Roving Survey of root rot disease (*Fusarium solani* f. Sp. *pisi*) of pea in Rajasthan

ABSTRACT

The survey conducted in the major pea-growing regions of Rajasthan during the Rabi season of 2021-22 highlighted root rot as a significant issue caused by Fusarium solani f. sp. pisi. The study covered areas in Jaipur, Sikar, Nagaur, Ajmer, and Alwar regions. To assess disease incidence, researchers randomly selected 25 square meter areas at four spots in each field, totaling 100 square meters per field. In each village, fields were chosen, and plants displaying typical root rot symptoms were collected for further analysis.

Upon examination, an average disease incidence of 23.68 percent was recorded across the surveyed districts. The highest incidence was observed in Jaipur at 30.85 percent, while the lowest was in Nagaur at 16.91 percent. To further understand the pathogen responsible for root rot, samples were collected and brought to the laboratory for isolation. This comprehensive survey provides valuable insights into the prevalence of root rot in pea crops across different regions of Rajasthan, aiding in the development of effective management strategies.

**Keywords:*Fusarium solani* f. sp. *pisi*, Survey,Pea, Rootrot~~per cent diseases incidence,~~ ~~districts~~.

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INTRODUCTION

Pea is a top vegetable crop grown in cool regions of the world. It is used as a vegetable (green pea) and pulse (dried pea). Duke (1981) reported that pea are four types *i.e.*Garden pea {*P. Sativum* sp. *Hortense* (Asch. And Graebn.)}, dry pea {*P. Sativum* sp. *Arvense* (L.) Poir.}, edible podded pea (*P. Sativum* sp. *Macrocarpon*), and early dwarf pea (*P. Sativum* var. *Humile*). It is a diploid species of the legume family. Pea is a crop in tropical and subtropical regions. The protein content of pea ranges from 15.5-39.7 per cent, fresh 100g green pea contain 44 calories, 75.6 per cent water, 6.2 g protein, 0.4 g fat, 16.9 g carbohydrate, 2.4 g crude fibre, 0.9 g ash, 32 mg Ca, 102 mg P, 1.2 mg Fe, 6 mg Na, 350 mg K, 405 µg–β carotene equivalent, 0.28 mg thiamine, 0.11 mg riboflavin, 2.8 mg niacin and 27 mg ascorbic acid; while dried pea contain 10.9 per cent water, 22.9 per cent protein, 1.4 per cent fat, 60.7 per cent carbohydrate, 1.4 per cent crude fiber and 2.7 per cent ash (Duke, 1981; Hulse, 1994).

Peas are cultivated both as a vegetable and as a pulse crop, often intercropped with cereals to enhance soil fertility through nitrogen fixation in their root nodules. This crop holds significant economic importance in India, where it ranks fourth in terms of area (10.53%) and fifth in production (6.96%) globally (FAO, 2021).

Root rot disease poses a significant threat to pea cultivation, particularly in the third A zone of Rajasthan, causing substantial losses during the initial plant establishment.The root rot disease incited by *Fusariumsolani* (Mart.) Appel and Wolleweber f. sp. *pisi* (E. R. John) Snyder and Hansen is a serious disease of pea (*Pisumsativum* L) throughout the world. *Fusariumsolani* f. sp. *pisi* produces three types of microscopic spores. Microconidia is small, one-celled and elliptical. Macroconidia are much larger, septate, and slightly curved. Chlamydospores are thick-walled and rounded. The chlamydospore is resistant to extreme environmental conditions and can persist in soil for 5 years or more in the absence of pea. Root decay generally begins on the finer feeder roots and progresses gradually to the main tap root of the plant. In some cases, all roots are destroyed, leaving only remnants below the attachment of the seed. Root rot in peas is characterized by cortical decay and a brilliant red discoloration of vascular tissues in the root (Lin *et al.,* 1984). Pea plants infected with *Fusarium solani* f. sp. *pisi* show poor growth, yellowing, and drying of foliage with the partially or fully damaged root system (Hamid *et al.,* 2012). Looking to this, the survey was made to know the occurrence of this important disease in Rajasthan region.

MATERIALS AND METHODS

Based on the survey conducted in Rajasthan during 2021 to assess the distribution and prevalence of root rot of peas,The survey covered several districts including Jaipur, Sikar, Ajmer, Nagaur, and Alwar. In each district, two tehsils were selected. Within each tehsil, four villages were chosen. From each village, two fields were selected for the study. Disease incidence was recorded by counting both diseased and healthy plants in randomly selected 25 square meter areas at four random spots within each field, totaling 100 square meters per field. In each village, plants displaying typical symptoms of root rot were collected from the surveyed areas. These samples were carefully labeled and placed in paper bags for transportation to the laboratory. In the laboratory, efforts were made to isolate the pathogen responsible for root rot from the collected plant samples. This step is crucial for identifying the specific causative agent of the disease.

