International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(1): 1180-1183
www.biochemjournal.com
Received: 15-11-2025
Accepted: 18-12-2025

Manoj Kumar Buswal
Department of Plant Pathology, CCS Haryana Agricultural University, Hisar, Haryana, India

Jaywant Kumar Singh
Krishi Vigyan Kendra, Nawada, Bihar, India

Sanjeev Kumar
ICAR-National Soybean Research Institute, Indore, Madhya Pradesh, India

Ravinder Chauhan
Department of Plant Pathology, CCS Haryana Agricultural University, Hisar, Haryana, India

Corresponding Author:
Manoj Kumar Buswal
Department of Plant Pathology, CCS Haryana Agricultural University, Hisar, Haryana, India

Assessing the relative efficacy of antagonists, organic amendments and chemical means in managing black scurf disease in potato crop

Manoj Kumar Buswal, Jaywant Kumar Singh, Sanjeev Kumar and Ravinder Chauhan

DOI: https://www.doi.org/10.33545/26174693.2026.v10.i1Sn.7237

Abstract
Rhizoctonia solani (teleomorph: *Thanatephorus cucumeris*) causing black scurf disease is a ubiquitous fungus that attacks tubers, underground stems and stolons of potato. In potato, qualitative losses mainly occur through the production of misshapen tubers and the development of sclerotia on the tuber surface. Disease management can be achieved through the use of antagonists, organic amendments and by chemical controls. The infected tubers were planted in the field after dipping in the solutions of MEMC-6 w/v (0.1%), Monceren 250 EC (0.1%) and *T. harzianum* & *T. viride* (10^6 conidia/ml suspension) for 10-15 minute. Vermicompost and *Neem* cake (20 g/kg soil) were applied as soil application at 20 days before planting. Among fungicides treated tuber, monceren showed highest reduction in disease upto 98.58% over the control with the lowest disease incidence (1.0%,). Tuber treated with bioagent *T. harzianum* showed reduction in disease (65.09%) over the control with 24.67% disease incidence. Among the organic amendments, vermicompost controlled disease up to 48.11 percentwith 36.67% disease incidence based on mean of two years.

Keywords: Bioagent, black scurf, fungicides, organic amendments, potato

Introduction

Potato (*Solanum tuberosum*) is herbaceous, starchy, tuberous plant under *Solanaceae* family. Potato crop is attacked by many fungal, bacterial and viral diseases which are widely spread while few are localized, which significantly affect the growth and production of potato. In recent years, with an increase in potato planting area and continuous cropping, among fungal diseases of potato, soil-borne diseases, including potato black scurf have become increasingly serious. *Rhizoctonia solani* (teleomorph: *Thanatephorus cucumeris*) is a fungal pathogen associated with severe diseases in many crop species. It is one of the fungi responsible for black scurf of potato. *Rhizoctonia solani* Kuhn AG-3 is the main causal organism of black scurf disease of potato and it is a major problem all over the world. Black scurf usually does not affect yield of potato crop if it is low in intensity but the quality of tuber is affected resulting in the poor market value. Erampalli and Johston (2001) [17] revealed that *Rhizoctonia solani* Kuhn decrease the progeny, tuber quality as well as quantity. In potato, it is associated with stem cankers and tuber blemishes. These diseases can cause both quantitative and qualitative damage to the potato crop. Quantitative losses occur due to infection of stems, stolons and roots that affect tuber size and number, whereas, qualitative losses mainly occur through the production of misshapen tubers and the development of sclerotia on the tuber surface (known as black scurf). On tuber surface, brown to black irregular hard-masses of sclerotia are formed (as shown in Fig. 1). Though these structures adhere tightly to the tuber skin, they are superficial and do not cause damage, even in storage and help to perpetuate the disease from one season to the next. The loss of quality caused by black scurf, particularly for fresh market potatoes, financial loss is the most economically damaging aspect of this disease (Atkinson *et al*., 2010; Keiser *et al*., 2012; Kumar *et al*., 2017) [3, 8, 10]. According to Keiser (2008) [7], yield losses caused by black scurf reached upto 50 percent, severely affecting potato production thus resulting in marked economic losses. It is spread in India in different regions with different levels of severity and is a major problem in fields where potato is cultivated year after year in the same field

(Arora, 2012) [2]. In Haryana, severe yield losses due to this disease have been reported (Lakra, 1992) [12].

