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EVALUATION OF POTATO GERMPLASM FOR LATE BLIGHT AND POTATO CYST NEMATODE RESISTANCE UNDER NORTH-WESTERN INDIAN HILLS

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ABSTRACT: Late blight disease caused by the fungus *Phytophthora infestans* is the main yield limiting factor amongst the diseases of potato in India and across the globe. Potato Cyst Nematode/PCN (*Globodera* spp.) is another biotic factor of economic importance and is a quarantine organism. Exploitation of genetic resistance is the most preferred management strategy. In the present study, indigenous potato genotypes collected from different parts of the country along with checks were evaluated for their resistance against late blight under natural epiphytotic field conditions and in laboratory under artificially inoculated conditions including detached leaf and tuber slice assays and PCN through Root ball technique during 2020-2023. The converted field scale values i.e. average AUDPC value ranged from 7 in highly resistant genotype Rangpuria to 1596 in susceptible accession AGR/56. The field blight response was comparatively more correlated (r =0.63) with susceptibility levels measured in the detached leaf assay compared to that with tuber slice assay (r =0.48). Genotypes Kanpuria Safed, JG-1, Rangpuria and Desi Aloo showed resistance to late blight both under laboratory and field conditions. For PCN, Garlentic, Jeevan Jyoti and JG-1 have combined resistance (0 female/root ball) over the years to both the species. Majority of the studied genotypes have medium to high pollen viability with desirable tuber traits and yield advantage. The identified resistant genotypes excel their usage as parental lines in breeding for biotic stress resistance specifically for late blight and PCN.

KEYWORDS: Late blight, PCN, Yield, Indigenous potato germplasm

INTRODUCTION

Potato (*Solanum tuberosum* L.) is presently the most important non-grained food crop that was introduced in the early 17th century. Since its introduction as a garden vegetable in Western India, potato farming extended throughout India over the next two and a half centuries. *S. tuberosum* ssp. *andigena* was probably the first potato species introduced in India. These initial introductions later on got adapted and are known by varied names in different dialects/languages creating uncertainty about their identification and nomenclature. Potato Synonym Committee, National Institute of Agricultural Botany, England based on morphological examinations culled duplicate samples and initially identified 16 non-European varieties known as *desi* or indigenous samples or varieties that are result of survivors of earlier introductions and chance selections in the Indian agro-climates. Pal and Pushkarnath 1951 testified bud mutation can also be the origin of these *desi*/ indigenous potato varieties. *Desi* varieties have salient features of tolerance to abiotic stresses *viz*., heat and drought and to degenerative viruses, shorter dormancy, early maturity and preferred culinary and quality parameters. Slower rate of degeneration benefits potato growers by lesser need of seed replacement.

The collection of *desi* potato germplasm repository at CPRI Shimla is strengthened by

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explorations in different parts of the country and present repository constitutes more than 100 indigenous accessions conserved *in vitro* at Shimla and *in vivo* at Kufri.

Late blight and PCN are one of the two major biotic factors hindering potato cultivation in north India hills constituting parts of Himachal Pradesh, Uttrakhand and Jammu & Kashmir. Late blight, a fungal infection caused by *Phytophthora infestans* (Mont.) de Bary, causes significant yield losses leading to high levels of fungicidal usage across all potato growing conditions. Emergence of new virulent pathotypes necessitates search of new chemical formulation as well as resistance sources to manage this pathogen. Host resistance is the most environment-friendly, cost effective, durable and consumer health friendly way of disease management and late blight over fungicidal applications. Search of new resistance genes in cultivated as well as wild potato species and interspecific somatic hybrids are being done (Bhatia *et al.* 2023) to broaden the genetic base for blight resistance.

PCN, *Globodera rostochiensis* and *G. pallida* are important pests feeding on potato roots causing major losses up to 30%. In India both species are prevalent as mixed populations in all potato growing areas of southern hills and recent interception in north-western hills also confirm presence of both species. Like late blight, host resistance is durable method of managing PCN populations. Cultivated and wild species viz., *S. tuberosum* ssp. *andigena*, S. *vernei*, *S. gourlayi*, *S. sparsipilum* and *S. spegazzinii* are mainly used in PCN resistance breeding (Dalamu *et al.* 2012).

