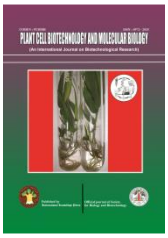

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Field Screening of Chilli (*Capsicum annuum* L.) Germplasm for Fusarium Wilt Resistance

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Authors' contributions

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

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ABSTRACT

One of the most important commercial spices, chilli (*Capsicum annuum* L.), is grown and used all over the world for pickles, vegetables, spices, and condiments. Chilli is rich in essential vitamins and bioactive molecules and plays a crucial role in providing nutrients and has anti-inflammatory and antioxidant properties. Nonetheless, several biotic and abiotic factors prevent chilli from being

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produced; among the most serious fungal illnesses is Fusarium wilt. This study aims to identify resistant sources among 120 chilli germplasm lines against *Fusarium oxysporum* f. sp. *capsici* under natural conditions (field). During the 2022 and 2023 cropping seasons, the pathogen was isolated from samples of infected roots and stems, and the genotypes were tested. Values for the Area Under the Disease Progress Curve (AUDPC) and disease incidence were noted. Results indicated varying levels of resistance, with 27 genotypes showing moderate resistance, 31 genotypes showing moderate susceptibility, 45 genotypes being susceptible, and 17 genotypes being highly susceptible. This research highlights the importance of resistant varieties for managing Fusarium wilt in chilli crops, offering environmentally friendly and farmer-accessible solutions.

Keywords: Germplasm; chilli; resistance; fusarium wilt.

1. INTRODUCTION

Botanically called as *Capsicum annuum* L., chilli is a member of the Solanaceae family and is widely used as a commercial spice vegetable in many countries across the world. It is often referred to as the "wonder spice." For vegetables, pickles, spices, and sauces, various types are grown [1,2]. Chili fruit is rich in vital vitamins (A, B, and C), which helps the impoverished in India get enough ascorbic acid and carotene, which is a precursor to vitamin A [3]. Because of their anti-inflammatory and antioxidant qualities, bioactive molecules such fatty acids, volatile oils, capsaicinoids, and carotenoids are more important in a healthy diet [4]. Nearly every tropical and subtropical region in the world has chilli growing there. Chilli is cultivated throughout the world over an area of 1832 thousand hectares producing 2959 thousand tons [5]. The largest producer of Chilli in the world is India with 20.6 lakh tonnes of production [6] followed by China with 450 thousand tonnes and Mexico with 400 thousand tonnes [7]. In the U. T of Jammu and Kashmir, chilli crops occupy 2.15 thousand hectares with an annual production of 50 thousand metric tons [8]. The popularity and demand for chilli are providing a boost are to the chilli industry, but in the recent years, the production and productivity is constrained due to many biotic and abiotic stresses. In terms of biotic stresses, the chilli plant faces viral, bacterial, and fungal diseases [9]. Among the fungal diseases Fusarium wilt is the greatest devastating malady and has emerged as a serious problem in past decade with the disease incidence of 2-85 per cent in different regions of India [5]. This disease causes 25 % yield losses in some areas whereas 70- 100 % losses have been observed in an epidemic form under suitable environmental conditions [10]. There are numerous traditional and molecular methods available for treating the disease. Some of these, like the careless use of chemicals, have direct or indirect implications on human health, while others are too expensive for farmers to implement. Therefore, it is imperative that we investigate these easily accessible and environmentally friendly farming methods.The paramount approach to accomplish the disease is the use of resistant assortments. Therefore, the goal of the current study was to identify the germplasm resistance to *Fusarium oxysporum* f. sp. *capsici.*

