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Survey of *Sclerotinia* stem rot disease incidence of mustard crop in eastern Part of Uttar Pradesh, India

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ABSTRACT

A survey conducted to assess the incidence of *Sclerotinia* stem rot in rape-seed mustard during Rabi seasons of 2022-2023 and 2023-2024. The survey was conducted in five districts of eastern Part of Uttar Pradesh, namely Raebareli, Pratapgarh, Ayodhya, Jaunpur, Varanasi, Six Villages Were selected in each district Randomly. The city of Varanasi recorded that highest average PDI (Percentage Disease Incidence) at 25.65, indicating a severe level of infection following Varanasi, the city of Jaunpur, Ayodhya, Pratapgarh and Raebareli also experienced varying degree of infection. In Raebareli district recorded minimum PDI (21.35)in 2022-2023 rabi seasons. The study focuses on analyzing the PDI data to understand the extent of the Infection in these cities. This research paper abstract presents the numerical values (23.79, 22.81, 21.90, 21.35) Corresponding to a specific season, namely season 2022-2023. Percentage of disease incidence recorded in the district of Jaunpur (28.06), Varanasi (27.70), Ayodhya (24.28), Pratapgarh (23.19) Raebareli (23.03) during the 2023-2024 seasons.

***Key words**: Survey,* Sclrotinia*, and Percent disease incidence (PDI), Rapseed mustard*

Introduction

One of the main oilseed crops grown in Rajasthan, India, is mustard (*Brassica juncea* L.). During the Rabi season, mustards are the most important oilseed crop in the crop group. The main purpose of growing mustard is for its oil. In North India, where it is hard to find alternative oil, the oil is used extensively for human consumption across the nation. The mustard crop is cultivated in both tropical and subtropical regions. In the world, India ranks third in terms of both average and production of mustard. In 2020, mustard yielded 9123.64 million tons of output and 1331 kg/hectare on 6856.27 hectares of cultivable land in India (2020, Anonymous).

In India, *Brassica juncea*, also referred to as rapeseed mustard, is one of the most important cultivable species. It includes a significant amount, around 90%, of the total amount of land used for cultivation (9.168 million hectares) and the amount of mustard crops produced (11.75 million metric tons). Notably, according to the Ministry of Agriculture and Farmers Welfare, Government of India (2022), its production reached 1178 kg per hectare during the agricultural year 2021-2022.

One of the most important oilseed crops in the *Brassica* group is *Brassica juncea* L. Czern. & Coss, also referred to as Indian mustard. According to Thakur *et al*., (2020), Bhaghel *et al*., (2020), and Shyam *et al*. (2021) it is classified as a naturally oc-

curring amphidiploid with a genome size of 920 Mb. As to Khan *et al*., (2019), Indian mustard has two sets of chromosomes (2n = 36) in its genome, and it has a tendency towards cross-pollination.

It is a plant that is grown all over the world for its oil, condiment, and leafy vegetable qualities (Shyam *et al*., 2021). Being an essential oilseed crop for India, it is highly significant because of its significant industrial, nutritional, and economic ramifications (Kaur *et al*., 2019).

More than twenty diseases have a significant negative impact on the crop's finances. the deadly mustard illness, which can be brought on by viruses, bacteria, fungus, or phytoplasma. The fungus *Sclerotinia sclerotiorum* (Lib.) de Bary is the second most important cause of disease, behind *Alternaria blight*. Mustard stem rot is a widespread and global disease that has been documented in a number of other nations, including Canada (Morall, 1976), Germany (Kirchner and Pluschkell, 1973), and Nepal Chaudhary *et al*., (2004). Shaw and Ajrekar (1915) were the first in India to report this disease on mustard crops, originating from Pusa, Bihar. Mustard stem rot has recently become a major issue in several states, including Uttar Pradesh, Haryana, Himachali Pradesh, Punjab, and Bihar (Thakur and Kumar, 2000).