Different options available to control diseases include use of organic amendments, bio-agents and fungicides. Therefore, disease can be managed with help of antagonists and by chemical means. Chemical control of black scurf has been extensively studied in many potato-producing countries (Jeger *et al*., 1996) [6]. Bioefficacy of different fungicides, *i.e*., Penflufen 240 FS, Monceren 250 EC, Carbendazim 50 WP and Emisan 6 FS, was evaluated against black scurf of potato by dip treatment on Kufri Bahar cultivar (Kumar and Raj, 2016) [9].

A variety of *Trichoderma* spp. isolates have been found to effectively control soil borne plant pathogenic fungi such as *R. solani*, *Sclerotium rolfsii*, *Pythium* spp. and *Fusarium* spp. (Singh J.K *et.al*., 2017) [14]. Therefore keeping in view, the economic importance of the diseases and inadequate information on the efficacy of fungicides, organic amendments and bio-agents, the present study wasconducted with the objectives "Assessing the relative efficacy of antagonists, organic amendments and chemical means in managing black scurf disease in potato crop".

Materials and Methods

Field experiment was conducted at Research farm of Vegetable Science, CCSHAU Hisar, during two *rabi* season to test the efficacy of promising fungicides, antagonists and organic amendments which were found best under *in vivo*/*vitro* conditions. Infected potato tubers of susceptible cultivar 'Kufri Bahar' were planted during first fortnight of November, first and second year under field conditions (plot size 3.0 x 2.0 m, spacing 60 x 45 cm) using RBD with three replications. The infected tubers were planted in the field after dipping in the solutions of MEMC-6 FS w/v (0.1%), Monceren 250 EC (0.1%) and *T. harzianum* & *T. viride* (10^6 conidia/ml suspension) for 10-15 minutes. Carboxy-methyl cellulose (CMC @ 1%) was used as sticker during tuber treatment for antagonists. Organic amendments i.e., vermicompost and *Neem* cake (20 g/kg soil) were applied as soil application at 20 days before of planting. The disease incidence and disease index/severity were recorded after harvesting of the potato.

Observations recorded

i. Disease incidence was calculated by using the formula described by Ahmed *et al*. (1995) [1] as described below:

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

ii. Disease index (severity) was calculated by using the formula of Kumar and Raj (2016) [9]

$$\text{Percent disease index (severity)} = \frac{\text{Sum of all numerical rating}}{\text{Total number of tubers observed} \times \text{Max. grade}} \times 100$$

Statistical analysis

The data of *in vivo* experiments was analyzed by using statistical package of programs OPSTAT (Sheoran, 2006) [13]. Angular (arcsine) transformation was applied for analysis of the percent data in RBD design. Analysis of variance (ANOVA) in one-way or two ways for the analysis of the data wasused to calculate the critical difference (CD) and coefficient of variations (CV) for the significance of the treatments.

Fig 1: Infected potatoes showing sclerotia of *Rhizoctonia solani*

Results and Discussion

The results of field experiments on the management of *Rhizoctonia solani* causing black scurf of potato is presented in table 3. Results indicated that tuber treatment with fungicides, bioagents and organic amendments resulted in significant reduction in disease incidence.

In chemical treatments, monceren followed by MEMC, whereas, in antagonists *T. harzianum* followed by *T. viride* were found effective, while in case of organic amendments, vermicompost was more effective followed by *Neem* cake against *Rhizoctonia solani*. Among all the above treatments, least percent disease severity was observed in monceren treatment that supported minimum disease incidence, whereas, maximum percent disease severity was found in *Neem* cake treated tubers.

Among fungicides, monceren showed highest reduction in disease (98.17 and 99.02%, respective years) over the control with the lowest disease incidence (01.33 and 00.67%, respective years), followed by MEMC which reduced black scurf disease up to 82.57 and 84.46 percent over control with the disease incidence 12.67 and 10.67 percent in respective years.

Tuber treated with bioagent *T. harzianum* showed reduction in disease (63.30 and 66.99%, respective years) over the control with the disease incidence (26.67 and 22.67%, respective year), followed by *T. viride* treatment.

Among the organic amendments, vermicompost which controlled disease up to 47.71 and 48.55 percent during the respective years, were found more effective than *Neem* cake which was least effective among the treatments that showed lowest reduction (41.28 and 38.84%) in the disease over control with the highest (58.82 and 56.78%) disease incidence in the respective years.