2. MATERIALS AND METHODS

2.1 Isolation of Pathogen

Samples of chilli roots and stems infected with *Fusarium oxysporum* f. sp. *capsici* were gathered from the experimental field of Plant Pathology Division, SKUAST-Jammu. After giving these contaminated root and stem samples a thorough rinse under tap water, they were dried in between the filter paper folds. To isolate the pathogen, the infected and healthy portions of the root/stem were sliced using a sterilized knife. The infected piece was then surface sterilized by dipping it in a solution of sodium hypochlorite (1.0%) for 30 seconds, and then it was washed three times with sterilized distilled water. After removing too much moisture from the bits using sterilized filter paper, they were aseptically put onto potato dextrose agar (PDA) medium in Petri plates. The plates were placed in a BOD incubator and incubated at 25±2°C. By comparing the pathogen's morphological characteristics, such as growth behavior, shape, size, and septation in microconidia and macroconidia, it was possible to identify the pathogen linked to the diseased samples. *F. oxysporum* f. sp. *capsici* was characterized by its thin walled, relatively slender, and slightly septate macroconidia, which typically had 2 to 6 septa. The macroconidia were evenly curved, fusoid in shape, with the widest part in the middle and tapering to pointed ends. The microconidia were abundantly present having 0-1 septation, oval to ellipsoid in shape. The pathogen produced mycelia that were either floccose, sparse, or abundant, and their color varied from white to violet. The chlamydospores, when present, appeared singly, in pairs, or in chains, either terminally or intercalary. These morphological and cultural characteristics confirmed the pathogen as *F. oxysporum*. The culture was maintained on PDA slants in a refrigerator at 4°C after being purified using the single spore isolation method.

2.2 Mass Multiplication of Pathogen

The pathogen was mass-multiplied on a corn meal sand (1:1) medium. The corn meal sand medium was stored in 250 g conical flasks, which were sealed with non-absorbent cotton plugs. The flasks were then autoclave-sterilized for 30 minutes at 15 p.s.i. Following chilling, 5 mm discs containing a pure culture of *F.o.* f. sp. *capsici* that was seven days old were aseptically inserted into the sterilized flasks. For appropriate growth, the inoculation flasks were incubated in BOD for seven days at 25°C.Plants after complete establishment were drenched with 50 ml of spore suspension containing 1× 10^6 spores/ml.

2.3 Collection and Establishment of Chilli Germplasm for Screening Against Fusarium Wilt

One hundred twenty chilli germplasm lines viz., EC 334182, EC 378632, EC 389238, EC 390029, EC391087, EC399577, EC402109, EC402113, EC405253, EC596920, EC596953, EC 596958, EC599969, EC599977, EC599981, EC390030, EC399580, IC203429, IC208534, IC208580, IC208586, IC208591, IC214949, IC214966, IC215011, IC255927, IC255928, IC255929, IC255941, IC255943, IC255944, IC264480, IC276117, IC278055, IC284474, IC284648, IC315760, IC319335, IC324215, IC332928, IC342394, IC343448, IC344563, IC344650, IC344727, IC362007, IC362009, IC362026, IC363905, IC369591, IC369592, IC394731, IC410533, IC528876, IC537599, IC537661, IC545649, IC545652, IC545654, IC545721, IC545722, IC545723, IC545735, IC561618, IC561685, IC561723, IC570376, IC570408, IC572470, NIC23923, Walia, DC/SKT-20, Phuley Jyoti, PKM-1, Local call, CBS-8, IC-119455, IC-119474, Pb-Lal, ISC-2, EC341075, CMB-15, CO-5661, Uttal Ava, Uttal Roshan, CSB-15, IC-1402, CV-2, IC413714, PBC-357,IIHR-8, Kashi- Anmol, IIHR-16, COO 714, EC492576, AC-Assam-10, LCA-443, 9771-16, DC-24, BS-20, CO-54, Convent, PBC-602, EC519630, EC519687, Kashi-Gaurav, Surgicall, SBT-12626, IIVRC-18225, IIHR-MS-4, CSB-9, LCA-434, SBT-12694, DSL-2, C6-56861, EC622085, Kashi Abha, Kisan Mela and Fazabad Mirch were procured from ICAR-National Bureau of Plant Genetic Resources, Hyderabad and ICAR- Indian Institute of Vegetable Research, Uttar Pradesh. Over the course of the 2022 and 2023 cropping seasons, the germplasm lines were screened in the field at the SKUAST-J Research Farm in Chatha.The seedlings of one hundred twenty distinct chilli germplasm lines' seedlings were raised in nursery beds. One month old seedlings of each germplasm were transplanted into the main field at the spacing of 60×45 cm in three replications with each replication consisting of 10 plants.Three replications were maintained for every germplasm. Following a 20-day period of transplanting, plants were drenched with 10 ml of spore suspension containing 1 x10^6 spores per ml. Up until the crop reached maturity, weekly data on the percentage of disease incidence was collected. Utilizing the formula below, the incidence of disease was determined.