All parts of the mustard plant were affected by the pathogen, which in severe cases resulted in various symptoms. Stem rot can be caused by the fungus's sclerotia, which can develop outside the stem and are easily noticeable. A lengthy, water-shoaked patch on the stem is the disease's visible sign. A cottony mycelial growth of the fungus subsequently covers these places that are shoked with water. The lesions progressively enlarge until, under ideal circumstances, they fully encircle the stem, causing the plant to wilt and die. Numerous grayish-white to black sclerotia of various sizes and forms occur on the surface of the lesion as well as inside the pith, and the affected area turns white and begins to shred (Chahal, 1982).

Materials and Methodology

During the 2022–2023 and 2023–2024 agricultural Ravi seasons, a thorough survey was carried out to determine the incidence and severity of *sclerotinia* stem rot in Indian mustard (*Brassica juncea*). Farmers' fields will serve as the main site of data collection for this project, enabling observations to be made in their natural habitat. *Sclerotinia* stem rot is a fungal disease that affects Indian mustard. A survey was conducted in the Eastern parts of Uttar Pradesh, India to record the prevalence and spatial distribution of this disease.

The study focused on the primary areas for mustard cultivation, covering six villages and six fields from each district and village. Raebareli, Pratapgarh, Ayodhya, Janpur, and Varanasi were among the districts. Random sampling was used to choose the settlements in each district. It was found in this study that each village visited anywhere between five and ten fields. The average distance between each village and these fields was 15 to 20 km.

Data on soil type, cultivars cultivated, disease incidence, and agronomic techniques were among the features of the survey that were collected, as Table 1 indcates. For additional research and assessment, this data was thoroughly documented.In this investigation, a random square meter quadrant was chosen from each field using a systematic sampling technique. This sampling strategy was designed to provide fair representation of the whole field area. The number of infected plants found in each chosen quadrant was then methodically tallied.

Accurate measurement of the degree of plant infection in the corresponding fields was made possible by this technology. A combination of the total number of plants and the number of affected plants were used to calculate the disease incidence. An observation, monitoring, and documentation of the disease's incidence were conducted.

Percentage disease incidence (PDI) was measured by the formula

PDI = [Total number of infected plant / total number of observed plant] × 100

Results and Discussion

Farmer Practices

Based on the data in Table 1, it can be concluded that farmers mainly choose hybrid varieties for a variety of reasons, such as choosing appropriate varieties, taking soil type into account, putting appropriate agronomic practices into practice, and strategically timing sowing. The current study aimed to explore the differences in soil types in the area by conducting an extensive field survey across five districts in eastern Uttar Pradesh. This study looks into the distribution of sandy soil in Varanasi,

Table 1. Cropping information (district, village, soil type, agronomic practices, showing time). Table 2- Sclerotinia stem rot percent disease incidence

