

Status of major wheat diseases in sub mountainous region of district Ropar, Punjab, India

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Summary

The wheat diseases, including yellow rust, brown rust, powdery mildew and karnal bunt, continue to be the major impediments to the successful cultivation of wheat crops in the sub-mountainous region of Ropar (Punjab). During the survey, it was observed that the yellow rust disease is a pre-dominant disease of wheat in this region and has always appeared first foci of infection in Ropar district for the last several years in Punjab. The disease caused maximum infection on cultivar Barbat, HD 2967, Shriram 212 followed by WH 1105, HD 3086, PBW 677, HD 3226 and low infection on Unnat PBW 343 and PBW 1 Zn, DBW 222 and PBW 766. However, no infection was recorded in PBW 725, Unnat PBW 550 and PBW 752. The brown rust disease was absent from most of the fields. Although, occasionally found in few low-level fields (5-10S among infested fields). The head blight disease was primarily recorded in durum wheat in wet areas and the maximum incidence (16.45%) was found in the Barbet cultivar in season 2021-22. The karnal bunt disease frequently appeared in this region depending upon the weather condition at the booting stage of the crop and recorded the prevalence range of 0.1-0.40 per cent in surveyed fields. The survey reports will help to prioritize disease management in extension programmes in this region.

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Introduction

Wheat (*Triticum aestivum* L.) is India's second most important cereal crop and plays a vital role in food and nutritional security of the country. It is one of the major food grains of the country and a staple food of the people of North India, where people have a preference for chapatti. In Punjab, it's an important *rabi* cereal crop which is being grown in an area of 35.12 lakh hectares during the year 2019-20 with a total production and productivity of 176.2 lakh tonnes and 50.04 q/ha, respectively in Punjab (Anonymous 2021). Wheat yield is affected by many factors in which, climatic conditions and disease epidemics are most important. Among diseases, yellow rust (*Puccinia striiformis* f. sp. *tritici*) causes maximum damage to the wheat yield. It is locally known as "Piliya" (yellow) in northern India. Yellow rust appeared in severe form in plain areas in J & K, foothills of Punjab and Himachal Pradesh, parts of Haryana, Tarai region of Uttarakhand (Sharma & Saharan 2011; Singh et al. 2017; Ranjini et al. 2022). Jindal et al. (2012) recorded that the losses in yield due to yellow rust varied 4.2-68.8 per cent depending on the resistance of variety. The maximum yield reduction of 68.3 per cent was observed in old cultivar Agra Local, which is highly susceptible to yellow rust, followed by HD 2733 (40.6%) and PBW 343 (30.98%). Singh et al. (2019) assessed the yield losses

due to yellow rust on bread wheat cultivars in Punjab and observed the maximum yield reduction of 75.1 per cent in the highly susceptible cultivar PBW 343 followed by HD 2967 (49.5%) and PBW 621 (25.6%).

Powdery mildew is caused by biotrophic parasitic fungus *Erysiphe graminis* f.sp. *tritici* Em. Marchal (syn: *Blumeria graminis*), with well-developed haustoria that permit it to feed on the cell contents without extensive injury to the supporting tissue. It was endemic in India's northern and southern hills' foot hills and valley areas. However, changing cropping practices has become a significant disease in warmer regions and plains (Bahadur et al. 1996). It is observed to be severe in northern India, especially in Punjab, on widely grown wheat varieties PBW 343, WH 542, UP 2338 etc. Rani and Munshi (2004) reported that disease index was positively and significantly correlated with temperature, whereas humidity was not a prerequisite for disease development.