Disease incidence (%) =

$$\frac{Total\ number\ of\ infected\ plants}{Total\ number\ of\ plants}$$

The area under disease progress curve (AUDPC) was also calculated by using the formula as given below

$$AUDPC=\sum_{i=1}^{n-1} \frac{(yi+yi+1)}{2!} \times (ti+1-ti)$$

Where *yi* is an assessment of a disease (percentage, proportion, ordinal score, etc.) at the *i*th observation, *ti* is time (in days, hours, etc.) at the *i*th observation, and *n* is the total number of observations.

Employing a disease rating scale from 1 to 6 provided by Bayoumi and El-Bramawy [11], the germplasm lines were categorized into various reaction categories after the disease incidence was recorded.

Table 1. Scale used for screening of germplasm line

Disease score	Fusarium wilt incidence	Description	Response
1	0%	Immune	I
2	1-10%	Resistant	R
3	11-20%	Moderately resistant	MR
4	21-30%	Moderately susceptible	MS
5	31-50%	Susceptible	S
6	>50%	Highly susceptible	HS

3. RESULTS AND DISCUSSION

In 2022 and 2023, 120 chilli germplasm lines were evaluated against *Fusarium oxysporum* in artificially inoculated circumstances. Disease incidence and the Area Under Disease Progress Curve (AUDPC) were assessed for 120 genotypes of chillies between the years 2022 and 2023. The results showed that all germplasm lines had rapid disease progression, with the ranges being 13.04-63.42 and 16.12-66.12 percent, 129.05-721.36 and 148.61-765.58, respectively (Table 2). Different chilli germplasm lines shown varying disease response to Fusarium wilt under field conditions.

