Original Research Article

Effect of Soil-borne and Tuber-borne Inoculum Density of *Rhizoctonia solani* Kühn on Black Scurf Development and Tuber Yield of Potato

Abstract

Black scurf of potato caused by *Rhizoctonia solani* Kühn is an important soil-borne disease that reduces tuber yield and quality. The present study was conducted to evaluate the influence of soil-borne and tuber-borne inoculum density of *R. solani* on black scurf development in potato. The experiment was carried out under pot conditions during two consecutive years. For soil-borne inoculum, five potato cultivars viz., Kufri Ashoka, Kufri Chandramukhi, Kufri Pukhraj, Kufri Jyoti and Kufri Sinduri were tested with three inoculum levels (6 g, 12 g and 18 g) along with control. For tuber-borne inoculum, six inoculum levels (0%, 5%, 10%, 20%, 40% and 80%) were evaluated using Kufri Jyoti. Results revealed that disease incidence and severity increased significantly with increasing inoculum density in both soil-borne and tuber-borne inoculum experiments. Among cultivars, Kufri Pukhraj recorded maximum disease incidence and severity, whereas Kufri Sinduri showed comparatively lower disease development. Maximum disease incidence and severity were observed at 18 g soil inoculum and 80% tuber inoculum levels. The findings indicated that higher inoculum density enhanced disease development and varietal differences in susceptibility were evident. The study highlights the importance of reducing inoculum load and using tolerant cultivars for effective management of black scurf disease in potato.

Keywords: Potato, *Rhizoctonia solani*, Black scurf, Inoculum density, Disease severity

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1. INTRODUCTION

Potato (*Solanum tuberosum* L.) is one of the most important food crops worldwide and ranks fourth after wheat, rice, and maize in terms of global production. It plays a significant role in ensuring food security, nutritional supply, and income generation for farmers. However, potato productivity is constrained by several biotic stresses, among which black scurf disease caused by *Rhizoctonia solani* Kühn is considered one of the most destructive soil-borne diseases affecting potato cultivation worldwide (Tsror, 2010; Lan et al., 2024; Yang et al., 2024).

A necrotrophic soil-borne pathogen, *R. solani* causes stem canker and black scurf disease in potato, leading to poor emergence, reduced plant vigour, delayed plant growth, and yield losses. The disease is characterized by black sclerotia formation on tuber surfaces, which reduces tuber quality and marketability. The pathogen survives in soil and infected seed tubers in the form of sclerotia, which act as primary inoculum sources for subsequent cropping seasons (Banville, 1989; Lehtonen et al., 2008; Yang et al., 2024).

Both soil-borne and tuber-borne inoculum play important roles in disease development. Soil-borne inoculum infects emerging sprouts and stolon, while infected seed tubers serve as primary inoculum sources initiating early infection. The severity of black scurf disease is influenced by inoculum density, host susceptibility, environmental conditions, and agronomic practices (Wharton et al., 2007; Tsror, 2010; Abo-Akel et al., 2024; Chauhan & Nibhoria, 2025). Inoculum density is considered one of the most critical factors influencing disease development. Higher inoculum density increases pathogen pressure and enhances infection frequency, resulting in increased disease severity and yield losses. Several studies have reported that increasing inoculum density of *R. solani* significantly increases stem canker incidence, stolon infection, and black scurf severity in potato (Naz et al., 2008; Yang et al., 2024).

Seed-borne inoculum plays a particularly important role in disease initiation due to the close proximity of pathogen inoculum to developing sprouts and stolon. Infected seed tubers act as primary inoculum sources and facilitate early infection and disease establishment. Recent studies have emphasized that tuber-borne inoculum significantly contributes to disease development and spread of black scurf in potato (Wharton et al., 2007; Yang et al., 2024; Abo-Akel et al., 2024). Varietal differences in susceptibility to *R. solani* have also been reported in several studies. Some cultivars exhibit tolerance to black scurf disease, while others show high susceptibility depending on genetic background and environmental conditions (Lehtonen et al., 2008; Abo-Akel et al., 2024; Rafiq et al., 2024). Therefore, evaluation of potato cultivars against varying inoculum densities is essential for developing effective disease management strategies.