Head blight or head scab of wheat caused by different *Fusarium* spp. can cause a high reduction in yield if the environment is favourable for disease development during the anthesis stage of the crop in northern states of India, mainly Punjab, Himachal Pradesh and the Nilgiri hills in Tamil Nadu (Saharan et al. 2020). It was reported first time from England in 1884 by Smith and at that time, it was considered to be caused by *Fusisporium culmorum*. *Fusarium* head blight of wheat is associated with more than 17 *Fusarium* spp. (Parry et al. 1995). Among *Fusarium* species isolated from head scab-infected samples from Himachal Pradesh, Punjab and Tamil Nadu, *F. graminearum* was identified from a maximum number of samples indicating its dominance

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(Saharan et al. 2020; Maheshwari et al. 2022). Extensive surveys carried out during 2000–2012 in the Lahaul valley of Himachal Pradesh, the Gurdaspur area of Punjab and in Nilgiri hills of Tamil Nadu revealed the dominance of *F. graminearum* in causing head scab (Saharan et al. 2004; Gupta et al. 2014; Maheshwari and Haldhar, 2018; Haldhar et al. 2017). During 2005, severe FHB incidence was observed on the ruling wheat variety PBW 343 and durum wheat variety PDW 274 in the Gurdaspur area of Punjab, where > 90% of ear heads were infected (Saharan et al. 2007).

Karnal bunt is a disease of wheat, durum, rye and triticale (hybrid wheat and rye). After the first report by Mitra in 1931, McRae reported Karnal to bunt in a virulent form at Karnal in 1934, and later the disease was found in Sind Province of Pakistan in 1941 and the erstwhile United Province and the Delhi State of India in 1942 (Mundkur 1944). 1943 it was prevalent in Punjab and North West Frontier Provinces of Pakistan (Mundkur 1943). By 1969, Karnal bunt had spread to extensive areas in the states of India viz., Jammu & Kashmir, Punjab, Haryana, Himachal Pradesh, Uttar Pradesh, Delhi and Rajasthan (Swaminathan et al., 1971). Disease surveys were conducted to identify the most common diseases of wheat and to help establish management practices better adapted to national needs.

Material and Methods

The survey of different wheat diseases was conducted during the period of subsequent seasons of 2019-20 to 2021-22. Regular monitoring of wheat crop was carried out in various parts of the sub-mountainous region of Ropar district, Punjab, for various diseases in the farmer's wheat fields at regular intervals. Monitoring for the yellow rust was started from the first week of December. The surveys were undertaken with the first field after 10 km and the subsequent stops were made for more samples after every 30 kms on either side of the road. The data on rust severity were recorded using a modified Cobb's scale and for other foliar diseases, it was recorded using 0-9 scale. The disease severity of brown rust and powdery mildew were surveyed in February. The disease head blight was recorded from the infected ear head of the wheat plant and the incidence of head blight was calculated. The infection of karnal bunt disease was recorded after the harvest of crop by collecting the grain samples and analysed the infected grains percentage. The data from surveys of wheat crops was analysed to study the shift in pattern and emergence of minor diseases.

Results and Discussion

The wheat diseases are a severe problem in the sub-mountainous region. The yellow rust is the most commonly occurring fungal disease in wheat. The disease is caused by *P. striiformis* f. sp. *tritici*, a pathogen primarily prevalent in wheat growing areas of low mountainous regions in block Anandpur Sahib, District Ropar, Punjab for the last several years (Table 1) due to cool and wet weather conditions and cultivations of susceptible varieties in small pockets. The intensive survey of wheat disease in this region from several years continuously recorded the maximum infection of yellow

