Assessment of Brown Spot Disease (*Bipolaris oryzae*) Severity in Paddy Fields of Prayagraj District, Uttar Pradesh, India

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Abstract— *Brown spot disease, caused by the fungus Bipolaris oryzae, poses a significant threat to rice production. This study assessed the severity and distribution of the disease in the paddy fields of the Prayagraj district, Uttar Pradesh, India, over two consecutive Kharif seasons (September 2011 and September 2012). A survey was conducted across eight tehsils (Karchhana, Soraon, Handia, Phulpur, Bara, Meja, Sadar, and Koraon), with five villages randomly selected from each. Disease severity was quantified using the Percent Disease Incidence (PDI) method. The pooled mean PDI across the tehsils ranged from a low of 25.08% in Phulpur to a high of 47.24% in Meja. High disease incidence was also noted in Soraon (45.57%). The village-level data revealed the highest pooled PDI of 50.0% in Dihi Khurd (Meja) on the PB-1509 variety. The disease was prevalent during both the Post tillering and Panicle initiation stages. The consistent and high incidence of brown spot disease in tehsils like Meja and Soraon confirms its endemic status in the region and underscores the urgent need for targeted integrated disease management strategies, including the development and deployment of resistant rice varieties*.

Keywords— Rice, Bipolaris oryzae, Prayagraj, Percent Disease Incidence (PDI), PB-1509 and PB 1121.

I. INTRODUCTION

Rice (*Oryza sativa* L.) is a staple food for more than half of the world's population and is critical to global food security [1]. In India, rice is the most important food crop, and its production is vital for the country's economy and sustenance. However, rice production is constantly threatened by various biotic and abiotic stresses. Among the biotic stresses, fungal diseases are a major limiting factor, with brown spot disease being one of the most destructive [2] [3].

Brown spot disease, caused by the ascomycete fungus *Bipolaris oryzae* (teleomorph: *Cochliobolus miyabeanus*), affects the rice plant at all growth stages, from the seedling to the grain-filling stage [4]. The characteristic symptoms include oval to circular spots on the leaves, which are initially dark brown and later develop a greyish-white center with a reddish-brown margin. Severe infection leads to premature leaf senescence, reduced photosynthetic efficiency, and poor grain filling, resulting in significant yield losses, which can range from 1% to 34% in various parts of Asia and Africa [5].

The severity of brown spot disease is highly influenced by environmental factors, particularly high humidity and temperature, as well as host factors such as varietal susceptibility and nutritional status of the plant, especially nitrogen and potassium

deficiency [6]. Given the significant economic impact of the disease, regular monitoring and assessment of its incidence and severity are crucial for effective disease management planning. This study aimed to determine the prevalence and severity of brown spot disease in the major rice-growing areas of the Prayagraj district, Uttar Pradesh, over two consecutive years, providing essential data for regional disease control efforts.

II. MATERIALS AND METHODS

The survey was conducted in the Prayagraj district of Uttar Pradesh, India, during the Kharif (monsoon) cropping season. The study spanned two consecutive years, with data collection carried out in September 2011 and September 2012. A total of eight tehsils (administrative blocks) were selected for the assessment, namely Karchhana, Soraon, Handia, Phulpur, Bara, Meja, Sadar, and Koraon. From each tehsil, five villages were randomly selected, making a total of 40 villages surveyed each year [7].

2.1 Field Sampling and Data Collection:

A random sampling technique was employed across paddy fields in the selected villages. In each village, several fields were visited, and plants were observed along a 'W'-shaped transect to ensure a representative sample of the area [8]. From each field, a minimum of 50 plants were randomly selected and thoroughly examined for characteristic symptoms of brown spot disease caused by *Bipolaris oryzae*, including oval, brown spots with a grey center on leaves and glumes. The stage of the crop (Post tillering or Panicle initiation) was also recorded.

2.2 Assessment of Disease Severity:

The Percent Disease Severity (PDS) was calculated for each village in both years. The severity was assessed using a standard 0-9 scale for brown spot disease [9], where 0 represents no disease and 9 represents very severe infection covering more than 50% of the leaf area. The percent severity was then calculated using the following formula:

$$\text{Disease severity } \% = \frac{\text{Sum of all disease rating}}{\text{Total number of rating} \times \text{Max. disease grade}} \times 100 \quad (1)$$

2.3 Pathogen Identification:

The causal agent of the disease was confirmed as *Bipolaris oryzae* through laboratory analysis. Infected leaf samples showing typical symptoms were collected, surface sterilized, and incubated on Potato Dextrose Agar (PDA) medium. The fungal colonies that developed were examined microscopically for conidial morphology, confirming the identity of the pathogen based on its characteristic geniculate conidiophores and fusiform, pale brown conidia [10].

The collected data was systematically compiled and analyzed using Microsoft Excel. The following calculations were performed: Pooled Disease Severity for each village: The average of the Percent Disease Severity recorded in September 2011 and September 2012 for each individual village. Percent Disease Severity for each Tehsil: The mean value of the Pooled Disease Severity from all five villages within a tehsil was calculated to represent the overall disease severity for that administrative block.

