

Survey and incidence of tomato wilt disease incited by *Fusarium oxysporum* f.sp. *lycopersici* (Sacc.) in different Agro-climatic Zones of Rajasthan

Research Article

Gahlot N*, Bunker RN, Abhinav and Charpota K

Department of Plant Pathology, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India

***Corresponding author:** Gahlot N, Department of Plant Pathology, Rajasthan College of Agriculture, Maharana Pratap University of Agriculture and Technology, Udaipur, Rajasthan, India; E-mail: nitishagahlot560@gmail.com

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Abstract

Fusarium wilt or vascular wilt of tomato, caused by *Fusarium oxysporum* f.sp. *lycopersici* is one of the major constraints in tomato production. A survey was carried out to assess the incidence and distribution of fusarium wilt in different Agro-climatic zones of Rajasthan in the year 2019-20 and 2020-21 (Figure 1). Total fifty villages of different agro-climatic zones were surveyed involving five fields of every village by counting infected or diseased plants in tomato field of 5×5 m² area of randomly selected from four to five places in each field. Highest wilt incidence was recorded in Zone IIIA (28.07%) followed by Zone IVA (24.02%) while, lowest percent disease incidence was recorded by Zone IVB (21.28%). At districts level, maximum disease incidence was found in Udaipur (31.08%) followed by Jaipur (28.07%) and Banswara (22.70%). Minimum wilt incidence was observed in Chittorgarh (16.99%) followed by Pratapgarh district (19.86%). The survey results revealed that disease incidence was noticed causing loss in tomato crop and production..

Keywords: Survey; Tomato; Wilt disease; *Fusarium oxysporum* f.sp. *lycopersici*

Introduction

Tomato (*Lycopersicon esculentum* Mill.) belongs to the family Solanaceae and it is viewed as one of the world's most mainstream vegetables [1-3]. It is widely grown throughout the world and considered as most important tropical vegetable crop. A number of biotic and abiotic factors affect the quality and productivity of tomato. Fusarium wilt caused by *Fusarium oxysporum* f.sp. *lycopersici* (Sacc.) W.C. Snyder and Hans a serious disease of tomato causes 30-40% yield loss and under favorable conditions losses increased to 80% [4]. *Fusarium oxysporum* is a soil borne pathogen by nature, which gets entry through the roots and disturb vascular system of the plant resulting yellowing, drooping and downward curvature of the leaves and finally death of plant. Browning of vascular system in infected stems and leaf petioles with larger size than normal, is strong evidence of *Fusarium* wilt (Figure 2). Survey and surveillance are the basic

requirement to assess the incidence of any disease and distribution of pathogen population and further studies on biology and variability of the pathogen.

Material & Methods

A survey was carried out to know the severity of tomato wilt during the year 2019-20 and 2020-21 in different Agro-climatic zones (IVA, IIIA and IVB) of Rajasthan, which includes five districts viz., Udaipur, Chittorgarh, Jaipur, Pratapgarh and Banswara. Total fifty villages were surveyed in all the five districts (Table 1). Observation on percent disease incidence was taken by counting infected or diseased plants in tomato field of 5×5 m² area of randomly selected from four to five places in each field by using the following formula.

$$\text{Percentage disease incidence} = \frac{\text{Total number of diseased / infected plants}}{\text{Total number of plant observed}} \times 100$$

Table 1: Survey for disease incidence of fusarium wilt of tomato in different Agro-climatic Zones of Rajasthan.