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Based on observation, the disease incidence was calculated by following formula (Horsfall and Cowling, 1978).

Number of diseased plants

$$\text{Per cent disease incidence} = \frac{\text{Number of plants infected}}{\text{Total number of plants observed}} \times 100$$

RESULTS AND DISCUSSION

A survey was conducted in major pea growing region of Rajasthan during Rabi season of 2021-22. It was concluded that root rot caused by *Fusarium solani* f. sp.*pisi* is fundamental obsessive issue for the major part of area of Jaipur, Sikar, Nagaur, Ajmer and Alwar regions. An average disease incidence of 23.68 per cent was recorded in these surveyed districts. The higher disease frequency of 30.85 % was assessed in Jaipur while least in Nagaur location (16.91 %).

The disease made its appearance at 21-90 days old crop. Initially, the leaves of infected pea plants turn light pale in colour starts drying and finally died.The severity of the disease was highest in Jaipur region which ranged from 30.85 to 29.64 per cent with an average of 30.25 per cent followed by Ajmer, Alwar, Sikar and Nagaur district.

Jaipur: Jobner and Mozmabad tehsils in the Jaipur district were selected for the survey. In Jobner tehsil four village *i.e.*Kalkh, khejrawas, Bobas and Hingoniya were chosen, while in Mozmabad tehsil four village *i.e.* Boraj, Jhag, Sewa, Gangati village were chosen. Four fields were chosen at random in each community for a roving survey. The average disease incidence in Jaipur district was 30.25 per cent with the highest average disease incidence in Jobner tehsil (30.85%) followed by Mozmabad tehsil (29.64%).

Sikar: Dhod and Sikar tehsils in the Sikar district were selected for the survey. In Dhod tehsil four village *i.e.*Mandota, Bidoli, Arjunpura, and Banura were chosen, while in Sikar tehsil four village *i.e.*Gokulpura, Dujod, Palwas, and Kasli village were chosen. Four field were chosen at random in each community for a roving survey. The average disease incidence in Sikar district was 21.48 per cent with the highest average disease incidence in Dhod tehsil (22.59%) followed by Sikar tehsil (20.37%).

Nagaur: Nawa and Merta tehsils in the Nagaur district were selected for the survey. In Nawa tehsil four village *i.e.*Lohrana, Maroth, Rajliya and Piprali were chosen, while in Merta tehsil four village *i.e.*Prithvipura, Satlas, Sogawas, and Bhuriyasani were chosen. Four field were chosen at random in each community for a roving survey. The average disease incidence in Nagaur district was 16.91 per cent with the highest average disease incidence in Nawa tehsil (17.93%) followed by Merta tehsil (15.90%).

Ajmer: Ajmer and Kishangarh tehsils in the Ajmer district were selected for the survey. In Ajmer tehsil four village *i.e.* Nand, Kayampura, Gegal, and Picholiya were chosen,

while in Kishangarh tehsil four village *i.e.*Moondoti, Salemabad, Raghunathpura, and Silora village were chosen. Four field were chosen at random in each community for a roving survey. The average disease incidence in Ajmer district was 26.77 per cent with the highest average disease incidence in Ajmer tehsil (27.77%) followed by Kishangarh tehsils (25.76%).

Alwar: Rajgarh and Bansur tehsils in the Alwar district were selected for the survey. In Rajgarh tehsil four village *i.e.*Kaleshgarh, Goth, Berli, and Bhangarh were chosen, while in Bansur tehsil four village *i.e.* Chula, Harsora, Bhoopsera, and Balawas village were chosen. Four field were chosen at random in each community for a roving survey. The average disease incidence in Alwar district was 22.99 per cent with the highest average disease incidence in Rajgarh tehsil (24.51%) followed by Bansur tehsils (21.46%).

The root rot of pea caused by *Fusarium solani* is an exigent pathological concern especially in Jaipur, Sikar, Nagaur, Ajmer and Alwar. According to the data in Table 1, Fig. 1 and Plate-1 the average disease incidence of 23.68 per cent was recorded in five districts of Rajasthan. Jaipur (30.25%) had the highest disease incidence followed by Ajmer (26.77%), Alwar (22.99), Sikar (21.48%) and Nagaur (16.91%). No area or location in the surveyed region was completely devoid of the root rot of pea.

Similar results were also reported by Swaroop*et al.* (2014) that conducted a survey on root rot of pea disease and they recorded incidence observed from 18.22% to 32.43% in the Jobner and nearby areas. Thakur *et al.* (2016) also reported the incidence of root rot caused by *Fusarium solani* complex pea growing area in Zone IV of Himachal Pradesh. The disease noticed severe form with incidence of 54.7 per cent at HAREC, Kukumseri whereas, in Zone II and III, the status of the disease remained moderate with an incidence of 17.7 to 35.3 per cent at Bajaura and Palampur, respectively.

