



Original Research Article

Evaluation of cultivars of potato (*Solanum tuberosum*) for disease reaction against late blight pathogen [*Phytophthora infestans* (Mont) de Bary]

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A B S T R A C T

Keywords

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Categorization of thirty five genotype/cultivars into different reaction groups, based on the late blight intensity exhibited by them over two years of evaluation, revealed that an overall mean blight incidence in the range of 41.11 to 78.80 per cent and blight intensity in the range of 23.21 to 69.05 per cent with “A” values in the range of 105.37 to 428.66. The genotypes PP 48, PP 2500, DPL 11, 92-P-27, MP 92-63, SMP 91-15-15 and MPT 11 exhibited least mean disease incidence of less than 50 per cent and blight intensity of less than 30 per cent. The genotype which yielded the minimum “A” value for the disease include MPT 11 (114.21) 92-p-27 (120.81), MP1 (118.51), PP2500(115.06), MP 97-699(120.18), DTP-1(117.12) and PP48(105.33). None of the 35 genotypes/cultivars was resistant to late blight (*P.infestans*) disease. However, 31 genotypes/cultivars fell under moderately resistant category whereas four other genotypes/cultivar were categorized as susceptible.

Introduction

Potato (*Solanum tuberosum* L.) is the fourth most important food crop in the world (Marnique, 2000) after wheat, rice and corn (Rhodes, 1982). It is a versatile, carbohydrate rich food prepared and served in a variety of way. Potato is grown in various climatic conditions throughout the world (Haverkot, 1990; and Rhodes, 1982) in about 18.6 million hectares in 150 countries, and is an important part of global food supply (Anonymous, 2003). The area under crop in the Jammu and Kashmir state is approximately 2500

hectares with production of 22589.20 tonnes (Anonymous, 2009). However, its yield and quality is adversely affected by frequent occurrence of a number of fungal, bacterial and viral diseases, among which late blight [*Phytophthora infestans* (Mont) de-Bary] is highly destructive (Chycoski and Punja, 1996; Song, *et al.*, 2003). The disease resulting in heavy yield losses under favourable conditions each year (Flier, *et al.*, 2001) with reduction in global production by approximately 15 per cent (Anonymous, 1997). Losses of

up to 10 to 75 per cent by the disease have been reported in India (Dutta, 1979). Kumar *et al.* (2010) reported yield loss to the extent of 15 to 100 per cent in Punjab, the losses depending on the crop growth stage at which the disease first appears (Mohan and Thind, 1999). The cultivation of *P. infestans* -resistant potato genotype is believed to be a better option of disease control and several resistant and moderately resistance varieties have been developed and are being cultivated over larger areas throughout globe (Finckh *et al.*, 2006). However, evolution of new pathotypes and races (Fry and Goodwin, 1997) at faster frequency necessitate availability of alternate measures of late blight control to at least reduce selection pressure on the pathogen while at the same time keeping the disease at low ebb. The cultivation of disease resistant host genotype is regarded as the most viable and economical alternative to health-hazardous chemical control measures in combating the disease. The identification of such varieties and host genotypes suitable for the region is, therefore, of primary importance. In present study thirty five genotypes were evaluated for their resistance to late blight pathogen.

Materials and Methods

Isolation of pathogen and production of inoculums

Blighted samples were brought to the laboratory and the isolation of pure culture was made on V-8 agar medium using standard plant pathological technique. A pure culture of *P. infestans* was transferred onto V8 medium amended with rose Bengal in 90 mm diameter Petri dishes and incubated for about 14 days at 18°C in darkness for sporangia production. The

inoculum was harvested from 10 to 14 days old cultures by adding 10 ml sterile distilled water to each plate and scraping the surface lightly with the edge of a glass rod to dislodge the sporangia. These sporangial suspensions were filtered through a double layer of cheese cloth to remove mycelia fragments, and diluted to appropriate concentration with the aid of Haemocytometer. The sporangia were chilled at 4°C for 2 hours to induce zoospore liberation.