Although several studies have reported the role of soil-borne and seed-borne inoculum in disease development, limited information is available regarding the comparative influence of soil-borne and tuber-borne inoculum densities under controlled conditions. Therefore, the present investigation was undertaken to evaluate the effect of soil-borne and tuber-borne inoculum density of *R. solani* on black scurf disease development and tuber yield in potato.

2. MATERIALS AND METHODS

2.1 Isolation of *Rhizoctonia solani* from Infected Potato Tubers

Infected potato tubers showing black scurf symptoms were collected from different sources such as local markets, farmers' fields, and institutional farms. Sclerotia were separated from infected tubers and washed thoroughly under running tap water. Surface sterilization of sclerotia was carried out using 0.1% mercuric chloride solution for 20–30 seconds to eliminate surface contaminants. The sterilized sclerotia were rinsed three times with sterile distilled water to remove traces of mercuric chloride and then dried on sterile blotting paper. The sterilized sclerotia were aseptically transferred onto Potato Dextrose Agar

(PDA) medium previously sterilized in an autoclave at 121.6°C and 15 psi pressure for 20 minutes. The inoculated plates were incubated at 27 ± 2°C for 7 days in a BOD incubator. Plates were observed regularly for the appearance of mycelial growth of the pathogen.

2.2 Purification and Identification of the Pathogen

Purification of the isolated fungus was carried out by transferring hyphal tips from freshly grown cultures onto fresh PDA medium following the method described by Dhingra and Sinclair (1985). The pure cultures were maintained on PDA slants and subcultured at 15-day intervals to maintain viability. The cultures were stored at 4–5°C for further use (Kohn, 1992). The isolated pathogen was mass multiplied and inoculated into sterilized pot soil one month prior to planting of potato tubers. After the development of disease symptoms, infected plant parts such as stems and stolons were collected and re-isolated. The pathogen was identified based on cultural and morphological characteristics. Microscopic observations were made using temporary slides stained with cotton blue in lactophenol. The fungus was identified as *R. solani* based on morphological characteristics described by Parmeter (1970), Sneh et al. (1991), Bhuiyan (1994), and Tredway and Burpee (2001).

2.3 Mass Multiplication of Inoculum

The test pathogen was mass multiplied on sorghum grains following the method of Gupta and Kolte (1982). Sorghum grains were pre-soaked overnight in 5% sucrose solution and excess water was drained. The soaked grains were transferred into heat-resistant plastic bags at 100 g per bag and sterilized in an autoclave at 121.6°C and 15 psi for 20 minutes. After cooling, the sterilized grains were inoculated aseptically with 5 mm discs from 4-day-old culture of *R. solani* grown on PDA. Five discs were added to each bag, and the bags were incubated at 27 ± 2°C for three weeks. The bags were shaken at 24-hour intervals to ensure uniform colonization.

2.4 Influence of Inoculum Density of *R. solani* under Pot Conditions

2.4.1 Experimental design

Pot experiments were conducted to evaluate the influence of soil-borne and tuber-borne inoculum density of *R. solani* on black scurf development in potato. The soil-borne inoculum experiment was conducted during 2017–18 and 2018–19, whereas the tuber-borne inoculum experiment was conducted during 2018–19 and 2019–20. For the soil-borne inoculum experiment, a factorial Completely Randomized Design (CRD) with four replications was used. The experiment included five potato varieties (Kufri Ashoka, Kufri Jyoti, Kufri Sinduri, Kufri Pukhraj and Kufri Chandramukhi) and three inoculum levels (6 g, 12 g and 18 g per pot). For the tuber-borne inoculum experiment, a Completely Randomized Design with four replications was followed using the potato variety Kufri Jyoti.

