

Original Research Article

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Evaluation of F_{2:3} Families of Tomato (*Solanum lycopersicum* L.) for Tomato Leaf Curl Disease Resistance

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A B S T R A C T

Tomato leaf curl disease is the most devastating disease, caused by tomato leaf curl virus (ToLCV) a Gemini virus transmitted by the vector *Bemisia tabaci* Gen. In this study 17 F_{2:3} families of tomato derived from the cross IIHR 2201 x C-13-1-2-1 along with the parents IIHR 2201, C-13-1-2-1 and check Arka Vikas (Susceptible), Arka Rakshak(Resistant) were screened against resistant/ Susceptible reaction for tomato leaf curl disease under field condition, during 2017-18 from end of October to beginning of February in the Department of Vegetable Science, College of Horticulture, Bengaluru. Based on coefficient of infection and per cent of disease incidence, out of 17 F_{2:3} families only seven families i.e. 18, 29, 64, 88, 144, 253, 261 showed highly resistant reaction, with less per cent of disease incidence and coefficient of infection, and Three families namely 43, 158, 224 showed resistant reaction, five families i.e. 81, 89, 133, 134, 248, showed moderately resistant reaction and only two families 33 and 35 showed moderately susceptible reaction.

Keywords

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Introduction

Tomato (*Solanum lycopersicum* L.) is one of the most economically important vegetable in India and it belongs to the family Solanaceae, having a diploid chromosome number of 24. Tomato is one of the most important

“protective foods” because of its special nutritive value. It has valuable vitamins for instance vitamin A and C, also contains fibers, organic acids, antioxidants.

The intensive cultivation of tomatoes in some areas has led to a significant increase in

farmer's income, but a complex of pests and diseases threatens its production and productivity. Tomato suffers from large number of fugal, bacterial, nematode and many viral diseases during its growth period. Among the viral disease, tomato leaf curl virus (ToLCV) is one of the most devastating disease in tropical and sub tropical region.

In India, tomato leaf curl disease (ToLCD) was first reported by Vasudeva and Samraj(1948).This disease is transmitted by whitefly (*Bemisia tabaci* G.), belongs to the genus *Begomovirus* of *Geminiviridae* family of the order homoptera (Haydar *et al.*, 1990; Louro *et al.*, 1996 and Morgan and Macleod, 1996). Tomato leaf curl virus infected plants produce disease symptoms like clearing of veins, reduction in leaf size, stunted growth, deformation of leaf lets, inward and outward curling and puckering of leaflets. The infected plants produced only few fruits in case of late infection and no fruits, at very early stage of infection. The diseased plants usually developed purple patches especially on older leaves, ToLCV can reach up to 100 per cent incidence with yield losses often exceeding 90 per cent (Vasudeva and Samraj 1948; Sastry and Singh, 1973, Saklani and Mathai, 1977; Raychaudhary and Nariani, 1977; Kapoor, 1981; Saikia and Muniyappa, 1989).

Disease intensity was highly influenced by the vector population and also climatic condition like temperature, humidity and rainfall. In Karnataka 90-100 per cent of plant was infected with ToLCD during February to end of May and from July to November per cent of disease incidence is low due to fall in whiteflies population brought about by low temperature (Saikia and Muniyappa, 1989).

To achieve this goal the breeder has the option of selecting desirable genotypes in an early generations, when progenies are nearly homozygous. In early stages of breeding

programmes, direct estimates of ToLCV resistance, yield and other component traits are quite difficult. Ahmad *et al.*, (2016) reported that tomato yellow leaf curl virus disease (TYLCV) is one of the main factors responsible for yield loss up to 100 per cent in tomato as compared to other diseases, therefore serious attention should be given to screen resistant lines from F₂ and F₃ generations against TYLCV disease. Keeping this background the present study was formulated to determine the level of resistance/susceptibility in F_{2:3} populations by evaluating F_{2:3} families in open field condition under natural screening.

