

Roving Survey of Chickpea Wilt Incited by *Fusarium oxysporum* f. sp. *ciceri* in Rajasthan, India

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(Received: 16 April 2024; Revised: 05 May 2024; Accepted: 04 June 2024; Published: 15 July 2024)

(Published by Research Trend)

ABSTRACT: Chickpea (*Cicer arietinum* L.) is an important annual legume crop of the family *Fabaceae*. Different abiotic and biotic agents affect adversely chickpea productivity around the world. Wilt disease is a major constraint to chickpea production due to the occurrence of wilt of chickpea causal organism of wilt *Fusarium oxysporum* f. sp. *ciceri* (Padwick) synd. and Hans. It produces microconidia, macroconidia, and chlamydo spores. Among all surveyed districts, disease incidence ranged from 9.17 to 23.40 per cent with an overall mean of 17.05 per cent in Rajasthan. The highest mean disease incidence was observed in Ajmer district (23.40%) followed by Pali (21.10%), Jaipur (20.16%), Bhilwara (17.86%), Tonk (17.73%), Sikar (15.81%), Bikaner (11.19%), and lowest was in Churu district (9.17%). Not a single location of surveyed districts was completely free from the disease incidence.

Keywords: *Fusarium oxysporum* f. sp. *ciceri*, Chickpea wilt, Percent disease incidence.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is an important annual legume crop of the family *Fabaceae*. It is one of the primitive crops of the world that originated in South-eastern Turkey about 8000-9000 years ago from its wild ancestor *C. reticulatus* (Dhawale and Dhale 2021). Different abiotic and biotic agents affect adversely chickpea productivity around the world. Chickpea is very sensitive to biotic stresses from a variety of organisms such as fungi, bacteria, viruses, mycoplasma, and nematodes. Worldwide around 172 infectious pathogens have been recorded which are harmful to Chickpea (Navas-Cortes *et al.*, 1998).

Wilt disease is a major constraint to chickpea production due to the occurrence of wilt of chickpea causal organism of wilt *Fusarium oxysporum* f. sp. *ciceri* (Padwick) synd. and Hans. It produces microconidia, macroconidia, and chlamydo spores. The wilt of chickpea is a root-occupying, soil-borne organism. No unequivocal information is accessible regarding trim misfortunes. In long periods of extreme pestilence, crop misfortunes have shot up as high as 60-70%. At the seedling and blossoming stage, loss of yield was 59% and 41% individually (Dhawale and Dhale 2021). Seeds gathered from wilt-infected plants indicate low weightage, more bluntness, and wrinkles than from normal plants. The yield misfortunes fluctuate somewhere in the range of 10% and 100% depending upon the agro-climatic conditions.

MATERIALS AND METHODS

A. Survey and incidence of disease

A survey in major chickpea growing districts viz., Bikaner, Ajmer, Tonk, Jaipur, Churu, Sikar, Pali, and Bhilwara was undertaken during the last week of December to the first week of January. The survey was

conducted during the *Rabi* season of 2020-21. Two tehsils under each district will be surveyed. In each tehsil, two villages will be selected and under each village three farmer's fields will be assessed. The selection of two villages from each tehsil was made randomly. To assess the disease incidence, five chickpea fields were selected in each village in each tehsil of each district, and the average incidence of the disease in each village was calculated. In each field, five spots of one square meter area were marked diagonally randomly to cover the entire field. Diseased and healthy plants were counted in each spot and the percent disease incidence was calculated as per the formula given below

$$\text{Per cent disease incidence} = \frac{\text{Number of diseased plants}}{\text{The total number of plants observed}} \times 100$$

B. Collection of diseased samples

Wilt-affected plants of chickpeas were collected from surveyed areas of Rajasthan viz., Bikaner, Ajmer, Tonk, Jaipur, Churu, Sikar, Pali, and Bhilwara. The samples of diseased plants were used for isolation of the causal fungus. Isolation was done from the diseased roots of chickpea samples, collected during a survey from the fields showing a higher percent of disease incidence.

