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Survey, distribution and incidence of Isabgol wilt incited by *Fusarium oxysporum* Schlecht in different agro climatic zones of Rajasthan

Abhinav, RN Bunker, Nitisha Gahlot and Pokhar Rawal

Abstract

A roving intensive survey was conducted during 2017 and 2018 to assess the incidence and distribution of isabgol wilt caused by *Fusarium oxysporum* Schlecht in different Agro climatic zones (IVA, IIB and IVB) of Rajasthan. Total forty three villages of different zones were surveyed involving five isabgol fields from every village and numbers of wilted plants were recorded in one meter square in each field. Maximum wilt incidence 34.74% was recorded in Zone IVA and minimum was recorded in zone IIB 30.51%. District wise maximum incidence 40.65% was recorded in Udaipur district followed 36.03% in Chittorgarh, 32.42% in Pratapgarh, 30.51% in Pali and minimum disease incidence 27.43% was recorded in Sirohi district. Survey data revealed that wilt disease of isabgol causes significant loss to isabgol crop and leading to low production and productivity in Rajasthan.

Keywords: Hernia, buffalo bull, umbilical, herniorrhaphy

Introduction

Isabgol (*Plantago ovata* Forsk.) is a short-stemmed medicinal annual herb that grows up to a height of 35 to 40 cm used Psyllium husk is medicinally important polysaccharide and it has been reported for the treatment of constipation, diabetes, diarrhoea, inflammation bowl diseases, ulcerative colitis, cancer, obesity and high cholesterol (Madgulkar *et al.*, 2015 and Sharma *et al.*, 2014) [6]. *Fusarium* wilt is the most important and widespread disease of Isabgol in Rajasthan which causes extensive damage to the crop. A number of fungal pathogens were involved causing severe yield losses and seed quality of Isabgol *viz.*, *Fusarium* wilt, damping off, leaf blight, downy mildews and powdery mildew Mandal (2010) [7]. *Fusarium* wilt is the most important and widespread disease of Isabgol in Rajasthan which causes extensive damage to the crop. It occurs every year in severe form in the entire Isabgol growing areas of the state. Recently in 2016-17, the incidence of wilt caused by *Fusarium* species infecting Isabgol observed up to 5-15% in Udaipur, Chittorgarh, Pratapgarh, Sirohi and Pali districts of Southern Rajasthan. (Annual Progress Report, 2016-17) [3]. Meena and Roy (2020) [8] reported yield losses 18 -40% in isabgol by *Fusarium oxysporum* Schlecht. In India, work on Isabgol wilt is very limited, so far only *Fusarium moniliforme*, *Fusarium oxysporum* Schlecht and *F. solani* are reported from Haryana (Mehta *et al.*, 1985; Elwakil and Ghoneem, 1999) [9, 4] but it is not known whether other species are also prevalent in different regions. The fungus *Fusarium oxysporum* is a cosmopolitan, soil borne filamentous fungi and economically important because many species of *Fusarium* are the causal agents of vascular wilt or root rot diseases in agricultural and medicinal crops throughout the world. Abhinav *et al.*, 2022 [1] worked on cultural, morphological and molecular variability of *Fusarium oxysporum* Schlecht causing wilt of isabgol. Survey and surveillance form the basis for any successful plant protection strategy. Successful plant protection depends upon early detection of the disease incidence followed by timely adoption and application of preventive measures. To know different species, biology and incidence per cent of *Fusarium oxysporum* Schlecht a detailed survey was conducted in present study during *Rabi* 2017-18 and 2018-19.

Materials and Methods

Occurrence and distribution of *Fusarium* wilt of Isabgol

A roving intensive survey was conducted at forty three villages of Udaipur, Chittorgarh, Sirohi, Pali and Pratapgarh districts of Rajasthan (Table 1.) during *Rabi* 2017-18 and 2018-19. Total number of plants wilted were recorded in one sq. meter of area and the Per cent Disease

Incidence was recorded by number of wilted plants from one sq. meter area from five randomly selected locations in each field by using the below mentioned formula. The diseased plants were uprooted and collected with gunny bags along with rhizospheric soil of wilted plant from the farmer's field and samples were brought to laboratory for further study.

