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Varietal Reaction of Potato against Late and Early Blight Diseases under West Bengal condition

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ABSTRACT: Potato is an important starchy solanaceous food crop. Its production drastically reduced by late blight and early blight diseases under favourable conditions. Therefore to find out resistant variety against these diseases ten varieties of potato were screened against late and early blight diseases during 2019-2020 and 2021-2022 cropping season. It was observed that three varieties *i.e.* Kufri Himalini, Kufri Kesar and Kufri Chipsona-3 showed the less disease incidence (36.42, 44.56 and 46.69% respectively) and disease severity (16.21, 20.94 and 21.35% respectively) against late blight disease after 73 DAP compared to other varieties. Kufri Gaurav, Kufri Khyati, Kufri Neelkantha and Kufri Garima exhibited slightly higher disease incidence (58.20, 66.17, 67.15, and 68.29% respectively) and disease severity (32.10, 41.77, 42.31 and 42.49% respectively) than Kufri Himalini, Kufri Kesar and Kufri Chipsona-3. Kufri Jyoti, Kufri Pukhraj and Kufri Pushkar were highly susceptible due to significantly higher disease incidence (100, 100 and 100% respectively) and disease severity (61.99, 63.55 and 66.17% respectively) than other varieties. Similar type of result was obtained against early blight disease of potato also. Kufri Himalini, Kufri Kesar and Kufri Chipsona-3 were highly resistant to early blight disease due to lower disease incidence (19.29, 19.89 and 21.13% respectively) and severity (9.19, 10.23 and 11.52 % respectively) and Kufri Jyoti, Kufri Pukhraj and Kufri Pushkar were highly susceptible due to higher disease incidence (54.29, 56.23 and 57.23% respectively) and severity (27.14, 27.23 and 29.13% respectively). The result revealed that Kufri Himalini, Kufri Kesar and Kufri Chipsona-3 were highly resistant against both the diseases due to less disease incidence and severity compared to other varieties. Therefore these three varieties can be used for commercial cultivation against late blight and early blight of potato in West Bengal situation.

Keywords: Disease incidence, disease severity, early blight, potato, variety.

INTRODUCTION

Potato is an important starchy food crop belonging to the family solanaceae. It is cultivated in different parts of India widely. It seems to be originated from South America more preciously from mountains of southern Peru and Bolivia. Potato is the world's fourth-largely consumed food crop following rice, wheat and maize (Gupta and Modgil 2008). Potato occupies an area of 20.64 million hectares in the world with an annual production of 392.96 million tons and an average productivity of 19.03 tons per hectare. Potato is a short duration crop widely grown all over the world. India ranks first in the area (2.17 m ha) and production (51.28 m tons) with an average productivity of 23.63 t/ha. Potato production in India expanded from 2.7 million tons in 1961 to 51.28 million tons in 2020. The top producers of potato in the world are India (28.01%), China (23.90%) and Russia (8.1%). Potato is grown almost in all the states of India. Major potato growing states are Uttar Pradesh, West Bengal, Bihar, Gujarat, Madhya Pradesh, Punjab, Assam, Chhattisgarh, Jharkhand and Haryana. In West Bengal potato occupies an area of 4.6 lakh hectares with a production of 13.16 m tonnes per annum. The potato is susceptible to many diseases which consistently cause yield losses in potato production. Late blight, early blight, Phoma leaf spot, common scab, black scurf, dry rot and wilting are the important fungal diseases in West Bengal. Among these diseases, the most commonly occurring and destructive foliar diseases are late blight and early blight in West Bengal. Severity and incidence caused by late blight pathogen varied from 1.50 to 60.00% and 2.00 to 75.00% respectively and the yield declined up to 65.00% (Bisht *et al*., 1997). The disease incidence of early blight varies from 19.10% to 30.50% and yield loss up to 40.00% from year to year depending upon the weather condition and varieties grown. The crop losses can be reduced following suitable chemical control measures. But chemical control measure is hazardous to human being and environment and repeated use of

chemical fungicides develop resistance to the pathogens. The management of these diseases using various cultural practices is more acceptable and ecologically viable. Keeping these views in mind the present experiment was conducted to find out suitable potato cultivar which will be more resistant to both of these diseases.