Twenty seven germplasm lines viz., EC 596958, EC 599977, IC 214949, IC 214966, IC 215011, IC 255929, IC 255944, IC 276117, IC 278055, IC 284648, IC 332928, IC342394, IC362007, IC362009, IC369591, IC369592, IC410533, IC528876, IC537599, IC545652, IC545735, IC561685, Walia, EC492576, EC519687, Kashi-Gaurav, Kashi Abha were found moderately resistant with disease incidence (13.07, 13.05, 16.09, 16.11, 16.14, 13.22, 15.94, 13.04, 16.04, 13.23, 16.40, 13.15, 13.13, 16.23, 13.15, 16.44, 16.16, 13.15, 16.21, 16.09, 13.06, 16.08, 13.26, 16.22, 16.15, 16.14 and16.18%) and AUDPC value (131.23, 129.05, 159.97, 161.95, 164.99, 145.53, 160.73, 137.47, 158.98, 140.3, 165.56, 139.88, 137.17, 160.18, 137.53, 165.34, 160.45, 137.53, 160.74, 158.73, 134.95, 153.44, 130.27, 157.01, 163.99, 163.03 and164.71), respectively during the growing season of 2022, while the disease incidence (16.24, 16.19, 20.39, 20.09, 20.15, 16.20, 20.06, 16.14, 20.19, 16.27, 20.13, 16.14, 16.12, 20.13, 16.36, 20.03, 20.19, 16.12, 20.06, 20.06, 16.2, 20.09, 20.07, 20.08, 20.1, 20.1, 20.17, %) and AUDPC value (151.06, 148.65, 202.28, 196.68, 200.36, 151.56, 231.91, 149.59, 235.66, 153.91, 192.75, 149.95, 149.02, 192.68, 157.91, 191.57, 204.79, 155.75, 201.54, 201.53, 152.45, 175.26, 203.86, 197.88, 184.04, 187.39 and 193.95) were recorded during the growing season of 2023. Whereas thirty one genotypes viz., EC 334182, EC 402113, EC 596920, EC596953, EC 599981, IC 208580, IC 208586, IC 315760, IC 319335, IC344650, IC362026, IC363905, IC537661, IC545654, IC545722, IC561723, IC572470, Phuley Jyoti, PKM-1, PBC-357, UtKal Ava, UtKal Roshan, CV-2, IC413714, IIHR-8, LCA-443, CO-54, Convent, PBC-602, EC519630, IIVRC-18225, LCA-434 were found moderately susceptible with disease incidence and AUDPC value in the range of 23.03-29.83 per cent, and 207.20-297.43 respectively during the growing season of 2022. Whereas, during 2023 growing season disease incidence, and AUDPC value in the range of 25.98-30.33 per cent and 245.07-315.98, respectively (Table 2). Forty five genotypes viz., EC 378632, EC 399577, EC405253, EC 599969, EC 399580, IC 208591, IC 264480, IC 284474, IC 324215, IC343448, IC344563, IC394731, IC545649, IC545721, IC545723, IC561618, IC570408, NIC23924, DC/SKT-20, Local Kisan call, CBS- 8, IC-119474, Pb-lal, ISC-2, EC341075, CSB-15, CO-5661, CO-56861, PBC-357, Kashi- Anmol, IIHR-16, COO-714, AC-Assam-10, DC-24, BS-20, Sujya call, SBT-12626, IIHR-MS-4, CSB-9, SBT-12694, DSL-2, EC622085, Kisan Mela 2, and Faizabad Mirch with disease incidence and AUDPC value in the range of 32.91-50.00 and 35.10-50.27 per cent, 297.03-470.61 and 303.03-477.75 during 2022 and 2023 growing seasons, respectively were susceptible. Seventeen genotypes viz., EC 389238, EC 390029, EC 391087, EC 402109, EC 390030, IC 203429, IC 208534, IC 255927, IC 255928, IC 255941, IC 255943, IC344727, IC570376, IC-119455, IC-1402, 9771-16 and Kisan call-2, with disease incidence, and AUDPC value in the range of 52.99-73.51 and 56.02-76.16 per cent, 459.26- 721.37 and 491.54-765.78, respectively during 2022 and 2023 growing seasons were highly susceptible (Table 2).

Table 2. Evaluation of different chilli germplasm against Fusarium wilt during 2022 and 2023 under field conditions