Percent wilt incidence was calculated by the formula given by Wheeler, 1969 as follows: No. of diseased plant

$$\text{Percent disease incidence} = \frac{\text{No. of diseased plant}}{\text{Total number of plants assessed}} \times 100$$

Table 1: Surveyed location of Isabgol wilt in different Agro-climatic zones of Rajasthan

Agro-climatic zones of Rajasthan	District	Teshil	Village	GPS	
				Latitude	Longitude
Zone IV A (Sub Humid Southern Plain)	Udaipur	Bhindar	Menar	24.5996 ⁰ N	74.1064 ⁰ E
			Amarpura	24.5726 ⁰ N	74.0976 ⁰ E
			Balathal	24.7052 ⁰ N	73.9757 ⁰ E
		Vallabhnagar	Vana	24.6075 ⁰ N	74.1468 ⁰ E
			Bamaniya	24.5694 ⁰ N	74.1211 ⁰ E
			Arniya	24.4641 ⁰ N	74.3265 ⁰ E
		Salumbar	Bhimpura	24.2206 ⁰ N	74.0344 ⁰ E
			Deopura	24.3058 ⁰ N	73.7874 ⁰ E
		Udaipur	RCA Farm	24.5806 ⁰ N	73.7038 ⁰ E
	Chittorgarh	Bari sadri	Jarkhana	24.4251 ⁰ N	74.4364 ⁰ E
			Haripura	24.9848 ⁰ N	74.3851 ⁰ E
		Rashmi	Bhimgarh	25.0231 ⁰ N	74.3991 ⁰ E
			Pahuna	25.0609 ⁰ N	74.3609 ⁰ E
			Lalpura	25.1073 ⁰ N	74.4233 ⁰ E
		Kapasana	Dolatpura	25.1254 ⁰ N	74.8551 ⁰ E
			Jaitpura	24.8188 ⁰ N	74.2913 ⁰ E
			Gulabpura	25.9032 ⁰ N	74.6605 ⁰ E
			Gundli	24.7739 ⁰ N	74.2502 ⁰ E
Zone II B Transitional plain of Luni basin	Pindwara	Pindwara	Kheri	24.8302 ⁰ N	74.6591 ⁰ E
			Rampura	24.9251 ⁰ N	72.8309 ⁰ E
			Arashana	24.8173 ⁰ N	72.9771 ⁰ E
		Sirohi	Amla	24.7658 ⁰ N	72.6742 ⁰ E
			Mandwa	24.8779 ⁰ N	72.8323 ⁰ E
			Rajpura	24.8562 ⁰ N	72.9047 ⁰ E
	Abu road	Varada	25.0346 ⁰ N	72.6890 ⁰ E	
		Vadeli	24.8064 ⁰ N	72.7529 ⁰ E	
		Maval	24.4532 ⁰ N	72.7038 ⁰ E	
		Khara	24.4072 ⁰ N	72.7038 ⁰ E	
		Jhamar	24.5052 ⁰ N	72.7235 ⁰ E	
		Zone IV B (Humid Southern Plain)	Pratapgarh	Pali	Budhwara
Changwa	25.4992 ⁰ N				73.3045 ⁰ E
Girwar	25.5501 ⁰ N				73.1748 ⁰ E
Sumerpur	Sonpura			25.1145 ⁰ N	73.1099 ⁰ E
	Dhanapura			25.1165 ⁰ N	73.0036 ⁰ E
	Palri			25.1309 ⁰ N	73.0136 ⁰ E
Bali	Beejapur			25.0568 ⁰ N	73.2574 ⁰ E
	Peepla			25.0591 ⁰ N	73.3650 ⁰ E
	Kotra			25.1170 ⁰ N	73.2308 ⁰ E
Sirohi	Avleshwar	24.0167 ⁰ N	74.8671 ⁰ E		
	Jahajpur	23.9407 ⁰ N	74.8114 ⁰ E		
	Bajrangarh	23.9847 ⁰ N	74.8825 ⁰ E		
	Gandher	23.9347 ⁰ N	74.8444 ⁰ E		
	Bhojpur	24.1167 ⁰ N	74.3793 ⁰ E		

Results and Discussion

The result of the roving intensive survey revealed that the incidence of wilt disease showed its widespread occurrence in almost all isabgol areas of Rajasthan during two consecutive seasons of *Rabi* 2017-18 and 2018-19. Total forty three villages were surveyed (Table 1). The result revealed that per cent disease incidence of surveyed fields was ranged from 20.35 to 45.13 and 23.67 to 44.72 in the year of *Rabi* 2017-18 and 2018-19, respectively.

