh, Gurdaspur and Ludhiana in Punjab, Ambala, Yamuna Nagar, Karnal and Kaul in Haryana. The observations on first appearance of the disease and stages of crop were recorded to find out the movement of the pathogen.Surveys were conducted in wheat growing areas of Haryana, Punjab and Himachal Pradesh during the experimental year to record the disease severity of powdery mildew. The observations on disease commencement and stage of crop influenced, were made to find out the movement of the pathogen at different locations.The disease severity of powdery mildew was recorded from first fortnight of January till end of March due to different time duration of disease initiation at different locations.

The data on disease reaction was recorded when the susceptible check showed the maximum disease reaction till the senescence or drying of leaves.The observations were made on 10 spots and 10 leaves were tagged on per plant basis. The scale (0-9) devised by Saari and Prescott (1975) for appraising the foliar disease intensity of wheat disease was followed, as given below

Scaling for appraising the intensity of foliar disease in wheat

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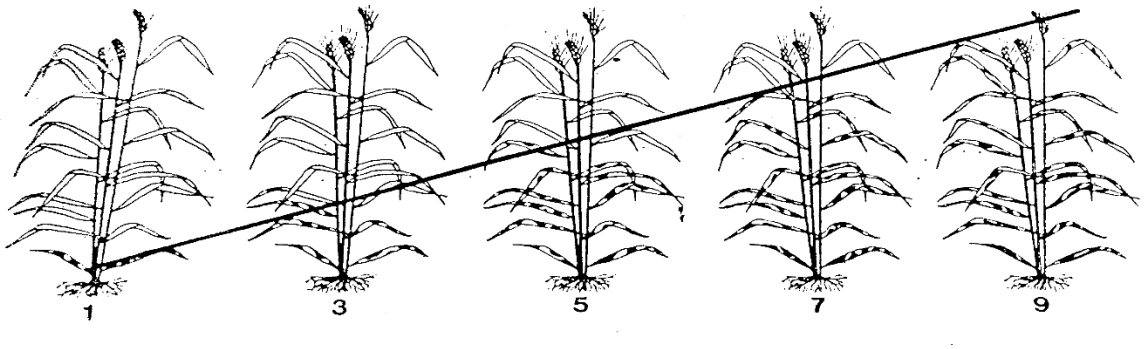

Disease severity scale

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

RESULTS

It was observed that the disease was first noticed in hilly areas of Dhaulakuan (468 m above mean sea level) during first week of February, when the crop was at ear heading stage followed by second week of February, in foot hill areas of Gurdaspur and plains of Yamunanagar (325 M and 224 M above mean sea level) coinciding with anthesis stage (Table.1). However, in Ambala, Ludhiana, Karnal and Kaul was recorded at anthesis, post anthesis and grain formation stage.The observations revealed the appearance of conidial stage of powdery mildew in hills of North India and subsequently the pathogen spread to foot-hills and plains of North India. Similarly inHaryana, Punjab and Himachal Pradesh the conidial stage of the pathogen first appeared in hilly areas of Dhaulakuan at ear heading stage during the first weeks of February followed by Gurdaspur (Punjab) and plains of Yamunanagar (Haryana) at anthesis stage during the second week of February. The survey at regular intervals updates the clear understanding regarding the current status and future scenario (West JS *et al*. 2003, Sankaran *et al*., 2010).

Table 1. Appearance of wheat Powdery at different location in North West Plain Zone

Location	Height from sea level (m)	Crop Stage	Appearance of disease	
			2012-13	2013-14
Dhaulakuan	468	Ear heading	12-02-2013	07-02-2014
Yamunanagar	325	Anthesis	13-02-2013	16-02-2014
Gurdaspur	274	Anthesis	14-02-2013	15-02-2014
Ambala	277	Anthesis	20-02-2013	22-02-2014
Ludhiana	250	Post anthesis	23-02-2013	25-02-2014
Karnal	248	Post anthesis	25-02-2013	19-02-2014
Kaul	242	Grain formation	23-02-2013	22-02-2014

These results are in agreement with the findings of (Awad et al., 2015) that attributed the annual occurrence of powdery mildew of wheat in the plains and foot-hills of North-India by conidial stage on self grown wheat plants at hills.

Survey and surveillance of powdery mildew in wheat growing areas of NWPZ

The survey conducted during 2012-13 and 2013-14 revealed the presence of the conidial stage of the pathogen at Dhaulakuan, Gurdaspur and Yamunanagar during first week of February on main crop (Table. 2).

Table 2. Survey and surveillance of powdery mildew in wheat growing areas of North West Plain Zone (NWPZ)

Location	Months	Disease grade		Stages of Crop
		2012-13	2013-14	
Dhaulakuan	January	0	0	Tillering
	February	3	4	Ear heading

	March	6	7	Grain formation
Karnal	January	0	0	Tillering
	February	2	3	Post anthesis
	March	5	6	Grain formation
Gurdaspur	January	0	0	Tillering
	February	2	2	Anthesis
	March	5	6	Grain formation
Yamunanagar	January	0	0	Tillering
	February	1	1	Ear heading
	March	4	3	Post anthesis
Ludhiana	January	0	0	Tillering
	February	1	1	Anthesis
	March	3	2	Grain formation
Ambala	January	0	0	Tillering
	February	1	1	Anthesis
	March	3	2	Grain formation
Kaul	January	0	0	Tillering
	February	1	1	Grain formation
	March	3	2	Milking stage

The results on disease severity depicted the highest disease grade at Dhaulakuan, which commenced in first week of February and reached to peak (60 to 70%) during March, followed by Gurdaspur and Karnal, where the disease severity reached to maximum (50-60 %) at grain-formation stage during both the years. Whereas, the disease severity remained low (10-30%) at Kaul, even late in the season, coinciding with milking stage of crop growth. Several workers have pointed out that both sexual and asexual stages of *E. graminis* f. sp. *tritici* play an important role in the disease epidemiology (Naik and Kulkarni, 2018). Distribution information of disease across a certain region isvital to macro-decision making process, such as strategic planning, identifying areas requiring intensive field survey, adjusting the budget for prevention practices, allocating limited fungicides andyield forecasts [Zhang, J.C et al and Cooke BM *et al.*]. Besides, the information about an extent and intensity of a disease occurrence is also useful in loss assessment for agricultural insurance.It will be necessary to plan further trials with a wide range of differences in mildew infection. More accurate ground and aerial survey techniques may then be used for further development.

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