

## GENETIC POTENTIAL OF TOMATO CULTIVARS AGAINST LATE BLIGHT DISEASE CAUSED BY *PHYTOPHTHORA* *INFESTANS*

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### ABSTRACT

This study was conducted in the research area of Department of Plant Pathology, University of Agriculture, Faisalabad, Pakistan during 2012-13. Late blight disease caused by *Phytophthora infestans* is an emerging threat to successful cultivation and production of tomato crop in Pakistan. In this study, 28 varieties/ lines were assessed for two years against this disease using RCBD. During 2012, Only one variety namely Naqeeb exhibited resistant response with 9.07 percent disease incidence while ten varieties/ lines viz. Riogrande (12.20), Anahu (12.50), Siberian (13.25), Lo-3686 (13.25), Earlina (13.50), LA-1932 (14.31), 17868 (25.25), CLN- 1621L (38.11), 6233 (39.75) and Lo-2752 (39.90) percent disease incidence respectively, showed moderately resistant response. Five varieties/ lines namely Wayahead, Lo-2831, Pakits, KQP-5180 and 17860 exhibited moderately susceptible response with 40.05, 45.25, 45.35, 45.95 and 56.53 percent disease incidence respectively. Similarly, seven varieties/ lines namely 6235, La-1401, Lo-2875, BL-1174, Lo-4360, FS-2187 and Lo-3708 expressed susceptible response with 65.35 to 78.41 percent disease incidence while 17856, Lo-2846, BL-1076, 17899 and long keeper showed high susceptibility with (81.25, 83.41, 84.38, 88.25 and 89.42) percent disease incidence respectively. Similar results were produced during second year.

**KEYWORDS:** *Solanum lycopersicum*; *Phytophthora infestans*; Screening; Resistance, Pakistan.

### INTRODUCTION

Tomato (*Solanum lycopersicum* L.) is an important, widely grown vegetable crop and is ranked fourth in terms of its production in the world (5). It is used as salad, for making ketchup and is cooked with other vegetables and meat (21). It has high nutritional value as it contains vitamin A, C, E and niacin (9). It is cultivated on an area of 4.9 million ha with 37.624 million tons of

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production in the world (4) while in Pakistan; it is grown on an area of 127.1 thousand hectares with 3.73 million tons' production (3). Its successful cultivation, production and marketing have been facing several biotic and abiotic factors. Among these constraints, late blight disease caused by *Phytophthora infestans* is a potential threat (15) and causes 60-70 percent yield losses under favorable environmental conditions (10). In case of sever attack, complete failure of crop had been observed in Pakistan (21).

*P. infestans* survives on infected fruits while its sporangia spread through rain, water or irrigation by producing zoospores in the presence of cool and wet conditions. (14). After penetration of the pathogen, all above ground plant parts are severely affected. The first symptom usually appears on leaves as water-soaked, oily, pale, dark-green or brown/ black, circular or irregular lesions. During period of abundant moisture, sporulation of the pathogen can be seen by naked eye as a white, cottony growth on the underside of affected leaves and/ or on fruit lesions. Under conducive environmental conditions, disease progresses rapidly through the plant canopy resulting in brown shriveled foliage. Oily, brown and often-sunken lesions form on both green and ripe fruits of tomato (5). Without proper protective measures, under conducive environmental condition, late blight of tomato, can completely defoliate and demolish a crop within fourteen to twenty-one days (1). The intensity of late blight disease in various tomato cultivars depends not only on their early maturity, but also on other biological traits (22).

Several methods to manage this disease like use of different chemicals and plant extracts etc. are available but the use of resistant germplasm is the most convenient one (12) because it not only reduces the fungicide use but also easily accessible to farmers. Keeping in view the aforementioned reasons, efforts were directed in the present studies to search out the source of resistance against late blight disease owing to its eco-friendly behavior and the most economical method for disease management.

## MATERIALS AND METHODS

### Establishment of disease screening nursery

This study was carried out in the research area of Department of Plant Pathology, University of Agriculture, Faisalabad, Pakistan during 2012-13. Seeds of 28 varieties/ lines viz. Naqeeb, Riogrande, Anahu, LA-1932, 17868, CLN-1621L, 6233, Lo-2752, Wayahead, Lo-2831, Pakits, KQP-5180, 17860, 6235, La-1401, BL-1174, Lo-4360, FS-2187, Lo-3708, Lo-2846, BL-1076 and