S.N.	District	Village	Variety	Soil Type	Agronomic Practices	Sowing Time
01		Bhishampur	Shreeram 1666, CS-60, RLM 198	Sandy loam	After harrowing Sowing behind country plough	1st week Oct. to 3rd week Nov.
		Bhitkuri	Sabera 707, PAC 737, RLM 1724	Sandy loam with rotavator	Two time ploughing by cultivator and sowing	1st week Oct. to 3rd week Nov
	Varanasi	Chaklola	PAC 737, Sabera 707, RLM 198	Sandy loam	Two time Harrowing and sowing with cultivator	1st week Oct. to 3rd week Nov
		Dilawalpur	Shreeram 1666, CS-60, RLM 198	Sandy loam	After harrowing Sowing behind country plough	1st week Oct. to 3rd week Nov
		Arjunpur	PAC 737, Sabera 707, Shreeram 1666	Sandy loam	Two time ploughing by cultivator and sowing with rotavator	1st week Oct. to 3rd week Nov
		Barki	Champion,vardan	Sandy loam	After harrowing Sowing behind country plough	1st week Oct. to 3rd week Nov
02		Badalpatti	Hybage 7044, Sabera 707, RLM 198	silt	Two time harrowing with disk harrow and sowing with cultivator	Mid Oct. to first week of Nov.
		Balua	Pineer 45S46, Sabera 707	Sandy loam	Two time harrowing with disk harrow and sowing with cultivator	Mid oct. to first week of Nov.
	Jaunpur	Akbarpur	Varuna, Maya, Urvashi,	Sandy loam	Two time ploughing rotavetor and sowing with cultivator	Mid oct. to first week of Nov.
		Badwa	N.D.R. 8501,RLM 198	Sandy loam	Two time harrowing with dick harrow and sowing with cultivator	Mid oct. to first week of Nov.
		Ashapur	Varuna, 5222	silt	Two time ploughing rotavetor and sowing with cultivator	Mid oct. to first week of Nov.
		Balaipur	Pineer 45S46, Sabera 707	Sandy loam	Two time ploughing rotavetor and sowing with cultivator	Mid oct. to first week of Nov.
03		Adilpur	RLM 1724, RLM 198	silt	Two time ploughing rotavetor and sowing with cultivator	Mid oct to last week of Dec
		Bani	Varuna, Maya, Urvashi,	Sandy loam	Two time harrowing with dick harrow and sowing with cultivator	Mid oct to last week of Dec
	Ayodhya	Bhawanipur	N.D.R. 8501,RLM 198	silt	Two time ploughing rotavetor and sowing with cultivator	Mid oct to last week of Dec
		Chitaipur	Vardan	Sandy loam	Two time Ploughing by cultivator and sowing with rotavator	Mid oct to last week of Dec
		Bankat	Crystal-5222, 5210	Sandy loam	Two time Ploughing with rotavator and sowing with cultivator	Mid oct to last week of Dec
		Chitawan	C S-52, C S-58	silt	Two time Harrowing and sowing with cultivator	Mid oct to last week of Dec
04		Atri	Champion, 5210	Sandy loam	Two time Ploughing with rotavator and sowing with cultivator	2nd week of Oct to Nov last week
		Balipur	Pioneer 45s46,Varuna,	Silty loam	Two time Ploughing by cultivator and sowing with rotavator	2nd week of Oct to Nov last week
	Pratapgarh	Dariyapur	Hybage 7044, Sabera 707, RLM 198	Clay loam	Two time harrowing and sowing with cultivator	2nd week of Oct to Nov last week
		Chateri	Pioneer 45S46, Sabera 707	Clay loam	Two time harrowing with cultivator and sowing	2nd week of Oct to Nov last week

Table 1. Cropping information (district, village, soil type, agronomic practices, showing time). Table 2- Sclerotinia stem rot percent disease incidence

S.N.	District	Village	Variety	Soil Type	Agronomic Practices	Sowing Time
		Devkali	RLM 198, Pineer 45S46	Clay loam	Two time harrowing with cultivator and sowing with cultivator	2nd week of Oct to Nov last week
		Gopalpur	5111, 5222, 45s46, Rai kuria,	Clay loam	Two time harrowing with cultivator and sowing with cultivator	Last week of Oct to Nov last week
05		Daulatpur	Albeli-1, EJ 17	Deep loamy soil	Two time harrowing with rotavetor and sowing with cultivator	Last week of Oct to Nov last week
		Faridpur	NPJ 124 , 45s46	Deep loamy soil	Two time harrowing with rotavetor and sowing with cultivator	Last week of Oct to Nov last week
	Raebareli	Dhanapur	Azad mahek, CS 58	Loamy soil	Two time harrowing with rotavetor and sowing with cultivator	Last week of Oct to Nov last week
		Gaddipur	Rohini, 45s35, kaliya,	Deep loamy soil	Two time harrowing with rotavetor and sowing with cultivator	Last week of Oct to Nov last week
		Hajjpur	RGN 298, CS-60	Deep loamy soil	Two time harrowing with rotavetor and sowing with cultivator	Last week of Oct to Nov last week
		Ganeshpur	Azad mahek, CS58	Deep loamy soil	Two time harrowing with rotavetor and sowing with cultivator	Last week of Oct to Nov last week

Jaunpur, Ayodhya, Raebareli, and Pratapgarh, among other regions of Uttar Pradesh. The main goal is to find out how common and how much sandy soil there is in these places.