Agro-climatic zones of rajathan	District	Tehsil	Village	GPS	
				Latitude	Longitude
Zone IV A (Sub humid Southern plain)	Udaipur	Girwa	Pratappura	24.5869°N	73.6962°E
			Baleecha	24.3443°N	74.2326°E
		Mavli	Ganeshpura	24.7902°N	73.9742°E
			Bijanwas	24.6855°N	73.8623°E
			Akodra	24.7215°N	74.0858°E
			Badgaon	24.7175°N	74.0263°E
		Bhinder	Deoli	24.7582°N	74.3818°E
		Jhadol	Chatarpura	24.3591°N	73.5314°E
			Alsigarh	24.4775°N	73.5712°E
		Udaipur	RCA High-tech farm	24.5806°N	73.7038°E
	Chittorgarh	Nimbahera	Bamniya	24.9283°N	74.3509°E
			Semaliya	24.5710°N	74.6840°E
		Chittaugarh	Ghosunda	24.8539°N	74.5405°E
			Parliya	24.8340°N	74.5434°E
			Theekariya	24.7857°N	74.6567°E
			Barodiya	24.8826°N	74.6437°E
			Daulatpura	24.7214°N	74.1915°E
		Kapasana	Jaisinghpura	24.3402°N	74.4629°E
			Anoppura	24.9819°N	74.2238°E
		Bari sadri	Bari sadri	24.4130°N	74.4735°E
Zone III A (Sub humid Southern plain)	Jaipur	Jaipur	Hathod	26.9624°N	75.6877°E
			Pachar	26.9645°N	75.6265°E
			Durgapura	26.8505°N	75.7909°E
			Kalwar	26.9485°N	75.7168°E
		Chomu	Anatpura	27.1635°N	75.7228°E
		Jobner	Jobner	26.8809°N	75.8345°E
		Phulera	Bobas	26.9124°N	75.7872°E
		Bassi	Devgaon	25.5361°N	75.8621°E
		Chaksu	Barodiya	26.9202°N	75.8271°E
		Sambhar	Hingoniya	27.0325°N	75.4621°E
Zone IV B (Sub humid Southern plain)	Pratapgarh	Pratapgarh	Dateeyar	23.8746°N	74.5873°E
			Achalpur	23.0037°N	74.7161°E
			Bhojpur	24.1167°N	74.3793°E
			Chirwa	24.1831°N	74.6576°E
			Kesharpura	24.1993°N	74.8873°E
			Awleshwar	24.0159°N	74.8653°E
			Gandher	23.9347°N	74.8444°E
		Arnod	Jajli	23.8879°N	74.7432°E
			Bhogpura	23.7391°N	74.7459°E
		Peepalkhoont	Suhagpura	23.9186°N	74.7086°E
	Banswara	Banswara	Amlikhara	23.6093°N	74.5141°E
			Bodla	23.4912°N	74.3793°E
			Dhamaniya	23.5697°N	74.4247°E
			Jhamliya	23.5977°N	74.5859°E
			Borwat	23.4760°N	74.4915°E
		Bagidora	Bagidora	23.4043°N	74.2673°E
			Haripura	23.4008°N	74.2326°E
		Jhadol	Bagpura	23.8824°N	76.9669°E
		Anandpuri	Amleeya	23.5494°N	74.4394°E
		Garhi	Barodiya	23.7096°N	74.1387°E

Table 2: Percent wilt incidence of tomato in different districts of Rajasthan during 2019-20 and 2020-21.

