JOURNAL OF PURE AND APPLIED MICROBIOLOGY, Sept. 2016. Vol. **10**(3), p. 2433-2438

Management of Black Scurf of Potato Caused by *Rhizoctonia solani* with Organic Amendments and their Effect on Different Parameter of Potato Crop

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https://doi.org/10.22207/JPAM.10.3.89

(Received: 10 March 2016; accepted: 02 May 2016)

An integrated approach was made to control the black scurf of potato (*Solanum tuberosum* Linn.). Potato is one of the important crop and the fourth largest grown crop after rice, wheat and maize in the world. The pathogen was isolated from naturally infected tubers and the fungus was purified. In the pathogenicity test the symptoms were found on tuber, stem and stolon also. The efficacy of organic amendments (Vermicompost, Neem cake and Farm Yard Manure) was evaluated as soil application alone or in combination with the antagonist (*T. harzianum*). The Vermicompost and Neem cake both found effective in reducing the Black Scurf Disease Index (BSDI) while FYM was less effective in controlling the black scurf, stolon and stem canker. The Vermicompost and Neem cake also promote the growth of the plant i.e. increasing the shoot length, seed size and formation of tubers per plant was increased. The yield was also increased by the Vermicompost and Neem cake. The organic amendments can be too useful in reducing the soil-borne disease.

Keywords: Organic amendments, Vermicompost, Neem cake and FYM, *Rhizoctonia solani*.

The mechanisms involved in disease suppression are varied and complex and may differ depending upon the pathogen involved but there is evidence that organic amendments added to the soil can induce disease suppression by stimulating antagonist microorganisms (Cook, 1990). The addition of readily available carbon source to the soil, such as a green manure, compost and any organic amendments like plant extracts stimulates microbial activity and could cause intense competition for resources and produce fungistasis. Conversely, when C is added above the needs of the saprotrophic competitors, the germination of pathogens may be stimulated and fungistasis broken (Campbell, 1989). Kundu and Nandi (1985) reported that when the C: N ratio of soil increased, fungal populations decreased, but populations of bacteria increased. This is related closely to the level of organic matter decomposition. Another suppression mechanism could be pathogen propagule destruction. This can occur due to predation and/or parasitism by a biological control agent that feeds directly on or the pathogen resulting in a destruction of pathogen propagules or structures (Chernin and Chet 2002).

Black scurf is one of the most wide spread disease and found in all potato growing areas of the world. The typical symptoms are characterized by appearance of black coloured sclerotia on the tuber surface and brownish necrotic lesions on stem and stolon which can kill the eyes, delay in emergence, increases tuber defects (cracks, misshapen, netted skin with reduced quality and

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market value (Fig. no. 7. B). The Black scurf and stem canker (Fig. no. 7. D) or stolon canker of potato caused by *Rhizoctonia solani* Kuhn [also known by the name of its sexual stage *Thanetophorus cucumeris* (Frank) Donk] is a serious disease of potato worldwide and distributed in India in different regions in low to severe form. Biocontrol agents like *Trichoderma* and *Pseudomonas* are antagonistic to the Rhizoctonia solani and have been widely used to manage the disease (Elad, Y. *et. al.,* 1983). The organic amendments such as Vermicompost, Neem cake, FYM and many more organic agricultural byproducts have been used to manage the diseases in plants. In hills as well as in plains major damage to yield is by stem canker. In recent year the fungus causes significant yield reduction. It can cause a significant change in size distribution of tubers (too small or too large). As a result, farmers have to bear 5-7 % economic loss (Shekhawat, *et. al.*, 1993, Singh and Shekhawat, 1994a).