In lieu for above information, the present study was undertaken for search of novel late blight and PCN resistant genotypes in a set of *desi* potato genotypes that have not been studied up to now and to identify their potential usage as parental lines in resistance breeding based on yield, maturity and floral parameters.

MATERIALS AND METHODS

Late blight-Screening under natural epipytotic field condition

Thirty-eight potato genotypes were evaluated for late blight resistance in replicated, single row trials natural epiphytotic conditions at Kufri Hills (Figure 1a) (2743 m amsl; 31.10°N, 77.25°E) in summer season of 2021, 2022 & 2023 including 35 test accessions (*desi* genotypes) and standard controls namely Kufri Girdhari (highly resistant), Kufri Himalini (moderately resistant) and Kufri Jyoti (susceptible). Data on disease severity was recorded at an interval of seven days between two subsequent readings, and the area under the disease progress curve (AUDPC) was calculated (Shaner and Finney 1977). Based on AUDPC, the genotypes were graded as highly resistant/HR (< 250); resistant/R (251-350); moderately resistant/MR (351-650) and susceptible/S (> 650).

Late blight-Screening under Laboratory condition- Detached leaf and Tuber slice assays

Late blight reaction was reconfirmed by laboratory analysis by detached leaf assay (Singh *et al*. 1997) through challenge inoculation with complex races of *Phytophthora infestans* (Figure 1b). On an average, six leaflets of top 4-5th leaf from 2-4 plants of 45 days old were artificially inoculated by complex races of *P. infestans* using 6×10^4 sporangia/ml. On the basis of lesion area (cm^2), the genotypes are classified as highly resistant (lesion area up to 1.0 cm^2); resistant (1.1 to 2.5 cm^2); moderately resistant (2.51-5.0 cm^2) and susceptible (>5.0 cm^2). In Tuber slice assay, tuber slices (1 cm thick)in triplicate of each genotype placed in sterilized petri dishes are inoculated with zoospore suspension using filter paper discs (0.3 cm^2) dipped in the zoospore suspension (6×10^4 sporangia/ml). The genotypes are categorised as per scale given under foliage resistance by detach leaf assay.

PCN-Screening by Root ball assay

Meanwhile these accessions were also evaluated for PCN resistance through Root ball technique (Figure 1c) under glass house conditions with controls SM/11-120 (highly resistant) and Kufri Jyoti (highly susceptible). Five tubers of each genotype were planted in approx. 10 cm diameter pots in a glass house at 20-22 °C. The planting soil had a population of 200-250 cysts of both *Globodera* species per 100 mg, resulting in 8000-10000 eggs and larvae per test tuber. The number of females on the root balls of various cultures was counted after 60-65 days, when the females were evident on the root balls of the control plants (Kufri Jyoti). Grade 0-1 clones are the most desired level of resistance (Krishna Prasad 2006). The colour of developing females distinguishes the two species of *Globodera*. The genotypes were graded based on cyst count as highly resistant (0 female/root ball); resistant (1-5 female/root ball); moderately resistant (6-20 female/root ball); susceptible (21-50 female/root ball) and highly susceptible (>50 female/root ball).

Pollen viability

Freshly opened flowers or buds about to open (Balloon stage) are collected and stored in paper bags. The pollen samples were stained using acetocarmine glycerol. A small amount of pollen is mixed with an acetocarmine glycerol jelly drop placed in the centre of the slide. A slide cover was kept after a minute, and the mounted slides were checked for pollen staining. Pollen grains with full staining, plumpness, and clearly defined outlines were regarded as viable, whereas those without staining or with irregular shapes are non viable. Data recorded in four replicates are expressed as the percentage of the viable pollens. The genotypes are graded as highly fertile >70%; medium fertile 40-70%; low fertile 10-40%; sterile <10%.

RESULTS AND DISCUSSION

Among various biotic stresses of potatoes, late blight is one the most devastating affecting both foliage and tuber thus reducing tuber yield as well as tuber quality. It is widespread in both hills and sub-tropical regions of the country. Though initially considered disease of temperate world (Kumar *et al.* 2007), now the disease in also prevalent in the sub-tropical plains mandating development of at least moderately resistant varieties for these areas.

In the present study resistance responses of genotypes were compared by field evaluations and laboratory methods of detached and tuber slice assays. The majority ofgenotypes showed differential reaction within the field and lab assays.