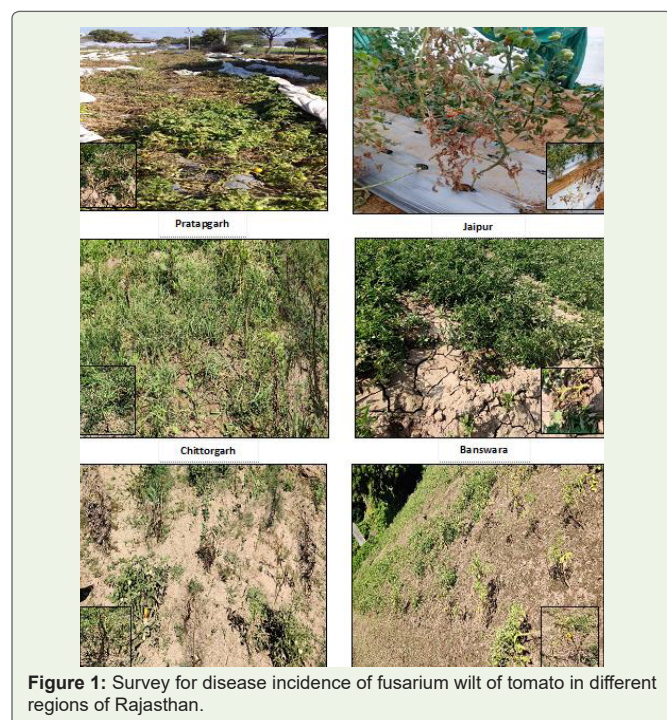
Percent wilt incidence				
Udaipur				
S. No.	Villages	2019-20	2020-21	Pooled
1.	Pratappura	28.34(32.16)	36.12(36.94)	32.23(34.55)
2.	Badgaon	31.45(34.11)	39.95(39.20)	35.70(36.66)
3.	Alsigarh	39.51(38.94)	46.26(42.85)	42.89(40.90)
4.	Ganeshpura	23.48(28.98)	28.08(32.00)	25.78(30.49)
5.	Bijanwas	20.67(27.04)	18.63(25.57)	19.65(26.30)
6.	Chatarpura	29.42(32.85)	25.99(30.65)	27.71(31.75)
7.	Baleecha	30.82(33.72)	32.10(34.51)	31.46(34.12)
8.	Deoli	24.12(29.41)	39.67(39.04)	31.90(34.22)
9.	Akodra	35.89(36.80)	29.45(32.86)	32.67(34.83)
10.	RCA High-tech farm	28.12(32.02)	33.50(35.36)	30.81(33.69)
Mean		29.18	32.98	31.08
SEm \pm		1.97	1.86	1.17
CD at 5%		5.85	5.54	3.37
CV		10.97	9.53	10.22
Percent wilt incidence				
Pratapgarh				
S. No.	Villages	2019-20	2020-21	Pooled
1.	Dateeyar	26.67(31.09)	30.42(33.47)	28.55(32.28)
2.	Achalpur	14.32(22.23)	10.78(19.16)	12.55(20.69)
3.	Jajli	27.77(31.80)	25.12(30.08)	26.45(30.94)
4.	Bhojpur	29.49(32.89)	32.50(34.75)	31.00(33.82)
5.	Kesharpura	12.42(20.63)	19.55(26.24)	15.99(23.43)
6.	Bhogpura	28.45(32.23)	22.73(28.47)	25.59(30.35)
7.	Chirwa	8.15(16.59)	11.67(19.97)	9.91(18.28)
8.	Suhagpura	13.50(21.55)	18.34(25.35)	15.92(23.45)
9.	Awleshwar	10.15(18.58)	12.50(20.70)	11.33(19.64)
10.	Gandher	22.78(28.50)	20.44(26.87)	21.61(27.69)
Mean		19.37	20.41	19.89
SEm \pm		0.68	1.01	0.53
CD at 5%		2.04	3.01	1.52
CV		6.15	8.62	7.55
Percent wilt incidence				
Jaipur				
S. No.	Villages	2019-20	2020-21	Pooled
1.	Hathod	27.77(31.80)	25.12(30.08)	26.45(30.94)
2.	Bobas	30.67(33.63)	34.42(35.92)	32.55(34.77)
3.	Devgaon	33.18(35.17)	40.47(39.50)	36.83(37.34)
4.	Kalwar	29.49(32.89)	32.50(34.75)	31.00(33.82)
5.	Anatpura	22.42(28.26)	29.55(32.92)	25.99(30.59)
6.	Jobner	28.45(32.23)	22.73(28.47)	25.59(30.35)
7.	Pachar	25.15(30.10)	31.67(34.25)	28.41(32.17)
8.	Durgapura	23.50(28.99)	26.34(30.88)	24.92(29.93)
9.	Barodiya	24.18(29.45)	30.78(33.70)	27.48(31.47)
10.	Hingoniya	22.78(28.50)	20.44(26.88)	21.61(27.69)
Mean		26.76	29.40	28.08
SEm \pm		1.87	1.60	1.06
CD at 5%		5.58	4.76	3.06
CV		11.83	8.98	10.36
Percent wilt incidence				
Chittorgarh				
S. No.	Villages	2019-20	2020-21	Pooled
1.	Bamniya	18.75(25.66)	23.69(29.13)	21.22(27.39)

