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INHERITANCE OF TOMATO LEAF CURL VIRUS RESISTANCE IN *LYCOPERSICON HIRSUTUM* F. *GLABRATUM*

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INDEX WORDS

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SUMMARY

Inheritance of resistance to tomato leaf curl virus (TLCV) was studied in the progenies derived from interspecific crosses between TLCV resistant *Lycopersicon hirsutum* f. *glabratum* line B 6013 and five susceptible cultivars (HS 101, HS 102, HS 110, Pusa Ruby and Punjab Chhuhara) of *L. esculentum*. P_1, P_2, F_1, F_2, B_1 and B_2 progenies of the five crosses were artificially inoculated with local strains of TLCV by means of the vector whitefly, *Bemisia tabaci* (GENN.), and the disease reaction was studied in all the crosses. Reaction of parents, F_1, F_2 and backcrosses suggests that resistance derived from *L. hirsutum* f. *glabratum* B 6013 is based on two epistatic genes, one from the wild parent and one from the cultivated one, resulting in a 13:3 segragation in the F_2.

INTRODUCTION

Among the virus diseases that attack the tomato in India, tomato leaf curl virus (TLCV) is most severe in the autumn season in Northern India (MAYEE et al., 1974). *L. hirsutum* f. *glabratum* line B 6013 was found resistant to TLCV. In the study reported here the inheritance of resistance to TLCV in *L. hirsutum* f. *glabratum* B 6013 was analysed.

MATERIALS AND METHODS

L. hirsutum f. *glabratum*, B 6013, a highly resistant wild entry, was crossed with five cultivated susceptible cultivars, i.e., HS 101, HS 102, HS 110, Pusa Ruby and Punjab Chhuhara. In each cross the wild entry was used as the male parent. Screening studies (during 1982–84) in the field, screenhouse and glasshouse indicated that *L. hirsutum* f. *glabratum* B 6013 is resistant to TLCV. The F_1s, segregating progenies and the parents were grown in pots in the screenhouse under muslin cloth nets and the 3–4 weeks old seedlings were exposed to viruliferous whiteflies, *Bemisia tabaci* (GENN.), for 5–7 days in an inoculation chamber under insect proof cages and after that the pots were shifted to benches in a screenhouse. In order to ensure infection, the potted plants were again exposed to viruliferous whiteflies under muslin cloth nets. This was done in a screenhouse in which the TLCV affected (infector rows) plants and the plants

to be screened were arranged on the benches in rows. After 25 days these infector rows were removed. The inoculated potted plants were kept under cover of muslin cloth nets for another 55 days, after which the nets were removed. Plants were evaluated for TLCV reactions after 90 days of inoculation. Each plant was assigned a disease score according to the following scale of symptoms. 0 = no visible symptoms, 1 = very mild curling of up to 25% leaves of the total plant, 2 = curling, puckering of 26–50% leaves of the total plant, 3 = severe curling, puckering of 51–75% leaves of the total plant, 4 = very severe curling, puckering of 76–100% leaves of the total plant. In all the crosses two classes, resistant (score, 0) and susceptible (score 1–4) were made for inheritance studies.

RESULTS AND DISCUSSION

In the disease score *L. hirsutum* f. *glabratum* B 6013 possessed the highest degree of resistance of TLCV while commercial cultivars differ in their degree of susceptibility (Table 1). Out of a total 121 F_1 plants derived from five interspecific crosses, 119 remained healthy till 90 days after inoculation, hence, resistance to the local strains of TLCV appeared to be dominant, even though only two plants in the cross Punjab Chhuhara × *L. hirsutum* f. *glabratum* B 6013 were slightly infected.

The F_2 progenies segregated for two classes, resistant (score, 0) and susceptible (score 1–4) in a ratio of 13 resistant: 3 susceptible (Table 2). The P value indicated a reasonably good fit in all the crosses individually as well as for the pooled F_2 data. In a 13:3 segregation the susceptible class is *aaB.*, all other genotypes are resistant.

Table 1. Number of plants in the five classes (scores) of tomato leaf curl virus symptoms in six parents and five F_1 hybrids.

Parents/cross	Score[1]					
	resistant	susceptible				
	0	1	2	3	4	total
Parents						
HS 101	–	–	1	12	7	20
HS 102	–	–	–	5	15	20
HS 110	–	–	–	2	18	20
Pusa Ruby	–	–	–	6	14	20
Pb. Chhuhara[2]	–	–	–	–	20	20
B 6013[2]	104	–	–	–	–	–
F_1 hybrids						
HS 101 × B 6013	20	–	–	–	–	–
HS 102 × B 6013	20	–	–	–	–	–
HS 110 × B 6013	21	–	–	–	–	–
Pusa Ruby × B 6013	20	–	–	–	–	–
Pb. Chhuhara × B 6013	38	2	–	–	–	–

[1] 0 = Symptoms absent; 1 = curling of leaves upto 25%; 2 = curling of leaves 26–50%; 3 = curling of leaves 51–75%; 4 = curling of leaves >75%.
[2] Pb. Chhuhara = Punjab Chhuhara; B 6013 = *L. hirsutum* f. *glabratum*, B 6013.