2.4.2 Evaluation of soil-borne inoculum

Three levels of inoculum (6 g, 12 g and 18 g) and five potato varieties (Kufri Ashoka, Kufri Jyoti, Kufri Sinduri, Kufri Pukhraj and Kufri Chandramukhi), commonly cultivated in West Bengal, were used to determine the appropriate inoculum density and susceptibility of varieties against black scurf disease. Mass-multiplied inoculum of *R. solani* was mixed thoroughly with sterilized pot soil 30 days before planting. Pots without inoculum served as control. Water was applied 2–3 times per week to facilitate pathogen establishment. Standard agronomic practices were followed during the experiment. Observations on black scurf disease incidence and severity were recorded 110 days after planting. Disease severity was assessed using a five-point scale developed by Tsror and Alon, (2005) **(Table 1)**.

Table 1. Disease rating scale for assessment of stem canker (*Rhizoctonia solani*) disease severity of potato (Tsror and Alon, 2005)

S. No.	Area affected	Rating
1.	Healthy tissue	0
2.	Several brown to black lesions	1
3.	< 20% of the tissue covered with lesions	2
4.	Up to 15% of the tissue covered with lesions	3
5.	Up to 30% of the tissue covered with lesions	4
6	Up to 60% of the tissue covered with lesions	5

2.4.3 Evaluation of tuber-borne inoculum

A pot experiment was conducted for two consecutive years to assess the effect of tuber-borne inoculum on black scurf development. Healthy and black scurf-infected seed tubers of Kufri Jyoti were used. Six levels of tuber-borne inoculum (0%, 5%, 10%, 20%, 40% and 80%) were maintained. The soil used in pots was sterilized prior to planting. The experiment was conducted in Completely Randomized Design with four replications. Observations on black scurf disease incidence and severity were recorded 90 days after planting using following formulae.

$$\text{Disease severity (\%)} = \frac{\text{Sum of the disease rating}}{\text{Total no. of rating} \times \text{Maximum disease grade}} \times 100$$

$$\text{Disease Incidence (\%)} = \frac{\text{No. of Plant with Stem canker or black scurf symptoms}}{\text{Total no of plants or tubers}} \times 100$$

2.5 Statistical Analysis

The tuber-borne inoculum experiment was conducted in a Completely Randomized Design with four replications, and the recorded data were analysed using one-way analysis of variance (ANOVA). The soil-borne inoculum experiment was conducted in a factorial Completely Randomized Design with four replications involving two factors, namely potato varieties and inoculum levels. Data from this experiment were analysed using two-way ANOVA to determine the effects of variety, inoculum level, and their interaction. Treatment means were compared at $P \leq 0.05$ level of significance.

3. RESULTS AND DISCUSSION

3.1 Isolation, Purification and Identification of *Rhizoctonia solani*

The pathogen was successfully isolated from infected potato tubers showing black scurf symptoms. The isolated fungus produced white to light brown mycelial growth on PDA medium, which later turned dark brown with the formation of sclerotia. The mycelium showed typical right-angle branching with constriction at the point of branching and septum near the branching point, which are characteristic features of *Rhizoctonia solani* **(Fig. 1)**. The purified culture was maintained on PDA slants and used for further studies. The pathogen was identified as *R. solani* based on cultural and morphological characteristics as described by Parmeter (1970) and Sneh et al. (1991).

Fig. 1. Cultural and morphological confirmation of *Rhizoctonia solani*

3.2 Mass Multiplication of *Rhizoctonia solani*

The isolated pathogen was successfully mass multiplied on sorghum grains. The inoculated grains showed uniform colonization with profuse mycelial growth within three weeks of incubation at 27 ± 2°C.

Pure culture of *Rhizoctonia solani*

Mycelium of *Rhizoctonia solani* under compound microscope

Initially, white mycelial growth developed on the grains, which later turned light to dark brown with the formation of sclerotia. The colonized grains were uniformly covered with fungal growth and served as a suitable inoculum source for further pot experiments. The mass-multiplied inoculum was subsequently used for soil infestation studies to evaluate the effect of inoculum density on black scurf disease development in potato.