RESULTS AND DISCUSSION

A. Survey and occurrence of disease

A roving survey was conducted during the *Rabi* season of 2021-22 in major chickpea-growing districts of Rajasthan covering eight districts viz., Sikar, Pali, Ajmer, Tonk, Jaipur, Bikaner, Churu, and Bhilwara comprising five agro-climatic zones in the state. During the survey, a total of 96 fields in 32 villages of sixteen tehsils of eight districts were covered and in each village three fields were chosen. To assess the disease incidence, three chickpea fields were selected in

each village and the average incidence in each village was calculated. The survey revealed that the wilt caused by the *Fusarium oxysporum* f. sp. *ciceris* an important pathological problem in chickpea-growing districts. Wilt incidence was observed in all the surveyed fields of eight districts. During the survey, farmers who were concerned about disease prevalence and severity had a little discussion. According to the survey's findings presented in Plate-2. It is apparent from data (Table 1-2 and Fig. 1) that every surveyed field revealed the presence of *Fusarium* wilt and it ranged from 9.15 to 23.40 per cent with an overall mean of 17.05 per cent.

The highest mean disease incidence was observed in Ajmer district (23.40%) followed by Pali (21.10%), Jaipur (20.16%), Bhilwara (17.86%), Tonk (17.73%), Sikar (15.81%), Bikaner (11.19%), and lowest was in Churu district (9.17%). Kishangarh tehsil in Ajmer district had the highest mean disease incidence of 23.75 per cent, followed by Ajmer tehsil with 23.06 per cent. Rajgarh tehsil in Churu district had the lowest mean disease incidence, with 9.20 per cent, followed by Taranagar tehsil with 9.20 per cent. Disease incidence was found maximum in local varieties compared to improved varieties of chickpea.

Table 1: Percent disease incidence of wilt of chickpea induced by *Fusarium oxysporum* f. sp. *ciceri* in different districts of Rajasthan in Rabi 2021-22.

Sr. No.	Districts	Tehsils	Villages	% disease incidence (PDI) in surveyed fields & their samples No.			Avg. PDI of villages	Avg. PDI of tehsils	Avg. PDI of districts
							(Avg. of three fields)	(Avg. of two villages)	(Avg. of two tehsils)
1.	Sikar	Fatehpur	Narsara	21.4 (1)	15.8 (2)	14.9 (3)	17.36	16.31	15.81
			Kishanpura	15.7 (4)	13.5 (5)	16.6 (6)	15.26		
		Danta Ramgarh	Palsana	9.6 (7)	22.9 (8)	17.9 (9)	16.80	15.31	
			Rajpura	13.7 (10)	19.7 (11)	8.1 (12)	13.83		
2.	Pali	Sojat	Bagawas	20.2 (13)	23.6 (14)	18.2 (15)	20.66	21.31	21.10
			Dhinawas	21.8 (16)	20.2 (17)	23.9 (18)	21.96		
		Marwar Junction	Kantaliya	17.7 (19)	25.4 (20)	22.6 (21)	21.90	20.88	
			Mushaliya	19.5 (22)	23.6 (23)	16.5 (24)	19.86		
3.	Ajmer	Ajmer	Saradhana	18.9 (25)	22.6 (26)	28.9 (27)	23.46	23.06	23.40
			Tabiji	22.7 (28)	25.7 (29)	19.6 (30)	22.66		
		Kishangarh	Sursura	18.8 (31)	26.5 (32)	23.7 (33)	23.00	23.75	
			Sarwar	23.5 (34)	22.4 (35)	27.6 (36)	24.50		
4.	Tonk	Malpura	Amarpura	10.7 (37)	13.7 (38)	23.8 (39)	16.06	17.86	17.73
			Sitarapura	24.3 (40)	20.6 (41)	14.1 (42)	19.66		
		Uniara	Bilota	21.9 (43)	9.7 (44)	18.7 (45)	16.76	17.60	
			Mandawara	13.2 (46)	22.5 (47)	19.6 (48)	18.43		
5.	Jaipur	Phulera	Gumanpura	16.4 (49)	24.2 (50)	14.5 (51)	18.36	20.08	20.16
			Boraj	22.3 (52)	18.6 (53)	24.5 (54)	21.80		
		Jobner	Jobner	22.9 (55)	15.8 (56)	16.7 (57)	18.46	20.25	
			Gokulpura	20.7 (58)	19.8 (59)	25.6 (60)	22.03		
6.	Bikaner	Bikaner	Belasar	11.1 (61)	9.4 (62)	13.5 (63)	11.33	11.91	11.19
			Kolasar	8.7 (64)	13.3 (65)	15.5 (66)	12.50		
		Nokha	Surpura	9.8 (67)	8.3 (68)	13.6 (69)	10.56	10.46	
			Sribalaji	12.6 (70)	10.8 (71)	7.7 (72)	10.36		
7.	Churu	Rajgarh	Dinharla	6.9 (73)	10.1 (74)	7.9 (75)	8.30	9.15	9.17
			Sidhmukh	9.6 (76)	8.7 (77)	11.7 (78)	10.00		
		Taranagar	Dani Kumaharan	8.9 (79)	10.6 (80)	9.7 (81)	9.73	9.20	
			Anandsinghpura	8.5 (82)	6.7 (83)	10.8 (84)	8.67		
8.	Bhilwara	Kotri	Barliyas	21.9 (85)	13.9 (86)	17.9 (87)	17.90	16.58	17.86
			Paroli	9.8 (88)	13.1 (89)	22.9 (90)	15.26		
		Asind	Shambhoogarh	18.9 (91)	25.9 (92)	17.4 (93)	20.73	19.15	
			Patan	22.5 (94)	18.6 (95)	11.6 (96)	17.56		
							Over all mean	17.05	