During *Rabi*, 2017-18 the per cent disease incidence of nine villages of Udaipur districts were ranged 35.63 (Deopura) to 45.13 (Amarpura). The maximum percent disease incidence

was recorded in Amarpura (45.13) followed by Bhimpura (43.96) and Balathal (43.95). The minimum per cent incidence was found in Deopura (35.63) followed by Arniya (37.25). The disease incidence of remaining villages recorded in range from 37.25 to 43.95.

In *Rabi*, 2018-19 the Per cent disease incidence of nine villages of Udaipur districts were ranged 38.31 (Bamaniya) to 44.72 (Amarpura). The maximum per cent disease incidence was recorded in Amarpura (44.72) followed by Balathal (43.10) and Bhimpura (42.33). The minimum Per cent incidence was found in Bamaniya (38.31) followed by Vana (38.36). The Per cent disease incidence of remaining villages

recorded in range from 38.36 to 42.33. The pooled data revealed that the maximum Per cent disease incidence was observed in Amarpura (44.92) followed by Balathal (43.53) and minimum was found in Deopura 37.17 followed by Arniya (38.07) table 2.

During *Rabi*, 2017-18 the per cent disease incidence of ten villages of Chittorgarh districts were ranged 30.77 (Gulabpura) to 38.71 (Haripura). The maximum percent disease incidence was recorded in Haripura (38.71) followed by Pahuna (37.11) and Dolatpura (36.76). The minimum per cent incidence was found in Gulabpura (30.77) followed by Kheri (32.06). The disease incidence of remaining villages recorded in range from 32.06 to 36.76.

In *Rabi*, 2018-19 the per cent disease incidence of ten villages of Chittorgarh districts were ranged 34.72 (Jaitpura) to 40.05 (Haripura). The maximum percent disease incidence was recorded in Haripura (40.05) followed by Dolatpura (39.15) and Gundli (38.43). The minimum per cent incidence was found in Jaitpura (34.72) followed by Kheri (35.12). The disease incidence of remaining villages recorded in range from 35.12 to 38.43. The pooled data revealed that the maximum per cent disease incidence was observed in Haripura (39.38) followed by Dolatpura (37.96) and minimum was found in Kheri 33.59 followed by Jaitpura (33.68) table 2.

During *Rabi*, 2017-18 the per cent disease incidence of ten villages of Sirohi districts were ranged 22.97 (Rajpura) to 32.49 (Mandwa). The maximum percent disease incidence was recorded in Mandwa (32.49) followed by Vadeli (32.03) and Amla (30.77). The minimum per cent incidence was found in Rajpura (22.97) followed by Khara (23.04). The disease incidence of remaining villages recorded in range from 23.04 to 30.77.

In *Rabi*, 2018-19 the Per cent disease incidence of ten villages of Sirohi districts were ranged 23.67 (Rampura) to 31.19 (Mandwa). The maximum Per cent disease incidence was recorded in Mandwa (31.19) followed by Vadeli (30.73) and Amla (30.37). The minimum Per cent incidence was found in Rampura (23.67) followed by Rajpura (25.32). The disease incidence of remaining villages recorded in range from 25.32 to 30.37. The pooled data revealed that the maximum Per cent disease incidence was observed in Mandwa (31.84) followed by Vadeli (31.38) and minimum was found in Rajpura 24.14 followed by Rampura (24.48) table 2.