MATERIALS AND METHODS

The experiment on the varietal reaction of potato against early blight and late blight diseases was conducted during the Rabi season in the District seed farm 'C' Unit, Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal during the year of 2019-2020 and 2021-2022. Ten different varieties of potato were selected for the studies *viz*. Kufri Garima, Kufri Neelkantha, Kufri Pushkar, Kufri Chipsona-3, Kufri Jyoti, Kufri Himalini, Kufri Khyati, Kufri Gaurav, Kufri Lima and Kufri Pukhraj.

Recording of data: Data was recorded to determine disease incidence and severity after appearance of the diseases in the field. Seventeen plants were selected randomly in each plot of each variety of potato crop. The observations were made at seven days interval after first appearance of the diseases. For measuring the disease severity lower, middle and upper leaf of each plant were selected and labelled for subsequent observations. Then the percentage of leaf area infected of each leaf was recorded. To determine the disease incidence total no. of plants and no. of infected plants in each plot were recorded and ultimately used this data to calculate the disease severity following the formula.

$$\text{Disease incidence (\%)} = \frac{\text{No. of plant infected}}{\text{No. of plant observed}} \times 100$$

The descriptive (0-6) scale (Campbell and Madden 1990) used for the assessment of late blight disease intensity and (0-5) scale (Ganie *et al.*, 2013) used for the assessment of disease intensity of early blight of potato (Table 1).

Table 1: Scales used for assessment of disease incidence.

Scale rating	Description (0-6 Scale) for late blight	Description (0-5 Scale) for early blight
0	Free from infection (no visible symptom)	Free from infection (no visible symptom
1	Trace to 20% leaf Infection.	0-10% leaf area damaged.
2	21-40% leaf Infection.	10.1-20% leaf area damaged.
3	41-60% leaf Infection.	20.1-50% leaf area damaged.
4	61-80% leaf Infection.	50.1-75% leaf area damaged.
5	81-90% leaf Infection.	75.1-100% leaf area damaged.
6	91-100% leaf Infection.	—

The percent disease index (PDI) was calculated using the formula according to the Mc Kinney (1923).

$$\text{PDI} = \frac{\text{Sum of numerical ratings}}{\text{Total no.of leaves observed} \times \text{highest disease rating}} \times 100$$

RESULTS AND DISCUSSION

Here ten varieties of potato were tested against late blight and early blight diseases of potato under field condition. The varieties exhibited different types of reactions, *i.e*.- a) highly resistant -Kufri Himalini, Kufri Kesar, Kufri Chipsona-3; b) moderately resistant - Kufri Gaurav, Kufri Khyati, Kufri Neelkantha, Kufri Garima; c) susceptible - Kufri jyoti, Kufri Pukhraj; and d) highly susceptible - Kufri Pushkar; against both these diseases. Kufri Himalini (T5) exhibited highly resistant reaction to late blight in terms of lower disease incidence (36.42%) and severity (16.21%) with yield 45.00 ton/ha followed by Kufri Kesar (T10) where per cent disease incidence and severity were 44.56 and 20.94% respectively at 73 DAP with a production of 44.50 t/ha. Higher disease resistance reaction was also exhibited by kufri chipsona-3 (T4) where percent disease incidence and severity were 46.69 and 21.35 respectively at 73 DAP and 44.10 t/ha yield. Kufri Gaurav (T8), Kufri Khyati (T6), Kufri Neelkantha (T9) and Kufri Garima (T1) were moderately resistant in terms of slightly higher disease incidence *i.e*. 58.20, 66.17, 67.15 and 68.29% respectively and severity *i.e*. 32.10, 41.77, 42.31, 42.49% respectively with lower yield *i.e*. 43.90, 42.50, 42.44 and 42.00 t/ha respectively compared to Kufri Himalini, Kufri Kesar and Kufri Chipsona-3. Kufri Jyoti (T2) and Kufri Pukhraj (T7) were susceptible to this disease and produced 31.70 t/ha and 31.45 t/ha respectively.

