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Exploring Chilli Anthracnose in Uttar Pradesh's Key Cultivation Regions

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Chilli, a significant spice and vegetable crop in India, faces susceptibility to various fungal diseases, including Anthracnose, Damping-off, Fusarium wilt, Collar rot, Dry root rot and Stem rot. Among these, Anthracnose and Fusarium wilt stand out as the most widespread and impactful. This study presents a comprehensive analysis of anthracnose disease incidence across 20 selected locations in major chili cultivation regions of Uttar Pradesh, spanning two years (2021-22 and 2022-23). By conducting district-wise and village-wise assessments, the prevalence of infections was assessed. The finding shows distinct disease incidence percentage across locations. Pooled data analysis revealed the highest average anthracnose disease incidence in Rajatalab, Varanasi (60.71%), followed by Kumarganj village, Ayodhya district (60.36%). Conversely, the lowest average incidence was recorded in Sangapur village, Amethi (37.88%). followed by Sonari village, Amethi (38.36%). This research offers valuable insights into the evolving patterns of anthracnose infections within chili growing regions, empowering the development of well-informed disease management strategies.

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1. INTRODUCTION

Among the Solanaceous plants grown in India, chilli (*Capsicum annuum* L.) is particularly significant due to its high nutritional content and variety of uses. The yield of chilli in the nation is still very depressing when compared to its productivity in developed countries, despite the evaluation in enhanced varieties and usage of the recommended package of practices. There are a number of key restrictions for pests, diseases, and low productivity. Diseases caused by bacteria, viruses, and fungi are significant and have a detrimental impact on both productivity and quality. Chilli anthracnose, also spelled as "fruit rot/die back" refers to a plant disease caused by the fungus *Colletotrichum* species, primarily *Colletotrichum capsici*. This disease affects chili pepper plants, causing various symptoms such as dark lesions or spots on the fruit, leaves, and stems. The initial report of anthracnose in India came from Coimbatore in the Madras Presidency [1]. Subsequent studies by various researchers have documented significant yield losses in different regions, including up to 50% in Thailand, 21% to 47% in Sri Lanka, 15% in Korea, and 50% in Malaysia [2]. Bansal and Grover [3] discovered that anthracnose resulted in fruit losses ranging from 10 to 35% in 1966 and 20 to 60% in 1967 across six districts in Punjab and Haryana. Fruit loss up to 66–84 percent was found in Northern Karnataka by Thind and Jhooty [4].

With the significance of chili cultivation in mind, this survey was conducted to investigate the incidence of anthracnose in crops. The aim is to provide valuable information on integrated disease management that serves as an alternative guide for farmers' decision-making processes.

2. MATERIALS AND METHODS

2.1 Survey and Collection of Disease Sample

An extensive field survey was conducted from major chilli growing areas of Uttar Pradesh during the year 2021-2022 and 2022-2023 in ten districts of Uttar Pradesh viz., Sultanpur, Pratapgarh, Amethi, Faizabad, Etawah, Kanpur, Jaunpur, Prayagraj, Deoria, and Varanasi. A total of 20 plant samples were collected for anthracnose pathogen. Plant samples were collected from infected chilli plant parts and fruits. The samples were carefully wrapped in old newspaper, placed inside propylene bags, and clearly labeled with details such as sample number, crop type, block, district, and date of collection. Subsequently, the survey data was recorded in a designated survey form. Finally, the samples were transported to the laboratory of the Department of Plant Pathology at CSAUA&T, Kanpur, for further analysis and investigation.

2.2 Collection of Disease Prevalence Data in Major Chilli Growing Areas in Uttar Pradesh

An extensive survey was conducted in 20 selected locations of Sultanpur, Pratapgarh, Amethi, Faizabad, Etawah, Kanpur, Junpur, Prayagraj, Deoria, and Varanasi districts of Uttar Pradesh during 2021-2022 & 2022-2023 (Table 1). Data were collected from the different sites through the application of participatory research appraisal tools and techniques, such as direct observation, and field visits using a questionnaire. On the basis of field symptoms infected plant samples were collected from the fields of villages adjoining to Block

Table 1. Name of location in different districts of U.P. Surveyed

S.No.	Districts	Locations
1	Sultanpur	Knuwar, Semari
2	Pratapgarh	Basupur, Kohandaur
3	Amethi	Sangapur, Sonari
4	Ayodhya	Milkipur, Kumarganj
5	Etawah	Bamhora, Lakhi
6	Kanpur	Vegetable farm kalyanpur, Sarsaul
7	Jaunpur	Machalishahar, Kalwan
8	Prayagraj	Naini, Mahewa
9	Deoria	Lar road, Sajaw
10	Varanasi	Ramana, Raja talab

Headquarters of each district. For the calculation of disease incidence in each location, randomly 20 chilli plants were selected and total number of fruits and infected fruits were counted.