Materials and Methods

The experiment was carried out at college of Horticulture, Bengaluru during 2017 from October end to beginning of February for screening of F_{2:3} segregating population of tomato for tomato leaf curl disease resistance. 30 days old healthy seedlings of seventeen F_{2:3} families of tomato derived from the cross IIHR 2201 x C-13-1-2-1 along with the parents IIHR 2201, C-13-1-2-1 and checks Arka Vikas (Susceptible), Arka Rakshak (Resistant) were transplanted in paired row system by following a spacing of 90 x 60cm. In each family 40 plants were maintained and total of 840 plants were planted for taking observation. Incidence of ToLCD infection and symptom severity was recorded at fifteen days interval after transplanting in the field. Symptom severity was recorded at 0-4 scale on each genotype as suggested by Banerjee and Kalloo (1987), Table 1. Per cent of disease incidence was calculated using the formula.

$$\text{Per cent ToLCD incidence (\%)} = \frac{\text{Total number of infected plants}}{\text{Total number of plants observed}} \times 100$$

Results and Discussion

Results obtained from the evaluation study of F_{2:3} families for tomato leaf curl disease resistance had shown that, the plant exhibits resistant reaction at different growth stages of plant. Some plant exhibit resistant reaction during its initial growth, later become susceptible *i.e.* during fruiting period, and some plants are susceptible from initial stages itself.

The results obtained from the experiment revealed that parents IIHR 2201 and C-13-1-2-1 showed highly resistant reaction with low per cent of disease incidence 7.5 and 10.00 and coefficient of infection 0.00. Checks Arka Rakshak showed highly resistant reaction with disease incidence of zero per cent and coefficient of infection 0.00. Arka Vikas showed susceptible reaction with disease incidence of 62.5 per cent and coefficient of infection of 56.87 (Table 2).

Out of 17 F_{2:3} families only seven families *i.e.* 18, 29, 64, 88, 144, 253, 261 showed highly resistant reaction with coefficient of infection 2.41, 3.60, 2.62, 1.80, 3.60, 1.95, 1.60 and per cent of disease incidence of 12.50, 15.00,

17.50, 10.00, 22.50, 12.50, 10.00 per cent respectively (Table 2).

Five families *i.e.* 81, 89, 133, 134, 248, showed moderately resistant reaction with the per cent disease incidence of 25.00, 37.50, 25.00, 35.00, 37.50 and coefficient of infection of 10.00, 15.46, 10.00, 15.05, and 17.81 respectively. The families 43, 158 and 224 showed resistant reaction with coefficient of infection 6.18, 8.35, 6.32, and per cent of disease incidence 22.50, 20.00, 27.50. Only two families 33 and 35 showed moderately susceptible reaction with the per cent disease incidence of 37.50, 45.00 and coefficient of infection 21.56, 26.41 (Table 2).

In the F_{2:3} segregating population, showed segregation for hypocotyl colour of the plants, *i.e.* purple and green. Plants with purple hypocotyl color showed maximum per cent of disease incidence compared to the plants with green hypocotyl color. This indicates it can be used as one of the morphological marker in selecting the resistant plants. This finding is Similar with the report of Thangam and Veeraraghavathatham (2006).

Table.1 The disease severity was scored as described by (Banerjee and Kalloo, 1987)

Symptom	Score	Response Value	Coefficient of infection	Reaction
Symptoms absent	0	0	0-4	Highly resistant (HR)
Very mild curling up to 25%	1	0.25	5-9	Resistant (R)
Curling, puckering of 26-50%	2	0.5	10-19	Moderately resistant (MR)
Curling, puckering of 51-75%	3	0.75	20-39	Moderately susceptible (MS)
Severe curling, puckering> 75%	4	1.00	40-69 70-100	Susceptible (S) Highly susceptible (HS)

Table.2 Reaction of F_{2;3} families of IIHR 2201 x C-13-1-2-1 their parents and checks for Tomato leaf curl disease incidence

Sl. No.	Families	Per cent of disease incidence(PDI)	Coefficient of infection(CI)	Reaction
1.	18	12.50	2.41	HR
2.	29	15.00	3.60	HR
3.	33	37.50	21.56	MS
4.	35	45.00	26.41	MS
5.	43	22.50	6.18	R
6.	64	17.50	2.62	HR
7.	81	25.00	10.00	MR
8.	88	10.00	1.80	HR
9.	89	37.50	15.46	MR
10.	133	25.00	10.00	MR
11.	134	35.00	15.05	MR
12.	144	22.50	3.60	HR
13.	158	20.00	8.35	R
14.	224	27.50	6.32	R
15.	248	37.50	17.81	MR
16.	253	12.50	1.95	HR
17.	261	10.00	1.60	HR
18.	IIHR -2201	7.50	0.00	HR
19.	C-13-1-2-1	10.00	0.00	HR
20.	Arka Vikas	62.50	56.87	S
21.	ArkaRakshak	0.00	0.00	HR