III. RESULTS AND DISCUSSION

3.1 Disease Incidence and Severity Across Tehsils:

The survey results revealed a widespread presence of brown spot disease across all eight tehsils of the Prayagraj district during both the 2011 and 2012 Kharif seasons. The raw data, presented in Table 1, shows the Percent Disease Incidence (PDI) for each village, the pooled PDI over the two years, and the mean PDI for each tehsil.

The mean Percent Disease Incidence (PDI) for the tehsils varied significantly, ranging from a minimum of 25.08% in Phulpur to a maximum of 47.24% in Meja. The tehsils can be broadly categorized based on their pooled PDI:

Category	**Mean Pooled PDI (%) Tehsils**
High Incidence	> 40% Meja (47.24%), Soraon (45.57%)
Moderate Incidence	30% - 40% Karchhana (39.92%), Bara (36.04%), Handia (35.47%), Sadar (33.93%)
Low Incidence	< 30% Koraon (28.17%), Phulpur (25.08%)

The high incidence observed in Meja (47.24%) and Soraon (45.57%) suggests that these areas may possess environmental conditions (e.g., higher humidity, poor soil fertility, or specific microclimates) or cultivation practices (e.g., susceptible varieties like PB-1121 and PB-1509, as noted in the raw data) that are highly conducive to the development and spread of Bipolaris oryzae [11]. Conversely, the lower incidence in Phulpur (25.08%) and Koraon (28.17%) might be attributed to less favorable conditions for the pathogen or the use of relatively more tolerant rice varieties.

3.2 Year-to-Year Variation:

A comparison of the PDI between September 2011 and September 2012 shows a mixed trend. While some villages, such as Akodha in Karchhana (38.5% in 2011 to 46.7% in 2012) and Tendua in Karchhana (34.2% in 2011 to 38.8% in 2012), experienced an increase in disease severity, others, like Dadanpur in Soraon (47.8% in 2011 to 46.5% in 2012) and Dihi Khurd in Meja (52.6% in 2011 to 47.4% in 2012), showed a slight decrease. The village Dihi Khurd in Meja recorded the highest PDI in 2011 (52.6%), which is a critical finding, indicating a severe outbreak in that specific location (**Table 1: Figure 1)**. The overall pooled data, however, suggests that the disease is consistently present at moderate to high levels across the district, confirming its endemic status [12].

3.3 Influence of Crop Stage and Variety:

The data indicates that the disease was prevalent during both the Post tillering stage and the Panicle initiation stage. The panicle initiation stage is a critical period for rice development, and disease infection at this stage can directly impact grain formation and yield [13]. The raw data shows that both the popular varieties, PB-1121 and PB-1509, were susceptible to the disease, with high PDI recorded in fields growing both varieties. For instance, the highest pooled PDI (50.0%) was recorded in Dihi Khurd (Meja) on the PB-1509 variety. This suggests that varietal resistance is a key area for future research and intervention in the region [14].

TABLE 1
POOLED PERCENT DISEASE INCIDENCE (PDI) OF BROWN SPOT DISEASE IN PRAYAGRAJ DISTRICT (2011-2012)