2.	Ghosunda	23.67 (29.11)	28.95 (32.55)	26.31 (30.83)
3.	Parliya	15.92(23.51)	19.45(26.16)	17.69(24.84)
4.	Semaliya	7.88(16.30)	10.56(18.96)	9.22(17.63)
5.	Theekariya	28.09(32.00)	30.34(33.42)	29.22(32.71)
6.	Barodiya	10.50(18.91)	13.92(21.91)	12.21(20.41)
7.	Jaisinghpura	19.43(26.15)	17.33(24.60)	18.38(25.38)
8.	Bari sadri	11.78(20.07)	14.50(22.38)	13.14(21.23)
9.	Anoppura	8.75(17.21)	12.10(20.35)	10.43(18.78)
10.	Daulatpura	12.52(20.72)	9.80(18.24)	11.16(19.48)
Mean		15.73	18.06	16.90
SEm \pm		0.71	0.70	0.43
CD at 5%		2.13	2.09	1.24
CV		7.90	6.76	7.29
Percent wilt incidence				
Banswara				
S. No.	Villages	2019-20	2020-21	Pooled
1.	Barodiya	20.83(27.15)	15.67(23.32)	18.25(25.24)
2.	Amleeya	18.69(25.61)	12.31(20.53)	15.50(23.07)
3.	Dhamniya	29.92(33.16)	22.33(28.20)	26.13(30.68)
4.	Bagidora	25.84(30.55)	28.56(32.30)	27.20(31.43)
5.	Haripura	37.68(37.86)	33.85(35.57)	35.77(36.72)
6.	Amlikhera	23.70(29.13)	27.28(31.48)	25.49(30.31)
7.	Bodla	12.21(20.45)	18.72(25.64)	15.47(23.04)
8.	Jhamliya	21.88(27.89)	23.12(28.74)	22.50(28.31)
9.	Borwat	28.85(32.49)	26.96(31.28)	27.91(31.88)
10.	Bagpura	10.96(19.33)	14.70(22.54)	12.83(20.54)
Mean		23.06	22.35	22.70
SEm \pm		0.83	0.85	0.51
CD at 5%		2.47	2.52	1.47
CV		6.25	6.60	6.42

Table 3: Percent wilt incidence of fusarium wilt of tomato in different Agro-climatic zones (IVA, IIIA, IVB) of Rajasthan during 2019-20 and 2020-21.

Percent wilt incidence					
S. No.	Agro-climatic zones of Rajasthan	Districts	2019-20	2020-21	Pooled
1.	Zone IVA	Udaipur	29.18 (32.70)	32.98 (35.03)	31.08 (33.86)
		Chittorgarh	15.92 (23.51)	18.06 (25.14)	16.99 (24.33)
		Mean	22.55	25.92	24.03
2.	Zone IIIA	Jaipur	26.75 (31.04)	29.40 (32.83)	28.07 (31.93)
		Mean	26.75	29.40	28.07
3.	Zone IVB	Pratapgarh	19.31 (26.06)	20.40 (26.85)	19.86 (26.46)
		Banswara	23.05 (28.69)	22.35 (28.21)	22.70 (28.45)
		Mean	21.18	21.37	21.28
	SEm \pm		0.898	0.803	0.521
	CD at 5%		2.927	2.618	1.563
	CV		5.47	4.70	10.17

The disease samples were uprooted, collected and packed in clean polythene bags along with rhizospheric soil of wilted plants from farmer's field then labeled and transferred to the laboratory for isolation and identification of the pathogen.