Identification of resistant genotypes

35 potato genotypes/cultivars obtained from division of Vegetable Science and planted in the potato seed multiplication Farm of Division of Vegetable Science at Yarikha, were assessed over a period of two years (2007 and 2008) in fungicide free micro-plot trials (15 plants/plot) with three replications for field resistance. The blocks of each genotype tested were surrounded by susceptible cultivar. After irrigation, plants were inoculated with a suspension of 2-3 x 10 sporangia/ml 2 weeks after crop growth, in the evening hours. The intensity of foliar blight was determined at 10 days interval from the on set of first symptoms until the end of vegetation period (dehaulming) and expressed in per cent of the infected leaf area using the disease rating scale given by Mohan and Thind (1999).

Disease Score	Score description in terms of foliage infected (%)
0	No visible symptoms
1	1-10
2	11-25
3	26-50
4	51-75
5	>75

The disease intensity was calculated by using the following formula

$$\text{Late blight intensity (\%)} = \frac{\text{Summation of numerical rating}}{\text{No. of plants Examined} \times \text{Maximum disease score}} \times 100$$

The area under disease progress curve (AUDPC “A” value) was determined for each genotype as per the method given by Shanner and Finney (1977) using the formula. The AUDPC value was calculated with the following formula (Shanner and Finney, 1977).

$$\text{AUDPC} = \frac{\left[\frac{D_1}{2} + \frac{D_2}{2} + \frac{D_3}{2} + \dots + \frac{D_{N-1}}{2} \right] \times T}{(N-1)}$$

Where D = % Disease intensity at different dates (D₁ + D₂, D₂ + D₃, D₃ + D₄ ... and so on)

T = Time interval between two observations

N = Total number of observations

The genotypes were classified into highly resistant, resistant, moderately resistant, and susceptible as per the following scale (Anonymous, 1997).

Disease intensity (%)	Category
Upto 5	Highly Resistant
5-20	Resistant
21-40	Moderately Resistant
Above 40	Susceptible

Results and Discussion

Evaluation of 35 genotypes under field epiphytotic conditions for their reaction to *P. infestans* during 2007 and 2008 cropping seasons (Table-1) revealed an overall mean blight incidence was in the range of 41.11 to 73.33 per cent, blight intensity in the range of 23.21 to 69.70 per cent and “A” values in the range of 105.37 to 428.66. The genotypes PP 48, PP 2500, DPL 11, 92-P-27, MP 92-63, SMP 91-15-15 and MPT 11 exhibited least mean disease incidence of less than 50 per cent and blight intensity of less than 30 per cent. The genotypes which yielded minimum “A” values for the disease include MPT 11 (114.21), 92-P27 (120.81), MP 1 (118.51), PP 2500 (115.06), MP 97-699 (120.18), DTP-1 (117.12) and PP 48 (105.33). The performance of the genotypes evaluated during 2007 cropping season revealed lesser blight incidence and intensity in released/elite genotypes compared to those of Gulmarg Special and Ardo special varieties which exhibited maximum blight incidence (73.33-75.55%) and intensity (66.20-68.40%). Least blight incidence of 33.33, 35.55 and 37.77 per cent was exhibited by genotypes 92-P-27, MPT-11 and MP-92-637, whereas Kufri Jyoti, Ardo special, Hurlpura and Gulmarg Special showed the maximum blight incidence of 71.11, 75.55, 73.33 and 73.33 per cent, respectively. The genotypes with least blight intensity were PP 2500 (21.40 %), DTP-1 (22.70%), DPL-11 (23.50 %), 92-P-27 (24.11%), MP-1 (24.50%), MP-92-37 (24.50 %) and PP 48 (24.50 %).

The genotype PP 48 depicted the minimum “A” value (103.12) for the late blight development followed by the genotype MPT-II, Mp-1, PP-2500, MP-92-625 and DTP-1 (112.12-112.70 %),

Table.1 Evaluation of potato genotypes against late blight (*Phytophthora infestans*) during 2007 and 2008 cropping seasons