3.3 Influence of Soil-borne Inoculum Density of *R. solani* on Potato Black Scurf Development

A pot experiment was conducted during two consecutive years (2017–18 and 2018–19) using five potato cultivars viz., Kufri Ashoka, Kufri Chandramukhi, Kufri Pukhraj, Kufri Jyoti and Kufri Sinduri with four inoculum levels (0 g, 6 g, 12 g and 18 g) to evaluate the influence of soil-borne inoculum density of *R. solani* on black scurf disease development. The pooled data of two years are presented in **Table 2.** The results revealed that black scurf disease incidence and severity increased significantly with increasing inoculum density from 0 g to 18 g in all tested cultivars. No disease was observed in un-inoculated control treatments, indicating that disease development was directly associated with the presence of pathogen inoculum.

Table 2. Influence of soil born inoculum level of *R. solani* on potato black scurf disease development during 2017-18 and 2018-19 through pooled (comparative study).

Variety	Percentage Disease incidence				Percentage disease severity			
	* Inoculum level (gm)				# Inoculum level (gm)			
	0 gm	6 gm	12 gm	18 gm	0 gm	6 gm	12 gm	18 gm
Kufri Ashoka	0.00 (0.00)	20.42 (21.04)	34.54 (35.47)	42.48 (43.64)	0.00 (0.00)	6.07 (11.67)	10.81 (20.77)	16.52 (31.75)
Kufri Chandramukhi	0.00 (0.00)	30.36 (31.16)	44.68 (45.88)	55.47 (56.96)	0.00 (0.00)	9.17 (17.63)	16.27 (31.28)	24.42 (46.94)
Kufri Jyoti	0.00 (0.00)	27.69 (28.44)	41.51 (42.63)	51.17 (52.62)	0.00 (0.00)	7.27 (13.97)	13.74 (26.41)	20.58 (39.56)
Kufri Pukhraj	0.00 (0.00)	36.10 (37.05)	48.40 (49.71)	61.13 (62.85)	0.00 (0.00)	12.59 (24.19)	19.72 (37.90)	27.37 (52.60)
Kufri Sinduri	0.00 (0.00)	7.62 (7.80)	14.50 (14.86)	19.45 (20.03)	0.00 (0.00)	2.01 (3.86)	5.16 (9.91)	9.66 (18.57)
S. Em±	0.58				0.58			
CV%	3.64				5.17			

*Figures in parentheses are the arcsine √percentage transformed values
Figures in parentheses are the square root transformed values

Among the cultivars, Kufri Pukhraj recorded the maximum disease incidence and severity at all inoculum levels (36.10% and 12.59% at 6 g; 48.40% and 19.72% at 12 g; and 61.13% and 27.37% at 18 g), followed by Kufri Chandramukhi, Kufri Jyoti, Kufri Ashoka and Kufri Sinduri **(Table 2)**. The lowest disease incidence and severity were observed in Kufri Sinduri at all inoculum levels, indicating comparatively higher tolerance to black scurf disease **(Fig 2)**. During 2017–18, similar trends were observed at 6 g inoculum level, the highest disease incidence and severity were recorded in Kufri Pukhraj, followed by Kufri

Chandramukhi, Kufri Jyoti and Kufri Ashoka, while the minimum disease incidence and severity were observed in Kufri Sinduri **(Table 3)**. At 12 g and 18 g inoculum levels, disease incidence and severity further increased in all cultivars **(Fig 2).**

During 2018–19, disease incidence and severity also increased proportionally with increasing inoculum density **(Table 4)**. Kufri Pukhraj again recorded the highest disease incidence and severity, whereas Kufri Sinduri showed minimum disease development **(Fig 2)**. The increase in disease incidence and severity with increasing inoculum density may be attributed to increased pathogen propagule pressure in soil, resulting in enhanced infection of sprouts, stolon and developing tubers. Higher inoculum density increases the probability of pathogen contact with host tissues, thereby promoting disease development.

