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Incidence of Stem Rot of Cluster-bean (*Cyamopsis tetragonoloba*) in Major Growing Areas of Rajasthan, India

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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

A survey was conducted in major cluster bean growing districts of Rajasthan during *Kharif* season 2022 and 2023 which showed the stem rot disease caused by *Sclerotium rolfsii* Sacc. is an imperative pathological problem, mostly in Bikaner, Shri Ganganagar and Hanumangarh districts. Average disease incidence was 22.33 per cent recorded in surveyed districts of Rajasthan. Highest average disease incidence (27.67%) was reported in Shri Ganganagar followed by Hanumangarh (22.50%) while lowest in Bikaner (16.83%) district.

Keywords: Survey; stem rot; Bikaner; clusterbean; village.

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1. INTRODUCTION

Cluster bean, also known as Guar or Guwar, is a vital legume crop primarily cultivated in arid and semi-arid regions of tropical India. Its cultivation contributes significantly to the agricultural economy, especially in the developing world [1]. The plant is valued for its gum, vegetable, fodder, and green manure properties, with the seeds containing about 30-33% gum. This gum finds applications in various industries such as textiles, paper, petroleum, pharmaceuticals, and food processing. Additionally, cluster bean enhances soil fertility by fixing nitrogen from the atmosphere [2]. The plant is characterized by its indeterminate growth habit, deep taproot system, and ability to withstand drought conditions. It thrives in arid zones with 30-40 cm rainfall and temperatures of 25° to 30°C, preferring medium texture sandy loam soils. However, it can tolerate saline and moderately alkaline soils but is susceptible to waterlogged conditions [3]. Originating from West Africa and India, cluster bean cultivation has spread to countries like Pakistan, Indonesia, Myanmar, parts of Central Africa, and the Southwestern United States. In India, Rajasthan leads in both area and production, followed by states like Gujarat, Punjab, and Haryana. Despite the release of stable yielding varieties, the crop faces challenges from phytopathogenic fungal and bacterial diseases, such as blight, leaf spot, stem rot, anthracnose, and powdery mildew [4]. Among these diseases, stem rot caused by *Sclerotium rolfsii* is particularly damaging, leading to heavy yield losses ranging from 50-70% [5]. *S. rolfsii* has a broad host range and survives as a saprophyte on plant debris, primarily through sclerotia. It infects plants through direct penetration or wounds, with hyphal growth facilitated by warm and moist conditions. Spread occurs through irrigation water and agricultural implements, contributing to secondary inoculum [6]. Cluster bean is a resilient and economically significant legume crop with multiple uses, but its cultivation is challenged by various diseases, notably stem rot caused by *S. rolfsii*, which necessitates effective management strategies.

In the present investigations, a survey for stem rot of clusterbean was carried out during *kharif*, 2022 and 2023 in major mothbean growing areas of Bikaner, Hanumanghar and Shri Ganganagar to get precise information on the incidence of the disease. The observations on survey revealed that stem rot severity and incidence different from different regions, because of type of growing varieties, environmental conditions, and presence of inoculum.

2. MATERIALS AND METHODS

Survey of stem rot of cluster bean was conducted to assess the prevalence and incidence in major cluster bean growing districts of Rajasthan. Survey was conducted in Bikaner, Shri Ganganagar and Hanumangharh districts of Rajasthan. Three tehsils under each district and four villages under each tehsil were included. Under each village four farmer's fields were assessed. In each field, five spots of 1 m^2 area were marked diagonally at randomly to cover entire field. Diseased (identified on the basis of symptoms) and healthy plants were counted in each spot and the per cent disease incidence (PDI) was calculated by using the following formulas.

Percent Disease Incidence = Number of infected plants / Total number of observed plants x 100

During survey, characteristic symptoms of disease were recorded and also samples collected for isolation of pathogen. Isolation process was done at pathology lab of college of agriculture, Bikaner.

2.1 Isolation of Pathogen

Collar region of infected cluster bean plant samples were cut into small pieces after washing with distilled water. The pieces were surface sterilized with 0.1 per cent Mercuric Chloride ($HgCl_2$) solution for 45 second followed by three washings of sterile water, dried by placing them between two sterile blotter paper and finally kept on previously poured sterilized petri plates filled with PDA medium with the help of forceps. The entire work of isolation was performed in laminar air flow which was sterilized by 70 per cent ethanol before use. The plates were incubated in the BOD incubator at 27 ± 1 ^{0}C. The plates were observed four days after incubation for mycelial growth from the infected bits. Mycelial bits of suspected Sclerotium species were transferred on another petri plates filled with PDA by the help of cork borer and inoculation needle.

Observations of disease incidence were recorded on five randomly selected diseased plants in each line on 0-9 scale basis given by Nene et al. [7].

3. RESULTS AND DISCUSSION

Survey was conducted in three major clusterbean growing districts *viz.,* Bikaner, Shri Ganganagar and Hanumangarh districts of Rajasthan. Data pertaining to the incidence of stem rot disease of clusterbean at different locations is presented in Table 1 and Fig. 1.