The calculation of the mean anthracnose of each location assessed by using following formula:

$$\textbf{PDI (Per cent Disease Incidence)} = \frac{\text{Number.of sample infected fruit}}{\text{Total no.of fruit per plant}} \times 100$$

3. RESULTS AND DISCUSSION

The experimental findings detailed in the Table 2 and Figs. 1&2 present an analysis of Chilli anthracnose disease incidence across various districts and villages over the span of two years, namely 2021-22 and 2022-23, with the inclusion of pooled data.

District-wise and village-wise examinations of fruits were conducted to determine the prevalence of infections. In the district of Sultanpur, the village of Kunwar exhibited a disease incidence of 42.61% in 2021-22, rising slightly to 42.87% in 2022-23, while Semari showed an increase from 41.58% to 45.73% over the same period. Similarly, in Pratapgarh, Basupur demonstrated an increase in disease incidence from 45.68% to 48.59%, whereas Kohandaur saw an elevation from 39.06% to 41.93%. Moving to Amethi, the village of Sangapur experienced an upswing from 35.66% to 40.10%, whereas Sonari displayed an increase from 36.56% to 40.17%.

In Ayodhya, Milkipur showcased a rise from 53.32% to 56.87%, and Kumarganj recorded an increase from 58.53% to 62.19%. Etawah's Bamhora observed an increase from 55.65% to 58.88%, while Lakhi witnessed an increment from 49.83% to 52.91%. Kanpur's Vegetable Farm exhibited an increase from 44.50% to 47.52%, and Sarsaul displayed an elevation from 52.75% to 55.79%. In Jaunpur, Machalishahar increased from 47.95% to 50.42%, and Kalwan rose from 52.78% to 55.99%. Prayagraj's Naini show an increase from 52.38% to 54.94%, while Mahewa displayed an increment from 50.00% to 54.81%. Deoria's Lar Road showed an increase from 53.19% to 56.41%, and Sajaw demonstrated an elevation from 55.95% to 58.57%. Lastly, in Varanasi, Ramana maintained a consistent 55.95% disease incidence in both years, and Raja Talab notably increased from 54.90% to 66.51%. These findings collectively reveal the varying trends in fruit disease incidence across districts and villages during the specified years, underscoring significant fluctuations in infection rates for different fruit types.