Table 2. Number of plants in the five classes (scores) of tomato leaf curl virus symptoms in Five F_2's and ten backcrosses.

Population	Score[1]						P value
	resistant	susceptible					
	0	1	2	3	4	Total	
F_2							13R:3S
HS 101 × B 6013	88	13	4	0	3	20	(0.95–1.00)
HS 102 × B 6013	113	14	5	3	5	27	(0.70–0.90
HS 110 × B 6013	85	10	7	1	1	19	(0.90–0.95)
Pusa Ruby × B 6013	89	12	3	3	4	22	(0.70–0.90)
Pb. Chh. × B 6013[2]	140	16	4	1	3	24	(0.10–0.20)
Summed data	515	65	23	8	16	112	(0.50–0.70)
Backcross to susceptible parents							1R:1S
HS 101 × (HS 101 × B 6013)	26	11	12	1	6	30	(0.50–0.70)
HS 102 × (HS 102 × B 6013)	48	25	8	4	18	55	(0.30–0.50)
HS 110 × (HS 110 × B 6013)	44	10	16	6	2	34	(0.20–0.30)
Pusa Ruby × (Pusa Ruby × B 6013)	63	19	6	9	15	49	(0.10–0.20)
Pb.Chh. × (Pb.Chh. × B 6013)	38	22	12	8	15	57	(0.05–0.10)
Summed data	219	87	54	28	56	225	(0.70–0.90)
Backcross to resistant parent							
(HS 101 × B 6013) × B 6013)	52	–	–	–	–	–	
(HS 102 × B 6013) × B 6013	65	–	–	–	–	–	
(HS 110 × B 6013) × B 6013)	57	–	–	–	–	–	
(Pusa Ruby × B 6013) × B 6013	64	–	–	–	–	–	
(Pb.Chh. × B 6013) × B 6013	60	–	–	–	–	–	

[1] See Table 1.
[2] Pb.Chh. and B 6013, see Table 1.

Apparently the resistant parent *L. hirsutum* f. *glabratum* B 6013 has the genotype *AA bb*, with major effect and the cultivated cultivars are *aa BB* with minor effect. Though the data suggest a digenic model for resistance, it is important to mention that Punjab Chhuhara differs in the degree of susceptibility (resistance) from the other cultivated cultivars.

To further test the 13:3 digenic hypothesis, backcrosses were evaluated. A total of 444 plants of five backcross progenies to the susceptible parents (Table 2) segregated into a ratio of 1 healthy (219):1 susceptible (225) and all plants of backcrosses to the resistant parent were resistant. It was felt that apart of a major gene there may be modifier genes coming from *L. hirsutum* f. *glabratum*, B 6013 resulting in a large number of moderately susceptible F_2 plants (score 1 and 2) where the susceptible cultivars had predominantly a score 4. In backcrosses with susceptible cultivars the tendency towards a reduced susceptibility was also observed. In a 13:3 digenic model the 50% susceptible plants in the first backcrosses should be of the *aaBb* genotype. 547 plants of 23 selfed progenies of susceptible Bc_1 segregated into resistant (*aabb*) and susceptible (AAB.) into a ratio of 1 healthy (123):3 susceptible (424) (Table 3). This clearly supports the 13:3 digenic model. HASSAN et al. (1984) tested for tomato

Table 3. Number of plants in the five classes (scores) of tomato leaf curl virus symptoms in selfed progenies of susceptible Bc_1 plants.

Crosses	Number of progenies tested	Score[1]						P value 1R:3S
		resistant	susceptible					
		0	1	2	3	4	Total	
HS 101 × (HS 101 × B 6013)	4	24	11	24	16	26	77	0.90–0.95
HS 102 × (HS 102 × B 6013)	5	28	6	30	23	34	93	0.50–0.70
HS 110 × (HS 110 × B 6013)	2	19	4	7	16	25	52	0.70–0.90
P.R. × (P.R. × B 6013)[2]	6	30	15	26	28	41	110	0.30–0.50
Pb.Chh. × (Pb. Chh. × B 6013)[2]	6	22	8	32	24	28	92	0.10–0.20
Summed data	23	123	44	119	107	154	424	0.70–0.90

[1] See Table 1.
[2] P.R., Pb.Chh. and B 6013, see Table 1.

yellow leaf curl virus and indicated that resistance derived from *L. hirsutum* is dominant and controlled by more than one gene.

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