PDI = Per cent disease incidence

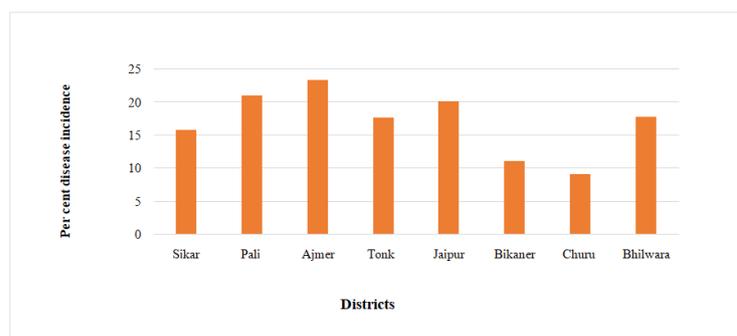


Fig. 1. Percent disease incidence of wilt of chickpea induced by *Fusarium oxysporum* f. sp. *ciceri* in different districts of Rajasthan in Rabi 2021-22.

Table 2: Per cent disease incidence of wilt of chickpea induced by *Fusarium oxysporum* f. sp. *ciceri* in different districts of Rajasthan in Rabi 2021-22.

Sr. No.	Districts	Tehsils	Villages	Name of farmer & their samples No.	Maximum PDI of Fields	Representative isolate* & their code No.
1.	Sikar	Fatehpur	Narsara	Mohan Singh (1)	21.40	FocSK-1
			Kishanpura	Gopal Meena (6)	16.60	FocSK-2
		Danta Ramgarh	Palsana	Hari Ram (8)	22.90	FocSK-3
			Rajpura	Dinesh Kumar (11)	19.70	FocSK-4
2.	Pali	Sojat	Bagawas	Mahendra Kumar (14)	23.60	FocPL-5
			Dhinawas	Raja Ram (18)	23.90	FocPL-6
		Marwar Junction	Kantaliya	Pokar Ram (20)	25.40	FocPL-7
			Mushaliya	Nathu Ram (23)	23.60	FocPL-8
3.	Ajmer	Ajmer	Saradhana	Prakash Kumawat (27)	28.90	FocAJ-9
			Tabiji	Suresh Kumar (29)	25.70	FocAJ-10
		Kishangarh	Sursura	Bhavar Lal (32)	26.50	FocAJ-11
			Sarwar	Vinod Kumar (36)	27.60	FocAJ-12
4.	Tonk	Malpura	Amarpura	Jagdeesh Kumar (39)	23.80	FocTK-13
			Sitarampura	Hera Lal (40)	24.30	FocTK-14
		Uniara	Bilota	Ramesh Chand (43)	21.90	FocTK-15
			Mandawara	Deva Ram (47)	22.50	FocTK-16
5.	Jaipur	Phulera	Gumanpura	Manish Jat (50)	24.20	FocJP-17
			Boraj	Madan Lal (54)	24.50	FocJP-18
		Jobner	Jobner	Harish Meena (55)	22.90	FocJP-19
			Gokulpura	Ram Dhan (60)	25.60	FocJP-20
6.	Bikaner	Bikaner	Belasar	Sita Ram (63)	13.50	FocBK-21
			Kolasar	Babu Lal (66)	15.50	FocBK-22
		Nokha	Surpura	Kamal Kishor (69)	13.60	FocBK-23
			Sribalaji	Mali Ram (70)	12.60	FocBK-24
7.	Churu	Rajgarh	Dinharla	Pankaj (74)	10.10	FocCR-25
			Sidhmukh	Shiv Lal (78)	11.70	FocCR-26
		Taranagar	Dhani Kumharan	Roshan Meena (80)	10.60	FocCR-27
			Anandsinghpura	Bhola Ram (84)	10.80	FocCR-28
8.	Bhilwara	Kotri	Barliyas	Arkesh (85)	21.90	5
			Paroli	Kana Ram (90)	22.90	FocBL-30
		Asind	Shambhoogarh	Kishan Singh (92)	25.90	FocBL-31
			Patan	Mangi Lal (94)	22.50	FocBL-32