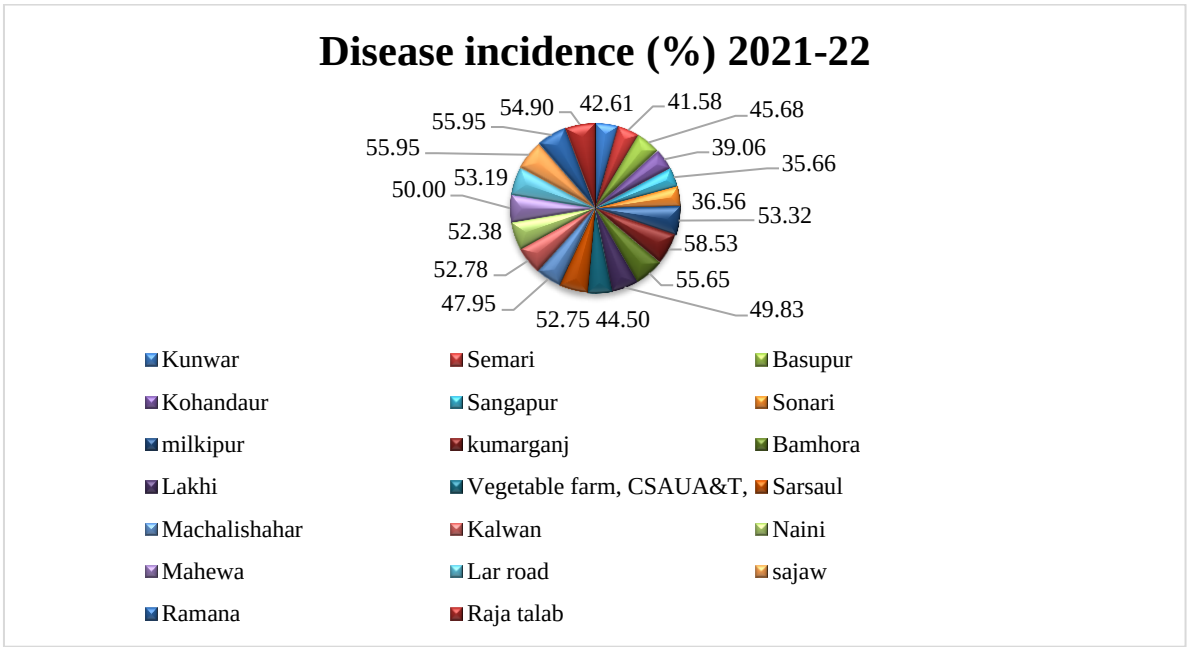

Fig. 1. Disease incidence in villages of different districts of Uttar Pradesh during 2021-2022

Table 2. Disease incidence of *Colletotrichum capsici* from different locations during 2021-22 and 2022-23

		2021-22			2022-23			Pooled data		
District	**Village/ Location**	**Total number of examined fruits**	**Total number of infected fruits**	**Disease incidence (%)**	**Total number of examined fruits**	**Total number of infected fruits**	**Disease incidence (%)**	**Total number of examined fruits**	**Total number of infected fruits**	**Disease incidence (%)**
Sultanpur	Kunwar	1021	435	42.61	1024	439	42.87	1022.5	437	42.74
	Semari	1496	622	41.58	1499	626	45.73	1497.5	624	43.65
Pratapgarh	Basupur	1088	497	45.68	1091	501	48.59	1089.5	499	47.14
	Kohandaur	1083	423	39.06	1086	427	41.93	1084.5	425	40.49
Amethi	Sangapur	830	296	35.66	833	300	40.10	831.5	298	37.88
	Sonari	1529	559	36.56	1532	563	40.17	1530.5	561	38.36
Ayodhya	Milkipur	1444	770	53.32	1447	774	56.87	1445.5	772	55.10
	Kumarganj	1360	796	58.53	1363	800	62.19	1361.5	798	60.36
Etawah	Bamhora	911	507	55.65	914	511	58.88	912.5	509	57.27
	Lakhi	1188	592	49.83	1191	596	52.91	1189.5	594	51.37
Kanpur	Vegetable farm, CSAUA&T,	746	332	44.50	749	336	47.52	747.5	334	46.01
	Sarsaul	910	480	52.75	913	484	55.79	911.5	482	54.27
Jaunpur	Machalishahar	757	363	47.95	760	367	50.42	758.5	365	49.19
	Kalwan	648	342	52.78	651	346	55.99	649.5	344	54.38
Prayagraj	Naini	905	474	52.38	908	478	54.94	906.5	476	53.66
	Mahewa	736	368	50.00	739	372	54.81	737.5	370	52.41
Deoria	Lar road	816	434	53.19	819	438	56.41	817.5	436	54.80
	Sajaw	899	503	55.95	902	507	58.57	900.5	505	57.26
Varanasi	Ramana	899	503	55.95	902	507	58.57	900.5	505	57.26
	Raja talab	938	515	54.90	941	519	66.51	939.5	517	60.71

