

Original Research Article

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Screening of Potato Varieties against Black Scurf Caused by *Rhizoctonia solani* Kuhn

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ABSTRACT

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Black scurf also known as stem canker disease on potato is causing an economically losses to the potato crops which causes both quantitative and qualitative damage occurs in potato production areas worldwide. The pathogen limits the growth by forming cankers on sprouts, underground stems, and stolons, and makes tubers lewd by producing black scurf (sclerotia) on tuber surfaces. In the present investigation, 18 potato varieties were screened against black scurf caused by *Rhizoctonia solani*. Out of eighteen varieties, three varieties expressed immune response, seven varieties found resistant, six varieties found moderately resistant, whereas the variety Kufri Ashok and Kufri Pukhraj expressed moderately susceptible and highly susceptible reaction respectively. None of the variety showed susceptible reaction.

Introduction

Potato (*Solanum tuberosum* L) is an annual, herbaceous and dicotyledonous plant belonging to genus *Solanum* and family Solanaceae. It is a main source of starch and carbohydrates. Potato is a balanced food containing less energy but nutritional high quality of protein, essential vitamins and minerals including trace elements (Mehdi *et al.*, 2008). Potato is one of the most important crop in the world. This is next only to rice, wheat and maize. Next to cereals, potato is the only crop which could supplement the need of the food of the country (Das *et al.*, 2000). The area under potato in world during

2016-17 was about 157.67mha. China ranks first with an area of 11.53 mha in potato followed by India (2.18mha) and Russian Federation (1.89 mha). Total production of potato in the world was 3065 mt in 2016-17. China ranks first in production of potato with 198.35 mt followed by India and Russian Federation with 48.60 mt and 29.59 mt, respectively (Anon., 2017a). In India, the main potato growing states are Uttar Pradesh followed by West Bengal, Bihar, Punjab, Gujarat and Madhya Pradesh. In Madhya Pradesh, potato is covering an area over 156 thousand hectares with a production of 3134 thousand MT and productivity of 10.06 MT/ha (Anon., 2017b).

Potato is infected by many diseases of fungal, viral and bacterial in origin. Important fungal diseases are late blight (*Phytophthora infestans*), early blight (*Alternaria solani*), Phoma leaf spots (*Phoma andigena* var. *andina*), Pink rot (*Phytophthora erythroseptica*), Charcoal rot (*Macrophomina phaseolina*) and black scurf (*Rhizoctonia solani*). Black scurf caused by *Rhizoctonia solani* Kuhn (*Thanetophorus cucumeris*) is a soil born fungus disease of potato worldwide. It is distributed in India in varied proportions and is a major problem in field wherever potato is grown year after year in the same field (Frank and Leach, 1980). Black scurf of potato is a serious disease of potato worldwide including India and is responsible for 10-25% yield loss in India (Sharma, 2015), up to 30% in Canada and yield losses up to 50% in other countries, thereby affecting potato production severely (Banville, 1989; Woodhall *et al.*, 2008 and Keiser, 2008). Dependable sources of resistance to *Rhizoctonia* have not been stated, though difference in disease expression of potato cultivars/varieties have been reported which encouraged screening for varietal differences in susceptibility (Kyritsis and Wale, 2002). The most reasonable approach to control the black scurf disease of potato is the use of resistant germplasm (Rauf, 2002). Although the differences among the susceptibility levels of *R. solani* can be seen between the cultivars but there is no immune cultivar of potato against *R. solani* (Jeger *et al.*, 1996; Naz *et al.*, 2008).

Materials and Methods

Eighteen potato varieties were evaluated to find out the disease reaction against *R. solani* under artificial black scurf infested field. The experiment was laid out in Randomized block design with three replications during Rabi 2015-16 and 2016-17 at Central Potato Research institute, Maharajpura, Gwalior. The

tubers were cultivated in heavily infested field with *R. solani* that was developed by continuous growing of potato variety Kufri chandramukhi. The recommended dose of fertilizers (N: P: K-120:60:60kg/ha) was applied in the form of urea, SSP (P₂O₅) and MOP (K₂O). Half dose of nitrogenous fertilizer and full dose of phosphorus and potash were applied in furrows as basal dressing at the time of sowing. Remaining half dose of nitrogenous fertilizer was given as top dressing in two split doses, one after first irrigation and second at the time of flowering. All recommended practices were followed to raise the crop up to 95 days after which the haulms were cut. Harvest of the tubers was carried out 15 days after cutting of the haulms. Observations on black scurf were recorded on 100 tubers selected at random from each replication of the treatments. For disease severity following disease rating scale (Table-1) was used developed by Ahmad *et al.*, (1995).

