Roving Survey of Collar Rot Disease of Chickpea Caused by *Sclerotium rolfsii* Sacc. in Rajasthan, India

Priyanka Kumari Meena [a*], R. S. Sharma [a], Suman Dhayal [b], Naveen [c], R. P. Ghasolia [d] and Yogita Nain [a]

[a] *Department of Plant Pathology, Rajasthan Agricultural Research Institute, Durgapura-302018, Jaipur, Rajasthan, India.*
[b] *Department of Agronomy, College of Agriculture, MPUAT, Udaipur-313001, Rajasthan, India.*
[c] *Department of Entomology, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior-474002 Madhya Pradesh, India.*
[d] *Department of Plant Pathology, SKNAU, Jobner-303328, Rajasthan, India.*

Authors' contributions

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

Original Research Article

ABSTRACT

Chickpea is one of the most cultivated legume crops and a rich source of protein in many countries. It is an important pulse crop of the semi-arid tropics and the warm temperate zones, ranking first in India. The survey conducted in the major chickpea-growing regions of Rajasthan during the *Rabi* season of 2021-22 emphasized that collar rot is a significant issue caused by *Sclerotium rolfsii*. The study covered areas in Jaipur, Tonk, Kota, Bundi, Swaimadhopur and Alwar regions. To assess disease incidence, researchers randomly selected 25 square meter areas at four spots in each field,

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Corresponding author: E-mail: pm484354@gmail.com;

totaling 100 square meters per field. In each village, fields were chosen, and plants displaying typical collar rot symptoms were collected for further analysis. Upon examination, an average disease incidence of 23.69 per cent was recorded across the surveyed districts. The higher disease frequency of (33.08%) was assessed in Kota while least in Alwar location (15.04%). To further understand the pathogen responsible for collar rot, samples were collected and brought to the laboratory for isolation. This comprehensive survey provides valuable insights into the prevalence of collar rot in chickpea crops across different regions of Rajasthan, aiding in the development of effective management strategies.

1. INTRODUCTION

Chickpea (*Cicer arietinum* L.) is one of the most important legume crop cultivated extensively in India, accounts for about 75 per cent of all pulse production [1]. It is grown under irrigation and rainfed circumstances. Chickpea is a grain legume crop providing an enormous source of minerals, fibers, and protein for humans as well as animals [2]. Chickpea is a highly nutritious pulse crop with low digestible carbohydrates (40-60%), protein (15-22%), essential fats (4-8%), and a range of minerals and vitamins. High levels of phosphorus (340 mg/100 g), calcium (190 mg/100 g), magnesium (140 mg/100 g), iron (7 mg/100 g), and zinc (3 mg/100 g) have been found in chickpea seeds. The fatty acid composition of the seed adds value because fat govern the texture, shelf-life, flavor, aroma, and nutritional composition of chickpea-based food products [3].

Chickpea has been and continues to be consumed by humans since ancient times owing to its good nutritional properties [4]. It is used as food in different styles in different countries [5], such as chickpea flour for making snacks in India [6], and chickpea is used in mush and soups/salads in Asia and Africa [7]. The diverse cooking styles make chickpea demand to consumers worldwide [4]. India ranks first in conditions of chickpea production and utilization in the world. About 65 per cent of the global area with 68 per cent of the global productivity is contributed by India. In India, it is grown over 10.6 million hectare with an annual production of 10.90 million tonne [8]. Madhya Pradesh, Maharashtra, Rajasthan, Karnataka, Uttar Pradesh and Andhra Pradesh are major chickpea growing states of India, covering 98.86 lakh/ha area, 107.37 lakh tonne/ha production and 1086 kg/ha of the productivity of the country. Despite the high total production and more nutritive value, productivity of chickpea was low due to many biotic and abiotic constraints. Heavy infestation of biotic stresses *i.e.* wilt (*Fusarium oxysporum* f. sp. *ciceri*), dry root rot (*Rhizoctonia* sp.) and collar rot (*Sclerotium rolfsii* Sacc.) at different crop growth stages. The dominated soil borne diseases *i.e.* wilt, and collar rot causes highest seedling mortality (5-10%) in chickpea reported by [9].