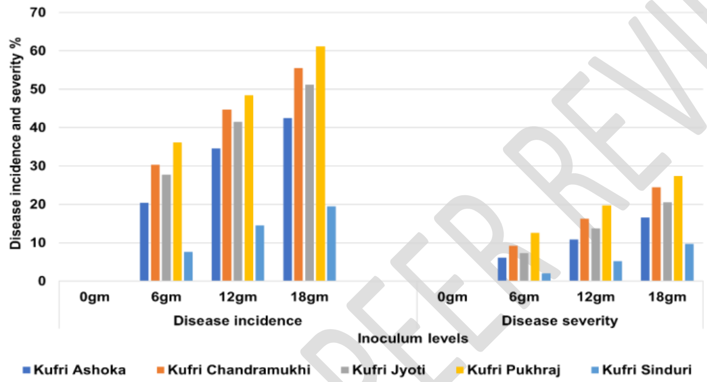

Fig. 2. Influence of soil born inoculum level of *Rhizoctonia solani* on potato black scurf disease development (Average 2017-18 and 2018-19)

Table 3. Influence of soil born inoculum level of *R. solani* on potato black scurf disease development during 2017-18.

Variety	Percentage disease incidence (%)				Percentage disease severity (%)			
	* Inoculum level (gm)				# Inoculum level (gm)			
	0 gm	6 gm	12 gm	18 gm	0 gm	6 gm	12 gm	18 gm
Kufri Ashoka	0.00 (0.00)	20.80 (27.10)	34.34 (35.9)	42.26 (40.50)	0.00 (0.71)	6.44 (2.63)	10.58 (3.32)	16.19 (4.08)
Kufri Chandramukhi	0.00 (0.00)	30.06 (33.20)	44.33 (41.70)	55.10 (47.90)	0.00 (0.71)	9.57 (3.17)	16.60 (4.13)	24.71 (5.02)
Kufri Jyoti	0.00 (0.00)	27.55 (31.60)	41.29 (40.00)	51.41 (45.80)	0.00 (0.71)	7.54 (2.83)	13.40 (3.73)	20.32 (4.56)
Kufri Pukhraj	0.00 (0.00)	35.72 (36.70)	48.09 (43.90)	61.30 (51.50)	0.00 (0.71)	12.44 (3.60)	19.49 (4.47)	27.08 (5.25)

Kufri Sinduri	0.00 (0.00)	7.43 (15.80)	14.22 (22.10)	19.78 (26.40)	0.00 (0.71)	1.89 (1.54)	5.49 (2.43)	9.47 (3.15)
	Inoculum level (A)	Variety (B)	Inoculum level x Variety (A x B)		Inoculum level (A)	Variety (B)	Inoculum level x Variety (A x B)	
S.Em±	0.26	0.29	0.58		0.03	0.04	0.08	
CD	0.74	0.83	1.67		0.10	0.11	0.22	
CV%	3.73				4.70			

*Figures in parentheses are the arcsine √percentage transformed values
Figures in parentheses are the square root transformed values

Table 4. Influence of soil born inoculum level of *R. solani* on potato black scurf disease development during 2018-19.

Variety	Percentage disease incidence				Percentage disease severity			
	*Inoculum level (gm)				#Inoculum level (gm)			
	0 gm	**6 gm**	**12 gm**	**18 gm**	**0 gm**	**6 gm**	**12 gm**	**18 gm**
Kufri Ashoka	0.00 (0.00)	20.04 (26.56)	34.74 (36.11)	42.70 (40.80)	0.00 (0.71)	5.71 (2.49)	11.03 (3.39)	16.85 (4.16)
Kufri Chandramukhi	0.00 (0.00)	30.65 (33.61)	45.03 (42.14)	55.83 (48.35)	0.00 (0.71)	8.77 (3.04)	15.95 (4.05)	24.12 (4.96)
Kufri Jyoti	0.00 (0.00)	27.83 (31.81)	41.72 (40.23)	50.92 (45.53)	0.00 (0.71)	7.00 (2.73)	14.08 (3.82)	20.85 (4.62)
Kufri Pukhraj	0.00 (0.00)	36.48 (37.15)	48.70 (44.26)	60.96 (51.33)	0.00 (0.71)	12.74 (3.64)	19.95 (4.52)	27.66 (5.31)
Kufri Sinduri	0.00 (0.00)	7.80 (16.14)	14.77 (22.57)	19.12 (25.91)	0.00 (0.71)	2.13 (1.61)	4.82 (2.30)	9.86 (3.22)
	Inoculum level (A)	Variety (B)	Inoculum level x Variety (A x B)		Inoculum level (A)	Variety (B)	Inoculum level x Variety (A x B)	
S.Em±	0.34	0.38	0.75		0.04	0.04	0.08	
CD	0.96	1.07	2.15		0.10	0.11	0.23	
CV%	4.79				4.81			

