Short Research Article

Status of rice diseases in Northern Himalayas: A case study of Himachal Pradesh

Abstract

Rice is a major staple crop around the world whose production is hampered by multiple fungal diseases. During 2022 and 2023, surveys were conducted in eight districts of Himachal Pradesh to assess the status of rice diseases. Additionally, seed health status of farmer's own saved seeds was also monitored. Incidence of varying degrees were reported of diseases *viz.*,bacterial leaf blight, neck blast, sheath rot, false smut, brown spot, narrow brown spot and leaf scald. Furthermore during 2022, rice stunting, was also observed in Himachal Pradesh. Farmer saved seeds were analyzed for seed health status which indicated the presence of false smut and brown spot to an alarming level.

Keywords: Seed Health, Pathogens, Diseases, Survey

1. INTRODUCTION

Rice is considered as one of the major staple cereal food source for more than half of the world's population and forms a significant component of the energy resource of the human race. About 480 million metric tons of milled rice are produced worldwide each year (USDA, 2018). Rice is an economically and scientifically important crop which is mostly produced and consumed in Asia and African countries (Dede et al. 2019; Islam et al. 2000). The assessment of seed health standard in rice is very important for farmers and food security as it is a first line approach in managing seed-borne diseases. Furthermore, the quality of planted seeds has a critical influence on the ability of crops to become established and to realize their full yield potential and value (McGee, 1995). Seed-borne diseases may not only introduce new pathogens to affect the quantity or quality of the crop yield but also contaminate the soil permanently (Anselme, 1981). Most crop diseases that are important economically are seed-borne and seed transmitted, including blast disease of rice, bakanae, loose smut, flag smut, karnal bunt, and ear cockle of wheat (Akter and Hossain, 2015). Worldwide, nearly 56 fungal pathogens are reported to infest rice, of which 41 are reported to be seed-borne (Ou, 1985).

This research was carried out to assess seed health status of farmers own saved seeds and also to monitor the incidence of diseases associated with rice production in varied agro-climatic conditions of Himachal Pradesh.

2. METHODOLOGY

Roving field surveys between 2022 & 2023 were undertaken in eight districts of Himachal Pradesh *viz.,* Bilaspur, Chamba, Hamirpur, Kangra, Kullu, Mandi, Sirmour and Una. The data on disease incidence and variety infected was collected. Various Rice diseases, including false smut, bacterial leaf blight, neck blast, sheath rot, sheath blight, brown spot, and leaf scald, were surveyed. Seed samples from farmer saved seeds were also obtained to examine the health status. Nearly four hundred samples were analyzed for presence of seed borne

Comment [BS1]: Missing Authors Guidelines

Comment [BS2]: The title should bea brief Need to be change

Comment [BS3]: The abstract should be concise and informative. It should not exceed 300 words in length. It should briefly describe the purpose of the work, techniques and methods used, major findings with important data and conclusions.
Elaborate the abstract within 220-300 words write in past/present tense

Comment [BS4]: Remove these

Comment [BS5]: Write in small letters
About 4-8 keywords should be given.

Comment [BS6]: Provide a factual background, clearly defined problem, proposed solution, a brief literature survey and the scope and justification of the work done.

Comment [BS7]: Add current data

Comment [BS8]: Add latest references of atleast of 10-15 which will justifying your study.

Comment [BS9]: Missing Methodology

Comment [BS10]: Give adequate information to allow the experiment to be reproduced. Already published methods should be mentioned with references. Significant modifications of published methods and new methods should be described in detail.

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pathogen(s). Seed samples were analyzed for the detection of seed borne fungi by following International Rules for Seed Health Testing (ISTA). In Blotter paper method, three pieces of filter paper were soaked in sterilized distilled water and placed at the bottom of 9cm diameter Petri dish. Seeds of each sample both sterilized (s) and unsterilized (Us), were used in this method with four replications. Sterilization of seeds was done by immersing seeds in sodium hypochlorite solution (1%) for 3 minutes followed by three subsequent washings with distilled water. Seeds were then placed on the moist filter paper at the rate of 10 seeds per Petri dish. The Petri dishes were then incubated at 25+1□for seven days. After incubation, the seeds were examined under microscope for visualizing the seed borne fungal infections.