Bikaner: The survey in Bikaner district was conducted in twelve villages of three *tehsils, viz*., Bikaner, Nokha and Shri Dungargarh. The average disease incidence ranged from 15.30 % to 18.99 % was recorded during the *Kharif* 2022 and 2023. The maximum per cent disease incidence was observed in clusterbean fields at Nathusar village of Lunkaransar *tehsil* that is upto 19.64% and minimum (14.31%) in Bigga village of Shri Dungargarh *tehsil*. In the Bikaner *tehsil*, the average disease incidence was highest in Malasar village (17.04%) followed by Kesar Desar Boran village (16.45%), Udairamsar village (16.07%) and lowest in Khara village (15.73%). The average disease incidence in Bikaner *tehsil* was recorded 16.32%. In the Lunkaransar *tehsil*, the average disease incidence was highest in Nathusar village (18.99%) followed by Khari village (18.84%), 1 Lkd village (18.54%) and lowest in Adsar village (17.87%). Average 18.56% disease incidence was recorded in Lunkaransar *tehsil*. In the Shri Dungargarh *tehsil*, the average disease incidence was highest in Punrasar village (16.44%) followed by Udrasar village (15.61%), Sudsar village (15.30%) and lowest in Bigga village (15.05%). The average disease incidence in Shri Dungargarh *tehsil* was recorded 15.60%. The average disease incidence of the district was recorded 16.83 per cent.

Shri Ganganagar: The survey in Shri Gnganagar district was conducted in twelve villages of three *tehsils*, *viz*., Suratgarh, Raisinghnagar and Shri Ganganagar. The average disease incidence ranged from 25.41 to 30.70 per cent was recorded during the *Kharif* 2022 and 2023. The highest per cent disease incidence was observed at 16 Z (30.70%) village of Shri Ganganagar *tehsil* and minimum per cent disease incidence in 1 BMM (25.41%) village of Suratgarh *tehsil*. In the Suratgarh *tehsil*, the average disease incidence was highest in 1 RM village (26.11%) followed by 10 Sgr village (25.91%), 1 Gmd village (25.51%) and minimum in 1 Bmm village (25.41%). Average disease incidence in Suratgarh *tehsil* was recoded 25.73%. In the Raisinghnagar *tehsil*, the average disease incidence was highest in Luhara village (27.83%), followed by Amargarh village (27.27%), Tatarsar village (27.03%) and lowest in Bagicha village (26.83%). In the Raisinghnagar *tehsil,* average disease incidence was recorded 27.24%. In the Shri Ganganagar *tehsil*, the average disease incidence was highest in 16 Z village (30.70%), followed by 14 Z village (30.55%), 12 Z village (29.74%) and lowest 15 Z village (29.12%). Average disease incidence was recorded in Shri Ganganagar *tehsil* was 30.03%. The average disease incidence of the district was recorded 27.67 per cent.

Hanumangarh: The survey in Hanumangarh district was conducted in twelve villages of three *tehsils*, *viz*., Nohar, Hanumangarh and Bhadra. The average disease incidence ranged from 20.93 to 24.69 per cent was recorded during the *Kharif* 2022 and 2023. The highest per cent disease incidence was observed at 10 JRK (24.69%) village of Hanumangarh *tehsil* and minimum per cent disease incidence in 1 NTR (22.86%) village of Bhadra *tehsil*. In the Nohar *tehsil*, the average disease incidence was highest in 1 JSN village (22.30%), followed by 1 B BARANI village (22.29%), 1 KM village (21.81%) and minimum in 1 BKK village (21.62%). Average disease incidence Nohar *tehsil* was 22.00%. In the Hanumangarh *tehsil*, the average disease incidence was highest in 10 JRK village (24.69%), followed by 1 ARW village (24.64%), 1 LGW village (24.40%) and lowest in 1 NWN village (23.84%). In Hanumangarh *tehsil* average disease incidence was recorded 24.39%. In the Bhadra *tehsil*, the average disease incidence was highest in 1 MRN village (21.43%), followed by 1 BHD village (21.08%), 1 NTR village (20.99%) and lowest in 1 DPN village (20.93%). Average disease incidence in Bhadra *tehsil* was recoded 21.11%. The average disease incidence of the district was recorded 22.50 per cent.

Similar trend in incidence of stem rot in groundnut fields in Andhra Pradesh during *kharif* 2012 and 2013 was reported by Rani et al. [8]. Field survey conducted in the Marathwada region of Maharastra, India, during 2003 revealed the 17.3 % average incidence of disease and the cultivar JL 24 recoded higher incidence compared to local cultivars. Sivakumar et al. [9] conducted survey of Stem rot of groundnut in major groundnut growing areas of Tamil Nadu. The results of the survey revealed that stem rot incidence ranged from 7.88 to 32.02 %. The maximum incidence of 32.33 % was recorded in Adhivaraganallur village of Cuddalore district.