In the natural epiphytotic field conditions, three genotypes *viz.*, Kanpuria Safed, Rangpuria and Desi aloo had average AUDPC values of

Fig.1. Field (a) and Detached leaf assay (b) for late blight; Root ball assay for PCN (c)

years 2021, 2022 and 2023 lower than 250 and grouped as highly resistant to late blight (**Table 1**). Only accession JG-1 was resistant (AUDPC 251-350) while three accessions,Australian White, G-4 and NJ-62 were moderately resistant (AUDPC 351-650). Majority (80%) of accessions were categorised as susceptible. The results corroborate with earlier evaluations of native potato genotypes for two seasons under natural epiphytotic conditions with minor difference of some accession previously found highly resistant are now resistant and vice versa (Dalamu *et al.* 2023). Late blight appears every year in epiphytotic form at hills in potato

Table 1. Potato genotypes and their late blight response under laboratory and natural epiphytotic field condition and PCN though Root ball assay during 2020 -2023

Genotypes	Late blight Reaction							PCN Reaction			
	Laboratory		Field condition (AUDPC)					Root ball assay			
	Detached leaf assay	Tuber slice assay	Natural epiphytotic condition (hot spot)					GRO/ GPA			
	2022		2021	2022	2023	Average	Disease reaction	2020	2021	2022	2023
AGR/56	R	MR	1481	1595	1712	1596	S	S/HS	S/HS	S/HS	S/HS
Aruconia	R	MR	862	1241	996	1033	S	S/ S	S/ S	S/S	S/ S
Australian White	R	MR	574	608	583	588	MR	HS/HS	HS/HS	HS/HS	S/ S
Beeta	R	R	780	810	930	840	S	HS/ S	HS/ S	HS/ S	S/ S
Bengal Jyoti	S	MR	1582	1280	1571	1478	S	HS/ S	HS/ S	HS/ S	HS/ S
Bhura Aloo/Alu	S	MR	1357	1394	1300	1350	S	HS/ S	HS/ S	S/ S	S/ S
Dehati Aloo/ Alu	S	R	775	717	765	752	S	HS/ MR	S/MR	HS/ MR	HS/MR
Desi Aloo/ Alu	HR	R	251	255	102	203	HR	HS/ S	HS/ S	HS/ S	S/ S
DRR Blue	S	R	1501	1396	1282	1393	S	HS/HS	HS/HS	HS/HS	HS/HS
Deshla Lal	S	R	1568	1469	1685	1574	S	S/ S	S/ S	HS / S	S/ S
Garlentic	R	R	1479	1469	1685	1544	S	HR/ HR	HR/ HR	HR/ HR	HR/ HR
G-4	MR	R	461	500	478	480	MR	S/ S	HS/ S	HS/ S	S/ S
Hamraj Hatti	S	R	1268	1281	1256	1268	S	S/ MR	S/MR	S/MR	S/ MR
Jeevan Jyoti	S	S	1405	1468	1309	1394	S	HR/ HR	HR/ HR	HR/ HR	HR/ HR
JG-1	R	R	244	240	268	251	R	HR/ HR	HR/ HR	HR/ HR	HR/ HR
JG-22	S	MR	1180	944	980	1035	S	S/S	HS/S	HS/S	S/S
Kanpuria Safed	HR	R	12	17	41	23	HR	HS/HS	HS/S	S/S	S/S
Kacha Bhutia	MR	R	1614	1464	1512	1530	S	S/S	S/S	S/HS	S/S
K-22	R	S	1500	1569	1545	1538	S	HS/HS	HS/HS	HS/HS	HS/ HS
KP/PC-292	R	R	1280	1281	1274	1278	S	HS/MR	S/MR	S/MR	S/MR
Lal Ankh	S	S	1303	1298	1298	1300	S	HS/HS	HS/ HS	HS/ HS	HS/ HS
Lal Mitti-1	R	R	1486	1304	1571	1454	S	HS/ HS	HS/HS	HS/ HS	HS/ HS
Lal Mitti-2	S	R	1528	1383	1476	1462	S	HS/ HS	HS/ HS	HS/ HS	HS/ HS
Lal Gulab	S	MR	1080	947	980	1002	S	HS /MR	S/MR	S/ S	S/ S
Lah Saw Smit	S	S	1521	1566	1592	1560	S	HS/ S	HS/ S	HS/ S	HS/ S
NJ-12	S	S	898	920	973	930	S	HS/ HS	HS/HS	HS/HS	HS/ HS