Comment [BS13]: Add the institute were the investigation was carried out with location name year and season of study

3. RESULTS AND DISCUSSION

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3.1 Surveys during Kharif 2022 and 2023

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In 2022, the incidence of false smut, sheath rot was low (5-10%), while high incidence of neck blast disease (15-20%) was observed in Sawa 200 in Kangra district (Figure 1). In Mandi district, the incidence of neck blast was low (10-15%), with a high incidence of false smut disease (20-25%) and sheath rot (15-20%) observed in US 312, US 315 in Balh. In Sirmour district, the incidence of neck blast, sheath rot, sheath blight, brown spot was low (5-10%), with a high incidence of false smut disease (upto 50%). In Una district, the incidence of sheath blight, narrow brown leaf spot was low (3-5%), with a high incidence of sheath rot (10-15%), false smut (upto 30%) observed in Hybrids 25P35, Az 6444 variety (Table 1). In Chamba district, the incidence of false smut, narrow brown leaf spot was low (5-10%), with a high incidence of sheath rot (10-15%) observed in PAC 807 plus variety. In Bilaspur district, the incidence of neck blast was low (1-10%) observed in local grown variety. In Kullu district, the incidence of false smut was low (5-10%), with a high incidence of neck blast (10-15%) observed in local variety. Rice stunting has been observed as an emerging disease in almost all major rice growing areas of Himachal Pradesh affecting almost all the cultivated varieties in the farmers fields including the hybrids. All the varieties/hybrids *viz.*,Sawa 134, Sawa 234, Buland Raja 88, PR 121were infected with stunting disease. No effect of date of planting was observed on the severity of stunting in most of the rice varieties. Furthermore, during year 2023, bacterial leaf blight, brown spot and false smut incidence was recorded in Sirmour and Kangra districts of Himachal Pradesh. Brown Spot, narrow brown and false smut were also prevalent in all the districts surveyed. However, the incidence of blast was negligible across all the districts with patchy occurrence to an extent of 5 per cent distribution in Kangra and Sirmour districts. Prevalence of other diseases like sheath rot, sheath blight were noticed. Incidence of leaf scald disease was observed in few pockets in surveyed areas of Kangra district in Basmati varieties.

	
Sheath blight of rice	Smut balls of false smut of rice
	
Blast of rice	Brown spot of rice on panicle

Comment [BS16]: Add the photos of remaining diseases also.

Figure 1: Diagnostic symptoms observed during surveys of different rice disease during *kharif*2022 and 2023

Table 1 Status of diseases in rice hybrids/ improved rice varieties cultivated by farmers in Himachal Pradesh during *kharif* 2022 and 2023

Location District/ Blocks (Latitude & Longitude)	Location	Variety	Disease Incidence (%)					
			False Smut	Bacterial Leaf Blight (BLB)	Neck Blast	Sheath Rot	Sheath Blight	Brown Spot (BS)/ Narrow Brown Leaf Spot (NBLS)
Kangra								
Rait (32°11'03"N 76°12'47"E)	Rehlu	HPR 2720	5-10	-	-	5-10	-	-
	Shahpur	Sawa 200	5-10	-	15-20	5-10	-	-
	Shahpur	PAC 807 plus	5-10	-	-	-	-	-
	Dohab	PAC 807 plus	5-10	-	-	-	-	-
Dharamshala (32°13'00"N 76°19'08"E)	Bandi	Sawa 200, PAC 807 plus	10-15	-	5-10	-	-	-
	Gharoh	HPR 2612	-	-	5-10	-	-	-
		HPR 2720	5-10	-	-	5	-	-
	Jadrangal	Local, hybrid	10-15	-	-	5-10	-	-
	Banoi	Az 6508	10-15	-	-	-	-	-
Nagrota Bagwan (32°06'29"N 76°22'56"E)	Chahri	Sawa 200	10-15	-	40-50	10-15	-	-
	Malan	Az 6508	10-15	-	-	-	-	-
	Massal	Sawa 200, Shahi	10-15	-	25-30	5-10	-	-