HR- Highly resistant

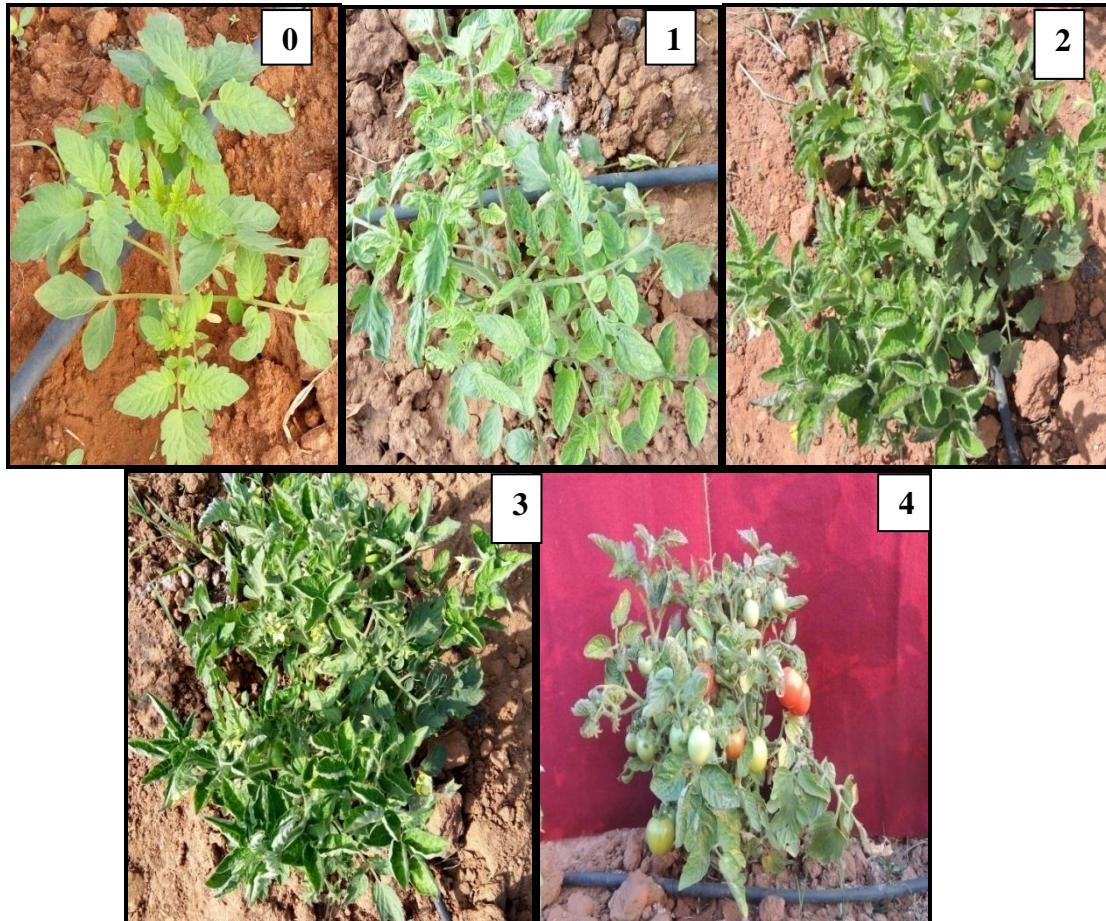
R- Resistant

MR- Moderately resistant

MS- Moderately susceptible

S – Susceptible

Fig 1. Tomato leaf curl disease symptom severity in $F_{2:3}$ segregating population of IIHR 2201 x C-13-1-2-1 (Plant number 253-13), 0: Symptoms absent; 1: very mild curling (up to 25% leaves); 2: curling and puckering of 26-50 % leaves; 3: curling and puckering of 51-75 % leaves; 4: severe curling and puckering of >75 % leaves.



In conclusion, families 18, 29, 64, 88, 144, 253 and 261 exhibited highly resistant reaction with less per cent of disease incidence and coefficient of infection. The resistant line can be used in the further breeding programme to develop resistant varieties and screened for the resistant gene.

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