Genotypes	Late blight Reaction							PCN Reaction			
	Laboratory		Field condition (AUDPC)					Root ball assay			
	Detached leaf assay	Tuber slice assay	Natural epiphytotic condition (hot spot)					GRO/ GPA			
	2022		2021	2022	2023	Average	Disease reaction	2020	2021	2022	2023
NJ-47	S	S	1170	941	980	1030	S	S/MR	S / MR	S/ MR	S/ MR
NJ-62	S	R	624	608	597	610	MR	S/MR	S/MR	S/ S	S/ S
NJ-78	S	S	1413	1368	1309	1363	S	S/ S	S/ S	S/ S	S/ S
NJ-130	S	S	1138	1044	1008	1163	S	HS/ S	HS/ S	HS/ S	HS/ S
PSK-76	MR	S	1207	1255	1244	1235	S	HS/HS	HS/HS	HS/ HS	HS/ HS
Phulwa Red	S	S	1314	1344	1317	1325	S	MR/ R	MR/ R	MR/ R	MR/ R
Rangpuria	HR	R	5	7	8	7	HR	S/HS	S/HS	S/HS	S/HS
VB-8	R	S	1380	1365	1309	1351	S	S/S	S/S	S/S	S/S
V2-2912	S	S	842	901	934	892	S	HS/S	HS/S	HS/S	HS/S
Kufri Jyoti (Control)	S	S	1200	1215	1212	1209	S	HS/ HS	HS/ HS	HS/ HS	HS/ HS
Kufri Girdhari (Control)	-	-	7	11	20	13	HR	-	-	-	-
Kufri Himalini (Control)	-	-	423	398	418	413	MR	-	-	-	-
SM/11-120 (Control)	-	-	-	-	-	-	-	HR/ HR	HR/ HR	HR/ HR	HR/ HR

GRO: *G. rostochiensis*; GPA: *G. pallida*

and other solanaceous crop growing regions as well as in kharif potato season compared to lower intensity in plains. Low temperature (16-20°C) with high relative humidity (>70%) are congenial for initiation of disease infection and further spread. In detached leaf assay, three accessions, Desi aloo, Kanpuria Safed and Rangpuria were highly resistant (lesion area up to 1.0 cm^2) while none genotype in tuber slice assay. The reaction pattern of some accession was similar in both field and laboratory assays and within two lab methods while others had differential responses under varying screening methodologies.

Correlation of late blight reaction in field condition versus laboratory assays

The genotypes were grouped as resistant and susceptible based on all the three methods of late blight evaluations. The field assay of foliar blight resistance under natural epiphytotic condition had higher association with detached leaf assay (r=0.63) compared to that with tuber slice assay (r=0.48) that may be attributed to difference in plant parts used in resistance screening. Similar results are reported by Srivastava *et al.* 2015 in a group of exotic potato germplasm evaluated under field and detached leaf techniques where up to 64 percent accessions reported similar reaction. The differences may be due to variations in foliage vs tuber infection, age and maturity of tuber, storage conditions, canopy coverage, spatial and temporal variations in pathogen pressure etc. Inconsistencies in field versus laboratory method of blight screening have also been previously reported (Douches *et al.* 2002) where high levels of resistance in lab assays were not found in the field necessitating both method of screening for confirmation of resistance and laboratory assays cannot substitute evaluation under

field conditions.

PCN populations are present in mixed form in infected soil necessitating search of genotypes bearing resistance to both species. Three genotypes, Garlentic, Jeevan Jyoti and JG-1 were highly resistant (0 female/ root ball) to both white and pale cyst nematodes (**Table 1**). Only Phulwa Red was moderately resistant (6-20 female/root ball) to *G. rostochiensis* and resistant to *G. pallida*. Accessions, Dehati Aloo, Hamraj Hatti, KP/ PC-292 and NJ-47 were moderately resistant to *G. pallida* only. Majority of the genotypes (80%) were either susceptible or highly susceptible to both the PCN species. However, Sudha *et al.* 2019 reported 67% genotypes (44 out of 66) evaluated at Southern hills resistant to both the species of PCN. Such high number of resistant lines in that study is due to inclusion of mainly parental lines and advanced selections where PCN was intercepted long ago in 1960s and resistance breeding including development of parental lines was undertaken in mission mode.