S.N.	Tehsil Name	Village Name	Variety	PDI (Sept 2011) (%)	PDI (Sept 2012) (%)	Pooled PDI (Village Mean) (%)	Mean Tehsil PDI (%)	Crop Stage
1	Karchhana	Hasimpur	PB-1121	38.4	38.5	38.45	39.92	Panicle initiation stage
		Tendua	PB-1509	34.2	38.8	36.5		Post tillering stage
		Akodha	PB-1509	38.5	46.7	42.6		Panicle initiation stage
		Jamoli	PB-1509	39	42.6	40.8		Post tillering stage
		Karma	PB-1121	42	40.5	41.25		Panicle initiation stage
2	Soraon	Husenpur	PB-1121	42.6	47.2	44.9	45.57	Post tillering stage
		Sangipur	PB-1121	41.6	48.6	45.1		Panicle initiation stage
		Budauna	PB-1121	46.2	45.8	46		Post tillering stage
		Dadanpur	PB-1121	47.8	46.5	47.15		Panicle initiation stage
		Jogipur	PB-1509	45	44.4	44.7		Post tillering stage
3	Handia	Raghupur	PB-1509	34.6	36.2	35.4	35.47	Panicle initiation stage
		Thata	PB-1121	38.6	37.2	37.9		Post tillering stage
		Madaripur	PB-1509	39.5	43	41.25		Panicle initiation stage
		Yasinpur	PB-1509	28.6	32.8	30.7		Post tillering stage
		Rastipur	PB-1509	30	34.2	32.1		Panicle initiation stage
4	Phulpur	Chata	PB-1509	26.2	24.7	25.45	25.08	Post tillering stage
		Pali	PB-1121	24.6	22	23.3		Panicle initiation stage
		Saray Taki	PB-1509	24.8	27.4	26.1		Post tillering stage
		Poore Durgi	PB-1509	25	26.5	25.75		Panicle initiation stage
		Husenpur	PB-1509	25.4	24.2	24.8		Post tillering stage
5	Bara	Dera	PB-1121	35.2	38.4	36.8	36.04	Panicle initiation stage
		Kota	PB-1121	34.2	32.6	33.4		Post tillering stage
		Bhondi	PB-1121	31.6	35	33.3		Panicle initiation stage
		Lohra	PB-1121	38.6	42.2	40.4		Post tillering stage
		Ankoria	PB-1121	40.2	32.4	36.3		Panicle initiation stage
6	Meja	Ahopur	PB-1509	48.5	47.2	47.85	47.24	Post tillering stage
		Jafra	PB-1509	44.6	46.3	45.45		Panicle initiation stage
		Barva	PB-1121	46.4	48.2	47.3		Post tillering stage
		Kukur Katva	PB-1509	48.7	42.5	45.6		Panicle initiation stage
		Dihi Khurd	PB-1509	52.6	47.4	50		Post tillering stage
7	Sadar	Fulwa	PB-1509	41.2	35.2	38.2	33.93	Panicle initiation stage
		Rahimabad	PB-1509	31.4	28.4	29.9		Panicle initiation stage
		Nasirpur Silna	PB-1121	36.8	33.2	35		Panicle initiation stage
		Hari Rampur	PB-1509	32.2	37.5	34.85		Post tillering stage
		Tiyara	PB-1509	28.4	35	31.7		Panicle initiation stage
8	Koraon	Baghol	PB-1509	26.8	32.6	29.7	28.17	Panicle initiation stage
		Jokhat	PB-1121	22.5	35.2	28.85		Post tillering stage
		Derhan	PB-1509	28.6	30	29.3		Panicle initiation stage
		Uday Mala	PB-1121	27.4	28	27.7		Panicle initiation stage
		Newada	PB-1509	27	23.6	25.3		Panicle initiation stage

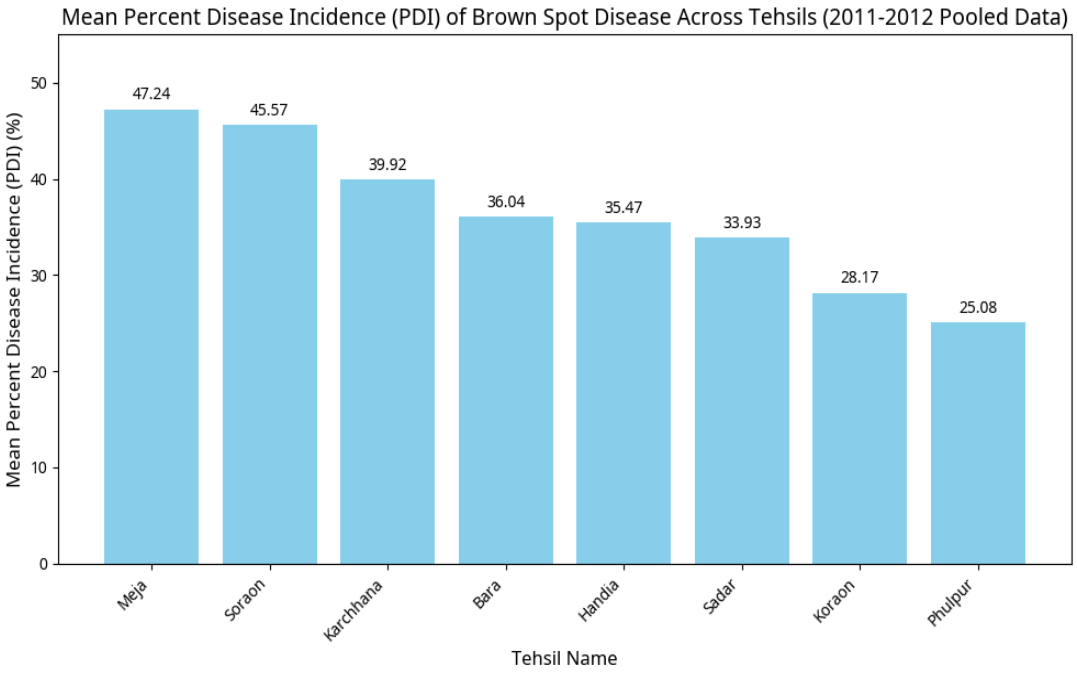

FIGURE 1: Mean Percent Disease Incidence (PDI) of Brown Spot Disease Across Tehsils (2011-2012 Pooled Data)

FIGURE 2: Disease Photograph

IV. CONCLUSION

The study successfully quantified the severity of brown spot disease in the Prayagraj district, identifying Meja and Soraon as the tehsils with the highest disease incidence. The consistent presence of the disease over two years, coupled with high PDI values in specific villages and varieties, underscores the urgent need for effective disease management. Future research should focus on the correlation between soil nutrient status, specific environmental parameters, and the observed disease severity to develop an integrated pest management (IPM) strategy that includes the use of resistant varieties, balanced fertilization, and timely fungicide application.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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