MATERIALS AND METHODS

The present investigation on "Role of Organic amendments for the management of Black Scurf of Potato caused By *Rhizoctonia solani* (Kuhn)" was carried out Crop Research Center, Sardar Vallabhbhai Patel University of Agriculture & Technology, Modipuram, Meerut, Uttar Pradesh. The black scurf susceptible variety Kufri Bahar was selected for the study of black scurf disease. The seed tubers were already infected with sclerotia of *R. solani* and germinated. The plot size was 5×4 m. with nine rows. The row to row space was maintained at 60 cm and plant to plant space was maintained at 20 cm. Central seven rows were used to record the observations. The organic amendments (Vermicompost, Farm Yard Manure and Neem cake) were applied as soil treatment and the chemicals (Bavistin and Boric acid) and biocontrol agent (*Trichoderma harzianum* and *Pseudomonas fluorescence*) were used as tuber treatment. The *Trichoderma harzianum* was also used in combination with each of organic amendment and with the Bavistin too, a treatment of *Trichoderma harzianum* and *Pseudomonas fluorescence* were also used as combination of both. The observation of Black Scurf disease Index **(BSDI)** were calculated on the basis of rating system as given below:

Black scurf disease index

Five plants were selected randomly in each plot before cutting of stem of plant in field. The tubers were collected in polyethylene begs. Then the visual observation was taken to observe the black scurf incidence and severity.

Black scurf disease severity and incidence was expressed as Black Scurf Disease Index **(BSDI)** and was calculated with following formula;

$$BSDI = \frac{0(n1)+1(n2)+2(n3) + 3(n4) + 4(n5) + 5(n6)}{N \text{ (Total number of tubers)}} \times \frac{100}{5}$$

Where:
n1= Numbers of tuber in 0 rating
n2= Numbers of tuber in 1 rating
n3= Numbers of tuber in 2 rating
n4= Numbers of tuber in 3 rating
n5= Numbers of tuber in 4 rating
n6= Numbers of tuber in 5 rating

Disease severity was assessed on a visual disease rating scale 0-5 based on per cent tuber surface showing disease showing disease symptom as described by **Ahmad *et. al.*, (1995).**

Where:
0= no symptoms on tuber present
1= less than 1% tuber area affected
2= 1-10% tuber are affected
3= 11-20% tuber are affected
4= 21-50 % tuber are affected
5= 51% or more tuber area affected

RESULTS

Results indicate that there was no significance effect of different treatments on the plant emergence. While in the case of tillers per mother tuber per plot there was significant effect of different treatments over check. Maximum number of tillers per mother tuber per plot was observed when the Vermicompost was applied as soil application followed by the neem cake. It was found that plant obtained maximum shoot length (23.05 cm) when vermicompost was applied in soil with combination of *Trichoderma harzianum* while in case of vermicompost alone it was 20.18 cm. in case of neem cake alone it was 19.72 cm and in case of neem cake with combination of *Trichoderma harzianum* it was 19.80 cm as shown in figure six.