S. No.	Germplasm	Disease incidence (%)			AUDPC			Host response
		2022	2023	Pooled	2022	2023	Pooled	
1	EC 334182	23.33	26.07	24.70	221.71	281.23	251.47	MS
2	EC 378632	33.15	35.10	34.13	318.01	321.48	319.74	S
3	EC 389238	53.50	56.15	54.82	459.26	491.61	475.43	HS
4	EC 390029	53.67	56.11	54.89	461.42	480.62	471.02	HS
5	EC 391087	56.25	60.28	58.26	492.96	584.99	538.98	HS
6	EC 399577	33.30	36.37	34.84	297.30	328.76	313.03	S
7	EC 402109	53.80	56.20	55.00	464.04	491.54	477.79	HS
8	EC 402113	23.28	26.01	24.64	218.46	256.94	237.7	MS
9	EC405253	46.18	50.03	48.11	439.26	473.87	456.56	S
10	EC 596920	26.09	30.33	28.21	263.99	289.49	276.74	MS
11	EC596953	26.11	30.12	28.12	268.12	284.9	276.51	MS
12	EC 596958	13.07	16.24	14.66	131.23	151.06	141.14	MR
13	EC 599969	32.91	36.10	34.51	299.43	319.13	309.28	S
14	EC 599977	13.05	16.19	14.62	129.05	148.65	138.85	MR
15	EC 599981	23.21	26.16	24.68	217.3	259.91	238.61	MS
16	EC 390030	55.86	60.07	57.97	498.75	572.16	535.45	HS
17	EC 399580	43.89	46.08	44.99	390.44	427.22	408.83	S
18	IC 203429	63.42	66.08	64.75	592.84	685.43	639.14	HS
19	IC 208534	73.51	76.16	74.84	721.37	765.78	743.57	HS
20	IC 208580	23.11	26.19	24.65	215.50	261.84	238.67	MS
21	IC 208586	26.11	30.19	28.15	265.27	292.13	278.70	MS
22	IC 208591	40.00	43.1	41.55	360.36	370.22	365.29	S
23	IC 214949	16.09	20.39	18.24	159.97	202.28	181.13	MR
24	IC 214966	16.11	20.09	18.10	161.95	196.68	179.31	MR
25	IC 215011	16.14	20.15	18.14	164.99	200.36	182.68	MR
26	IC 255927	52.99	56.02	54.51	466.29	492.81	479.55	HS
27	IC 255928	56.14	60.04	58.09	516.87	565.47	541.17	HS
28	IC 255929	13.22	16.20	14.71	145.53	151.56	148.55	MR
29	IC 255941	56.04	60.19	58.12	510.3	578.03	544.16	HS
30	IC 255943	56.06	60.05	58.05	510.15	563.45	536.8	HS
31	IC 255944	15.94	20.06	18.00	160.73	231.91	196.32	MR
32	IC 264480	35.85	40.33	38.09	323.59	381.45	352.52	S
33	IC 276117	13.04	16.14	14.59	137.47	149.59	143.53	MR
34	IC 278055	16.04	20.19	18.12	158.98	235.66	197.32	MR
35	IC 284474	50.00	48.99	49.49	470.61	470.00	470.31	S
36	IC 284648	13.23	16.27	14.75	140.30	153.91	147.11	MR
37	IC 315760	26.23	30.09	28.16	249.71	296.29	273.00	MS
38	IC 319335	26.40	30.11	28.26	255.51	299.29	277.4	MS
39	IC 324215	46.17	50.10	48.13	446.97	477.75	462.36	S
40	IC 332928	16.40	20.13	18.27	165.56	192.75	179.15	MR
41	IC342394	13.15	16.14	14.65	139.88	149.95	144.92	MR
42	IC343448	33.14	36.11	34.62	308.97	339.61	324.29	S
43	IC344563	43.27	46.03	44.65	405.55	434.02	419.78	S
44	IC344650	26.27	30.10	28.18	252.23	285.87	269.05	MS
45	IC344727	56.01	60.13	58.07	520.75	584.33	552.54	HS
46	IC362007	13.13	16.12	14.62	137.17	149.02	143.09	MR
47	IC362009	16.23	20.13	18.18	160.18	192.68	176.43	MR
48	IC362026	26.02	30.08	28.05	246.96	297	271.98	MS
49	IC363905	26.56	30.17	28.37	256.82	302.52	279.67	MS
50	IC369591	13.15	16.36	14.76	137.53	157.91	147.72	MR
51	IC369592	16.44	20.03	18.24	165.34	191.57	178.45	MR
52	IC394731	46.41	50.2	48.31	431.73	458.3	445.01	S