Results & Discussion

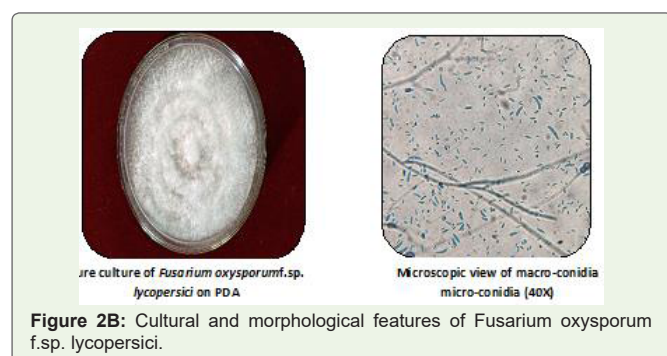
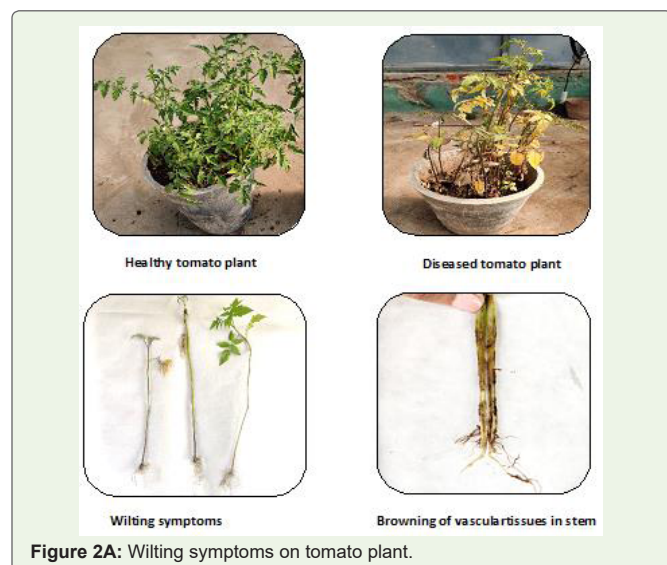
Survey was carried out to know the severity of tomato wilt during the year 2019-20 and 2020-21 in different Agro-climatic zones (IVA, IIIA and IVB) of Rajasthan, which includes five districts viz., Udaipur, Chittorgarh, Jaipur, Pratapgarh and Banswara. Total fifty villages were surveyed which are mentioned in materials and methods and evident from Table 3. The results of pooled data showed that percent disease incidence of all five districts varied from 9.22% to 42.89% in both the year [5,6].

In Udaipur district surveyed villages during 2019-20, showed variation in percent disease incidence ranging from 20.67% (Bijanwas) to 39.51% (Alsigarh). Highest percent disease incidence was recorded in Alsigarh (39.51%) followed by Akodra (35.89%) and Badgaon (31.45%). Minimum percent disease incidence was recorded in Bijanwas (20.67%) followed by Ganeshpura (23.48%). The disease incidence in left over villages was ranged from 24.12% (Deoli) to 30.82% (Baleecha). During 2020-21, ten villages of Udaipur districts depicted percent disease incidence ranging 18.63% (Bijanwas) to 46.26% (Alsigarh). The maximum percent disease incidence was showed by Alsigarh (46.26%) followed by Badgaon (39.95%) and Deoli (39.67%) while, minimum percent disease incidence was showed by Bijanwas (18.63%) followed by Chatarpura (25.99%). Percent disease incidence in remaining villages was ranged from 28.08% (Ganeshpura) to 36.12% (Pratapapura). It is evident from pooled data that highest percent disease incidence was showed by Alsigarh (42.89%) followed by Badgaon (35.70%) whereas, lowest percent disease incidence was recorded by Bijanwas (19.65%) followed by Ganeshpura (25.78%).

During the survey in 2019-20 in villages of Pratapgarh percent disease incidence range was found from 8.15% (Chirwa) to 29.49% (Bhojpur). The maximum wilt incidence was found in Bhojpur (29.49%) followed by Bhogpura (33.63%). The minimum wilt incidence was showed by village Chirwa (28.26%) followed by Awleshwar (10.15%). Survey done in 2020-21 showed that percent wilt incidence ranged from 10.78% (Achalpur) to 32.50% (Bhojpur). The highest wilt incidence was depicted by Bhojpur (32.50%) followed by Dateeyar (30.42%). The lowest wilt incidence was showed by Achalpur (10.78%) followed by Chirwa (11.67%). Pooled data revealed that maximum percent wilt incidence was found in Bhojpur (32.50%) followed by Dateeyar (28.55%). Minimum disease incidence was showed by Chirwa (9.91%) followed by Achalpur (12.55%).