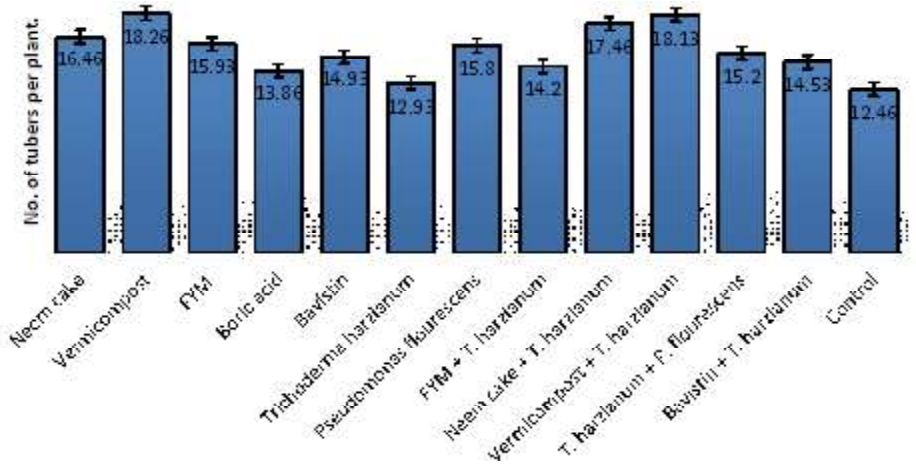

Fig. 1. Effect of different treatment on formation of tubers per plant

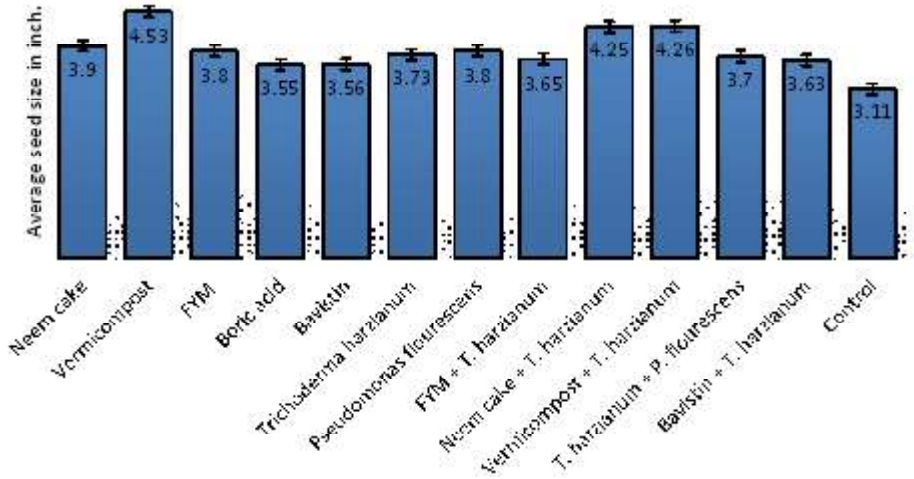

Fig. 2. Effect of different treatments on seed size of progeny tubers

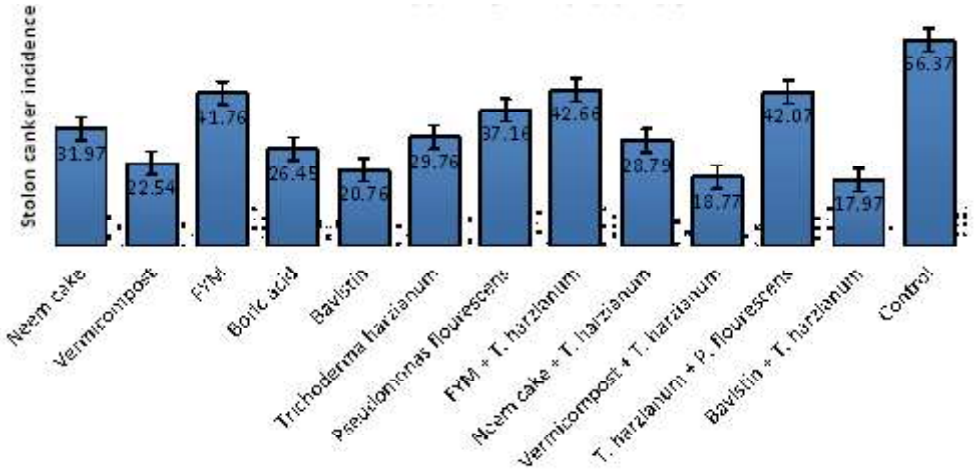

Fig. 3. Effect of different treatments on stolon canker incidence