Table 2: Disease incidence of late blight in different varieties of potato.

Treatment	Disease incidence at seven days of interval					Yield ton/ha
	45 DAP	52 DAP	59 DAP	66 DAP	73 DAP	
T_1	28.88(32.50)	36.66(37.26)	56.49(48.75)	62.24(52.09)	68.29(55.75)	42
T_2	30.75(33.66)	42.10(40.46)	72.51(58.39)	96.49(79.28)	100.00(90.01)	31.70
T_3	36.19(36.98)	48.63(44.22)	76.45(60.98)	98.19(82.49)	100.00(90.01)	27.55
T_4	0.00(0.0)	13.62(21.65)	28.32(32.15)	38.96(38.62)	46.69(43.10)	44.10
T_5	0.00(0.0)	2.46(8.90)	8.78(17.22)	26.88(31.23)	36.42(37.12)	45.00
T_6	15.15(22.90)	22.66(28.41)	48.86(44.73)	56.48(48.73)	66.17(54.25)	42.50
T_7	32.18(34.55)	46.88(43.21)	74.33(59.59)	97.28(80.62)	100.00(90.01)	31.45
T_8	0.00(0.0)	14.36(22.24)	34.47(35.95)	46.59(43.05)	58.20(49.72)	43.90
T_9	1.32(6.49)	26.32(30.87)	51.21(45.70)	58.63(49.97)	67.15(55.04)	42.44
T_{10}	0.00(0.0)	10.87(19.20)	23.13(28.73)	35.54(36.60)	44.56(41.88)	44.50
SE(±)	0.65	0.77	0.70	0.69	0.62	0.41
CD(P=0.05)	1.93	2.28	2.09	2.05	1.86	1.22

T1= Kufri Garima, T2= Kufri Jyoti, T3= Kufri Pushkar, T4= Kufri Chipsona-3, T5= Kufri Himalin, T6= Kufri Khyati, T7= Kufri Pukraj, T8= Kufri Gaurav, T9= Kufri Nilkanth, T10= Kufri Kesar, DAP = Days after planting.

But among theses varieties Kufri Pushkar (T3) was highly susceptible due to higher disease incidence (100.00%) and disease severity (66.17%) (Table 2 & 3). Mohsan *et al.* (2016) also reported that one of the potato varieties, FD 73-73 was highly resistant to late blight disease due to low infection (10%) which was similar with the result of this experiment where Kufri Himalini, Kufri Kesar and Kufri Chipsona-3 were also highly resistant to this disease.

Same trend was also observed against early blight disease. Kufri Himalini (T5), Kufri Kesar (T10) and Kufri Chipsona-3 (T4) exhibited highly resistant reaction due to lower disease incidence *i.e.* 19.29, 19.89 and 21.13% respectively and disease severity *i.e.* 9.19, 10.23 and 11.52% respectively with yield *i.e.* 45.00t/ha, 44.50t/ha and 44.10 t/ha respectively. Kufri Khyati (T6), Kufri Gaurav (T8), Kufri Neelkantha (T9) and Kufri Garima (T1) were moderately resistant and Kufri Jyoti (T2), Kufri Pukhraj (T7) and Kufri Pushkar (T3) were treated as highly susceptible due to higher disease incidence *i.e.* 54.29, 56.23, and 57.23% respectively and disease severity *i.e.* 27.14, 27.23, and 29.13% respectively compared to other cultivars (Table 4 & 5). These findings are similar with Dey *et al.* (2012) who reported that Kufri Jyoti and Kufri Ashoka showed less disease incidence (4.12 and 12.36%) and disease intensity (1.87 and 3.20%) at 14 days after first appearance of the disease in the field.

