Screening of chilli genotypes for resistance to leaf curl virus: A begomovirus

Abstract

Leaf curl virus disease is a serious threat to chilli production. Screening of chilli genotypes against leaf curl viral disease aid in the identification of resistant lines and development of F_1 hybrids having resistance to the disease. In the present investigation fifty four chilli genotypes were screened for leaf curl virus resistance in the natural epiphytotic field condition and artificial inoculation using viruliferous white flies at Horticulture Research and Extension Centre (University of horticulture science, Bagalkot) during 2020-2023. Among the fifty four genotypes DCA-262 (0%), Khandhari (0%) and Bhoot Jolokia (0%) were found to be immune and genotypes EC 391087 (9%), IC 342426 (5%), Punjab Lal (7%), PunjabSurkh (9%) were found to be highly resistance to leaf curl virus under natural condition. The genotypes Khandhari (0%) and Bhoot Jolokia (0%) were found to be immune and genotypes EC 391087 (11%),Punjab Lal (10%), PunjabSurkh (10%) were found to be highly resistance to leaf curl virus under artificial inoculation. The checks Byadgi Dabbi (100%) and ByadgiKaddi (98%) were found to be highly susceptible in both natural and artificial condition.

Keywords: Chilli leaf curl virus, resistance, white fly, host plant resistance

Introduction

Chili (*Capsicum annuum* L.), a significant spice and vegetable crop that is frequently used in Indian cuisine. It is produced all year round as a cash crop and utilized in green and red ripe dried stages for its flavor and colour. It is a great source of vitamins A, B, and C in terms of nutrition(MacGillivary, 1961). Because it dilates blood vessels, the alkaloid capsaicin, which gives chilies their pungency, has therapeutic benefits and can prevent heart attacks(Purseglove 1977). It is one of the most well-liked and lucrative vegetable crops farmed worldwide is chilli.

The yield of chilli is adversely affected due to leaf curl disease caused by Chilli leaf curl virus belonging to genus Begomovirus and family Geminiviridae (Raj *et al.,* 2005). It causes the greatest damage regarding disease incidence and yield loss. There have been

reports of 100% losses of marketable fruit in extreme circumstances(Senanayake *et al.*, 2007, Zehra *et al.*, 2010). White fly (*Bemisiatabaci*) acts as a vector for the transmission of virus into the host plant.Common symptoms include leaf puckering, curling, and rolling; blistering of the veinous regions; vein thickening and swelling; internode and petiole shortening; leaf crowding; and overall plant stunting(Peiris 1953, Joshi and Dubey 1976, Sinha *et al.*, 2011). Evasive techniques have been attempted with varying degrees of success, including agronomic treatments, sick plant removal, and pesticide applications to suppress vectors. Managing the disease with pesticides isgreat challenging because of recurrent development of resistance against pesticides by whitefly. Utilizing host plant resistance is a long-term, cost-effective, environmentally secure, and reliable method of managing diseases, particularly those brought on by viruses. Wild relatives or accessions of the cultivated species are renowned for their wealth of useful genes including those of diseaseresistant (Mammadov *et al.*, 2018).Therefore, the goal of the current study was to screen chilli genotypes under natural epiphytotic and artificial conditions using viruliferous whiteflies to identify the source of resistance to the chilli leaf curl virus.

Materials and methods

The present investigation on screening and identification of chilli leaf curl virus resistant genotype in chilli was carried out at Horticulture Research and Extension Centre, (University of Horticulture Science, Bagalkot) during 2020-2023. The experimental material consisting of 54 genotypes during 2020-21. The experiment was laid out in Randomised Block Design with two replications and two checks. Seedlings of chilli genotypes were raised in protray and 35 days old were transplanted at a distance of 60x45 cm in the month of January during the summer season fovourable for white fly incidence and also the experimental site was found to be naturally conductive for incidence and multiplication of whiteflies in the past years. Susceptible check genotype was planted at every 6^{th} row after 5 rows of chilli genotypes under investigation. All the cultural practices were followed as per recommended for chill cultivation.The virus scoring was carried out at an experimental plot during early and grand growth stages. For artificial screening under inoculation conditions, chilli genotypes were raised and challenged by viruliferous white fly maintained on suuceptible symptomatic chilli plants in the wooden cage covered with nylon net.Adult whiteflies collected from the symptomatic plants were given an acquisition access period (AAP) of 48 hrs on the genotypes under investigation. Seedlings were inoculated at the three-leaf stage, using 10–12 viruliferous whiteflies per seedling for an inoculation access period

(IAP) of 48 hrs. Seedlings were then transplanted in a open field condition and disease incidences were scored.