The objective of this research is to enhance the current understanding of soil types and their geographical distribution in Uttar Pradesh by investigating the composition and properties of the soil. The purpose of this study was to find out where in Ayodhya, Jaunpur, Raebareli, Pratapgarh and Varanasi sandy loamy soil is found. To find and record this sort of soil in the previously specified locations, the researchers made field observations.

The results showed that sandy loamy soil is common, demonstrating its importance in the local soil composition. The findings of this study add significantly to our understanding of the different types of soil found in these areas, particularly the silty loamy and silty clay loam soils that have been found in Ayodhya, Pratapgarh, and some areas Varanasi. The basis for good crop growth and development is laid by field preparation, which is an essential phase in agricultural techniques. Farmers use a range of mechanized instruments, including the rotavator, disc harrow, and cultivator, to attain the best possible field conditions.

These tools are essential for getting the soil ready for planting and creating an environment that is conducive to plant growth and seed germination. One common farming tool is the rotavator, which is made to break It has been noted that the farmers in the agricultural area of Ayodhya, Pratpgargh, follow a custom of planting their crops at a set period.

This period of time begins in the middle of October and finishes the last week of December. The best time to plant crops for agricultural purposes is between the last week of September and the second week of November, according to studies done in Raebareli.It has been determined that this is the best time of year to start planting crops in the area. In Pratapgarh, Uttar Pradesh, India, research indicates that the sowing season usually starts in the second week of October and lasts until the first week of November.

This is said to be the best time of year to start planting crops in the area. The data that is currently available indicates that Jaunpur festival season runs from the first week of October to the last week of November. Similarly, the festival season in Varanasi starts in the last week of October and ends in the third week of November.

PDI

Based on the conclusions shown in Table 2. There is significant variation in the prevalence of sclerotinia stem rot disease in *Brassica juncea*, or rapeseed mustard, across the five well-known districts located in eastern Uttar Pradesh. In the survey districts, the observed disease incidence ranged from 21.35 to 28.06 throughout the course of the following years, 2022-2023, and 2023-2024, indicating a consistent and steady trend in prevalence.

The disease's symptoms have been reported in a total of five districts located in Uttar Pradesh's eastern areas. Still, it is important to highlight that varanasi had the highest incidence of the disease between 2022 and 2023, with a significant prevalence rate of 25.65%. The urban centers in Uttar Pradesh, photo of disease incidence, India that have the highest scores are outlined below: With the highest score of 23.79 in the current study, jaunpur demonstrated its significance in the characteristics that were observed. Subsequently, Ayodhya exhibited a score of 22.81, signifying its closeness to Jaunpur for the assessed criteria.

The municipality of Ayodhya performed admirably in the current survey, placing third with a noteworthy score of 22.81. Nearby, Pratapgarh placed fourth with a score of 21.90, demonstrating an excellent performance. The municipality of Pratapgarh has a near position with a score of in the current study, suggesting a notable susceptibility to specific conditions associated with plant pathology. Likewise, Raebareli rounds off the list with a score of 21.35, indicating a comparatively reduced susceptibility to the previously mentioned plant pathology factors.