Severity of black scurf on each tuber was assessed using a five-point scale developed by Ahmad *et al.*, (1995).

$$\text{Disease severity} = \frac{\text{Sum of individual rating} \times 100}{\text{No. of tubers examined} \times \text{Max disease rating}}$$

Results and Discussion

Eighteen varieties of potato were evaluated against black scurf of potato during 2015-16 and 2016-17. Data on disease severity was tabulated in Table 2, 3, 4 and 5. During 2015-16, four varieties *viz.*, Kufri Jawahar, Kufri Surya, Kufri Pushkar and Kufri Anand expressed immune response [Table 2 and 3]. Seven varieties namely KufriKhyati, KufriSinduri, KufriHimsona, KufriLalima, Kufri Kanchan, Kufri Chipsona-2 and Kufri Chipsona-3 were found to be resistant. Five varieties *viz.*, Kufri Jyoti, Kufri Frysona, Kufri Chipsona-1, KufriLavkar and Kufri

Chandrmukhi found moderately resistant, whereas Kufri Ashok and Kufri Pukhraj expressed moderately susceptible and highly susceptible reaction respectively. None of the variety showed susceptible reaction.

During 2016-17, five varieties viz., Kufri Surya, Kufri Pushkar, Kufri Anand, Kufri Sinduri and KufriHimsona expressed immune response [Table 2 and Table 4]. Seven varieties namely Kufri Jawahar, KufriLalima,

KufriKhyati, Kufri Chipsona-2, Kufri Kanchan, Kufri Frysona and Kufri Jyoti found resistant. Five varieties viz., Kufri Chipsona-1, Kufri Chipsona-3, Kufri Lavkar, Kufri Chandrmukhi and Kufri Ashok found moderately resistant. Only one variety namely Kufri Pukhraj showed highly susceptible reaction respectively. None of the variety showed moderately susceptible and susceptible reaction.

Table.1 Disease rating scale for assessment of black scurf disease of potato

S. No.	Area affected	Rating	Reaction
1	no symptoms	0	Immune
2	less than 1 %	1	Resistant
3	1-10 %	2	Moderately resistant
4	11-20 %	3	Moderate susceptible
5	21-50 %	4	Susceptible
6	above 50 %	5	Highly susceptible

Table.2 Field evaluation of potato varieties against black scurf during 2015-16 and 2016-17

Variety	2015-16		2016-17		Mean	
	Disease severity	Reaction	Disease severity	Reaction	Disease severity	Reaction
Kufri Kanchan	0.77	R	0.87	R	0.82	R
KufriFrysona	1.08	MR	0.93	R	1.01	MR
Kufri Chipsona-1	1.11	MR	1.02	MR	1.07	MR
Kufri Chipsona-2	0.87	R	0.77	R	0.82	R
KufriChipsona-3	0.96	R	1.05	MR	1.01	MR
Kufri Jyoti	1.04	MR	0.99	R	1.02	MR
KufriKhyati	0.28	R	0.52	R	0.40	R
KufriHimsona	0.59	R	0.00	I	0.30	R
KufriChandrmukhi	1.39	MR	1.69	MR	1.54	MR
Kufri Jawahar	0.00	I	0.21	R	0.11	R
KufriPukhraj (166)	4.67	HS	4.32	HS	4.50	HS
Kufri Surya	0.00	I	0.00	I	0.00	I
KufriLavkar	1.24	MR	1.08	MR	1.16	MR
KufriSinduri	0.31	R	0.00	I	0.15	R
KufriLalima	0.77	R	0.28	R	0.52	R
Kufri Pushkar	0.00	I	0.00	I	0.00	I
Kufri Anand	0.00	I	0.00	I	0.00	I
Kufri Ashok	2.17	MS	1.88	MR	2.03	MS