rust on cultivar Barbat, HD 2967, Shri Ram 212 followed by WH 1105, HD 3086, PBW 677, HD 3226 and low infection on *Unnat* PBW 343 and PBW 1 Zn, DBW 222 and PBW 766. However, no infection was noticed in PBW 725, *Unnat* PBW 550 and PBW 752 (Fig 1). Table 2 revealed that the survey of 232 fields, 41.38 per cent of the field was found infected with a range of 20 – 60S disease severity and the mean percentage of yellow rust in the infected field was recorded 48.54 per cent during 2019-20 crop season. In subsequent seasons (2020-21), surveyed 115 wheat fields and found 28.70 per cent field were infected with a range of 5–40S and the mean severity recorded 18.26 per cent. In next season of 2021-22, the total 90 fields of wheat were visited during survey, in which 17.77 per cent of the field were found infected with a range of disease severity 20 – 40S and the mean percentage of yellow rust in the infected field was recorded 17.40 percent. Kaur et al. (2018) conducted a survey of yellow rust from the last 10 years, it has become clear that yellow rust has been making its first appearance in wheat fields of sub-mountainous districts of Punjab viz. Ropar, Hoshiarpur, SBS Nagar, Pathankot, and Gurdaspur districts every year. Jindal et al. (2012) recorded that rust development was higher on Agra Local, WL 711, HD 2733, HD 2687 and PBW 343, with scores up to 80S. Singh et al. (2019) assessed the stripe rust severity on seven wheat varieties, namely HD 3086 (Resistant), PBW 725 (Resistant), PBW 677, *Unnat* PBW 343, PBW 621, HD 2967 and PBW 343 (Susceptible check) 2016-17 and 2017-18. They found that the PBW 621, PBW 343 and HD 2967 show susceptible reactions with disease severity being in the range of 40-80S during both the years, while disease severity in cultivars *Unnat* PBW 343 and PBW 677 was 10-20MS/S and 10-20S, respectively. During survey, the infection of brown rust was also noticed only in 3.45 per cent field with infection level observed 5-10S during 2019-20 however, less infection recorded in few fields of season 2020-21 and 2021-22. The disease powdery mildew was recorded in 4.74 per cent fields of 232 surveyed with a range of 8.4-31.6 per cent in season 2019-20. In season 2020-21, powdery mildew disease was recorded in the 8.50 – 40.2 per cent range in infected fields with a mean severity of 26.42% (Table 2). Sharma et al. (2017) recorded the progression of powdery mildew on different varieties of wheat and triticale in relation to environmental conditions in Karnal (Haryana) and Dhaulakuan (Himachal Pradesh). They observed powdery mildew on all the variety in the third week of February except cultivar DDK 1029 and TL 2934, which were infected in the last week of February in Karnal. The temporal variation in disease index of susceptible variety (PBW 343) was observed in both seasons and locations.

The head blight disease was recorded mostly in durum wheat in the wet area of district Ropar and the maximum incidence (16.45%) was found in the Barbet cultivar in season 2021-22. The mean infection of disease was recorded more in season 2019-20 (0.36%), however, the less infection was recorded in season 2020-21 (0.21%) and 2021-22 (0.28%). Saharan et al. (2020) reported head blight incidence in the state of Punjab, Himachal Pradesh and the Nilgiri hills in Tamil Nadu. In

2005, due to continuous rain in March, head scabs appeared in severe form on durum variety PDW 274 in Gurdaspur area of Punjab (Saharan et al. 2007). Karnal bunt is the most important disease of wheat in Punjab affecting the quality of the wheat grains. The prevalence of karnal bunt disease infection level observed in range of 0.1-0.4 percent across the district in last three years. The mean infection of disease was recorded more in season 2019-20 (0.32%). However, less infection was recorded in season 2020-21 (0.21%) and 2021-22

(0.28%). It has been noticed that the disease is prevalent every year in this sub-mountainous region for long time but it never caused serious yield losses. Kaur et al. (2006) noticed that most of the commercial HYVs developed in India in the post-green revolution era were susceptible to karnal bunt. The present survey was aimed to study the shift in pattern, emergence of disease in this region which will help to prioritize disease management in extension programmes.