17899 were collected from vegetable section, Ayub Agriculture Research Institute (AARI), Faisalabad and six varieties/ lines namely 17856, Lo-2875, Earliana, Lo-3686, Siberian and Long keeper were purchased from local market. Disease free nursery was established during 2012 to find out source of resistance against late blight disease of tomato. Seedlings of each variety were grown on beds at 60cm apart with three replications. The beds were spaced 1.5m from each other under RCBD. All agronomic practices including recommended dose of fertilizers and irrigation schedule were followed to keep the crop in good condition. Plots were exposed to natural epidemics of disease during the entire growing season. Susceptible cultivar “Long Keeper” was cultivated on borders around the field as check. The disease was recorded by using Henfling (11) scale (1987) as given below (Table.1)

**Table 1. Henfling scale for recording of late blight disease of tomato.**

S. No.	Disease rating	Disease incidence (%)	Description	Response
1	0	0	Immune	I
2	1	1-10	Resistant	R
3	2	11-40	Lesion are easily seen at close distance	MR
4	3	41-60	Moderately susceptible	MS
5	4	61-80	Susceptible	S
6	5	81-100	Highly susceptible	HS

Disease incidence was calculated using the following formula (16).

$$\text{Disease incidence} = \frac{\text{No. of infected plants}}{\text{Total no. of observed plants}} \times 100$$

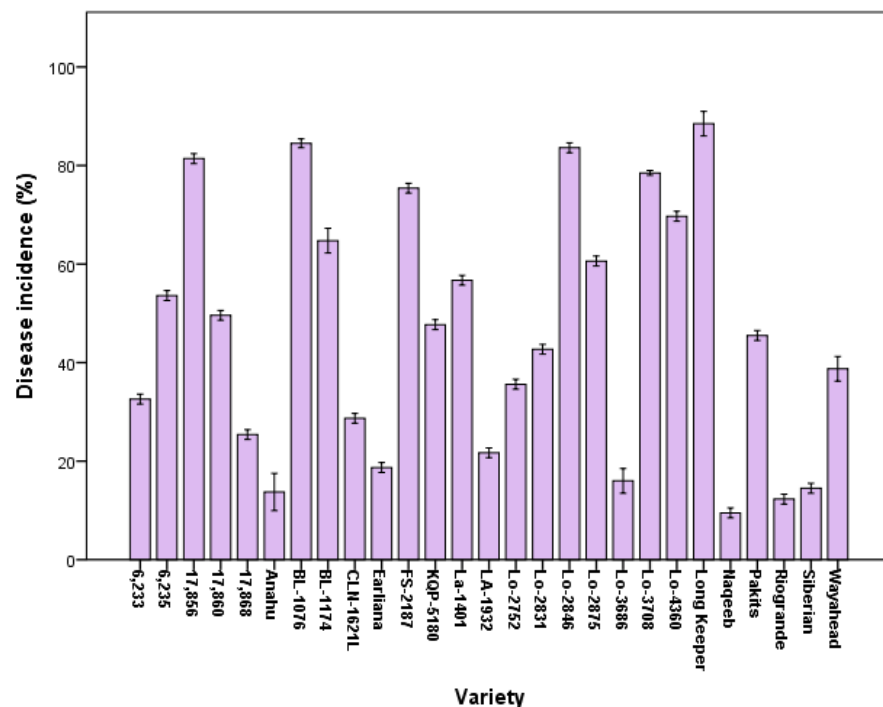
### **Statistical analysis**

Data regarding disease incidence was subjected to statistical analysis through SAS/ STAT software (2) and disease incidence means were compared by LSD test (24).

## **RESULTS AND DISCUSSION**

Only one variety namely Naqeeb exhibited resistant response with 9.067 percent disease incidence (rating 1). Ten varieties/ lines viz. Riogrande (12.20), Anahu (12.50), Siberian (13.25), Lo-3686 (13.25), Earlina (13.50), LA-1932 (14.31), 17868 (25.25), CLN- 1621L (38.11), 6233 (39.75) and Lo-

2752 (39.90) percent showed moderately resistant response (with rating 2) while five varieties/ lines namely, Wayahead, Lo-2831, Pakits, KQP-5180 and 17860 exhibited moderately susceptible response with 40.05, 45.25, 45.35, 45.95 and 56.53 percent disease incidence respectively (under rating 3). Similarly, six varieties/ lines including 6235, La-1401, Lo-2875, BL-1174, Lo-4360, FS-2187 and Lo-3708 expressed susceptible response with 65.35 to 78.41 percent disease incidence (rating 4) while 17856, Lo-2846, BL-1076, 17899 and long keeper exhibited high susceptibility with (81.25, 83.41, 84.38, 88.25 and 89.42) percent disease incidence with rating 5 respectively ( Fig.1 and Table 2). During 2013, five varieties exhibited highly susceptible, 5 susceptible, five moderately susceptible response while ten varieties expressed moderately resistant and only one variety showed resistant response towards late blight disease of tomato (Fig.2 and Table.3).