Among all the above treatments as shown in table 3, least disease severity was found with monceren treatment than rest of the treatments, whereas, maximum percent disease severity was found in *Neem* cake treated tubers.

A similar type of results on bioefficacy of different fungicides monceren 250 EC (0.25%) and emisan-6 FS (0.25%) was evaluated against black scurf of potato by dip treatment on Kufri Bahar cultivar by Kumar and Raj (2016) [9] which showed disease incidence 01.7 and 19.9 percent with disease control 97.6 and 69.3 percent, as well as reduced disease index were 0.3 and 0.9 percent, respectively in both the conditions.

Similar types of findings under *in vitro* were also found by Buswal *et al*. (2025) [4] while working with Rhizoctonia solani. Experimental results demonstrated at a concentration of 100 ppm, the monceren fungicide completely inhibited mycelial growth up to 100 percent, followed by MEMC (81.0% inhibition whereas, *Trichoderma harzianum*, inhibiting mycelial growth by 71.11 percent.

Kumar *et. al*. (2018) [11] reported that the soil amendment of vermicompost could control disease up to 40.00 and 50.01 percent at the dose of 10 and 20 g/kg soil/pot respectively.

Similar observations were also made by Tsror *et al*. (2001) [16] while working with *R. solani* in field condition. They have reported that *T. harzianum*, organic cattle manure composts had reduced disease incidence and severity of the pathogen. The present findings are also in conformity with the reports of Singh and Chaudhari (2012) [15] as the black scurf disease of potato was managed effectively by treatment of tuber with *T. harzianum* @ 8 g/kg and *Neem* ban @ 5 ml/lt, which showed the disease incidence 20.96 and 25.41 percent and disease control 63.21 and 47.00 percent over control, as well as it reduced the disease index 0.62 and 0.76%, respectively.

Table 1: Treatments for field experiment:

Treatment	Description
T_1	MEMC-6 FS w/v (0.1%)
T_2	Monceren 250 EC (0.1%)
T_3	*Trichoderma harzianum* @ 10^6 conidia/ml
T_4	*Trichoderma viride* @10^6 conidia/ml
T_5	Vermicompost @ 20g /kg soil
T_6	*Neem* Cake @ 20g /kg soil
T_7	Control (Infected tubers)

Table 2: Rating scale (0-4 scale) used for the measurement of the disease index (severity)

Treatment No.	Treatments
0	Healthy
1	Up to 25% tuber area scurfed
2	26-50% tuber area scurfed
3	51-75% tuber area scurfed
4	>75% tuber area scurfed

Table 3: Efficacy of fungicides, bio-agents and organic amendments against black scurf of potato under the field conditions

Treatments	First Year		Second Year		Pooled Means		Per cent disease severity		
	Disease Incidence (%)	Disease control (%)	Disease Incidence (%)	Disease control (%)	Pooled Disease Incidence	Pooled Disease control (%)	First Year	Second Year	Pooled mean
MEMC -6 FS w/v (0.1%)	12.67 (20.75)*	82.57	10.67 (18.94)	84.46	11.67 (19.96)	83.49	8.33 (16.73)	9.17 (17.58)	8.75
Monceren 250 EC (0.1%)	01.33 (05.42)	98.17	00.67 (02.71)	99.02	01.00 (5.76)	98.58	2.5 (7.53)	1.67 (4.69)	2.09
T. harzianum @ 10^6 conidia/ml	26.67 (31.05)	63.30	22.67 (28.39)	66.99	24.67 (29.75)	65.09	10.83 (18.33)	12.50 (20.63)	12.75
T. viride @ 10^6 conidia/ml	29.33 (32.75)	59.64	26.67 (31.01)	61.16	28.17 (31.89)	60.38	14.17 (21.78)	13.33 (21.28)	15.00
Vermicompost @ 20g /kg soil	38.00 (37.98)	47.71	35.33 (36.36)	48.55	36.67 (37.17)	48.11	18.33 (25.33)	17.50 (24.62)	17.08
Neem Cake @ 20g /kg soil	42.67 (40.75)	41.28	42.00 (40.31)	38.84	42.34 (40.54)	40.09	28.33 (32.11)	20.83 (27.09)	24.17
Control (Infected tubers)	72.67 (58.82)	-	68.67 (56.78)	-	70.67 (57.39)	-	35.83 (36.62)	26.67 (31.07)	32.50
SEm ±	2.17		2.71		1.89		2.33	2.05	
CD (p = 0.05)	6.77		8.44		5.90		7.33	6.39	
CV (%)	11.57		15.35		10.33		18.01	16.91	

Acknowledgments

The author acknowledges with appreciation the contributions of Dr. Anil Kumar, Ex-Professor and Head, Department of Plant Pathology, CCSHAU, Hisar, whose guidance, technical expertise and financial support were instrumental in the successful execution of this research.