*Representative isolate of each village surveyed district was established from the field showing highest PDI

Wilt-affected plants appeared in all the surveyed fields. Samples were collected along with information such as cultivars, soil type, number of irrigations, and disease appearance. Among all surveyed districts, disease incidence ranged from 9.17 to 23.40 per cent with an overall mean of 17.05 per cent in Rajasthan. The highest mean disease incidence was observed in Ajmer district (23.40%) followed by Pali (21.10%), Jaipur (20.16%), Bhilwara (17.86%), Tonk (17.73%), Sikar (15.81%), Bikaner (11.19%), and lowest was in Churu district (9.17%). Not a single location of surveyed districts was completely free from the disease incidence. As per verbal discussions held with the farmers during the survey, it can be summarized that the disease incidence was higher in fields where mono-cropping with local cultivars followed year after year in sandy loam to sandy soils. As compared to improved varieties, local varieties were found more susceptible to *Fusarium oxysporum* f. sp. *ciceri*.

Similar results were also reported by Chand and Khirbat (2009) that the pathogen is highly variable in its cultural characteristics and pathogenicity. Yield losses vary between 10 to 100% depending on varietal susceptibility and agroclimatic conditions.

Sunkad *et al.* (2019) chickpea is affected by both biotic and abiotic stresses which lead to a decline in production. Wilt disease caused by the fungus *i.e.*, *Fusarium oxysporum* f. sp. *ciceri* (Padwick) is a destructive disease recording major productivity loss in

all chickpea growing areas worldwide. Early wilting (77–94%) and late wilting (24–65%) are two stages of disease incidence.

A survey was conducted in the 2014-2015 Rabi season to obtain information on the distribution and incidence of chickpea wilt in respect of soil type and irrigation condition. Local cultivars were predominant in most farmer's fields. Wilt disease was found at all the sites and incidence ranged from 1.69 to 18.67% irrespective of cultivar type and location. The result indicated that wilt is recently highly distributed in all visited chickpea-growing areas of the central part of India. The wilt incidence was higher in rainfed conditions (11.37%) as compared to irrigated conditions (7.56%). Based on the survey, deep black soil was found most suitable for wilt development.

Similarly, results were found by Nathawat *et al.* (2020) wilt disease of chickpea was found to be prevalent in all districts of Rajasthan surveyed. The disease varied from mild to severe in Sikar, it was maximum of 31.90 per cent followed by Hanumangarh, Sriganganagar, and Jaipur in 2015-16. The least wilt disease incidence was observed 19.75 percent in the Tonk district.

The survey revealed that disease incidence was significantly higher in fields having a higher number of irrigations as compared to the fields receiving less irrigation. It was also noted that wilt incidence was higher where the crop was cultivated in the lighter textured soil of Rajasthan. The highest incidence was

found in sandy loam soil in the surveyed areas of Rajasthan, the variation in disease incidence might be due to the use of varieties of soil types and applied of variable disease management practices.

SUMMARY AND CONCLUSIONS

The wilt of chickpeas is one of the important limiting factors in the successful cultivation of chickpea in different parts of Rajasthan. In the present study, an attempt was made to investigate various important aspects of the disease. A survey was conducted in eight districts of Rajasthan to know the incidence of disease on the crop. The highest disease incidence was assessed in Ajmer (23.40%) while the least in Churu (9.17%) location. Under natural conditions, the disease symptoms first appeared on roots showing reddish to brownish discoloration. Further, the disease progressed upwards showing yellowing of the lower leaves progressing upwards.

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How to cite this article: Kewal Chand, S.K. Goyal, R.P. Ghasolia, Shalish Godika and Ranjana Meena (2024). Roving Survey of Chickpea Wilt Incited by *Fusarium oxysporum* f. sp. *ciceri* in Rajasthan, India. *Biological Forum – An International Journal*, 16(7): 68-71.