Survey in Jaipur district which was carried out in ten villages during 2019-20 showed variation from 45.19% (Devgaon) to 33.43% (Hingoniya). The most disease incidence was found in Devgaon (45.19%) followed by Bobas (44.17%) and least disease incidence was found in Hingoniya (33.43%) followed by Durgapura (34.11%). During survey 2020-21 among ten villages of Jaipur, maximum percent wilt incidence was found in Devgaon (48.13%) followed by Barodiya (43.57%), while minimum wilt incidence was found in Durgapura (32.73%) followed by Hingoniya (36.53%). From pooled data it is depicted that maximum wilt incidence concluded in Devgaon (46.66%) followed by Bobas (42.61%) while minimum wilt incidence concluded in Durgapura (33.42%) followed by Hingoniya (34.98%).

In Chittorgarh, among surveyed ten villages in 2019-20



wilt incidence fluctuated between 7.88% (Semaliya) to 28.09% (Theekariya). In which maximum wilt incidence found in Theekariya (28.09%) followed by Ghosunda (23.67%). Minimum wilt incidence was shown by Semaliya (7.88%) followed by Anoppura (8.75%). In 2020-21 survey data of percent wilt incidence in Chittorgarh villages, it was found 9.80% (Daulatpura) which was extended up to 30.34% (Theekariya). Highest wilt incidence showed by Theekariya (30.34%) followed by Ghosunda (28.95%). Minimum wilt incidence found in Daulatpura (9.80%) followed by Semaliya (10.56%). Pooled data depicted highest wilt incidence in Theekariya (29.22%) followed by Ghosunda (26.31%). Lowest wilt incidence depicted in Semaliya (9.22%) followed by Anoppura (10.43%)

In Banswara survey data 2019-20, ten villages showed wilt incidence varied from 10.96% (Bagpura) to 37.68% (Haripura). Maximum wilt incidence found in Haripura (37.68%) followed by Dhamniya (29.92%). Minimum wilt incidence found in Bagpura (10.96%) followed by Bodla (12.21%). Survey data 2020-21 of wilt incidence ranged from 12.31% (Amleeya) to 33.85% (Haripura). Highest wilt incidence showed by Haripura (33.85%) followed by Bagidora (28.56%). Lowest wilt incidence showed by Amleeya (12.31%) followed by Bagpura (14.70%). Pooled depicted highest wilt incidence in Haripura (35.77%) followed by Bagidora (27.20%), lowest wilt incidence found in Bagpura (12.83%) followed by Bodla (15.47%).

All five districts of different Agro-climatic zones (IV A, III A and IV B) showed variation in percent wilt incidence of tomato wilt during two consecutive years 2019-2020 and 2020-21. During 2019-20 maximum percent disease incidence was depicted in Agro-climatic Zone IIIA (26.75%) followed by Zone IVA (22.55%). Minimum percent disease incidence was showed by Zone IVB (21.18%). During 2020-21 highest disease incidence was showed by Agro-climatic zone IIIA (29.40%) followed by Zone IVA (25.92%). Minimum percent disease incidence was showed by Zone IVB (21.37%). In pooled data maximum disease incidence recorded in Agro-climatic zone IIIA (28.07%) followed by Zone IVA (24.02%). Minimum (21.28) percent disease incidence was recorded in Zone IVB (Table 3). Such reports

on survey documented by Kapoor (1988) from different agro-climatic regions of India (Delhi, Maharashtra and Tamil Nadu) in 1981-1983 and recorded 3 to 100% disease incidence on eight tomato cultivars. Similarly, Khan *et al.* (2016) recorded 10.67% to 80.34% wilt incidence in different districts of Uttar Pradesh for fusarium wilt of tomato.

Conclusion

It is concluded Fusarium wilt disease of tomato, caused by *Fusarium oxysporum* f.sp. *lycopersici* (Sacc.) is one of the major constraints in tomato production. Survey results showed prevalence and disease severity in different Agro-climatic Zones and highest in Zone IIIA [7].

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