S. No.	Germplasm	Disease incidence (%)			AUDPC			Host response
		2022	2023	Pooled	2022	2023	Pooled	
53	IC410533	16.16	20.19	18.18	160.45	204.79	182.62	MR
54	IC528876	13.15	16.12	14.64	137.53	155.75	146.64	MR
55	IC537599	16.21	20.06	18.14	160.74	201.54	181.14	MR
56	IC537661	25.89	29.96	27.93	241.90	278.61	260.25	MS
57	IC545649	42.85	46.11	44.48	385.58	430.26	407.92	S
58	IC545652	16.09	20.06	18.08	158.73	201.53	180.13	MR
59	IC545654	23.22	26.13	24.67	207.20	256.36	231.78	MS
60	IC545721	36.00	36.74	36.37	319.54	343.84	331.69	S
61	IC545722	29.83	30.14	29.98	297.43	290.43	293.93	MS
62	IC545723	36.05	40.08	38.06	334.27	369.87	352.07	S
63	IC545735	13.06	16.20	14.63	134.95	152.45	143.70	MR
64	IC561618	43.15	46.08	44.62	389.38	424.2	406.79	S
65	IC561685	16.08	20.09	18.09	153.44	175.26	164.35	MR
66	IC561723	26.30	30.16	28.23	248.28	292.82	270.55	MS
67	IC570376	63.11	66.12	64.61	599.52	649.31	624.41	HS
68	IC570408	46.03	50.08	48.06	415.92	473.05	444.48	S
69	IC572470	26.06	30.04	28.05	246.67	315.98	281.32	MS
70	NIC23924	46.24	50.09	48.17	426.02	476.54	451.28	S
71	Walia	13.26	20.07	16.66	130.27	203.86	167.07	MR
72	DC/SKT-20	36.08	40.15	38.12	349.3	356.84	353.07	S
73	Phuley Jyoti	23.07	26.07	24.57	207.36	256.87	232.11	MS
74	PKM-1	33.16	36.19	34.67	355.22	303.03	329.12	S
75	Local Kisan call	43.28	46.09	44.69	369.81	453.23	411.52	S
76	PBC-357	26.21	30.14	28.18	264.48	297.44	280.96	MS
77	CBS- 8	36.15	40.16	38.16	354.38	386.26	370.32	S
78	IC-119455	53.07	56.04	54.56	477.35	497.71	487.53	HS
79	IC-119474	46.11	50.06	48.09	423.68	450.03	436.85	S
80	Pb-lal	36.04	40.32	38.18	351.67	372.69	362.18	S
81	ISC-2	40.00	43.10	41.55	402.64	401.23	401.93	S
82	EC341075	46.13	50.12	48.13	448.47	434.85	441.66	S
83	CSB-15	46.18	50.27	48.22	449.88	441.88	445.88	S
84	CO-5661	46.18	50.06	48.12	449.88	427.64	438.76	S
85	UtKal Ava	26.09	30.07	28.08	253.77	276.76	265.27	MS
86	UtKal Roshan	26.04	30.21	28.12	250.80	283.19	266.99	MS
87	CO-56861	46.07	50.09	48.08	444.96	431.92	438.44	S
88	IC-1402	56.11	60.01	58.06	513.50	556.76	535.13	HS
89	CV-2	26.08	30.10	28.09	261.72	280.13	270.92	MS
90	IC413714	23.25	26.08	24.67	222.50	256.07	239.28	MS
91	PBC-357	36.15	40.12	38.13	355.9	353.56	354.73	S
92	IIHR-8	26.05	30.20	28.13	261.36	284.41	272.88	MS
93	Kashi- Anmol	33.16	36.19	34.68	315.92	317.61	316.77	S
94	IIHR-16	33.06	36.07	34.57	313.17	337.45	325.31	S
95	COO-714	46.08	50.25	48.17	445.84	458.96	452.40	S
96	EC492576	16.22	20.08	18.15	157.01	197.88	177.44	MR
97	AC-Assam-10	46.11	50.12	48.12	445.81	456.90	451.35	S
98	LCA-443	23.15	30.09	26.62	218.79	277.50	248.14	MS
99	9771-16	53.07	56.03	54.55	475.56	518.93	497.25	HS
100	DC-24	33.28	36.04	34.66	312.00	324.46	318.23	S
101	BS-20	36.08	40.04	38.06	331.52	363.80	347.66	S
102	CO-54	23.03	25.99	24.51	245.65	248.19	246.92	MS
103	Convent	25.83	30.09	27.96	261.96	284.57	273.27	MS
104	PBC-602	23.08	26.17	24.63	241.72	251.88	246.8	MS
105	EC519630	23.27	25.98	24.63	244.69	245.07	244.88	MS
106	EC519687	16.15	20.10	18.13	163.99	184.04	174.01	MR
107	Kashi-Gaurav	16.14	20.10	18.12	163.03	187.39	175.21	MR

