



Varietal screening against black scurf of potato and its management by fungicide

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Summary

One of the most important diseases affecting soil and tuber crops, especially within the fungal category, is black scurf of potatoes, caused by *Rhizoctonia solani*. The primary source of infection is seed tubers that are infected. Indian farmers commonly used boric acid to control potato black scurf. In two consecutive years (2022–24), the bio-efficacy of novel compounds against the potato black scurf disease was assessed. Compared to the untreated tuber, all of the new generation fungicides dramatically reduced disease. The results showed that tuber treatment with Thifluzamid 24.0 SC @ 0.35 per cent had the lowest percentage of disease incidence and intensity (8.0 and 5.0). This was comparable to tuber treatment with Penflufen 22.43 per cent FS @ 0.1 per cent (8.3 & 6.7) and tuber treatment with Pencycuron 22.9 SC @ 0.35 per cent (9.9 & 6.8). and produced the maximum B: C ratio (2.41) and the highest tuber yield (25.6 t/ha). Twenty two varieties of potato were evaluated against black scurf of potato and revealed that Kufri Ganga, Kufri Mohan, Kufri Pushkar, Kufri Kiran, Kufri Thar 2, Kufri Thar 3 and Kufri Surya were found as resistant, However Kufri Sukhyati, Kufri Lima, Kufri Neelkanth, Kufri Jamunia, Kufri Badshah, Kufri Sindhuri, Kufri Thar 1, Kufri Chipsona-1, Kufri Chipsona-2 and Kufri Chipsona-3 were as moderate resistant while, Kufri Pukhraj and Kufri Bahar as susceptible but none was found highly susceptible.

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Introduction

The fungus *Rhizoctonia Solani* Kuhn (teleomorph *Thanatephorus cucumeris* [A.] is the cause of black scurf on potatoes. B. Frank] Donk) is a severe potato disease that affects both India and other countries. In India, it reduces potato yield by 10–25%, depending on the growing region hills and plain (Sharma, 2015), but in Canada, yield loss of up to 30% has been documented (Banville, 1989; Woodhall et al. 2008), in addition to lowering market acceptability among consumers because of the black sclerotial that is present on the tubers' surface. The hallmark signs of black scurf include. The *Rhizoctonia* disease complex in potatoes causes dark brown to black hard masses of sclerotia that are superficially irregularly shaped and range in size from tiny, flat on tubers with tightly adhered stem canker (Tsrar, 2010; Jatav et al. 2016). Additionally, the *R. solani* may attack and kill newly sprouting plants in the soil, reducing crop stand and increasing yield loss (Lakra, 1992). A significant disease issue in fields where potatoes are grown year after year in the same spot, black scurf is found throughout India in various regions at varying degrees of severity (Khurana et al. 1998; Arora 2012; Mehietal. 2017; Yadav & Sharma 2023;

Meena et al. 2023).

Although biological and cultural control methods are employed, they are not totally successful, and black scurf disease continues to be a persistent issue. The Central Potato Research Institute in Shimla has advised treating seeds with 3% boric acid as a dip treatment before cold storage. According to several researchers, *R. solani* can be successfully controlled by applying chemical seed dressing (Rauf et al. 2007; Meena & Yadav 2022).

Material and Methods

During the 2022–2023 and 2023–2024 crop seasons, the field experiment was carried out at the Agricultural Research Station, Ummedganj-Kota, Agriculture University, Kota (23° 45' and 26° 33' North latitudes and 75° 27' and 77° 26' East longitudes at 273 m altitude from mean sea level). 100% diseased and infested cv seed tubers. In this experiment, Kufri Bahar tubers were used. At the time of planting, the bioefficacy of tuber treatment with Pencycuron 22.9 SC @ 0.35 per cent, Penflufen 22.43 per cent FS @ 0.1 per cent, Thifluzamid 24.0 SC @ 0.35 per cent, and Mancozeb 50 per cent + carbendazim 25 per cent WS @ 0.5 per cent against potato black scurf was assessed. Before being planted, the tubers were shade-dried following treatment. As a standard control, the untreated tubers were retained. Every year, during the first week of November, the experiments were planted. The treated seed tubers were planted in plot sizes of 2.4 x 3.6 meters, with a spacing of 60 (row-row) x 20 cm (plant plant). Randomized Block