**Fig. 1. Evaluation of genetic potential of tomato varieties/lines against late blight disease during 2012.**

Typical symptoms on tomato plant expressed the presence of the pathogen causing late blight disease (22). Many factors are responsible for the initiation of disease including time of infection, plant age, fungal strain, host genetic make-up, type of infection and environmental factors (13).

Late blight caused by *P. infestans* is the major threat for the crop in the tomato growing regions of the world (7). This disease can cause damage to the major parts of the plant and when appeared in epidemic form can result in its complete destruction of tomato crop (18). The reported decrease in yield is 50-75 percent owing to the infection of this disease (10).

**Table 2. Response of tomato varieties/ lines against late blight disease caused by *P. infestans* during 2012.**

S. No.	Varieties/ Lines	Disease incidence (%)	Disease rating	Response
1	Naqeeb	9.067 u	1	R
2	Riogrande	12.200 t	2	MR
3	Anahu	12.500 t	2	MR
4	Siberian	13.250 s	2	MR
5	Lo-3686	13.257 s	2	MR
6	Earliana	13.500 s	2	MR
7	LA-1932	14.317 r	2	MR
8	17868	25.250 q	2	MR
9	CLN-1621L	38.117 p	2	MR
10	6233	39.750 o	2	MR
11	Lo-2752	39.900 o	2	MR
12	Wayahead	40.050 o	3	MS
13	Lo-2831	45.250 n	3	MS
14	Pakits	45.350 n	3	MS
15	KQP-5180	45.950 m	3	MS
16	17860	56.533 l	3	MS
17	6235	63.350 k	4	S
18	La-1401	63.500 k	4	S
19	Lo-2875	65.667 j	4	S
20	BL-1174	67.750 i	4	S
21	Lo-4360	69.750 h	4	S
22	FS-2187	75.250 g	4	S
23	Lo-3708	78.417 f	4	S
24	17856	81.250 e	5	HS
25	Lo-2846	83.417 d	5	HS
26	BL-1076	84.383 c	5	HS
27	17899	88.250 b	5	HS
28	Long Keeper	89.417 a	5	HS
	<b>LSD</b>	0.5557		

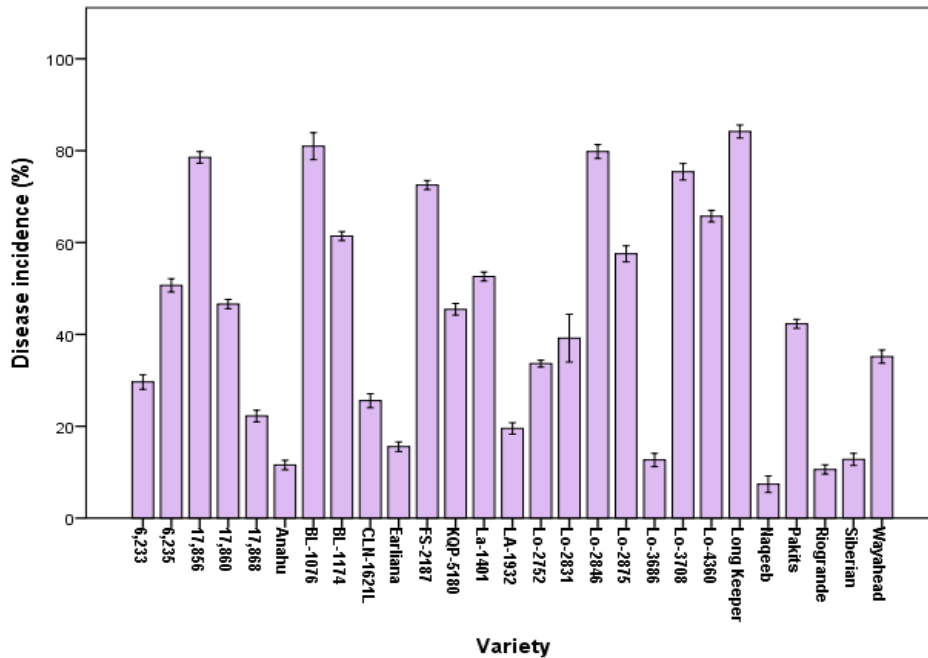
\*Mean values in a column sharing similar letters do not differ significantly as determined by the LSD test ( $P \leq 0.05$ ), R = Resistant, MR = Moderately Resistant, MS = Moderately Susceptible S = Susceptible, HS = Highly susceptible