Table 3: Disease severity of late blight disease in different varieties of potato.

Treatment	Disease Severity at seven days of interval					Yield ton/ha
	45 DAP	52 DAP	59 DAP	66 DAP	73 DAP	
T_1	12.44(20.64)	16.33(23.83)	26.99(31.30)	39.21(38.76)	42.49(40.68)	42
T_2	13.55(21.59)	19.10(25.91)	34.55(36.00)	46.44(42.96)	61.99(51.95)	31.70
T_3	16.99(24.34)	22.33(28.20)	36.32(37.06)	52.99(46.72)	66.17(54.44)	27.55
T_4	0.00(0.00)	5.66(13.73)	12.16(20.40)	17.66(24.83)	21.35(27.51)	44.10
T_5	0.00(0.00)	1.43(6.87)	3.99(11.46)	11.88(20.15)	16.21(23.74)	45.00
T_6	5.58(13.63)	10.33(18.74)	22.66(28.41)	36.76(37.32)	41.77(40.27)	42.50
T_7	14.88(22.68)	21.44(27.58)	35.33(36.47)	47.68(43.67)	63.55(52.87)	31.45
T_8	0.00(0.00)	5.66(13.73)	15.77(23.39)	21.89(27.89)	32.10(34.51)	43.90
T_9	0.55(4.24)	11.66(19.96)	23.41(28.94)	37.63(37.84)	42.31(40.58)	42.44
T_{10}	0.00(0.00)	3.39(10.53)	9.66(18.09)	15.77(23.39)	20.94(27.23)	44.50
SE(±)	0.37	0.57	0.55	0.59	0.63	0.41
CD(P=0.05)	1.11	1.70	1.64	1.77	1.89	1.22

T1= Kufri Garima, T2= Kufri Jyoti, T3= Kufri Pushkar, T4= Kufri Chipsona-3, T5= Kufri Himalin, T6= Kufri Khyati, T7= Kufri Pukraj, T8= Kufri Gaurav, T9= Kufri Nilkanth, T10= Kufri Kesar, DAP= Days after planting.

Table 4: Varietal reaction on disease incidence of early blight of potato.

Treatment	Disease Incidence at seven days of interval					Yield ton/ha
	45 DAP	52 DAP	59 DAP	66 DAP	73 DAP	
T_1	5.33(13.31)	13.33(21.38)	17.97(25.08)	26.94(31.27)	32.31(34.64)	42
T_2	10.37(18.77)	26.67(31.09)	33.29(35.24)	43.37(41.19)	54.29(47.47)	31.70
T_3	13.66(21.68)	31.32(34.03)	41.69(40.22)	48.57(44.18)	57.23(49.16)	27.55
T_4	00.00(0.00)	6.66(14.93)	12.91(21.05)	17.45(24.69)	21.13(27.35)	44.10
T_5	00.00(0.00)	5.32(13.30)	10.66(19.01)	15.32(23.02)	19.29(26.05)	45.00
T_6	3.33(11.96)	11.67(19.97)	15.21(22.95)	23.45(28.96)	29.51(32.90)	42.50
T_7	12.66(20.83)	28.33(32.16)	34.93(36.23)	45.69(42.53)	56.23(48.58)	31.45
T_8	00.00(0.00)	7.33(15.69)	14.47(22.33)	19.72(26.36)	27.89(31.88)	43.90
T_9	5.24(13.19)	12.23(20.46)	15.56(23.23)	24.13(29.42)	30.79(33.70)	42.44
T_{10}	00.00(0.00)	5.97(14.11)	12.41(20.62)	16.67(24.09)	19.89(26.47)	44.50
SE(±)	0.50	0.61	0.64	0.51	0.58	0.41
CD(P=0.05)	1.51	1.82	1.92	1.54	1.74	1.22

T1= Kufri Garima, T2= Kufri Jyoti, T3= Kufri Pushkar, T4= Kufri Chipsona-3, T5= Kufri Himalin, T6= Kufri Khyati, T7= Kufri Pukraj, T8= Kufri Gaurav, T9= Kufri Nilkanth, T10= Kufri Kesar, DAP= Days after planting.