*Figures in parentheses are the arcsine √percentage transformed values
Figures in parentheses are the square root transformed values

The variation in susceptibility among potato cultivars may be attributed to genetic differences in host resistance. Kufri Pukhraj was found to be highly susceptible, whereas Kufri Sinduri showed comparatively lower disease development, indicating tolerance against *R. solani*. These findings are in agreement with Naz et al. (2008), who reported that increasing inoculum density of *R. solani* significantly increased stem canker incidence, stolon infection and black scurf severity in potato. Similarly, Banville (1989) also reported that increased soil inoculum density resulted in greater disease severity and reduced plant vigour. The results of the present investigation clearly indicate that soil-borne inoculum plays an important role in black scurf disease development in potato.

3.4 Influence of Tuber-borne Inoculum Density of *R. solani* on Potato Black Scurf Development

A pot experiment was conducted during two consecutive years (2017–18 and 2018–19) to evaluate the influence of tuber-borne inoculum density on black scurf disease development in potato. Six levels of tuber-borne inoculum (0%, 5%, 10%, 20%, 40% and 80%) were tested. The pooled data are presented in **Table 5.** The results indicated that disease incidence and severity increased significantly with increasing tuber-borne inoculum density. No disease symptoms were observed in healthy seed tubers, indicating that infected seed tubers served as the primary source of inoculum.

Table 5. Influence of tuber born inoculum levels of *R. solani* on potato black scurf disease development through pooled (comparative study)

Tuber-born Inoculum (%)	*Disease incidence (%)			#Disease severity (%)		
	2017-18	2018-19	Pooled Mean	2017-18	2018-19	Pooled Mean
0	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.71)	0.00 (0.71)	0.00 (0.00)
5	10.03 (18.44)	10.92 (19.27)	10.48 (7.30)	1.71 (1.48)	1.61 (1.44)	1.66 (2.39)
10	16.76 (24.16)	16.28 (23.78)	16.52 (11.38)	5.52 (2.45)	5.24 (2.39)	5.38 (7.74)
20	28.61 (32.32)	28.02 (31.96)	28.31 (19.52)	15.22 (3.96)	15.77 (4.03)	15.49 (22.28)
40	51.42 (45.82)	50.08 (45.04)	50.75 (34.96)	20.39 (4.57)	20.66 (4.60)	20.53 (29.52)
80	70.90 (57.36)	70.09 (56.85)	70.50 (48.65)	29.40 (5.47)	28.93 (5.42)	29.16 (41.96)
S.Em± CD CV%	0.58 1.73 3.92	0.42 1.24 2.82	0.50 1.02 4.93	0.06 0.18 3.93	0.06 0.17 3.63	0.50 1.02 5.78

*Figures in parentheses are the arcsine √percentage transformed values
Figures in parentheses are the square root transformed values

During 2017–18, the highest disease incidence and severity were recorded in 80% tuber inoculum (70.90% and 29.40%), followed by 40% (51.42% and 20.39%), 20% (28.61% and 15.22%), 10% (16.76% and 5.52%) and 5% (10.03% and 1.71%) inoculum levels **(Table 6)**. During 2018–19, similar trends were observed (**Table 6)**. The highest disease incidence and severity were recorded in 80% tuber inoculum (70.09% and 28.93%), followed by 40%, 20%, 10% and 5% inoculum levels **(Fig)**. The pooled data of two years revealed that maximum disease incidence and severity were recorded at 80% tuber inoculum (70.50% and 29.16%), followed by 40% (50.75% and 20.53%), 20% (28.31% and 15.49%), 10% (16.52% and 5.38%) and 5% (10.40% and 1.66%) **(Table 5)**.