It has been reported that collar rot disease is more severe and most frequently at high moistures and high temperatures conditions [10]. Collar rot mostly appears in the early growth stage of the crop particularly before pod formation. Affected younger seedlings turn yellow and may collapse, but older seedlings may dry without collapsing. If affected seedlings are uprooted from moist soil in the earlier stages of infection. The yellowing of leaves and constriction at the collar region with white mycelial strands of *S. rolfsii*, attached around the collar region are major characteristic symptoms of disease [11]. In advanced stage of infection, all the leaves shed, turn brown dry and often adhere to dead stem. The mycelium of pathogen grows over the diseased tissue and nearby the soil forming a white mat of mycelial thread with the typical brown to chocolate brown mustard seed sized sclerotia [12]. Collar rot is an emerging soil-borne disease of chickpea that may stimulate 55-95 per cent mortality of chickpea seedlings under favorable environmental conditions *viz.*, high soil temperature (25-30°C) and heavy rainfall [13]. Warm and humid condition with a temperature ranging between 25–30°C is optimum for its growth and sclerotial germination [14-16]. The survey was made to know the distribution and occurrence of this important problem in chickpea in different region of Rajasthan.

2. MATERIALS AND METHODS

Survey was conducted during the *Rabi* season of 2021 in fourty four fields of twenty two villages of eleven tehsil of six major chickpea growing

districts of Rajasthan (Jaipur, Kota, Bundi, Sawaimadhopur, Tonk and Alwar) was undertaken study the incidence of collar rot disease. In each tehsil, two villages were randomly selected, and under each village, two farmer's fields were assessed, and incidence was recorded. In each field, five spots of one square meter area were marked diagonally at randomly to cover entire field. The collar rot infected samples of chickpea was also collected from the above-surveyed areas. Diseased and healthy plants were counted in each spot and the per cent disease incidence. Based on observation, the disease incidence was calculated by following formula (Horsfall and Cowling, [17].

$$\text{Per cent disease incidence} =$$

$$\frac{\text{Number of diseased plants}}{\text{Total number of plants observed}} \times 100$$

3. RESULTS AND DISCUSSION

A survey was conducted in major chickpea growing region of Rajasthan during *Rabi* season of 2021-22. Collar rot caused by *Sclerotium rolfsii* was major issue for the major part of Jaipur, Tonk, Kota, Bundi, Swaimadhopur and Alwar regions. An average disease incidence of 23.69 per cent was recorded in these surveyed districts. The higher disease frequency of (33.08%) was assessed in Kota while least in Alwar location (15.04%). The survey was conducted during early crop stage was between 20 to 60 days. The most extreme disease frequency was seen in plants at seedling to podding stage. The severity of the disease was highest in Kota region which ranged from 34.36 to 31.80 per cent with an average of 33.08 per cent followed by Swaimadhopur, Jaipur, Tonk, Bundi and Alwar district. Information on the predominance of collar rot of chickpea.

3.1 Jaipur

Sanganer and Phagi tehsils in the Jaipur district were selected for the survey. Two fields were chosen at random in each community for a roving survey. The average disease incidence in Jaipur district was 24.34 per cent with the highest average disease incidence in Phagi tehsil (26.17%) followed by Sanganer tehsil (22.52%).

3.2 Tonk

Malpura tehsil in the Tonk district was selected for the survey. Two fields were chosen at random in each community for a roving survey. The average disease incidence in Tonk district was 22.93 per cent with the highest average disease incidence in Malpura tehsil (22.93%).

3.3 Alwar

Rajgarh and Alwar tehsils in the Alwar district were selected for the survey. Two fields were chosen at random in each community for a roving survey. The average disease incidence in Alwar district was 15.04 per cent with the highest average disease incidence in Alwar tehsil (16.10%) followed by Rajgarh tehsil (13.97%).