Table 1. Appearance of first infection foci of yellow rust in Ropar district in last years

First infection	Variety	Village	Block
26.12.2019	HD 3086, WH 711	Chandesar, Daroli	Anandpur Sahib
18.01.2021	Shri Ram 212	Manakpur	Anandpur Sahib
14.01.2022	HD 2967	Nikku Nangal	Anandpur Sahib

Table 2. Incidence of wheat disease in sub-mountainous region of district Ropar, Punjab

Season	Disease of wheat crop	No. of field surveyed	Infected field (%)	Disease infection level (%)	
				Range	Mean
2019-20	Severity of yellow rust	232	41.38	20 – 60 S	48.54
	Severity of leaf rust	232	3.45	5 – 10 S	7.65
	Severity of powdery mildew	232	4.74	8.4 – 31.6	13.42
	Incidence of head blight	114	7.89	1.5 – 12.80	7.24
	Incidence of karnal bunt	110	18.18	0.2 – 0.40	0.32
2020-21	Severity of yellow rust	115	28.70	5 – 40 S	18.26
	Severity of leaf rust	115	2.61	5 S	5.00
	Severity of powdery mildew	115	12.17	8.50 – 40.2	22.42
	Incidence of head blight	92	8.70	1.24 – 10.28	5.64
	Incidence of karnal bunt	100	6.00	0.1 – 0.30	0.21
2021-22	Severity of yellow rust	90	17.77	5 – 60 S	27.40
	Severity of brown rust	90	3.33	5 S	5.00
	Severity of powdery mildew	90	8.88	12.5 – 44.2	26.42
	Incidence of head blight	132	10.60	2.85 – 16.45	8.15
	Incidence of karnal bunt	100	11.00	0.1 – 0.40	0.28

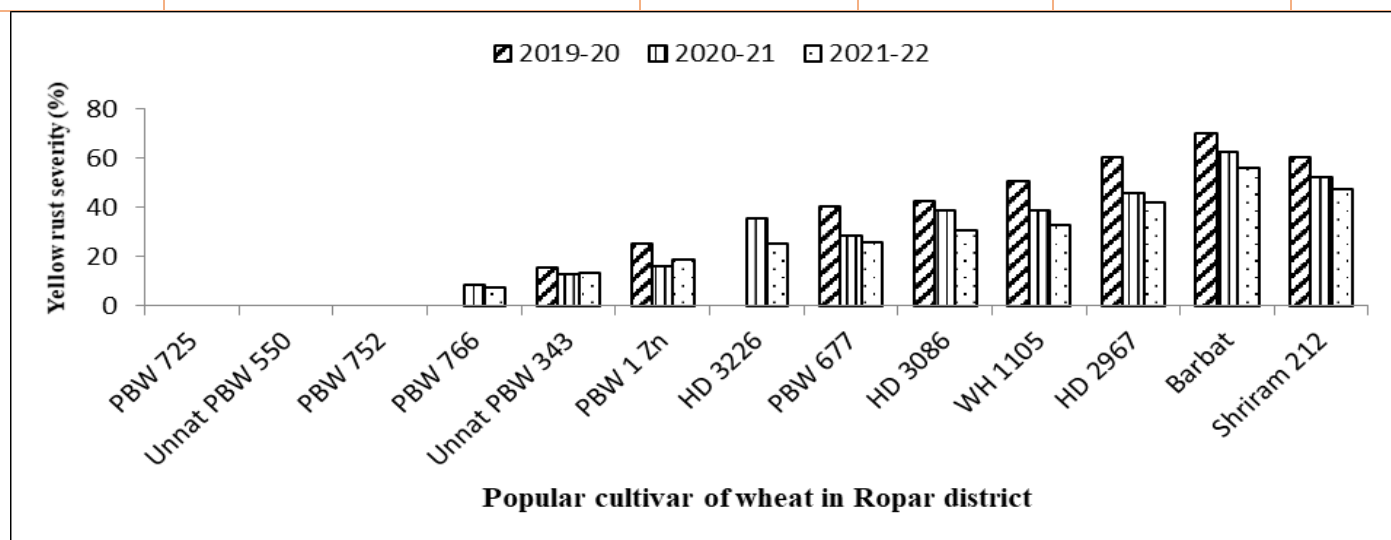


Figure 1. Disease severity of yellow rust on popular cultivars of wheat

Declarations of interests

All authors of this manuscript declare that they have no conflict of interest.

Data sharing

All relevant data are within the manuscript.

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