Genotype	Late blight incidence (%)			Late blight intensity (%)			“A” value		
	2007	2008	Mean	2007	2008	Mean	2007	2008	Mean
HB (87-185)	53.33	66.66	59.99	38.14	37.10	37.62	233.10	232.91	233.00
HB (82-185)	55.55	64.44	59.99	37.60	39.01	38.30	231.30	236.81	234.05
SM (86-991)	51.11	60.00	55.55	33.10	35.51	34.30	215.00	215.12	215.06
HB (83-195)	55.55	66.66	61.10	38.40	37.23	37.81	212.55	198.12	205.33
HB (82-36)	51.11	60.00	55.55	36.40	38.31	37.35	213.25	228.75	221.00
HB (82-372)	57.77	60.00	58.88	38.90	37.39	38.14	257.05	176.80	216.92
MPT (11)	35.55	46.66	41.11	27.90	26.90	26.90	112.12	116.3	114.21
SM (9,85-50)	57.77	55.55	56.66	35.30	31.33	33.31	215.12	227.80	221.46
SM (50-55)	53.33	66.66	59.99	33.91	34.90	34.40	223.40	213.85	218.62
SM (87-51)	57.77	55.55	56.66	35.01	37.11	36.06	257.40	243.80	250.60
HB (50-45)	51.11	53.33	52.22	38.41	38.12	38.26	200.70	248.20	224.45
(92-P-27)	33.33	40.00	36.66	24.50	28.50	26.50	128.12	113.51	120.81
Kufri Jyoti	71.11	73.33	72.22	60.21	66.50	63.35	421.77	435.55	428.66
DPL (11)	42.22	53.33	47.77	23.50	24.90	24.15	211.87	115.90	163.88
MP (92-637)	37.77	55.55	46.66	24.50	25.89	25.19	153.39	200.31	176.85
ATL	55.55	60.00	57.77	44.20	39.33	41.76	206.57	242.30	224.43
SMP (91-15-15)	51.11	48.88	49.99	27.90	28.98	28.44	148.77	122.87	135.82
MP (1)	51.11	57.77	54.44	24.11	25.70	24.90	112.62	124.40	118.51
Ardo Special	75.55	82.22	78.88	66.20	67.13	66.66	370.37	363.37	366.87
SM (92-168)	60.00	60.00	60.00	37.20	33.14	35.17	250.50	180.77	215.63
HB (82-18)	60.00	60.00	60.00	38.20	38.71	38.15	259.37	241.00	250.18
SM (92-338)	62.22	62.22	62.22	36.40	34.40	35.4	239.75	145.63	192.69
HB (82-36)	64.44	62.22	63.33	38.90	38.11	38.50	248.12	234.39	241.25
SM (90-45)	68.88	60.00	64.44	35.20	34.70	34.95	262.00	207.34	234.67
SM (98-237)	55.55	62.22	58.88	38.10	37.91	38.00	246.12	218.14	232.13
PP (2500)	46.66	48.88	47.77	21.40	26.50	23.95	112.25	117.88	115.06
Hurpur	73.33	75.55	74.44	66.66	67.90	67.28	403.45	420.00	411.72
MP (92-625)	51.11	53.33	52.22	25.40	28.50	26.95	112.70	144.38	128.54
MP (97-699)	53.33	55.55	54.44	26.90	24.70	25.80	121.26	119.10	120.18
DTP (1)	53.33	51.11	52.22	22.70	23.72	23.21	112.37	121.88	117.12
PP (48)	42.22	40.00	41.11	24.50	25.70	25.10	103.12	107.63	105.37
Gulmarg special	73.33	73.33	73.33	68.40	69.70	69.05	396.87	406.50	401.68
SM (55-50)	68.88	66.66	67.77	38.40	35.11	36.75	264.38	196.18	230.28
HB (85-50)	64.44	68.08	66.26	38.11	38.90	38.50	214.13	242.26	228.19
SM (85-36)	68.88	66.66	67.77	39.11	37.90	38.50	246.01	225.30	235.65

Data are average of 3 replications

whereas Kufri Jyoti and Gulmarg Special exhibited the maximum “A” values (401.68-428.66) for the disease. Similar response to *P. infestans* was shown by almost all the genotypes during 2008 cropping season as well with the genotype 92-P-27 and PP 48 exhibiting the least blight incidence of 40 per cent each compared to 75.55 per cent incidence recorded on cv. Hurlpura.