Pollen viability

Pollen viability determines potential usage of genotypes as parental lines and thereby success in breeding activities. Evaluation of pollen viability revealed 20 genotypes had moderate to high pollen viability (**Table 2**). Eight genotypes showed unviable pollen or sterile pollen. Flowering was profuse in seven genotypes, medium in thirteen and fifteen genotypes had sparse flowering. DRR Blue, Deshla Lal, G-4, Kacha Bhutia and NJ-62 bear profuse flowering with high pollen viability. Meanwhile genotypes with beneficial traits i.e late blight and PCN resistance, Desi aloo, Garlentic, Jeevan Jyoti, JG-1 and Rangpuria, though had sparse to medium flowering but pollen viability is high. Sudha *et al.* 2019 described 86% lines constituting potato parental lines, wild *Solanum* species, advanced

Table 2. Morphological features and yield performance of potato genotypes

Genotypes	Source	TTY (q/ha)#	MD (days)'	Canopy	PH (cm) **	Tuber skin colour	Flesh colour	Tuber shape	Eye depth	PMD®	Flowering intensity	PV$
AGR/56	Kashmir, J&K	110.00	Early	Semi-compact	Medium	Yellow	Cream	Ovoid	Medium deep	Absent	Medium	Sterile
Aruconia	Not available	258.30	Medium	Semi-compact	Tall	Whitish cream	Cream	Round	Shallow	Absent	Sparse	Sterile
Australian White	Midnapore, WB	121.40	Medium	Semi-compact	Medium	Brown	Yellow	Ovoid	Shallow	Present	Sparse	High
Beeta	Gangtok, Sikkim	129.10	Medium	Semi-compact	Medium	Whitish cream	Cream	Round	Shallow	Absent	Profuse	Medium
Bengal Jyoti	Nalanda, Bihar	475.00	Late	Compact	Medium	Whitish cream	Yellow	Oblong	Shallow	Absent	Medium	High
Bhura Aloo	Dholi, Bihar	390.00	Medium	Compact	Medium	Red	Cream	Round	Deep	Present	Sparse	Low
DehatiAloo	Patna , Bihar	152.00	Early	Open	Medium	Whitish cream	White	Ovoid	Shallow	Absent	Medium	High
Desi Aloo	Chamba, HP	354.00	Late	Semi-compact	Medium	Yellow	Yellow	Round	Shallow	Absent	Medium	High
DRR Blue	Allahabad, UP	236.20	Late	Open	Medium	Purple	Yellow	Round	Shallow	Absent	Profuse	High
Deshla Lal	Nalanda, Bihar	254.40	Early	Semi-compact	Medium	Red	Yellow	Round	Medium deep	Absent	Profuse	High
Garlentic	Kanpur, UP	309.00	Medium	Open	Small	Whitish cream	Yellow	Round	Shallow	Present	Sparse	High