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Design (RBD) was used to plant each treatment, which was repeated three times. The crop was grown in accordance with local agronomic standards. Crops were harvested two weeks after dehulling, and haulms were cut more than 100 days after planting. To record the incidence and severity of the disease, 225 tubers (75 tubers per replication) were randomly selected from each treatment at harvest. A 0–4 rating system was used to determine the severity of the disease: 0 indicated no disease, 1 indicated 1–25 per cent surface area covered, 2 indicated 26–50 per cent surface area covered, 3 indicated 51–75 per cent surface area covered, and 4 indicated >75 per cent surface area covered. At harvest, the following metrics were measured: tuber yield (t/ha), disease incidence, disease severity, and percentage disease control. The Somani (1986) method was used to calculate the disease index. IRRISTAT software (version 4.4) was used to analyse the experimental data.

Screening of potato varieties against black scurf disease

Twenty-two varieties of potato were evaluated against black scurf of potato and observations on black scurf were recorded on 100 tubers selected at random from each replication of the varieties. Severity of black scurf on each tuber was assessed using a five-point scale developed by Ahmad et al., (1995).

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

Result and Discussion

Disease management

The effectiveness of four fungicides against *R. solani*, which causes potato black scurf, was assessed. Thifluzamid 24.0 SC @ 0.35 per cent was found to have the same minimum percentage of disease incidence (8.0) as tuber treatment with Penflufen 22.43 per cent FS @ 0.1 per cent (8.3) and tuber treatment with Pencycuron 22.9 SC @ 0.35 per cent (9.9), according to the data shown in Table 1. The tuber treatment Thifluzamid 24.0 SC @ 0.35 per cent produced the highest tuber yield of potatoes (25.6 t/ha), which was comparable to tuber treatments with Penflufen 22.43 per cent FS @ 0.1 per cent (24.9 t/ha) and Pencycuron 22.9 SC @ 0.35 per cent (23.7 t/ha) (Table 2). Table 3

Table 1. Evaluation of fungicides against Black scurf disease

Treatments	Per cent disease incidence		Pooled
	2022-23	2023-24	
T ₁ : Untreated diseased tubers (Control)	45.50	22.75	34.1
T ₂ : Tuber treatment with Pencycuron 22.9 SC @ 0.35%	7.50	12.25	9.9

shows that the tuber treatment Thifluzamid 24.0 SC @ 0.35 per cent had the highest benefit-cost ratio (2.41). The current findings concur with the Mahi et al. findings. Thifluzamide 24 per cent SC @ 3.0 ml/10 kg seed was found to be highly effective in reducing disease incidence (95.69 per cent during 2014-15 and 96.50 per cent during 2015-16) and disease severity (97.39 per cent during 2014-15 and 97.43 per cent during 2015-16) while producing a higher yield (42.93 t/ha). Carboxin 37.5 + Thiram 37.5 WS @ 25 g/10kg tubers were the next most effective. Rauf and associates. found that pencycuron was useful in treating potato black scurf disease, reducing the incidence of black scurf, stem girdling, sprout

killing, and stem canker. The current findings concur with Khanna et al. (1991) findings that carbendazim was a very good treatment for potato black scurf. Kumar et al. (2012) found that thifluzamide 24 per cent SC was effective against rice sheath blight as a preventive and curative measure without exhibiting any signs of phytotoxicity. In summary, the findings showed that the slurry method of Thifluzamide 24 per cent SC @ 0.35 per cent was effective against potato black scurf disease.