3.4 Kota

Digod tehsil in the Kota district was selected for the survey. Two fields were chosen at random in each community for a roving survey. The average disease incidence in Kota district was 33.08 per cent with the highest average disease incidence in Ladpura tehsil (34.36%) followed by Digod tehsil (31.80%).
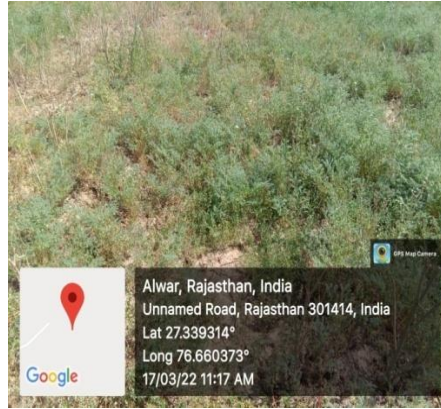
3.5 Swaimadhopur

Chauth Ka Barwara and Swaimadhopur tehsils in the Swaimadhopur district were selected for the survey. Two fields were chosen at random in each community for a roving survey. The average disease incidence in Swaimadhopur district was 28.58 per cent with the highest average disease incidence in Swaimadhopur tehsil (29.55%) followed by Chauth Ka Barwara tehsil (27.60%).

3.6 Bundi

Bundi and Keshoraipatan tehsils in the Bundi district were selected for the survey. Two fields were chosen at random in each community for a roving survey. The average disease incidence in Bundi district was 18.20 per cent with the highest average disease incidence in Keshoraipatan tehsil (19.94%) followed by Bundi tehsil (16.47%). The results obtained are presented in the Tables 1-2, Fig. 1 and Fig. 2.

4. DISCUSSION

A total of 44 fields from six districts covering eleven tehsils with 22 villages of Rajasthan were surveyed. The survey results revealed that the collar rot caused by *Sclerotium rolfsii* is an important pathological problem, mainly in chickpea growing districts and collar rot incidence appeared in all the surveyed districts.
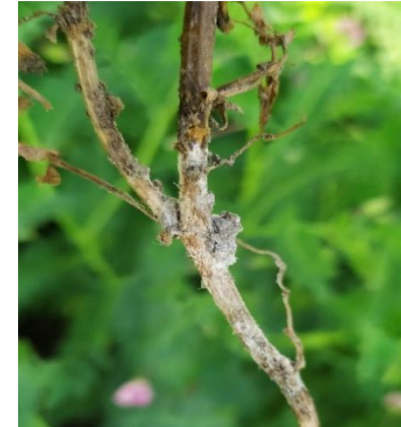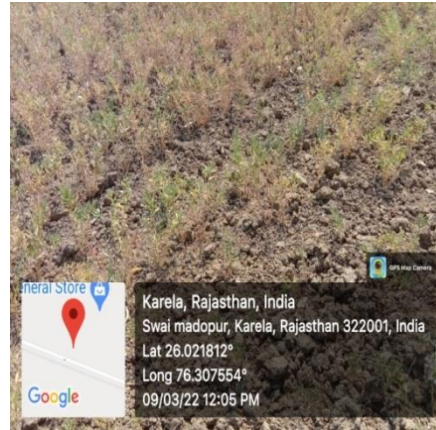
Alwar

Jaipur

Kota

Bundi

Swaimadhopur

Tonk

Fig. 1. Survey of collar rot disease of chickpea in different areas of Rajasthan

Table 1. Status of collar rot incidence in chickpea growing districts of Rajasthan during the survey

Districts	Tehsils	Villages	No. of field	PDI in surveyed fields (%)		Avg. PDI (avg. of 2 fields)	Avg. PDI (Tehsils)	Mean of districts
Jaipur	Sanganer	1. Manpura Teelawala	2	21.92 (1)	24.65 (2)	23.28	22.52	24.34
		2. Mohanpura	2	23.73 (3)	19.78 (4)	21.75		
	Phagi	1. Renwal manji	2	28.13 (5)	25.56 (6)	26.84	26.17	
		2. Nimeda	2	26.57 (7)	24.43 (8)	25.50		
Tonk	Malpura	1. Malpura	2	22.07 (9)	25.33 (10)	23.70	22.93	22.93
		2. Diggi	2	20.76 (11)	23.58 (12)	22.17		
Alwar	Rajgarh	1. Shrichandpura	2	15.54 (13)	10.76 (14)	13.15	13.97	15.04
		2. Kali pahari	2	16.22 (15)	13.36 (16)	14.79		
	Alwar	1. Malakhera	2	18.68 (17)	15.74 (18)	17.21	16.10	
		2. Haldeena	2	12.45 (19)	17.56 (20)	15.00		
Kota	Digod	1. Digod	2	28.30 (21)	33.56 (22)	30.93	31.80	33.08
		2. Borkhera	2	34.53 (23)	30.83 (24)	32.68		
	Ladpura	1. Ummedganj	2	38.06 (25)	35.12 (26)	36.59	34.36	
		2. Chhatrapura	2	30.05 (27)	34.20 (28)	32.12		
Swaimadhopur	Chauth Ka Barwara	1. Kawad	2	25.56 (29)	23.34 (30)	24.45	27.60	28.58
		2. Jonla	2	29.12 (31)	32.40 (32)	30.76		
	Swaimadhopur	1. Karela	2	34.02 (33)	30.56 (34)	32.29	29.55	
		2. Itawa	2	28.21 (35)	25.43 (36)	26.82		
Bundi	Bundi	1.Baldevpura	2	17.23 (37)	14.23 (38)	15.73	16.47	18.20
		2. Rajwas	2	15.67 (39)	18.76 (40)	17.21		
	Keshoraipatan	1. Ajeta	2	19.02 (41)	16.98 (42)	18.00	19.94	
		2. Rampura	2	24.23 (43)	19.54 (44)	21.88		
						Over all mean = 23.69		