Between 2023 and 2024, a comprehensive study

Table 2. Percent disease incidence of *sclerotinia* stem rot disease of mustard

S. N.	District Name	Village Name	PDI of *sclerotinia* stem rot 2022-23	Avg. PDI *sclerotinia* stem rot 2022-23	PDI *sclerotinia* stem rot 2023-24	Avg. PDI *sclerotinia* stem rot 2023-24
01		Bhishampur	26.34		28.17	
	Varanasi	Bhitkuri	23.42		25.32	
		Chaklola	25.47	25.65	27.36	27.70
		Dilawalpur	26.23		28.53	
		Arjunpur	27.21		29.47	
		Barki	25.26		27.37	
02		Badalpatti	24.14		27.34	
		Balua	23.47	23.79	26.47	
	Jaunpur	Akbarpur	25.32		28.53	28.06
		Badwa	21.43		29.46	
		Ashapur	25.14		28.33	
		Balaipur	23.25		28.27	
03		Adilpur	22.41		23.75	
	Ayodhya	Bani	23.43		25.35	
		Bhawanipur	25.31		27.17	24.28
		Chitaipur	26.21	22.81	28.01	
		Bankat	20.23		21.31	
		Chitawan	19.27		20.31	
04		Atri	23.37		24.23	
		Balipur	22.51		23.17	
	Pratapgarh	Dariyapur	24.71	21.90	26.23	23.19
		Chateri	21.48		23.31	
		Devkali	20.01		22.04	
		Gopalpur	19.32		20.17	
05		Daulatpur	18.37		20.05	
		Faridpur	20.48		21.37	
	Raebareli	Dhanapur	21.36	21.35	22.75	23.03
		Gaddipur	23.27		25.27	
		Hazipur	24.31		26.46	
		Ganeshpur	20.32		22.32	

was carried out to evaluate the disease incidence in the area of interest known as Jaunpur. The study population had a significant disease burden, as seen by the noteworthy prevalence rate of 28.06% found in the findings. This study looked into the prevalence of plant disease in different areas.

According to the findings, Varanasi has a high incidence rate of 27.70%. Ayodhya showed a notable incidence rate of 24.28% after Jaunpur, and Pratapgarh demonstrated an incidence rate of 23.19%. Additionally, the incidence rate in Ayodhya was relatively high at 24.28%, while the incidence rates in Pratapgarh and Raebareli were 23.19% and 23.03%, respectively. These results offer important new information about the distribution of Plant pathology.

Throughout the areas under study the data points that are displayed highlight the alarming spread of illnesses in the areas throughout the given period of time. Numerous research carried out in the past include the following as a result of the disease's observed incidence of up to 72% in Rajasthan (Shivpuri *et al*., 2000; Ghosolia *et al*., 2004) and up to 80% in Punjab and Haryana (Kang and Chahal, 2000), it has taken on a serious proportion in mustard-growing areas of India (Lodha *et al*., 1992; Krishnia *et al*., 2000).

According to Sharma *et al*. (2001), Haryana has a disease incidence of up to 49.2%; however, in a few places, the disease incidence has reached as high as 80%. There have also been reports of yield losses from this illness of up to 70.9% in Uttar Pradesh and up to 50.9% in Rajasthan (Chauhan *et al*., 1992; Singh, 1998). According to Shukla (2005), plants infected at or before the start of flowering experienced a 100% yield loss, while infections after the flowering stage resulted in a yield loss of more than 50%.

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Author's Contribution

Mr. Devashish rai Planning of study, review and editing of MS.
Prof. Saba Siddiqui: Conceptualization of idea & Head of Department and supervision of the study.
Mr. Amrit Kumar singh Review and editing of MS and correction as per suggestion from reviewer and editor.
Dr. Malik M.Ahmadcorrection as per suggestion from reviewer and editor.
Mr. Mithilesh Kumar Pandey and Shivshankar Patel conceptualization of idea and writing original draft of Manuscript and collection of review literature and compilation.

Conflict of Interest

We have no conflict of interest to disclose.

Conclusion

A major case of mustard disease is suspected to be caused by stem rot in various districts of Eastern Uttar Pradesh that are known for farming mustard. It was discovered that there were differences in the disease's occurrence between the eastern Uttar Pradesh districts. In 2022-2023, the Raebareli district in eastern Uttar Pradesh had the lowest disease incidence (21.35) and Varanasi had the highest (25.65). The district of Raebareli recorded the lowest disease incidence in 2023-24, while Jaunpur recorded the highest disease incidence (28.06).

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