During *Rabi*, 2017-18 the Per cent disease incidence of nine villages of Pali districts were ranged 20.35 (Peepla) to 33.89 (Changwa). The maximum percent disease incidence was recorded in Changwa (33.89) followed by Sonpura (32.70) and Kotra (32.66). The minimum Per cent incidence was found in Peepla (20.35) followed by Beejapur (25.97). The Per cent disease incidence of remaining villages recorded in range from 25.97 to 32.66.

In *Rabi*, 2018-19 the Per cent disease incidence of nine villages of Pali districts were ranged 24.49 (Peepla) to 34.72 (Changwa). The maximum Per cent disease incidence was recorded in Changwa (34.72) followed by Girwar (34.53) and Kotra (34.41). The minimum Per cent incidence was found in Peepla (24.49) followed by Sonpura (28.09). The Per cent

disease incidence of remaining villages recorded in range from 28.09 to 34.41. The pooled data revealed that the maximum Per cent disease incidence was observed in Changwa (34.31) followed by Kotra (33.53) and minimum was found in Peepla 22.42 followed by Beejapur (27.25) table 2.

During *Rabi*, 2017-18 the Per cent disease incidence of five villages of Pratapgarh districts were ranged 30.41 (Jahajpur) to 34.49 (Avleshwar). The maximum Per cent disease incidence was recorded in Avleshwar (34.49) followed by Bhojpur (32.89) and Bajrangarh (32.83). The minimum Per cent incidence was found in Jahajpur (30.41) followed by Gandher (30.97).

In *Rabi*, 2018-19 the Per cent disease incidence of five villages of Pratapgarh districts were ranged 29.68 (Bhojpur) to 35.57 (Jahajpur). The maximum Percent disease incidence was recorded in Jahajpur (35.57) followed by Bajrangarh (33.28) and Avleshwar (32.72). The minimum Per cent incidence was found in Bhojpur (29.68) followed by Gandher (31.07). The pooled data revealed that the maximum Per cent disease incidence was observed in Avleshwar (33.61) followed by Bajrangarh (33.06) and minimum was found in Gandher 31.02 followed by Bhojpur (31.28) table 2.

Incidence of Fusarium wilt of isabgol was varied in all five districts of different Agro-climatic zones (IVA, II B and IV B) of Rajasthan during two consecutive seasons of Rabi 2017-18 and 2018-19. During Rabi 2017-18 maximum Per cent disease incidence was observed in zone IVA 34.38% followed by zone IV B 32.34 % and minimum was recorded in II B 30.18 %. Whereas, in Rabi 2018-19 maximum Per cent disease incidence was observed in zone IVA 35.11 % followed by zone IV B 32.50 % and minimum was recorded in II B 30.83%. The surveyed data presented in table 3. plate 1. India is leading in the production of isabgol and sole suppliers of seed coat 'husk' in the international market, which is economically as well as medicinally important part of the isabgol. Seed husk widely used in pharmaceutical industries as laxative, in treatment of inflammatory bowel disease, constipation, diarrhea, high blood pressure, etc. (Madgulkar et al., 2015).

Wilt of isabgol caused by *F. oxysporum* Schlecht is one of the most economically important disease in India, it was first reported from Haryana (Mehta et al., 1985) [9]. Very limited research on isabgol wilt has been done. Besides, comparatively similar findings were reported by various workers on other crops. Thaware et al. (2015) surveyed eight districts of Marathwada region for occurrence and distribution of *Fusarium oxysporum* causing fusarium wilt disease in chick pea. Jayanta et al. (2018) conducted survey in four districts of North Eastern Karnataka. The survey results revealed that disease incidence of Fusarium wilt was noticed throughout the North Eastern Karnataka viz., Raichur, Yadagir, Kalaburgi and Koppal districts wherever tomato was grown. In tomato, wilt was noticed in all locations surveyed with a range of 8.33 to 38.66%. Maximum wilt incidence was observed in Kalaburgi district (26.21%) and least incidence was in Raichur district (21.25%).