The blight intensity during the year ranged from 23.72 to 69.70 per cent with the genotype DTP-1 recording the minimum blight intensity and Ardo special the maximum incidence. The other promising genotypes with least intensity were MP-97-699 (24.70 %), DPL-11 (24.90%), MP-1 (25.70%) and PP-48 (25.70 %). The genotypes PP 48 again showed the minimum “A” value (107.63) for late blight development followed by the genotype MPT-11 (116.30), 92-P-27, DPL-11 (113.47), PP-2500 (117.88) and MP-97-699 (119.10); Kufri Jyoti and Gulmarg Special cultivars exhibited the maximum areas under disease progress curve (406.50-435.55).

Categorization of the genotypes/cultivars into different reaction groups based on the late blight intensity exhibited by them over the years of evaluation (Table-1) revealed that none of the 35 genotypes/cultivars was resistant to late blight (*P. infestans*) disease. However, 31 genotypes/cultivars fell under moderately resistant category, whereas four other genotypes/cultivars were categorized as susceptible. The moderately resistant lines included HB (87.18), HB (82.185), SM (86-991), HB (83-195), HB (82.36), HB (82-372), MPT(11), SM (9-85-50), SM (50-55), SM (87-51), HB (50-45), (92-P-27), DPL-11, MP (92-637), ATL, SMP (91-15-15), MP(1), SM (92-168), HB (82-

18),SM (92-338), HB (82-36), SM (90-45), SM (98-237), PP-2500, MP (92-625), MP (97-699), DTP (1), PP-48, SM (55-50), HB (85-50), SM (85-36) where as the susceptible genotypes/cultivars included Kufri Jyoti, Ardo Special, Hurlpura, and Gulmarg Special. The results further reveal that the “A” value for the moderately resistant genotypes /cultivars ranged from 105.37 to 250.60 and that for the susceptible lines ranged from 366.87 to 428.66.

Thirty five genotypes/cultivars evaluated during the present study under field conditions for their response to *P. infestans*, revealed, none of the varieties were resistant to the pathogen. During the year 2007 and 2008 cropping season, disease incidence on overall basis ranged from 41.11 to 78.88 per cent and blight intensity from 23.21 to 69.05 per cent with ‘A’ values in the range of 114.37 to 411.72 per cent. Based on the two years field evaluation under artificial epiphytotic conditions, 31 potato varieties/genotypes such as HB (82-185), SM (86-991), HB (83-195), HB (82-36), HB (82-372), MPT (11), SM (9,85-50), SM (50-55),SM (87-51), HB (50-45),(92-P-27), DPL (11), MP (92-637), ATL SMP (91-15-15), MP (1), SM (92-168),HB (82-18),SM (92-338), HB (82-36), SM (90-45), SM (98-237), PP (2500), MP (92-625),MP (97-699), DTP (1) and PP (48) were rated as moderately resistant and four varieties Kufri Jyoti, Ardo Special, Hurlpur and Gulmarg Special, were rated as susceptible, none of the varieties was categorized as resistant. This seems to be a matter of grave concern, and necessitates to introduce some host genotype(s) with known resistant genes for undertaking varietal improvement programme. Given the nature of the pathogen, which co-evolves at a faster pace, horizontal resistance

through gene pyramiding using appropriate breeding procedures could be adopted. Since low infection frequency, smaller lesion size and lower sporulation capacity have been shown associated with resistant varieties (Umaerus and Lihneel, 1976) and since these parameters determine the area under disease progress curve of varieties, AUDPC value have been for all the varieties under the present investigation. The genotypes which yield the minimum AUDPC were PP 48, PP 2500, DPT 11, 92-P-27, MP 92-63, SMP 91-15-15 and MPT 11. exhibited least mean disease incidence less than 50% and intensity less than 30%.The genotypes MPT 11 (114.21) 92-p-27, (120-81), MPI (118-51) PP 2500 (115.06) MP 97-699 (120.18) DTP -1 (117.12) and PP 48 (105.33).These findings are identical with those of Ranjan *et al.* (2005) and Umaerus *et al.* (1983). Namanda *et al.* (2004) reported the area under disease progress curve in the range of 25.1 to 890 and 19.1-945 for susceptible varieties 'Kabale' and 'Victoria', respectively, compared to 49.7 to 444.5 for resistant varieties 'Ruhika' and 'Nakpot 3', respectively.

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