		Dawat,						
	Pathiar	MRP 5632 (Suruchi)	10-15	-	-	5-10	-	-
Bhawarna (32°02'41"N 76°29'33"E)	Chimbalhaar	PAC 807 plus	<5	-	-	-	-	-
		HPR 2612	-	-	-	-	-	-
	Bagora	Sawa 200	5-10	-	5-10	5-10	-	-
		PAC 834	5-10	-	-	-	-	-
	Mainjha	PAC 834, Sawa 200	5-10	-	-	5-10	-	-
Mandi								
Sandhol (31°51'31"N 76°39'09"E)	Sandhol	HPR 2795	-	-	-	-	-	-
	Lasrana	Hybrid (Not known)	15-20	-	10-15	15-20	-	15-20 (BS); 40-50 (NBLS)
Balh (31°53'22"N 76°55'15"E)	Galma	US 312	25-30	-	-	5-10	-	10-15 (BS)
	Sundernagar	US 312, US 315	25-30	-	-	5-10	-	-
Sirmour								
Paonta Sahib (30°31'54"N 77°34'02"E)	Dhaulakuan	AZ 6444	25-30	-	5-10	5-10	10-15	10-15 BS
	Puruwala	Az 6444, Dhanya 834	25-30	-	5-10	5-10	5-10	10-15
	Surajpur	Az. 6444, Varsha Gold	30-35	-	5-10	5-10	10-15	5-10
	Rampur	Hyb 25P35	Up to	-	5	10-15	5-10	5-10

			50%					
	Kolar	Az. 6444, Dhanya 834, Varsha Gold	25-30	-	5-10	5-10	10-15	15-20
Una								
Una (31°28'14"N 76°16'07"E)	Rampur	Az 6444	10-15	-	-	-	-	5-10 NBLS/ BS
	Basal	Hyb. 25P35, Az 6444	10-20	-	-	-	-	10 BS
	Nangal Khurd	Hyb. 257, Hyb. 1067	25-30	-	-	-	-	10-15 NBLS/ BS
	Nandpur	Az 6444	7-10	-	3	12-15	3	5
	Ispur	Az 6444	3	-	3	12	3	5
	Andora	Hyb. 25P35, Az 6444	8	-	5	10	5	5
	Kuthiari	Hyb. 257, Hyb. 1067	10	-	3	10	5	4
	Chak	Az 6444	5	-	4	10	4	4
	Thathal	Az 6444	5	-	4	8	4	4
Chamba								
Bhatiyat (32°26'57"N 76°00'37"E)	Sihunta	PAC 807 plus	5-10	-	-	10-15	-	5-10 NBLS
Bilaspur								
Bilaspur	Jhandutta	Local	-	-	5-7	-	-	-

(22°04'46"N 82°08'27"E)	Bilaspur sadar	Local	-	-	2-3	-	-	-
	Ghumarwin	Local	-	-	10-11	-	-	-
	Nainadevi	Local	-		1-3	-	-	-
Kullu								
Kullu (31°57'16"N 77°06'40"E)	Baragran	Local	10	-	15	-	-	-
	Chhaki	Local	5	-	10	-	-	-
	Naggar Seri	Local	10	-	15	-	-	-
	Haripur	Local	10	-	15	-	-	-