References

1. Ahmad IS, Iftikhar MH, Soomro SK, Munir A. Diseases of potato in Northern areas during 1992. CDRI-PSPD, PARC, Islamabad, Pakistan. 1995. pp. 38.
2. Arora RK. Eco-friendly management of soil and tuber borne diseases of potato. Indian Phytopathol. 2012;65:116-121.
3. Atkinson D, Thornton MK, Miller JS. Development of *Rhizoctonia solani* on stems, stolons, and tubers of potatoes I. Effect of inoculum source. Am J Potato Res. 2010;87:374-381.
4. Buswal MK, Singh JK, Singh J, Punia R. Effect of chemicals and antagonists on the growth of *Rhizoctonia solani* (Kuhn) causing black scurf of potato (*Solanum tuberosum* L.). Int J Hortic Food Sci. 2025;7(6):87-91.
5. Errampalli D, Johnston HW. Control of tuber-borne black scurf (*Rhizoctonia solani*) and common scab (*Streptomyces scabies*) of potatoes with a combination of sodium hypochlorite and thiophanate-methyl preplanting seed tuber treatment. Can J Plant Pathol. 2001;23:68-77.
6. Jeger MJ, Hide GA, Van Den Boogert PHJF, Termorshuizen AJ, Van Baarlen P. Pathology and control of soil-borne fungal pathogens of potato. Potato Res. 1996;39:437-469.
7. Keiser A. *Rhizoctonia solani*—a fungal disease with multiple symptoms: means of preventive and curative control. In: Potato Research for a Production of Quality. Information Day, February 2008, Changins (In French).
8. Keiser A, Häberli M, Stamp P. Quality deficiencies on potato (*Solanum tuberosum* L.) tubers caused by *Rhizoctonia solani*, wireworms (*Agriotes spp*.) and slugs (*Deroceras reticulatum*, *Arion hortensis*) in different farming systems. Field Crops Res. 2012;128:147-155.
9. Kumar A, Kushal R. Evaluation of different fungicides against black scurf of potato caused by *Rhizoctonia solani*. Indian J Plant Prot. 2016;44(1):110-115.

10. Kumar M, Singh JK, Kumar S, Kumar A. A comprehensive overview on black scurf of potato. Int J Curr Microbiol App Sci. 2017;6(10):4981-4994.
11. Kumar M, Kumar A. Evaluation of efficacy of different organic amendments against *Rhizoctonia solani* under the screen house conditions. J Pharmacogn Phytochem. 2018;7(2):191-194.
12. Lakra BS. Correlation of infection intensities of black scurf with yield components of potato. Indian J Mycol Plant Pathol. 1992;22:203-204.
13. Sheoran OP. Online statistical analysis tool (OPSTAT). Available from: www.hau.ernet.in/about/opstat.php. CCS HAU, Hisar. 2006.
14. Singh JK, Kumar M, Kumar S, Kumar A, Mehta N. Effect of chemicals and antagonists on growth and sporulation of *Fusarium oxysporum* causing wilt of chilli (*Capsicum annuum* L.). Int J Chem Stud. 2017;5(5):2175-2181.
15. Singh N, Chaudhari SM. Management of black scurf (*Rhizoctonia solani*) and common scab (*Streptomyces scabies*) of potato through eco-friendly components. Indian Phytopathol. 2012;65(4):378-381.
16. Tsror L, Barak R, Sneh B. Biological control of black scurf on potato under organic management. Crop Prot. 2001;20:145-150.
17. Errampalli D, Johnston HW. Control of tuber-borne black scurf [*Rhizoctonia solani*] and common scab [Streptomyces scabies] of potatoes with a combination of sodium hypochlorite and thiophanate-methyl preplanting seed tuber treatment. Canadian Journal of Plant Pathology. 2001 Mar 1;23(1):68-77.