Table 5: Varietal reaction on Disease Severity of early blight of potato.

Treatment	Disease Severity at seven days of interval					Yield ton/ha
	45 DAP	52 DAP	59 DAP	66 DAP	73 DAP	
T_1	3.17(10.17)	7.16(15.50)	9.48(17.92)	13.47(21.52)	16.63(24.06)	42
T_2	5.18(13.12)	13.33(21.41)	17.29(24.57)	23.19(28.79)	27.14(31.40)	31.70
T_3	7.33(15.69)	16.11(23.66)	20.35(26.80)	24.27(29.50)	29.13(32.67)	27.55
T_4	00.00(0.00)	3.66(10.96)	6.41(14.64)	9.25(17.69)	11.52(19.83)	44.10
T_5	00.00(0.00)	2.11(8.19)	5.33(13.31)	7.32(15.68)	9.19(17.63)	45.00
T_6	1.31(6.17)	6.37(14.59)	8.11(16.53)	12.25(20.48)	14.23(22.13)	42.50
T_7	6.33(14.45)	14.13(22.07)	17.46(24.70)	22.19(28.09)	27.23(31.45)	31.45
T_8	00.00(0.00)	3.17(10.17)	7.23(15.58)	9.72(18.15)	14.39(22.29)	43.90
T_9	3.13(10.10)	6.13(14.31)	8.26(16.68)	12.03(20.29)	15.43(23.12)	42.44
T_{10}	00.00(0.00)	2.97(9.83)	6.21(14.40)	8.67(24.09)	10.23(18.64)	44.50
SE(±)	0.80	0.81	0.57	0.61	0.51	0.41
CD(P=0.05)	2.39	2.40	1.70	1.81	1.52	1.22

T1= Kufri Garima, T2= Kufri Jyoti, T3= Kufri Pushkar, T4= Kufri Chipsona-3, T5= Kufri Himalini, T6= Kufri Khyati, T7= Kufri Pukraj, T8= Kufri Gaurav, T9= Kufri Nilkanth, T10= Kufri Kesar, DAP = Days after planting.

But here almost similar type of result was found in three varieties *viz.*, Kufri Himalini, Kufri Kesar and Kufri Chipsona-3 after 28 days of appearance where disease incidence and disease severity ranging 19.29 - 21.13% and 9.19 to 11.52% respectively which was slightly higher than referred result. So these varieties may be accepted for cultivation with proper management practices.

CONCLUSION

Both late blight and early blight are vulnerable diseases of potato causing huge loss in the production. Therefore, resistant cultivar is required against both these diseases for commercial cultivation by the farmers. Here few varieties *viz*., Kufri Himalini, Kufri Kesar and Kufri Chipsona-3 were found to be highly resistant to this disease due to lower disease incidence and severity along with higher yield and Kufri Gaurav, Kufri Khyati, Kufri Neelkantha and Kufri Garima were moderately resistant. Therefore, Kufri Himalini, Kufri Kesar and Kufri Chipsona-3 can be commercially cultivated by farmers in West Bengal against both late and early blight of potato.

FUTURE SCOPE

After long time these resistant varieties potato may become susceptible to the pathogen due to emergence of new strain of pathogen through mutation and climate change favourable for them. Therefore, research work for the development of new resistant variety of potato need to be carried out through breeding programme and management of these diseases need to be carried out further using different approaches *viz.*, using of bio-agents, botanical pesticide and new molecules of chemical.

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Conflicts of interest. None.

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