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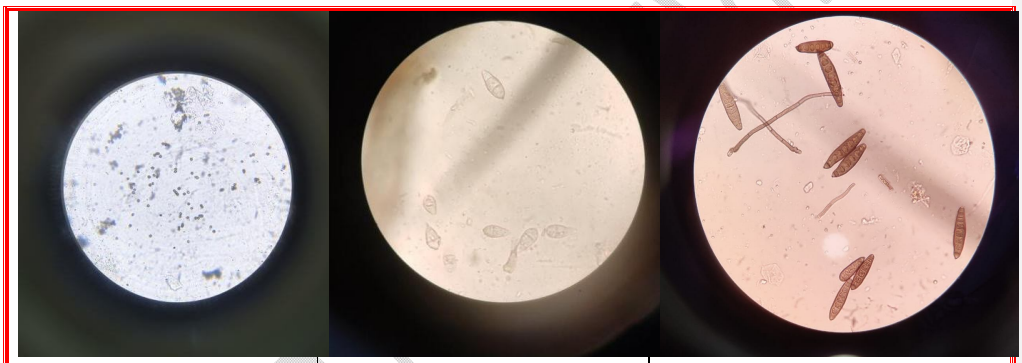
3.2 Seed health status of farmers own saved seeds in Rice

Nearly 400 samples of farmer saved seeds were analyzed for checking the seed health status. In samples collected and analyzed from Hamirpur district revealed 33.33% incidence of false smut and 25.08% incidence of brown spot across varieties such as Sawa 200, Star 795, and LG No. 1. Furthermore, samples from Kangra district exhibited 17.31% incidence of brown spot and 30.77% incidence of false smut, encompassing varieties including HD 3086, HS 562, 5258, GBW 343, 6129, Tanatan, Star795, Sawa 200, LV, 234No., 200 No., and Shriram (Figure 2). In Mandi district, analysis of samples showed 33.33% incidence of false smut and 29.63% incidence of brown spot among varieties such as Tanatan, Star795, Sawa 200, LV, and Chaina. Similarly, Chamba district's samples exhibited a 15.38% incidence of false smut and 7.69% incidence of brown spot across Vijeta 700 and LV varieties. Meanwhile, Una district's samples demonstrated a 50% incidence of false smut and a 20% incidence of brown spot within PR 126 and Star 795 varieties. Lastly, in Sirmour district, examination of samples revealed a 45% incidence of false smut and a 47.5% incidence of brown spot among varieties such as Arize 6444, Pusa 1509, HPR 2795, PR 130, PR126, Lal Killa, Pusa 1121, and Sarvati.



A. Spores of *Ustilaginoidea virens*	B. Spores of *Pyricularia oryzae*	C. Spores of *Helminthosporium oryzae*

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Figure 2: Microscopic observation of mycoflora associated with false smut, blast and brown spot from farmers saved rice seeds

Seed-borne infections in rice cause 50-80% yield losses, depending on the agroecology, disease severity, and crop susceptibility (Monajjem et al. 2014). Farmers who rely on their farm-saved seeds are likely to contaminate their subsequent seeds for the next planting season in instances where there is seed-borne pathogen transmission from the soil. Most seed-borne diseases caused by the fungi are disastrous as they may decrease seed germination, causing seed discoloration and produce toxins that may be detrimental to man and domestic animals. Distribution of some seed-borne fungi associated with rice seeds has been reported in many countries, including Nigeria (Suleiman and Omafe, 2013); Pakistan (Butt et al. 2011); Egypt (Madbouly et al. 2012); Bangladesh (Ora et al. 2011); Cameroon (Nguefack et al. 2007) and Chad Republic (Serferbe et al. 2016).

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4. CONCLUSION

This study shed light on the occurrence of false smut, brown spot and sheath rot consistently over both the year under study. It is evident from the study that seed-borne fungi were

associated with all the rice cultivars sampled from the study area. There was high prevalence of storage fungi associated with the rice seeds partly because of the storage practices employed by the farmers. The need to emphasize the role of healthy seed in establishment of a healthy crop is highlight with this work.

Comment [BS20]: Rewrite the Conclusion
missing justification of study
Needed writing in word limit of 80 words

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