S. No.	Germplasm	Disease incidence (%)			AUDPC			Host response
		2022	2023	Pooled	2022	2023	Pooled	
108	Sujya call	36.04	40.04	38.04	328.44	364.49	346.47	S
109	SBT-12626	46.06	50.24	48.15	414.67	443.66	429.16	S
110	IIVRC-18225	23.28	26.08	24.68	229.66	246.61	238.13	MS
111	IIHR-MS-4	33.35	38.75	36.05	327.57	339.31	333.44	S
112	CSB-9	40.00	43.24	41.62	383.18	379.97	381.58	S
113	LCA-434	23.27	26.08	24.68	233.08	246.75	239.91	MS
114	SBT-12694	43.03	45.78	44.41	418.79	436.72	427.75	S
115	DSL-2	43.08	46.14	44.61	420.84	431.27	426.06	S
116	Kisan call-2	53.06	56.04	54.55	482.59	496.02	489.31	HS
117	EC622085	42.96	46.08	44.52	380.88	423.57	402.23	Sssssss
118	Kashi Abha	16.18	20.17	18.18	164.71	193.95	179.33	MR
119	Kisan Mela 2	43.30	45.96	44.63	397.46	399.57	398.52	S
120	Faizabad Mirch	36.20	40.08	38.14	342.23	366.17	354.20	S