Table 1. Percent disease incidence of cluster bean stem rot disease in major growing districts of Rajasthan

District	Tehsil	Village	Disease incidence (%)		Mean PDI
			2022	2023	
Bikaner	Bikaner	Khara	15.49	15.96	15.73
		Udairamsar	16.05	16.09	16.07
		Kesar Desar Boran	16.12	16.77	16.45
		Malasar	16.86	17.22	17.04
	Average		16.13	16.51	16.32
	Lunkaransar	1 Lkd	18.44	18.64	18.54
		Adsar	17.51	18.23	17.87
		Khari	18.57	19.10	18.84
		Nathusar	18.34	19.64	18.99
	Average		18.22	18.90	18.56
	Shri Dungargarh	Bigga	14.31	15.79	15.05
		Punrasar	16.22	16.65	16.44
		Udrasar	15.52	15.69	15.61
		Sudsar	15.14	15.45	15.30
	Average		15.30	15.90	15.60
	Average of Bikaner district		16.55	17.10	16.83
Shri Ganganagar	Suratgarh	1 BMM	25.22	25.59	25.41
		1 Gmd	25.33	25.68	25.51
		10 Sgr	26.31	25.5	25.91
		1 RM	25.43	26.79	26.11
	Average		25.57	25.89	25.73
	Raisinghnagar	Amargarh	27.64	26.89	27.27
		Luhara	27.18	28.48	27.83
		Tatarsar	27.71	26.35	27.03
		Bagicha	26.70	26.96	26.83
	Average		27.31	27.17	27.24
	Shri Ganganagar	15 Z	29.28	28.96	29.12
		12 Z	29.45	30.02	29.74
		16 Z	30.68	30.72	30.70
		14 Z	30.48	30.62	30.55
	Average		29.97	30.08	30.03
	Average of Shri Ganganagar district		27.62	27.71	27.67
Hanumangarh	Nohar	1 BKK	21.52	21.71	21.62
		1 JSN	22.50	22.09	22.30
		1 KM	21.47	22.14	21.81
		1 B BARANI	21.67	22.90	22.29
	Average		21.79	22.21	22.00
	Hanumangarh	1 ARW	24.08	25.19	24.64
		1 LGW	24.15	24.64	24.40
		1 NWN	23.62	24.06	23.84
		10 JRK	24.19	25.19	24.69
	Average		24.01	24.77	24.39
	Bhadra	1 BHD	20.75	21.41	21.08
		1 DPN	20.90	20.96	20.93
		1 MRN	21.50	21.35	21.43
		1 NTR	21.53	20.44	20.99
	Average		21.17	21.04	21.11
	Average of Shri Hanumangarh district		22.32	22.67	22.50
Total mean			22.16	22.50	22.33

**Average of four fields in each village*

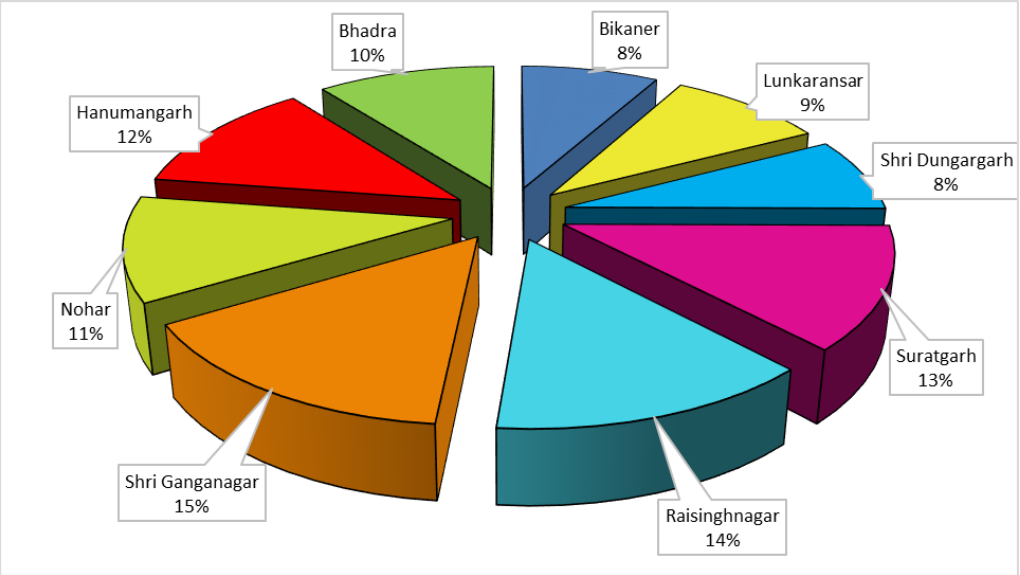

Fig. 1. Disease incidence in different tehsils of Rajasthan

4. CONCLUSION

The survey findings underscore the significant impact of stem rot disease on cluster bean cultivation in Rajasthan, particularly in the districts of Bikaner, Shri Ganganagar, and Hanumangarh. Understanding the distribution and severity of the disease across different regions and villages is crucial for implementing targeted management strategies to mitigate its effects on cluster bean production. Further research and collaborative efforts among agricultural stakeholders are warranted to develop effective disease management practices and ensure the sustainable cultivation of cluster beans in the region.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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