Fig 1. General view of chilli genotypes screening plot under artificial inoculation controlled condition

Observation recorded

Ten plants in each genotype in each replication were randomly selected, tagged and the disease index observations were recorded from the tagged plants in both natural screening as well as artificial screening.The leaf curl index was calculated for each chilli genotypes based on the ratings using the scale followed by Kumar *et al.,* (2006). From the recorded observation percent disease incidence (PDI) and disease severity were calculated.Based on the genotype performance against leaf curl virus reaction, they were categorized into six categories by adopting the method of Reddy *et al.* (2001).

Table 1: Indexing of leaf curl virus in chilli

Symptom severity grade	Symptoms	Reaction (%)	Category
0	No symptom	0	Immune

1	0-5% Curling and clearing of upper leaves	1 – 10	Highly Resistant
2	6-25% Curling, clearing of leaves and swelling of veins	11 – 25	Resistant
3	26-50% Curling, puckering and yellowing of leaves and swelling of veins	26 – 40	Moderately Resistant
4	51-75% leaf curling and stunted plant growth and blistering of internodes	41 – 60	Susceptible
5	>75% curling and deformed small leaves, stunted plant growth with small flowers and no or small fruit set	>60	Highly Susceptible

Results and discussion

There was high phenotypic variation for leaf curl virus disease incidence and severity among chilli genotypes studied. It ranged from 0 to 100 per cent within the evaluated genotypes. The lowest per cent of disease incidence and severity was found in Bhoot Jolokia (*Capsicum chinense*), Khandhari, DCA-262 (*Capsicum frutescence*) with least value of 0 per cent. In species*Capsicumannuum* EC 391087 (9%), IC 342426 (5%), Punjab Lal (7%), Punjab Surkh (9%) were found to be highly resistant having lesser disease severity.

Under artificial screening, a significant variance was observed in the leaf curl virus incidence and severity among the genotypes investigated. The disease severity ranged from 0 to 100 per cent, lowest was observed in Khandhari(*Capsicum frutescence*) and Bhoot Jolokia (*Capsicum chinense*) with 0 per cent disease incidence showing immunity to virus. Genotypes DCA-262 (6%), Punjab Lal (10%) and Punjab Surkh (10%) were found to be highly resistant to leaf curl virus. The highest per cent of disease incidence was observed in ByadgiKaddi,Byadgidabbi and followed by Shankershwar with disease severity of 100%, 98% and 97% respectively and were found to be highly susceptible.

Based on the observed data and calculated disease incidence and severity it was obtained that Bhoot Jolokia, Khandhari and DCA-262 were immune to leaf curl virus disease. Similar results were observed by (Rai *et al.,* 2014) and (Anaya-López *et al.,* 2003). Genotypes EC 391087, IC 342426, Punjab Lal and Punjab Surkh were found highly resistant

to virus. Similar results were observed by (Singh and Kaur, 1990), (Hundal *et al.*, 1995) and (Kumar *et al.*, 2006). Hence, the resistance observed was not due to any kind of escape or non-preference of whitefly during screening but due to some resistance mechanism present in these genotypes that either hinder virus replication or its movement throughout the plant (Verlaan*et al*. 2013). The resistance gene or allele that prevails in these genotypes is the most appropriate reason for observed resistance and immunity to leaf curl virus. Identification of new and stable chilli genotypes that are immune to leaf curl virus infection through different methods of screening is quite crucial for adopting them in chilli crop improvement program.