Table 2: Per cent Disease Incidence of Fusarium wilt of isabgol during *Rabi* 2017-18 and 2018-19 from different districts of Rajasthan

Percent Disease Incidence					
Udaipur					
Sr. No	Village	Variety	2017-18	2018-19	Pooled
1.	Menar	Gujarat isabgol -1	38.94 (39.56)	40.78 (42.67)	39.86 (41.12)
2.	Amarpura	Gujarat isabgol -2	45.13 (50.23)	44.72 (49.50)	44.92 (49.87)
3.	Balathal	JI-09-21	43.95 (48.17)	43.10 (46.69)	43.53 (47.43)
4.	Vana	Niharika	38.75 (39.18)	38.36 (38.52)	38.56 (38.85)
5.	Bamaniya	Jawahar Isabgol-4	40.95 (42.96)	38.31 (38.44)	39.63 (40.70)
6.	Arniya	Local	37.25 (36.67)	38.90 (39.45)	38.07 (38.06)
7.	Bhimpura	JI-09-21	43.96 (48.19)	42.33 (45.35)	43.15 (46.77)
8.	Deopura	Local	35.63 (33.94)	38.70 (39.10)	37.17 (36.52)
9.	RCA Farm	Gujarat isabgol -2	42.11 (44.97)	39.77 (40.92)	40.94 (42.95)
Mean			40.74	40.55	40.65
SEm±			1.028	1.146	0.667
CD at 5%			3.081	3.437	1.921
C.V			4.37	4.90	4.64
Chittorgarh					
Sr. No	Village	Variety	2017-18	2018-19	Pooled
1.	Jarkhana	Niharika	34.53 (32.15)	36.58 (35.52)	35.55 (33.84)
2.	Haripura	Gujarat isabgol -2	38.71 (39.18)	40.05 (41.40)	39.38 (40.29)
3.	Bhimgarh	Gujarat isabgol -1	34.18 (31.56)	36.38 (35.18)	35.28 (33.37)
4.	Pahuna	Local	37.11 (36.41)	36.21 (34.95)	36.66 (35.68)
5.	Lalpura	Gujarat isabgol -1	35.51 (33.74)	37.57 (37.18)	36.54 (35.46)
6.	Dolatpura	Gujarat isabgol -1	36.76 (35.82)	39.15 (39.87)	37.96 (37.85)
7.	Jaitpura	Local	32.64 (29.09)	34.72 (32.45)	33.68 (30.77)
8.	Gulabpura	JI-09-21	30.77 (26.18)	36.98 (36.18)	33.88 (31.18)
9.	Gundli	Local	36.60 (35.56)	38.43 (38.64)	37.52 (37.10)
10.	Kheri	Local	32.06 (28.19)	35.12 (33.11)	33.59 (30.65)
Mean			34.89	37.12	36.00
SEm±			0.944	0.788	0.532
CD at 5%			2.805	2.341	1.527
C.V			4.69	3.68	4.18
Sirohi					
Sr. No	Village	Variety	2017-18	2018-19	Pooled
1.	Rampura	Gujarat isabgol -1	25.29 (18.25)	23.67 (16.12)	24.48 (17.19)
2.	Arashana	Gujarat isabgol -2	28.22 (22.36)	25.34 (18.32)	26.78 (20.34)
3.	Amla	Local	30.77 (26.18)	30.37 (25.56)	30.57 (25.870)
4.	Mandwa	Gujarat isabgol -2	32.49 (28.92)	31.19 (26.89)	31.84 (27.91)
5.	Rajpura	Local	22.97 (15.23)	25.32 (18.29)	24.14 (16.76)
6.	Varada	Gujarat isabgol -1	27.01 (20.63)	28.79 (23.19)	27.90 (21.91)
7.	Vadeli	Local	32.03 (28.14)	30.73 (26.12)	31.38 (27.13)
8.	Maval	JI-09-21	25.04 (17.92)	26.87 (20.45)	25.95 (19.19)
9.	Khara	Niharika	23.04 (15.32)	26.43 (19.82)	24.74 (17.57)
10.	Jhamar	Local	26.10 (19.36)	26.89 (20.49)	26.49 (19.92)
Mean			27.30	27.56	27.43
SEm±			0.621	0.680	0.399
CD at 5%			1.845	2.020	1.144
C.V			3.94	4.27	4.11
Pali					
Sr. No	Village	Variety	2017-18	2018-19	Pooled
1.	Budhwara	Gujarat isabgol -2	28.22 (22.36)	30.73 (26.12)	29.48 (24.24)
2.	Changwa	Gujarat isabgol -2	33.89 (31.12)	34.72 (32.45)	34.31 (31.79)
3.	Girwar	Local	32.09 (28.23)	34.53 (32.17)	33.31 (30.20)
4.	Sonpura	Gujarat isabgol -1	32.70 (29.19)	28.09 (22.18)	30.40 (25.69)
5.	Dhanapura	Local	31.71 (27.63)	29.51 (24.26)	30.61 (25.95)
6.	Palri	Niharika	32.28 (28.53)	31.46 (27.25)	31.87 (27.89)
7.	Beejapur	Gujarat isabgol -1	25.97 (19.17)	28.53 (22.82)	27.25 (21.00)
8.	Peepla	Local	20.35 (12.10)	24.49 (17.19)	22.42 (14.65)
9.	Kotra	Local	32.66 (29.13)	34.41 (31.96)	33.53 (30.55)
Mean			29.99	30.72	30.35
SEm±			0.584	0.741	0.408
CD at 5%			1.749	2.220	1.176
C.V			3.37	4.18	3.80
Pratapgarh					
Sr. No	Village	Variety	2017-18	2018-19	Pooled