Table 6. Influence of tuber born inoculum levels of *R. solani* on potato black scurf disease development during 2017-18 and 2018-19

Tuber-born Inoculum (%)	2017-18		2018-19	
	* Disease incidence (%)	# Disease severity (%)	* Disease incidence (%)	# Disease severity (%)
0	0.00 (0.00)	0.00 (0.71)	0.00 (0.00)	0.00 (0.71)
5	10.03 (18.44)	1.71 (1.48)	10.92 (19.27)	1.61 (1.44)
10	16.76 (24.16)	5.52 (2.45)	16.28 (23.78)	5.24 (2.39)
20	28.61 (32.32)	15.22 (3.96)	28.02 (31.96)	15.77 (4.03)
40	51.42 (45.82)	20.39 (4.57)	50.08 (45.04)	20.66 (4.60)
80	70.90 (57.36)	29.40 (5.47)	70.09 (56.85)	28.93 (5.42)
S.Em± CD CV%	0.58 1.73 3.92	0.06 0.18 3.93	0.42 1.24 2.82	0.06 0.17 3.63

*Figures in parentheses are the arcsine √percentage transformed values
Figures in parentheses are the square root transformed values

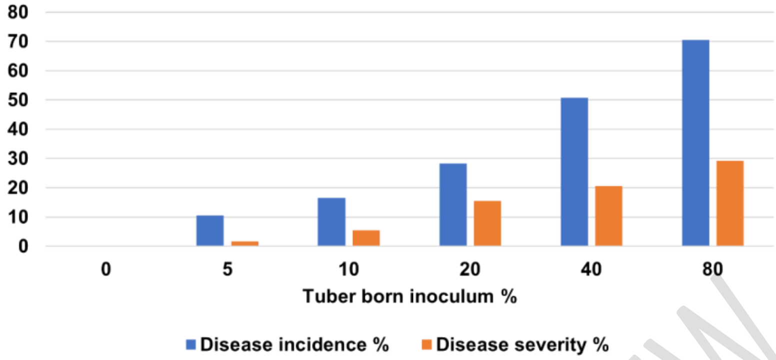

Fig. 3. Influence of tuber born inoculum levels of *R. solani* on potato black scurf disease development (Average 2017-18 and 2018-19)

The increase in disease severity with increasing tuber-borne inoculum density may be attributed to the direct contact between pathogen inoculum and emerging sprouts. Infected seed tubers act as primary sources of inoculum and initiate early infection, resulting in greater disease development. These findings are supported by Wharton et al. (2007), who reported that seed-borne inoculum plays an important role in disease initiation due to its close proximity to developing sprouts and stolon. Similarly, Banville (1989) also reported that infected seed tubers significantly increased black scurf severity in potato. The results of the present investigation clearly indicate that tuber-borne inoculum plays a crucial role in black scurf disease development and increasing inoculum density enhances disease severity.

4. CONCLUSION

Both soil-borne and tuber-borne inoculum of *Rhizoctonia solani* significantly influenced black scurf development in potato. Disease incidence and severity increased progressively with increasing inoculum density across all treatments. Among the cultivars tested, Kufri Pukhraj exhibited maximum susceptibility, whereas Kufri Sinduri showed comparatively lower disease development. In the tuber-borne inoculum experiment, the highest disease incidence and severity were recorded at 80% inoculum level, while healthy seed tubers showed no disease symptoms. These findings indicate that higher inoculum density enhances disease development and emphasize the importance of using disease-free seed tubers, reducing soil inoculum load, and selecting tolerant cultivars for effective management of black scurf disease in potato.

COMPETING INTERESTS

Authors have declared that no competing interests exist

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