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Evaluation of efficacy of different organic amendments against *Rhizoctonia solani* under the screen house conditions

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Abstract
Potato (*Solanum tuberosum L.*) is an important vegetable crop. Among fungal diseases of potato, black scurf disease caused by *Rhizoctonia solani* Kuhn is a major problem all over the world. Black scurf develops as the presence of brown to black colored sclerotia on the peel of potato tuber. Recently, use of organic amendment to control soil borne diseases is attaining an importance because it reduces the cost of cultivation, avoids the health hazards and also eco-friendly in nature which is an efficient non chemical method and indirect approach to control the pathogen. The soil amendment of vermicompost could control disease up to 40.00 and 50.01 per cent at the dose of 10 and 20 g/kg soil/pot respectively, followed by *Neem* cake (35.01 and 45%) and mustard cake (25 and 30%), whereas, least disease control was recorded by spent mushroom compost (10 and 15%) and farmyard manure (15 and 20.01%), respectively compared to the control.

Keywords: Potato, Black scurf, *Rhizoctonia solani*, Organic amendment, Disease

1. Introduction
Potato (*Solanum tuberosum L.*) is an important vegetable crops and ranks 3rd among food crops after rice and wheat in the world as well as India from human consumption point of view. Potato crop is attacked by many diseases, which are widely spread and others are localized, which affect the crop growth and production. Among fungal diseases of potato, black scurf disease caused by *Rhizoctonia solani* Kuhn is a major problem all over the world. Black scurf develops during plant senescence and is associated with the formation of sclerotia on progeny tubers and their malformation (Das *et al.*, 2014; El Bakali and Martin, 2006; Tsror, 2010) [6, 7, 22]. Black scurf usually do not affects 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) [8]. Black scurf disease of potato has been reported to cause marketable yield losses up to 30-50 per cent (Carling *et al.*, 1989; Keiser, 2008) [5, 13]. Among the different available options for the management, chemicals are neither economically viable, nor safe for the environment and due to strict regulations, the mostly synthetic chemicals are not used under organic management. Therefore, alternative environmentally safe disease and pest control practices are developed. Some of these practices are also adopted in conventionally grown crops. Use of organic amendments show antifungal activity against a large number of fungal diseases. The organic amendments provide an effective measure for soil borne black scurf disease management and it represents a substitute to reliance on fungicides. Some organic amendment *viz.*, vermicompost, *Neem* cake and farmyard manure (FYM) against *Rhizoctonia solani* Kuhn at different doses was found effective to inhibit the growth of pathogen. It was reported that the vermicompost and *Neem* cake reduced the growth of pathogen over the control (Siddarth *et al.*, 2014) [21]. Organic matter, such as cattle manure is an essential component of organic crop management as it improves soil structure, water holding capacity and cation exchange capacity and promotes plant growth. Some compost also suppresses soil-borne plant pathogens (Hoitink and Fahy, 1986; Hoitink and Boehm, 1999) [12, 11]. Cattle manure compost was also shown to reduce propagule density of *R. solani* in soil (Kuter *et al*., 1983) [14], mainly due to enhanced activities of antagonistic microorganisms such as *Trichoderma harzianum*, *Gliocladium virens*, *Pseudomonas fluorescens* and *Bacillus cereus* (Kwok *et al*., 1987; Nelson and Hoitink, 1983) [15, 17]. As, limited work has been done in management of black scurf disease of potato by the use of organic amendment. Keeping in view these research gaps, the present investigation was undertaken to sort out the most effective organic amendment under screen house conditions against the black scurf disease of potato caused by *Rhizoctonia solani*.

Materials and methods

The present study was carried out in the Department of Plant Pathology, CCS Haryana Agricultural University, Hisar. Potato tubers of susceptible variety 'Kufri Bahar' showing typical symptoms as sclerotia of black scurf at harvest were collected during March 2015. Afterward, the cultures of the pathogen were purified through hyphal tip method (Rangaswami and Mahadevan, 2004), maintained on PDA slants and stored in refrigerator at 4^0 C for further uses. Further, mass multiplication of *Rhizoctonia solani* on millet grain has been done as per slandered procedure. The inoculum thus produced was used in pot assay.

A pot experiment was conducted during seasons 2015-16 in the screen house for managing the black scurf of potato caused by *Rhizoctonia solani* by using different organic amendments. A plastic pot filled with sterilized field soil (by formaldehyde) was taken in which inoculum (20 g/pot) of *R. solani* pathogen multiplied on millet grains was applied in a hole (5.0 cm depth) and beneath each potato tuber at the time of sowing in the pot in the first fortnight of November 2015. A susceptible variety of potato *viz.,* Kufri Bahar was taken for the evaluation. For each treatment three replications were maintained in completely randomized design (CRD) during the experiment. The sterilized soil mixed with different organic amendments (Table 1) @ 10 and 20 g/kg soil/pot was filled in fresh plastic pots 3 weeks before planting of potato tubers under screen house condition to test efficacy of the different organic amendments.

