Research Article

Screening of potato germplasm against late blight disease

Muhammad Mohsan[*], Azher Mustafa, Shamim Akhtar, Muhammad Iqbal, Saba Saeed, Muhammad Zeeshan Niaz and Muhammad Rizwan Bashir

Plant Pathology Research Institute, Ayub Agricultural Research Institute Faisalabad, Pakistan
*Corresponding author: *mohsin415@yahoo.com*

Abstract

Late blight of potato, caused by *Phytophthora infestans* (Mont.) de Bary, is one of the most important diseases of potato (*Solanum tuberosum* L.) in all potato growing areas of Pakistan. Field experiments were conducted to screen out eighteen potato varieties against late blight. Most of the potato varieties showed susceptibility to *P. infestans*. During the year 2014-2015 only two varieties i.e NARC 39012-96 and FD 69-2 were found resistant. Three varieties/lines showed moderately resistant reaction. Three varieties/lines were categorized as moderately susceptible. Nine varieties/lines expressed susceptible response while five varieties/lines exhibited highly susceptible response. During the year 2015-2016 only one variety i.e FD 73-73 was found resistant while all other varieties/lines were moderately resistant to highly susceptible. Resistant source can be incorporated in breeding program to develop high yielding resistant variety of potato in future.

Keywords: Late blight of potato, *Phytophthora infestans*, potato

Introduction

Potato is an important vegetable cash crop grown all over the world and ranks fourth after wheat (*Triticum aestivum* L.), maize (*Zea mays* L.) and rice (*Oryza sativa* L.) (Ewing, 1997). It was introduced into England and Europe in 1590 from the Andean section of South America (Swiecz, 1995). It provides a balanced source of dietary nutrients such as dietary fiber (up to 3.3%), ascorbic acid (up to 42 mg 100 g-1), potassium (up to 693.8 mg 100 g-1), antioxidant phenols such as a solanine (0.001-47.2 mg 100 g-1) and lesser amounts of protein (0.85-4.2%), amino acids, minerals, vitamins, and some beneficial and harmful bioactive components (Swiecz, 1995). In Pakistan, total area under potato production is 101,500 ha with an average yield of 16.4 t ha-1 (Agric Static of Pakistan, 2010). It is a cool season crop and a temperature up to 24 ° C is considered best for the growth of young plants. However, the production of

tubers is ideal at 20 °C. In Pakistan, the average production of potato is quite low as compared to the rest of potato growing countries (Kelman, 1984). This low yield is due to the diseases that causes huge losses in terms of yield as well as market value of tubers Among the diseases, late blight of potato caused by *Phytophthora infestans* (Mont.) De Barry is the most devasting and causing 50 – 70 % potato yield loss under favorable environmental conditions (Khair and Haggag, 2007; Haq *et al*., 2008; Rahman *et al.,* 2008). This disease was held accountable for the Irish potato famine that resulted in more than a million death in the 1840s. Before the disease appeared in Ireland, it caused a devastating epidemic in the early 1840s in the Northeastern United States. In the Bolivian Andes, the disease resulted in a direct loss of approximately US dollar 30 million and US d ollar 100 million potential yields/year (Fernandez-Northcote *et al.*, 2000).

It spreads and inflicts damage to leaves, stems, petioles and tubers in epidemic form. It takes alarming proportion during the prevalence of lower temperature below 18 oC and 90- 95 % relative humidity, rains, fog and cloudy weather (Steven, 1990). Due to such heavy losses, this disease exerts a visible impact on a country's economy in term of pricing system, foreign exchange spending on potato import from foreign countries (Tariq *et al.,* 1995). Chemical control is expensive, short durational and have health hazard while biological control is in its infancy for this disease. So the most effective and environmental friendly way to prevent widespread devastation by late blight is to incorporate natural resistance in potato cultivars. The availability of resistant cultivars is scanty and calls for extensive screening of potato germplasm for the source of resistance. To identify the sources of resistance in the available germplasm, following studies were conducted.

Materials and Methods

Potato germplasm comprising 18 varieties / lines were collected from Potato Research Institute, Yousafwala, Sahiwal (PRI) and Ayub Agriculture Research Institute (AARI), Faisalabad. A trial on disease screening nursery was conducted in the Research Area of Plant Pathology Research Institute, Faisalabad. Each test entry was planted in a row of 10 meter in length with 0.762 m row to row distance. One row of a most susceptible variety check was planted all around the experimental field and disease nursery was sown in three replications. Progression of the disease based on visual symptoms was recorded at weekly basis by following Henfling modified disease estimation scale (Henfling, 1979). Plants showing clear symptoms such as light to dark brown spots on the upper side of the foliage appearing usually at the edges and downy growth 3-5 mm wide on the lower side of the leaves were considered diseased and percent infection was calculated (Tantius *et al*., 1986; Zanoni, 1991; Stevenson, 1990; Agrios, 2005; Haq *et al*., 2008). An indicator variable for the occurrence of outbreak during the season based on favorable temperature and relative humidity was used to describe the disease status throughout the tested period. All the recommended agronomic practices were followed to keep the potato nursery in good condition. No pesticide was sprayed so as to develop maximum disease pressure. The disease incidence was calculated on each cvs / lines of potato by using following formula.