Fig 2. Chilli genotypes showing susceptibility reaction to chilli leaf curl virus

Fig 3. Chilli genotypes showing resistance reaction to chilli leaf curl virus

Table 2: Reaction of chilli genotypes screened against leaf curl virus

Sl No	Genotypes	Natural screening			Challenge screening		
		Per cent disease index (%)	Disease severity (%)	Disease reaction	Per cent disease index (%)	Disease severity (%)	Disease reaction
1	EC 378633	86.67	80	HS	91.67	83	HS
2	EC 378688	73.33	54	S	78.33	61	HS
3	EC 391082	23.33	17	R	28.33	23	R
4	EC 391083	30.00	20	R	30.00	24	R
5	EC 391087	10.00	9	HR	20.00	11	R
6	EC 596952	76.67	51	S	81.67	58	S
7	EC 599993	70.00	69	HS	75.00	74	HS
8	IC 214965	36.67	36	MR	45.00	39	MR
9	IC 214966	26.67	17	R	31.67	23	R
10	IC 284628	20.00	12	R	23.33	21	R
11	IC 342426	10.00	5	HR	18.33	14	R
12	IC 342464	23.33	12	R	33.33	19	R
13	IC 537595	76.67	54	S	86.67	64	HS
14	IC 537657	46.67	36	MR	56.67	43	S
15	IC 537658	36.67	29	MR	45.00	37	MR
16	IC 537659	43.33	32	MR	50.00	40	MR
17	IC 537661	40.00	36	MR	48.33	45	S
18	IC 570388	60.00	45	S	66.67	60	S

19	IC 572454	66.67	52	S	78.33	65	HS
20	IC 572465	63.33	50	S	73.33	58	S
21	IC 572466	56.67	39	MR	65.00	50	S
22	IC 572475	90.00	80	HS	95.00	88	HS
23	IC 572477	93.33	84	HS	96.67	90	HS
24	Nic 23897	83.33	73	HS	91.67	77	HS
25	Nic 23906	90.00	80	HS	93.33	83	HS
26	DCA-111	33.33	26	MR	38.33	34	MR
27	DCA-245	90.00	80	HS	93.33	87	HS
28	DCA-299	80.00	57	S	88.33	65	HS
29	DCA-226	36.67	21	MR	45.00	31	MR
30	DCA-255	43.33	25	R	53.33	33	MR
31	DCA-92	83.33	59	S	90.00	68	HS
32	DCA-86	86.67	82	HS	95.00	90	HS
33	DCA-195	86.67	79	HS	91.67	88	HS
34	DCA-257	76.67	58	S	85.00	70	HS
35	DCA-107	73.33	55	S	80.00	66	HS
36	DCA-131	83.33	60	S	91.67	68	HS
37	LCA 305	30.00	20	R	43.33	28	MR
38	LCA 324	36.67	27	MR	46.67	32	MR
39	KDSC 210-10	46.67	31	MR	53.33	34	MR
40	Hissar Vijay	30.00	21	MR	35.00	25	R

41	Pant C1	26.67	19	R	35.00	25	R
42	Pusa Jwala	33.33	17	R	35.00	23	R
43	G-4	93.33	87	HS	96.67	90	HS
44	DCA-262 (Capsicum frutescence)	0.00	0	I	13.33	6	HR
45	Khandhari	0.00	0	I	0.00	0	I
46	Bhoot Jolokia	0.00	0	I	0.00	0	I
47	Punjab Lal	6.67	7	HR	13.33	10	HR
48	Punjab Tej	23.33	13	R	28.33	20	R
49	Punjab Sindhuri	20.00	12	R	25.00	19	R
50	Punjab Surkh	16.67	9	HR	20.00	10	HR
51	Suraj Mukhi	36.67	23	R	46.67	30	MR
52	ByadgiKaddi	100.00	98	HS	100.00	98	HS
53	Byadgi Dabbi	100.00	100	HS	98.33	100	HS
54	Shankeshwar	96.67	97	HS	93.33	95	HS
	S.Em±	1.50	1.50		3.38	3.38	
	C.D. at 5%	4.24	4.24		9.58	9.58	
	C.D. at 1%	5.65	5.65		12.76	12.76	

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