Table 1: Treatments of different organic amendments under screen house conditions

Treatment No.	Treatments
T_1	Farm Yard Manure (FYM)
T_2	Vermicompost
T_3	*Neem* cake
T_4	Mustard cake
T_5	Cotton cake
T_6	Mushroom spent compost
T_7	Control (without any organic amendments)

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

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

Results

Efficacy of soil incorporation of six organic amendments against *Rhizoctonia solani* under screen house conditions were tested individually and the results thus obtained are presented in table 2. A minimum disease incidence (black scurf) of 40.00 and 33.33 per cent was recorded at a dose of 10 and 20 g/kg soil/pot respectively, when the soil in pots were incorporated with vermicompost followed by *Neem* cake (43.33 and 36.67%) and mustard cake (50.00 and 46.67%) as compared to the highest disease incidence of 66.7 per cent in control treatment. Thus, application of vermicompost could control disease up to 40.00 and 50.01 per cent at the dose of 10 and 20g/kg soil/pot respectively, followed by *Neem* cake (35.01 and 45%) and mustard cake (25 and 30%), whereas, least disease control was recorded by spent mushroom compost (10 and 15%) and farmyard manure (15 and 20.01%), respectively compared to the control.

Table 2: Evaluation of organic amendments against black scurf disease incited by *Rhizoctonia solani* under screen house conditions

Oraganic amendments (OA)	10 g/kg soil/pot		20 g/kg soil/pot	
	Incidence (%)	Control (%)	Incidence (%)	Control (%)
FYM	56.67(48.83)*	15.00	53.33(46.90)	20.01
Vermicompost	40.00(39.13)	40.00	33.33(35.20)	50.01
Neem cake	43.33(41.14)	35.01	36.67(37.21)	45.00
Mustard cake	50.00(44.98)	25.00	46.67(43.06)	30.00
Cotton cake	53.33(46.90)	20.01	50.00(44.98)	25.00
Mushroom spent compost	60.00(50.75)	10.00	56.67(48.82)	15.00
Control (Inoculated)	66.67(52.75)		66.67(54.76)	
	OA (A)	Conc. (C)	Interaction (A X C)	
SEm ±	1.6	0.86	2.26	
CD (p = 0.05)	4.68	NS	NS	

All values represent means of three replications; NS- Non-significant**;** *Figures in parenthesis indicate angular transformed values

Discussion

Recently, use of organic amendment is gaining importance because it minimizes the cost of cultivation, avoids the health hazards and also eco-friendly in nature. Use of organic amendments to control soil borne diseases of plants is an efficient non chemical method and indirect approach to control the pathogen. Organic amendments not only reduce the disease severity but also enhance the antagonists, soil fertility and crop yield to a significant level.

In the present study, the results indicated that a minimum disease incidence occurred when the soil was incorporated with vermicompost followed by *Neem* cake and mustard cake as compared to the highest disease incidence in control treatment. In other words, application of vermicompost could control maximum disease at the both dose followed by *Neem* cake and mustard cake, whereas, least disease control by mushroom spent compost and farmyard manure as compared to control.

Similar results have been reported by Rahul *et al.* (2014) while working with *R. solani.* They found that vermicompost and *Neem* cake reduced the growth of the pathogen, whereas, FYM showed less inhibition. The findings are in conformity with the work of Mamta *et al.* (2005) who evaluated all the organic manures such as Jaivic, *Neem* cake, castor cake, and mustard cake applied with recommended dose of NPK, were positively correlated with tuber yield and negatively

correlated with disease development. Rahman and Ali (2016) reported that poultry waste considerably reduced the stem canker of potato and the lowest disease incidence and per cent disease index was found. However, in the present investigations soil application of vermicompost, *Neem* cake and mustard cake were the most effective for black scurf disease management, whereas, the animal manure used as soil amendment was less effective.

Similar result has been observed by Heidi *et al*. (2012) [10] who showed that the addition of manures (chicken, pigeons and cow) to the soil decreased significantly stem canker and black scurf disease. Mushroom compost and manure decreased damping-off of flax caused by *R. solani* with the compost being more efficient than the manure (Alabouvette *et al.,* 2004) [3]. The present findings on efficacy of amending soil with organic amendments such as oil seed-cake and plant residues on the plant growth was well supported by many workers Anis *et al.* (2010) [4] and Akhtera *et al.* (2015) [2] indicated significant reduction in soil-borne pathogens including *R. solani* and increased crop productivity. Mustard oilcake has also shown significant inhibition of the radial growth of *R. solani* infecting different crops. Present results were also in conformity with the previous studies by Gurjar *et al.* (2003) [9] on the effect of organic amendments like FYM, vermicompost, cotton oil, mustard oil, castor oil, neem oil and groundnut oil against the disease collar rot of chilli caused by *Sclerotium rolfsii*. All amendments were found significantly superior compared to control.

Conclusions

The organic amendments provide an effective measure for soil borne black scurf disease management. Among the organic amendment treatments, vermicompost was found more effective which controlled maximum disease followed by *Neem* cake, whereas, mushroom spent compost was least effective with lowest reduction in the disease over control followed by FYM.

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