Table 2. Details of different isolates of *S. rolfsii* collected during survey from ten tehsils of Rajasthan

| S. No.	Districts	Tehsils	Details of field chosen for establishing isolate		Representative isolates of tehsil and their code No.	Avg. disease incidence of tehsils (avg. 4 fields)
			Village (Field No.)	Disease incidence of field (%)		
1	Jaipur	Sanganer	Manpura Teelawala (2)	24.65	CSR 3	22.52
2	Jaipur	Phagi	Renwal Manji (5)	28.13	CSR 7	26.17
3	Tonk	Malpura	Malpura (10)	25.33	CSR 4	22.93
4	Alwar	Alwar	Malakhera (17)	18.68	CSR 10	16.10
5	Kota	Digod	Borkhera (23)	34.53	CSR 8	31.80
6	Kota	Ladpura	Ummedganj (ARS) (25)	38.06	CSR 9	34.36
7	Swaimadhopur	Chauth Ka Barwara	Jonla (32)	32.40	CSR 1	27.60
8	Swaimadhopur	Swaimadhopur	Karela (33)	34.02	CSR 6	29.55
9	Bundi	Bundi	Rajwas (40)	18.76	CSR 2	16.47
10	Bundi	Keshoraipatan	Rampura (43)	24.23	CSR 5	19.94
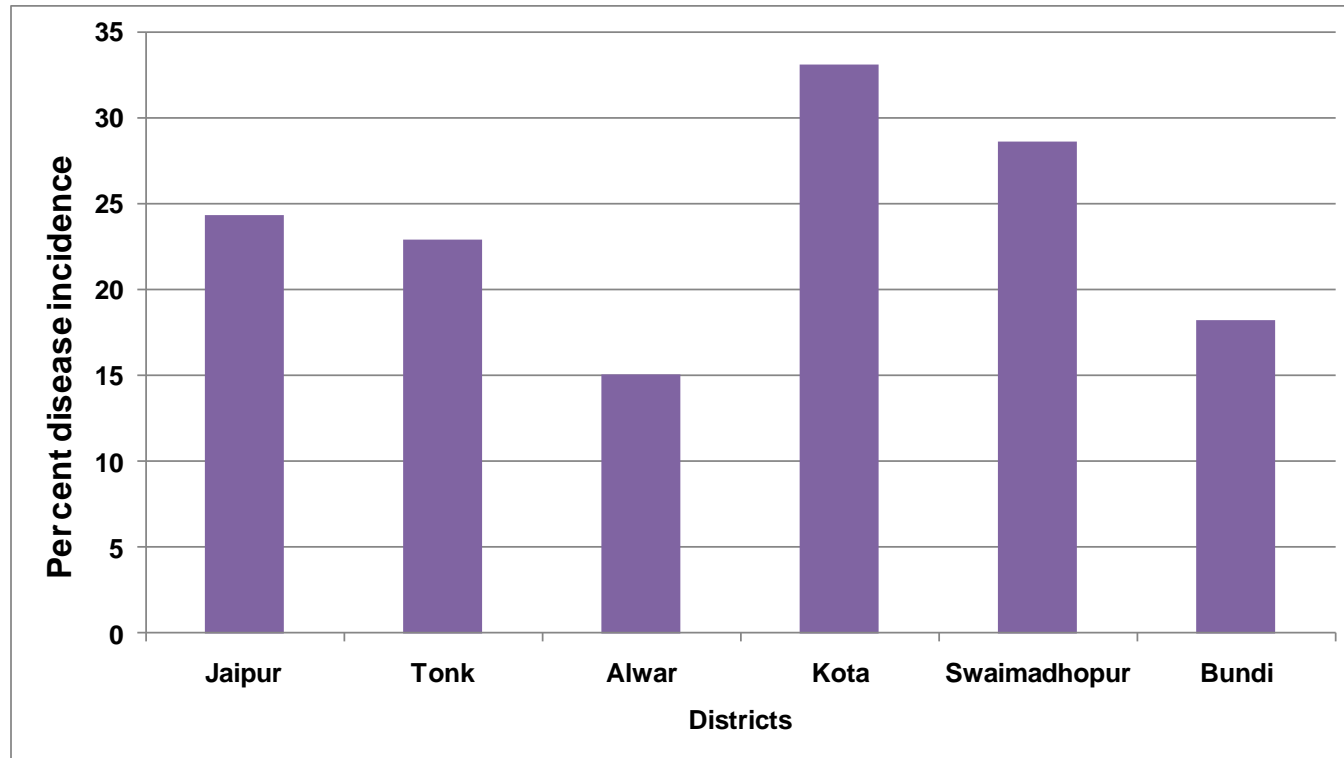
Fig. 2. Status of collar rot incidence in chickpea growing districts of Rajasthan during the survey