Table.3 Reaction of potato varieties against black scurf during 2015-16

Reaction	No. of varieties	Entries
Immune (I)	04	Kufri Jawahar, Kufri Surya, Kufri Pushkar, Kufri Anand
Resistant (R)	07	KufriKhyati, KufriSinduri, KufriHimsona, KufriLalima, Kufri Kanchan, Kufri Chipsona-2, KufriChipsona-3
Moderately resistant (MR)	05	Kufri Jyoti, KufriFrysona, Kufri Chipsona-1, KufriLavkar, KufriChandrmukhi
Moderately susceptible (MS)	01	Kufri Ashok
Susceptible (S)	00	Nil
Highly susceptible (HS)	01	KufriPukhraj

Table.4 Reaction of potato varieties against black scurf during 2016-17

Reaction	No. of varieties	Entries
Immune (I)	05	Kufri Surya, Kufri Pushkar, Kufri Anand, KufriSinduri, KufriHimsona
Resistant (R)	07	Kufri Jawahar, KufriLalima, KufriKhyati, Kufri Chipsona-2, Kufri Kanchan, KufriFrysona, Kufri Jyoti
Moderately resistant (MR)	05	Kufri Chipsona-1, KufriChipsona-3, KufriLavkar, KufriChandrmukhi, Kufri Ashok
Moderately susceptible (MS)	00	Nil
Susceptible (S)	00	Nil
Highly susceptible (HS)	01	KufriPukhraj (166)

Table.5 Reaction of potato varieties against black scurf (Average of 2015-16 and 2016-17)

Reaction	No. of varieties	Entries
Immune (I)	03	Kufri Surya, Kufri Pushkar, Kufri Anand
Resistant (R)	07	Kufri Jawahar, KufriSinduri, KufriHimsona, KufriKhyati, KufriLalima, Kufri Chipsona-2, Kufri Kanchan
Moderately resistant (MR)	06	KufriFrysona, KufriChipsona-3, Kufri Jyoti, Kufri Chipsona-1, KufriLavkar, KufriChandrmukhi
Moderately susceptible (MS)	01	Kufri Ashok
Susceptible (S)	00	Nil
Highly susceptible (HS)	01	KufriPukhraj (166)

Average of two years data was taken for all the varieties and according to disease severity the varieties were classified in six groups *viz.*, immune, resistant, moderately resistant, moderately susceptible, susceptible and highly susceptible. Out of eighteen varieties, three varieties *viz.*, Kufri Surya, Kufri Pushkar and Kufri Anand expressed immune response [Table 2, Table 5]. Seven varieties namely Kufri Jawahar, Kufri Sinduri, Kufri Himsona, Kufri Khyati, Kufri Lalima, Kufri Chipsona-2 and Kufri Kanchan found resistant. Six varieties *viz.*, Kufri Frysona, Kufri Chipsona-3, Kufri Jyoti, Kufri Chipsona-1, Kufri Lavkar and Kufri Chandrmukhi found moderately resistant. Kufri Ashok and Kufri Pukhraj expressed moderately susceptible and highly susceptible reaction respectively. None of the variety showed susceptible reaction.

In present investigation, screening for black scurf reaction of potato cultivars was done in 2015-16 and 2016-17. The screening of potato cultivars under natural condition in heavily black scurf infested field for two continuous years indicated that out of eighteen cultivars, three cultivar *viz.*, Kufri Surya, Kufri Pushkar and Kufri Anand were found absolutely free from black scurf incidence. Seven, six, one and one varieties expressed resistant, moderately resistant, moderately susceptible and highly susceptible reaction respectively. None of the variety showed susceptible reaction. Similarly Asenov (1986) evaluated fifty seven varieties and lines of potato against *R. solani* under field and green house conditions and found that only four varieties were highly resistant.

Mikheeva (1988) evaluated some potato varieties for field resistance to *R. solani* and found that the Norland variety showed highly susceptible reaction at a high inoculum concentration but Erfolg variety showed almost immune reaction. Similarly

Pietkiewicz and Pietkiewicz (1983) screened 44 varieties of potato and found that seven varieties were resistant to *R. solani* and three varieties *viz.*, Reda, Poprad and Odra were highly resistant.

Jeger *et al.*, (1996) and Mohsan *et al.*, (2016) concluded that there is no immune variety against black scurf disease. According to Rauf *et al.*, (2007), Atiq *et al.*, (2013) and Naz *et al.*, (2008) Cardinal variety showed resistant reaction, while Desiree was highly susceptible against black scurf.

Khandaker *et al.* (2011) reported that the varieties *viz.*, FD 74-28, FD 74-51, SL 1-4 showed high disease incidence. Only six germplasms appeared to be moderately resistant.

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