Williamson-Benavides *et al*. (2020) concluded that root rot is a devastating disease of pea which causes significant yield losses (15–60%) across the world. Similarly, Yan and Nelson (2022) reported that soil type significantly affected disease development, with higher severity in the lighter soils of sandy loam and silt loam compared with clay. Soil type also interacted with *Fusarium* species, in which the maximum severity was observed in sandy loam for *F. solani*.

Table .1:Per cent disease incidence of root rot of pea incited by *Fusarium solani* f. sp. *pisi* indifferent regions of Rajasthan

S.N.	District	Tehsils	Name of village surveyed	PDI in surveyed 2 fields of each village		Soil type	Avg. PDI (%) of tehsil
1	Jaipur	Jobner	1. Kalkh	28.19 (1)	28.88 (2)	Sandy loam	30.85
			2. Khejrawas	36.37 (3)	26.48 (4)		
			3.Bobas	25.81(5)	31.32 (6)		
			4.Hingoniya	32.38 (7)	37.36 (8)		
	Jaipur	Mozmabad	1. Boraj	26.67 (9)	35.00 (10)	Sandy loam	29.64
			2.Jhag	33.34 (11)	24.14 (12)		
			3. Sewa	31.34 (13)	20.19 (14)		
			4.Gangati	32.37 (15)	26.00 (16)		
						Mean	30.25
2	Sikar	Dhod	1.Mandota	19.45 (17)	20.75 (18)	Sandy loam	22.59
			2. Bidoli	16.71 (19)	25.28 (20)		
			3.Arjunpura	23.00 (21)	26.04 (22)		
			4.Banura	27.47 (23)	21.00 (24)		
	Sikar	Sikar	1.Gokulpura	17.65 (25)	23.34 (26)	Sandy loam	20.37
			2.Dujod	24.25 (27)	19.15 (28)		
			3.Palwas	13.89 (29)	28.58 (30)		
			4. Kasli	17.65 (31)	18.52 (32)		
						Mean	21.48
3	Nagaur	Nawa	1.Lohrana	21.31 (33)	24.14 (34)	Sandy loam	17.93
			2.Maroth	16.15 (35)	10.72 (36)		
			3.Rajliya	24.13 (37)	17.82 (38)		
			4.Piprali	18.11 (39)	13.04 (40)		
	Nagaur	Merta	1. Prithvipura	16.19 (41)	10.46(42)	Sandy loam	15.90

			2. Satlas	19.43 (43)	12.50 (44)		
			3.Sogawas	15.62 (45)	15.71 (46)		
			4. Bhuriyasani	23.34 (47)	15.90 (48)		
						Mean	16.91
4	Ajmer	Ajmer	1.Nand	24.88 (49)	25.81 (50)	Loamy soil	27.77
			2.Kayampura	32.15 (51)	33.49 (52)		
			3.Gegal	27.93 (53)	24.24 (54)		
			4. Picholiya	30.29 (55)	23.34 (56)		
	Ajmer	Kishangarh	1. Moondoti	24.28 (57)	23.67 (58)	Loamy soil	25.76
			2. Salemabad	21.52 (59)	22.69 (60)		
			3.Raghunathpura	20.06 (61)	26.67 (62)		
			4. Silora	34.26 (63)	22.88 (64)		
						Mean	26.77
5	Alwar	Rajgarh	1. Kaleshgarh	20.45 (65)	18.75 (66)	Clay loam	24.51
			2. Goth	20.00 (67)	26.49 (68)		
			3. Berli	32.36 (69)	27.25 (70)		
			4. Bhangarh	22.67 (71)	28.04 (72)		
	Alwar	Bansur	1. Chula	20.12 (73)	24.00 (74)	Clay loam	21.46
			2. Harsora	22.65 (75)	25.43 (76)		
			3. Bhoopsera	19.56 (77)	26.04 (78)		
			4. Balawas	15.30 (79)	18.52 (80)		
						Mean	22.99
						Overall mean	**23.68**

Conclusion

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Data clearly showed that the root rot of pea caused by *Fusarium solani* is an exigent pathological concern especially in Jaipur, Sikar, Nagaur, Ajmer and Alwar. The average disease incidence of 23.68 per cent was recorded in five districts of Rajasthan. Jaipur (30.25%) had the highest disease incidence followed by Ajmer (26.77%), Alwar (22.99), Sikar (21.48%) and Nagaur (16.91%). No area or location in the surveyed region was completely devoid of the root rot of pea.

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