Collar rot infected plants appeared in patches in all the affected fields. During survey it was also noticed that collar rot incidence varied from location to location. This disease is favored to higher moisture content and presence of un-decomposed organic matter near soil surface, which could be attributed to the higher level of disease incidence in different regions, Nene et al., [11]. Our results are supported by the findings of Singh et al. [18] who conducted roving survey of chickpea growing areas at different locations of Kota district of Rajasthan, to assess the incidence of collar rot disease during *Rabi* 2018-19 and collar rot incidence was ranged from 6.69-19.82 per cent. The maximum incidence was recorded in, Ummedganj (19.82%), followed by Galana (14.38%) Sultanpur (12.05%), Sangod (11.20%), Itawa (10.40%), Dhakerkhedi (9.32%) and Char-chouma (6.69%) fields, which was quite high to cause seedling mortality and crop losses. Singh et al. [19] also conducted a survey in Kymore Plateau and Satpura to evaluate the collar rot incidence in chickpea and also found similar findings in Hills during 2018 and collar rot incidence was ranged from 9.30 to 14.80 per cent. Highest incidence (14.80%) was in the Rampur Naikin block of Sidhi district and the lowest incidence (9.30%) was recorded in the Kundam block of Jabalpur district. Similarly, Srividya et al. [20] conducted the roving survey in Kurnool and Anantapur districts of Andhra Pradesh during *Rabi* 2017 indicated that chickpea collar rot disease incidence range was 4.66 to 18.00 per cent during 10 to 20 days after sowing. Temperature and moisture play a crucial role, along with other environmental factors such as soil pH, aeration, and nutrient availability, in the spread and growth of this pathogen across different regions [21].

5. CONCLUSION

Collar rot disease is a serious threat to chickpea production area. Data clearly showed that the collar rot of chickpea caused by *Sclerotium rolfsii* is an exigent pathological concern especially in Kota, Swaimadhopur, Jaipur, Tonk, Bundi and Alwar. The mean maximum collar rot incidence was recorded in Kota (33.08%) followed by Swaimadhopur (28.58%), Jaipur (24.34%), Tonk (22.93%), Bundi (18.20%) and Alwar (15.04%) districts. No area or location in the surveyed region was completely devoid of the collar rot of chickpea. Since *S. rolfsii* are soil inhabitants and survive long time in soil. The practical implications of research findings on collar rot disease in chickpea crops for agronomists and farmers are significant. Integrated disease management Implementing IPM strategies can help in controlling collar rot disease while minimizing reliance on chemicals. This may involve practices such as biological control using antagonistic micro-organisms, organic amendments, crop sanitation, and judicious use of fungicides only when needed and as part of an overall management strategy.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
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