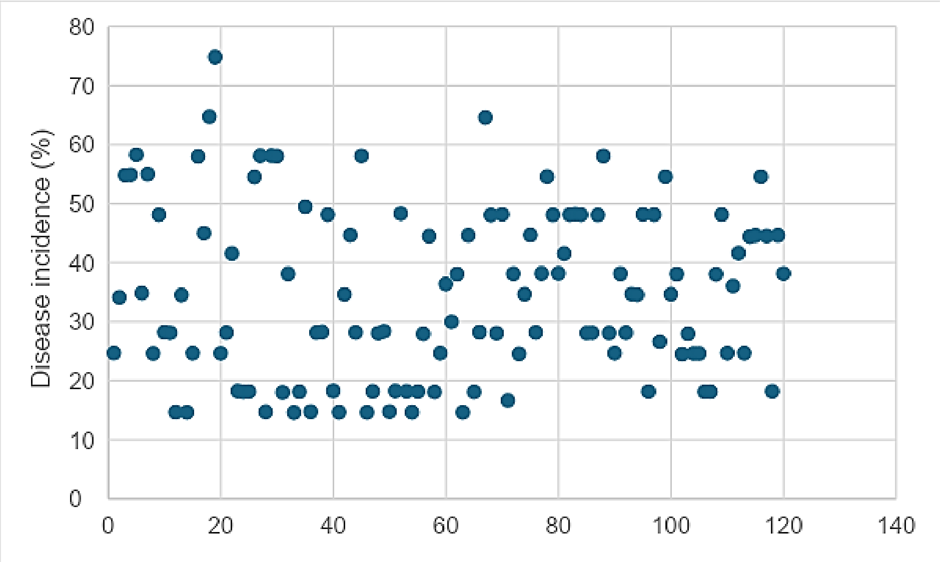

Fig. 1. Incidence of disease in screened chili germplasm

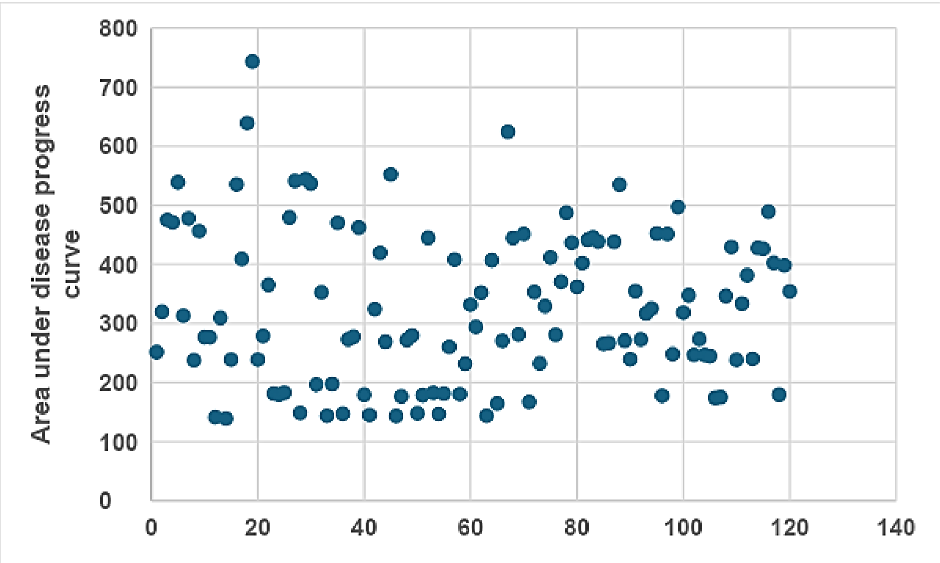

Fig. 2. Area under disease progress of screened chilli germplasm

A program of resistance breeding cannot begin unless a variety of reliable field sources of Fusarium wilt resistance have been identified. The application of resistant varieties is advantageous in that it lessens the fungicidal toxicity in addition to decreasing losses from diseases [3]. To ascertain the resistance of 120 chilli germplasm lines against fusarium wilt, a field investigation was conducted. Twenty-seven germplasm lines were discovered to be somewhat resistant, but none were proven to be immune or resistant. As the current investigations have shown, resistance to fusarium wilt in chili genotypes has been documented by several workers [12,13,14,15]. Parey et al*.* [16], also, assessed thirteen genotypes in a field and pot trial against *F. oxysporum*. While, DC-4, Anka lohit, LCA-235, LCA-333, and LCA-301 showed mild resistance reactions, no variety showed a resistant reaction. Maruti et al. [14] assessed fifty-six genotypes of chillies in relation to *Fusarium solani*. Their findings showed that none of the genotypes were resistant or immune. Cultivars with a moderate resistance may have a genetic background that makes them less suited to the Fusarium wilt pathogen due to their higher metabolic activity. Since, this chemical was exclusively produced by wilt-resistant lines, it must play a role in imparting resistance against wilt disease. The antifungal compounds like phenolics produced by resistant lines may be the cause of the resistance response because they were more potent than other compounds, especially those produced by susceptible lines [17]. Enzymes including cytochrome oxidase, polyphenol oxidase, and peroxidase have higher activity in resistant plants than in susceptible ones, but only to a limited extent. These enzymes cause specific metabolic processes that prevent the infection from establishing itself and growing [18]. Aggressive strains of the disease can also occasionally arise from the repeated cultivation of resistant varieties in the same geographic region. It is helpful to search different gene pools for resistance-inducing factors so that breeding programs can incorporate them and appropriately improve the cultivars.

Assessing resistant germplasm against *F. oxysporum* is the most effective strategy for combating the infection.

4. CONCLUSION

Out of one hundred twenty chilli germplasm screened, germplasms EC 596958, EC 599977, IC 214949, IC 214966, IC 215011, IC 255929, IC 255944, IC 276117, IC 278055, IC 284648, IC 332928, IC342394, IC362007, IC362009, IC369591, IC369592, IC410533, IC528876, IC537599, IC545652, IC545735, IC561685, Walia, EC492576, EC519687, Kashi-Gaurav, Kashi Abha were found moderately resistant. It is therefore advised to include these advanced lines/varieties into future breeding projects to generate resistant and highly productive cultivars.

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.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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