Screening of potato varieties against black scurf disease

Twenty two varieties of potato were evaluated against black scurf of potato in field conditions and result revealed that Kufri Ganga, Kufri Mohan, Kufri Pushkar, Kufri Kiran, Kufri Thar 2, Kufri Thar 3 and Kufri Surya were found as resistant, However Kufri Sukhyati, Kufri Lima, Kufri Neelkanth, Kufri Jamunia, Kufri Badshah, Kufri Sindhuri, Kufri Thar 1, Kufri Chipsona-1, Kufri Chipsona-2 and Kufri Chipsona-3 were as moderate resistant while, Kufri Pukhraj and Kufri Bahar as susceptible but none was found highly susceptible (Table 4). The present findings are in agreement with the results of Pietkiewicz and Pietkiewicz (1983), who 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. 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. Singh et al. (2021) screened eighteen varieties; out of them, three varieties expressed an immune response, seven varieties were found resistant, six varieties were found moderately resistant, whereas the varieties Kufri Ashok and Kufri Pukhraj expressed moderately susceptible and highly susceptible reaction respectively. None of the varieties showed a susceptible reaction.

T ₃ : Tuber treatment with Penflufen 22.43% FS @ 0.1%	7.25	9.25	8.3
T ₄ : Tuber treatment with Thifluzamid 24.0 SC @ 0.35%	7.00	9.00	8.0
T ₅ : Tuber treatment with Mancozeb 50%+carbendazim 25% WS @ 0.5%	9.50	12.00	10.8
S. Em. $\pm$	0.74	0.70	0.55
C.D.	2.33	2.17	1.60

Table 2. Evaluation of fungicides on tuber yield of potato

Treatments	Tuber yield (t/ha)		Pooled
	2022-23	2023-24	
T ₁ : Untreated diseased tubers (Control)	14.31	25.02	19.7
T ₂ : Tuber treatment with Pencycuron 22.9 SC @ 0.35%	17.55	29.94	23.7
T ₃ : Tuber treatment with Penflufen 22.43% FS @ 0.1%	18.31	31.53	24.9
T ₄ : Tuber treatment with Thifluzamid 24.0 SC @ 0.35%	19.38	31.82	25.6
T ₅ : Tuber treatment with Mancozeb 50%+carbendazim 25% WS @ 0.5%	17.50	28.15	22.8
S. Em. $\pm$	0.41	1.49	0.73
C.D.	1.27	4.64	2.14

Table 3. Economics of treatment for the management of Black scurf disease of potato

Treatment details	Cost of fungicides for treatment	Cost of Cultivation (Rs/ha)	Potato yield (t/ha)	Income (Rs./ha)	Net return (Rs/ha)	B:C ratio
T ₁ : Untreated diseased tubers (Control)	-	105000	19.7	197000	92000	1.88
T ₂ : Tuber treatment with Pencycuron 22.9 SC @ 0.35%	550	105550	23.7	237000	131450	2.25
T ₃ : Tuber treatment with Penflufen 22.43% FS @ 0.1%	1225	106225	24.9	249000	142775	2.34
T ₄ : Tuber treatment with Thifluzamid 24.0 SC @ 0.35%	1150	106150	25.6	256000	149850	2.41
T ₅ : Tuber treatment with Mancozeb 50% + carbendazim 25% WS @ 0.5%	1065	106065	22.8	228000	121935	2.15

Table 4. Field evaluation of potato varieties against black scurf

S. No.	Varieties	Disease severity	Reaction
1	Kufri Sukhyati	1.15	MR
2	Kufri Ganga	0.83	R
3	Kufri Pukhraj	3.23	S
4	Kufri Bahar	3.07	S
5	Kufri Mohan	0.63	R
6	Kufri Lima	1.08	MR
7	Kufri Neelkanth	1.80	MR
8	Kufri Jamunia	1.83	MR
9	Kufri Pushkar	0.65	R
10	Kufri Khyati	2.09	MS
11	Kufri Jyoti	2.12	MS
12	Kufri Badshah	1.47	MR
13	Kufri Sindhuri	1.15	MR
14	Kufri Kiran	0.87	R
15	Kufri Thar 1	1.33	MR
16	Kufri Thar 2	0.65	R
17	Kufri Thar 3	0.57	R

18	Kufri Surya	0.60	R
19	Kufri Chipsona-1	1.32	MR
20	Kufri Chipsona-2	1.35	MR
21	Kufri Chipsona-3	1.23	MR
22	Kufri Frysona	1.43	MR
S. Em. $\pm$		0.13	-
C.D.		0.36	-

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Conflict of interests

The authors declare no conflict of interest among them.

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