Genotypes	Source	TTY (q/ha)#	MD (days)*	Canopy	PH (cm) **	Tuber skin colour	Flesh colour	Tuber shape	Eye depth	PMD@	Flowering intensity	PV$
G-4	Farrukhabad, UP	386.80	Early	Semi-compact	Medium	Whitish cream	Cream	Oblong	Shallow	Absent	Profuse	High
Hamraj Hatti	Nalanda, Bihar	338.30	Medium	Compact	Medium	Red	Cream	Round	Medium deep	Absent	Sparse	Low
Jeevan Jyoti	Burdwan, WB	319.50	Early	Semi-compact	Medium	Red	Yellow	Round	Shallow	Present	Sparse	High
JG-1	East Khasi hills, Meghalaya	245.00	Medium	Semi-compact	Small	Whitish cream	Cream	Round	Shallow	Absent	Sparse	High
JG-22	Jammu & Kashmir	249.00	Medium	Compact	Small	Whitish cream	Cream	Ovoid	Medium deep	Absent	Medium	Low
Kanpuria Safed	Kanpur, UP	326.30	Medium	Compact	Medium	Yellow	Cream	Ovoid	Shallow	Present	Sparse	Low
Kacha Bhutia	Gangtok, Sikkim	414.30	Medium	Semi-compact	Medium	Whitish cream	White	Ovoid	Medium deep	Absent	Profuse	High
K-22	Midnapore, WB	148.00	Early	Compact	Medium	Whitish cream	White	Ovoid	Shallow	Absent	Medium	Low
KP/PC-292	Nakodar, Punjab	243.00	Early	Compact	Medium	Orange	White	Round	Shallow	Absent	Sparse	Sterile
Lal Ankh	Jorhat, Assam	305.20	Early	Semi-compact	Medium	Red	Cream	Round	Protruding	Absent	Sparse	Sterile
Lal Mitti-1	Nalanda, Bihar	243.20	Late	Semi-compact	Medium	Red	Yellow	Ovoid	Shallow	Absent	Medium	High
Lal Mitti-2	Nalanda, Bihar	263.00	Medium	Open	Medium	Red	Yellow	Ovoid	Shallow	Present	Sparse	Medium
Lal Gulab	Farrukhabad, UP	466.00	Medium	Compact	Medium	Red	Cream	Flattened	Shallow	Absent	Medium	High
Lah Saw Smit	Shillong, Meghalaya	277.30	Medium	Compact	Small	Whitish cream	Cream	Round	Medium deep	Present	Sparse	Medium
NJ-12	Kinnaur, HP	150.00	Medium	Compact	Tall	Whitish cream	Cream	Round	Medium deep	Absent	Sparse	Low
NJ-47	Kinnaur, HP	182.00	Medium	Open	Small	Whitish cream	Cream	Round	Medium deep	Absent	Sparse	Sterile
NJ-62	Chamba, HP	114.00	Medium	Compact	Medium	Whitish cream	Cream	Round	Round	Absent	Profuse	High
NJ-78	Chamba, HP	73.00	Medium	Semi-compact	Medium	Whitish cream	Yellow	Ovoid	Medium deep	Absent	Medium	Sterile
NJ-130	Kinnaur, HP	140.00	Medium	Semi-compact	Medium	Whitish cream	White	Ovoid	Round	Absent	Medium	Sterile
PSK-76	Basti, UP	243.70	Medium	Semi-compact	Medium	Whitish cream	White	Ovoid	Shallow	Absent	Medium	Low
Phulwa Red	Jorhat, Assam	294.50	Early	Semi-compact	Medium	Red	Yellow	Round	Shallow	Absent	Sparse	High
Rangpuria	Cooch Behar, WB	321.00	Late	Semi-compact	Tall	Whitish cream	Yellow	Ovoid	Medium deep	Absent	Medium	High
VB-8	Shimla, HP	320.00	Early	Semi-compact	Small	Whitish cream	White	Round	Shallow	Absent	Medium	High
V2-2912	Shimla, HP	292.00	Early	Open	Medium	Whitish cream	White	Ovoid	Medium deep	Absent	Profuse	Sterile

TTY: Total tuber yield-Average of three years (2017, 2018 & 2019); *MD:Maturity duration-Early < 80 days; Medium 80-100 days; Late >100 days; **PH:Plant height -Small <50cm; Medium 50- 70cm; Tall >70cm; @PMD:Premature bud dropping;$PV:Pollen viability-High>70%; Medium 40-70%; Low 10-40%; Sterile<10%

selections and cultivars with medium to high pollen viability. Additionally, only seven genotypes presented pre mature dropping of floral buds that is the major cause of sterility in potato.

Genotypes Desi aloo, JG-1, Kanpuria Safed and Rangpuria had consistent resistance to late blight across the seasons and method of evaluations. Garlentic, Jeevan Jyoti and JG-1 had steady resistance response to both species of *Globodera* in all the four years of evaluations. Additionally, these genotypes have high total tuber yield (average 312 q/ ha), plant maturity is early to mid to late with semi-compact canopy. Economic part, tubers are round to ovoid, tuber skin colour range from whitish cream to yellow to red and tuber flesh varied from cream to yellow with shallow eyes. High pollen fertility in majority of genotypes facilitates their usage as parental lines in breeding for combined resistance to late blight and PCN with early to medium maturation.

CONCLUSION

Late blight and PCN are the two most dreaded biotic stresses of potato. Resistance breeding requires constant attempt to stay ahead of the rapidly evolving pathogen signifying search of new resistance genes with robust phenotypic screening. Identified late blight and PCN resistant genotypes Kanpuria Safed, JG-1, Rangpuria, Desi Aloo, Garlentic and Jeevan Jyoti would augment the Indian potato resistance breeding activity.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest

ETHICAL STATEMENT

This article does not contain any studies with human participants or animals performed by any of the authors

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