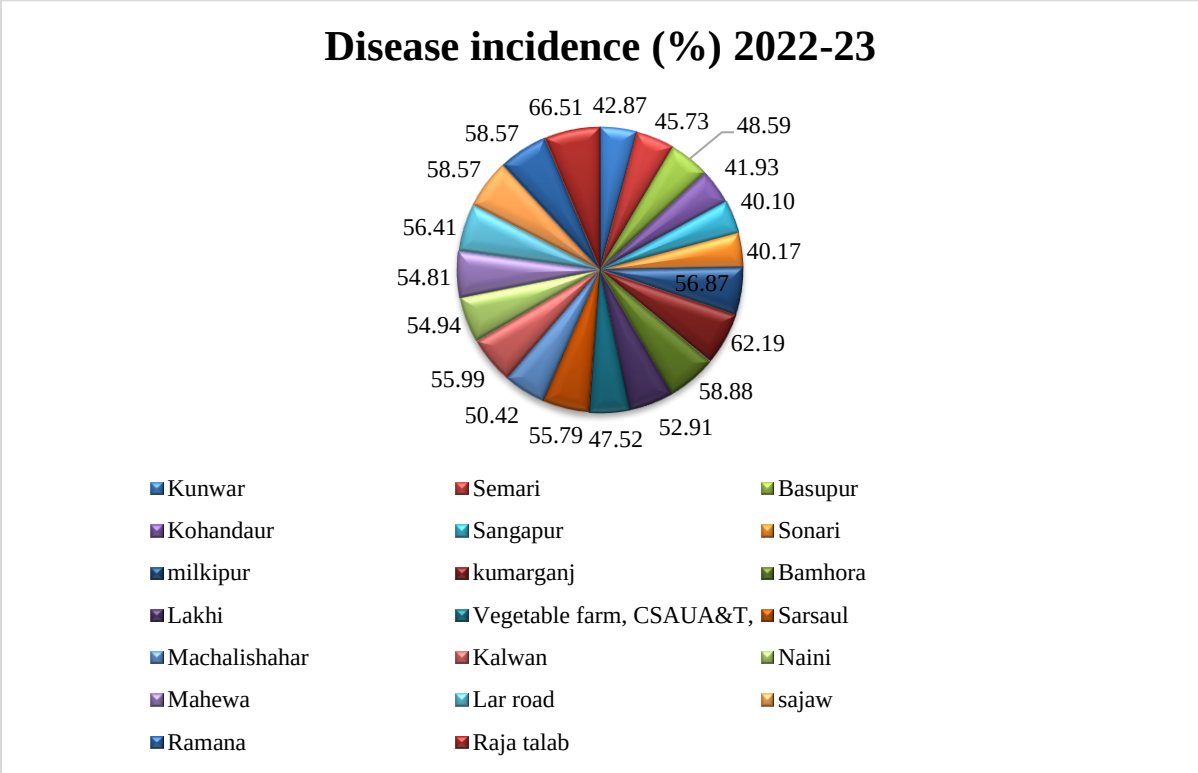

Fig. 2. Disease incidence in villages of different districts of Uttar Pradesh during 2022-2023

Out of the 20 selected locations, the highest average anthracnose disease incidence was observed in Rajatalab (Varanasi) at 60.71%, closely followed by Kumarganj village in Ayodhya at 60.36%. These findings align with the results reported by Mishra et al. [5], where disease incidence ranged from 40.80% to 54.90% in various districts of ayodhya. Differences in environmental conditions between Ayodhya and Amethi districts may have influenced disease incidence.

Climatic variables, such as temperature, humidity, and rainfall, can create conditions conducive for the development of anthracnose. Research by Thakur et al., [6] emphasizes the role of environmental factors in anthracnose severity. Variations in temperature and humidity can directly impact disease progression. Anamika et al., [7] also conducted survey in five locations of Rewa Province to assess the incidence of anthracnose of chilli and they observed 55.53 to 71.10 percent disease severity under field conditions. Similar results were reported by Yadav [8]. Similarly, Rai et al. [9] Surveyed anthracnose disease of chilli, Eastern Nimar region of Madhya Pradesh and found that the maximum incidence was recorded in Jaswadi (35.90%) followed by Titiysa (32.70%), Rustampur (29.80%), Singot (27.50%). and Chegav makhan (21.90%). Raja I et al.[10] conducted spot survey on the incidence of chilli anthracnose during 2020-2021 at three districts in Southern districts of Tamil Nadu. Maximum disease incidence (55.19%) was observed in Subramaniapuram village of Thoothukudi district and Pudhupatti village (50.37%) of Virudhunagar district. Both surveys contribute to our understanding of the prevalence of chili anthracnose in different regions of India, which is essential for disease management and agricultural policymaking.

4. CONCLUSION

The district-wise and village-wise examinations conducted to assess the prevalence of anthracnose infections in various chili cultivation areas provided valuable insights into the dynamic nature of disease incidence. The study spanned two years (2021-22 and 2022-23) and revealed varying trends in disease severity across different districts and villages within Uttar Pradesh. Across different locations, there were discernible shifts in anthracnose disease incidence percentages. The findings highlighted both increases and decreases in disease incidence, showcasing the complexity of disease

dynamics within the region. The study demonstrated that anthracnose can exhibit fluctuations in infection rates across diverse geographical areas and over different time periods. Overall, this study contributes to our understanding of anthracnose disease dynamics in chili cultivation areas, shedding light on the varying trends in disease incidence across districts and villages. Such insights are crucial for designing targeted disease management strategies that consider local factors, environmental conditions, and host-pathogen interactions. Continuous monitoring and research efforts are essential to adapt and develop effective measures to mitigate the impact of anthracnose on chili cultivation.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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