**Table 3. Response of tomato varieties/ lines against late blight disease caused by *P. infestans* during 2013.**

S. No.	Varieties/Lines	Disease incidence (%)	Disease rating	Response
1	Naqeeb	7.4 v	1	R
2	Riogrande	10.6 u	2	MR
3	Anahu	11.56 tu	2	MR
4	Siberian	12.66 t	2	MR
5	Lo-3686	12.8 t	2	MR
6	Earliana	15.56 s	2	MR
7	LA-1932	19.53 r	2	MR
8	17868	22.23 q	2	MR
9	CLN-1621L	25.56 p	2	MR
10	6233	29.63 o	2	MR
11	Lo-2752	33.63 n	2	MR
12	Wayahead	35.16 mn	3	MS
13	Lo-2831	36.40 m	3	MS
14	Pakits	42.3 l	3	MS
15	KQP-5180	45.46 k	3	MS
16	17860	46.6 k	3	MS
17	6235	50.66 j	4	S
18	La-1401	52.60 i	4	S
19	Lo-2875	57.53 h	4	S
20	BL-1174	61.40 g	4	S
21	Lo-4360	65.73 f	4	S
22	FS-2187	72.50 e	4	S
23	Lo-3708	75.40 d	4	S
24	17856	78.53 bc	5	HS
25	Lo-2846	79.80 b	5	HS
26	BL-1076	80.50 b	5	HS
27	17899	81.46 b	5	HS
28	Long Keeper	84.16 a	5	HS
	<b>LSD</b>	1.766		

\*Mean values in a column sharing similar letters do not differ significantly as determined by the LSD test ( $P \leq 0.05$ ), R = Resistant, MR = Moderately Resistant, MS = Moderately Susceptible, S = Susceptible, HS = Highly susceptible.

The disease affects not only vegetative growth of the host but also deteriorates the quality and yield of crop. Due to favorable environmental conditions, pathogenic races of *P. infestans* and susceptible germplasm contribute much in the wide outbreak of this disease. To remove all its effects caused by the disease, disease resistant varieties offers only the main successful solutions which are developed by transferring the resistant genes into susceptible variety. Although it will take a long time but for the short term solution, screening of germplasm for their relative resistance to late blight is mandatory (21).



**Fig. 2. Evaluation of genetic potential of tomato varieties/lines against late blight disease during 2013**

To achieve the objectives, 28 varieties/lines were evaluated against late blight of tomato and the result showed that some cultivars i.e. Naqeeb and ten other varieties/ lines viz. Riogrande, Anahu, Siberian, Lo-3686, Earlina, LA-1932, 17868, CLN- 1621L, 6233 and Lo-2752 showed resistant to moderately resistant response against *P. infestans* the casual pathogen of late blight disease of tomatoes. Varieties/ lines with race specific resistance (complete resistance based on R-gene) and non-specific resistance (partial resistance/ tolerance) against late blight disease are available. However resistant cultivars when grown frequently in the same geographical area become susceptible because new and more aggressive strains of the fungus overcome their resistance. Partial gene is not based on single gene like specific resistance because it is based on number of genes that work together. The resistant varieties would decrease the source of inoculums significantly (10).

Genetically resistant cultivars of tomato can be used to reduce the fungicide rates utilized for plant protection measures against the late blight of tomato (*P. infestans*). The most resistant tomato cultivars can be protected with half of the rate of fungicides without harming effect on the efficiency of control

(17). Late blight infection is different in tomato and potato groups with various maturities. At early stage spread of incidence was more severe and it became less severe at the stage of maturity in different cultivars. The research was conducted in the potato breeding program for the generation of biological mathematical models of late blight. Only one cultivar was found resistant to *P. infestans* (22).

Laboratory and field experiments were performed to know the effect of resistant tomato varieties in the management of late blight (*P. Infestans*). The resistant varieties inhibited disease development even without fungicide application and significantly affected the crop yield (23). Resistance of different tomato cultivars against *P. infestans* was examined *in vitro* using eight different fungal strains. An assay based on electrolytic leakage was used for screening leaves and tomato tissues with fungal culture filtrates. Resistance of tomatoes did not correlate with the resistance of leaves in all the varieties. The cv. Ajax appeared the least susceptible in both leaf and tomato tests while cv. Prima was found to be the most susceptible in tuber tests (6). The resistant varieties/lines of tomatoes identified in the screening program can be further exploited by the farmers and they could use these sources in the future. Breeders can incorporate these resistant genes into the susceptible varieties and then other commercially released cultivars which were found to possess other desirable horticulture characters.

## CONCLUSION

Resistant to moderately resistant varieties should be used to avoid losses caused by late blight disease of potato.

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<b>Mansoor Hamid</b>	<b>:</b>	<b>Made graphs of the paper</b>
<b>Fatima Nasir</b>	<b>:</b>	<b>Helped the author for correcting reference of the paper</b>