1.	Avleshwar	Gujarat isabgol -1	34.49 (32.12)	32.72 (29.23)	33.61 (30.67)
2.	Jahajpur	Gujarat isabgol -2	30.41 (25.63)	35.57 (33.85)	32.99 (29.74)
3.	Bajrangarh	Local	32.83 (29.39)	33.28 (30.12)	33.06 (29.76)
4.	Gandher	Local	30.97 (26.48)	31.07 (26.63)	31.02 (26.56)
5.	Bhojpur	Niharika	32.89 (29.53)	29.68 (24.57)	31.28 (27.05)
Mean			32.32	32.46	32.39
SEm±			0.769	0.658	0.438
CD at 5%			2.509	2.145	1.314
C.V			4.12	3.51	3.83

**Figures in parentheses are arcsine per cent angular transformed value

Table 3: Per cent Disease Incidence of Fusarium wilt of isabgol from different Agro-climatic zones (IVA, II B, IV B) of Rajasthan during Rabi 2017-18 and 2018-19

Percent Disease Incidence					
S. No.	Agro-climatic zones of Rajasthan	Districts	2017-18	2018-19	Pooled
1.	Zone IVA	Udaipur	40.77 (42.65)	40.57 (42.29)	40.67 (42.47)
2.		Chittorgarh	34.93 (32.79)	37.14 (36.45)	36.03 (34.62)
3.		Sirohi	27.44 (21.23)	27.64 (21.52)	27.54 (21.38)
Mean			34.38	35.11	34.74
4.	Zone II B	Pali	30.18 (25.27)	30.83 (26.27)	30.51 (25.77)
5.	Zone IV B	Pratapgarh	32.34 (28.63)	32.50 (28.88)	32.42 (28.75)
Mean			33.13	33.74	33.43
SEm±			0.388	0.306	0.214
CD at 5%			1.264	0.997	0.641
C.V			2.03	1.57	1.81

**Figures in parentheses are arcsine per cent angular transformed value



Plate 1: Survey for disease incidence in different districts of Rajasthan



Fig 1(a): Diseased plant



Fig 1: (b) Healthy plant

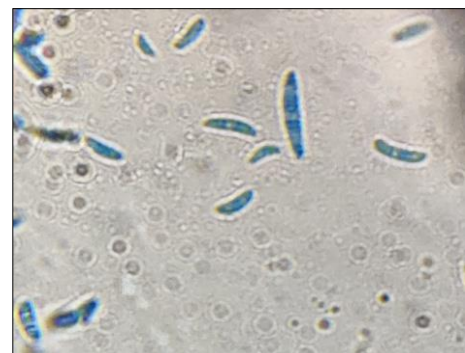


Fig 1: (c) Conidial morphology



Fig 1(d): Culture plate of *F. oxysporum* Schlecht

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