Preparation of PARP medium

PARP medium wasprepared by following the procedure described by Kanwissher and Michael (1978). 17 g corn meal agar was added in 1 liter distilled water and autoclaved at 121^{0}C at 15 psi pressure for 20 minutes. Allow the media to cool down up to 45^{0}C .Antibiotics were prepared in two small flasks. In one flask Pimaricin 0.4ml, Ampicillin 0.25g and PCNB 5ml were added and dissolved in 10ml distilled water. In second flask Rifampicin0.01g, 1ml DMSO and 10 ml distilled water were added. Now the mixtures of these two flasks were added in flask containing corn meal agar. The flask was shaken vigorously to make the solution homogenous

Results and Discussion

During the year 2014-2015, 22 varieties/lines received from different institutes were screened against late blight disease under natural field conditions. Different varieties/lines behave different response. Two varieties/lines i.e.NARC 39012-96, FD 69-2 showed resistant response against the disease. Three varieties/ lines (FD 73-75, FD 69-2, FD 74-1) exhibited moderately resistant reaction. Three varieties/lines i.e FD 35-36, FD 76-67, NARC 39-457-21) behaved as moderately susceptible. Nine varieties/lines came out as susceptible (FD 74-61, FD 78-51, FD 78-76, N-34, FD 76-18, FD78-10, FD 78-104, FD 73-77 and FD 78-3). Five varieties/lines showed highly susceptible response (FD 74-8, SH 704, FD 74-4, FD 75-21 and FD 35-36). During the year 2015-2016 eighteen varieties/lines were screened against the late blight disease under natural field conditions. Result depicted showed that only one variety i.e FD 73-73 was resistant. Two varieties/lines (SL 9-4 and FD 76-18) exhibited moderately resistant response. Seven varieties/lines (simply red, FD 77-4, FD 63-1, FD 78-36, Sante, FD 78-51 and SL 15-10) showed moderately susceptible response. Four varieties/lines namely FD 71-1, SL 15-10, FD 35-36 and FD 61-3 came as susceptible. Four varieties/lines i.e FD 76-67, FD 74-21, SL 5-2 and SL 14-15 showed highly susceptible response against late blight disease,

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

Disease rating was scored on weekly basis. The level of resistance or susceptibility was determined by following 1-9 grades developed by Shutong *et al*. 2007 scale for late blight disease of potato (Table.1). Differences in disease incidence among eighteen

varieties / lines were determined by LSD at 5% probability level (Steel and Torrie, 1997). All
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statistical tests were performed through computer's software M. Stat .C

Table 1 Henfling modified disease estimation scale for late blight of potato

Grade	% Incidence	Nature of Infection (Level of Resistance / Susceptibility)
0	0.0	No disease
1	10%	Small lesions on the inoculated point with the lesion area less than 10% of the whole leaflet
3	10% and 20%	Lesions area between 10% and 20% of the whole leaflet
5	20% and 30%	Lesion area between 20% and 30% of the whole leaflet
7	30% and 60%	Lesion area between 30% and 60%
9	Over 60%	Lesion area over 60% of the whole leaflet

Table: 2 Reaction of different potato varieties against late blight disease during 2015-16

Name of variety/line	Disease rating grade	Mean Value	Varietal response
Simply red	5	25.33 D	MS
FD 71-1	7	46.00 B	S
FD 77-4	5	26.00 D	MS
SL 15-10	7	38.33 C	S
FD 63-1	5	25.33 D	MS
FD 78-36	5	24.00 D	MS
FD 76-67	9	68.667 A	HS
Santé	5	26.33 D	MS
FD 74-21	9	67.667 A	HS
FD 35-36	7	53.00 B	S
SL 5-2	9	67.667 A	HS
FD 76-18	3	15.333 E	MR
FD 61-3	7	51.00 B	S
SL 9-4	3	15.00 E	MR
FD 73-73	1	5.33 F	R
FD 78-51	5	27.33 D	MS
SL 15-11	5	26.00 D	MS
SL 14-15	9	70.00 A	HS

Table: 3 Reaction of different potato varieties against late blight disease during 2014-15

Name of variety/line	Disease rating grade	Mean Value	Varietal response
FD 35-32	5	25.667 E	MS
FD 76-67	5	26.00 E	MS
SH 704	9	65.000 AB	HS
FD 74-8	9	70.333 A	HS
FD 74-4	9	72.667 A	HS
FD 74-51	7	52.00 CD	S
FD 78-51	7	51.00 CD	S
FD 78-76	7	50.33 CD	S
FD 75-21	9	74 A	HS
N-34	7	48.33 CD	S
FD 76-18	7	53.33 CD	S
FD 73-75	3	16.33 F	MR
NARC 39012-96	1	6.667 G	R
FD 69-2	1	7.667 FG	R
FD 69-25	3	15.667 FG	MR
FD 74-19	3	15.667 FG	MR
FD 78-10	7	57.00 BC	S
FD 78-104	7	49.33 CD	S
FD 73-77	7	46.00 D	S
FD 78-3	7	49.667 CD	S
NARC 39-457-21	5	25.667 E	MS
FD 35-36	7	55.667 C	HS

CV : 13.29

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