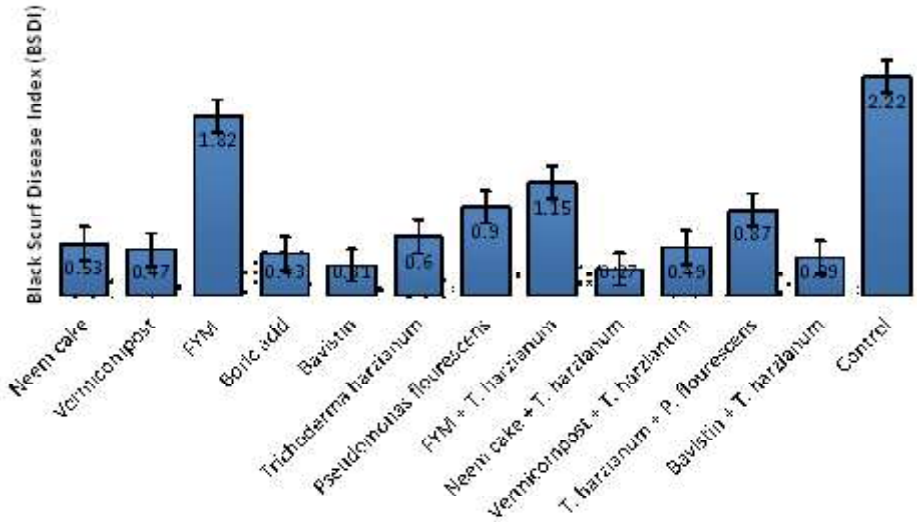

Fig. 4. Effect of different treatments on black scurf in field

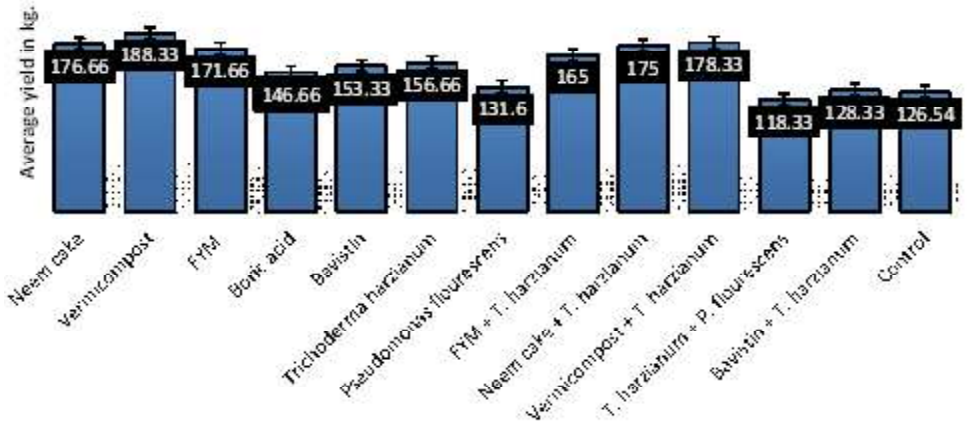

Fig. 5. Effect of different treatments on yield

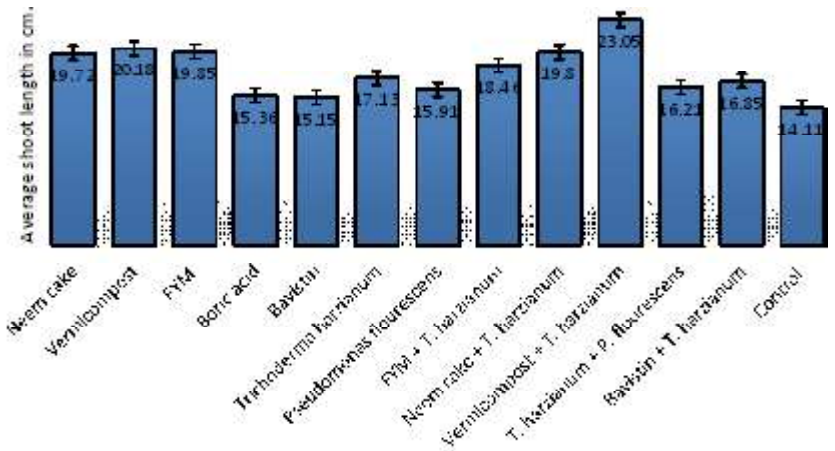

Fig. 6. Effect of different treatments shoot length

As compared to all treatments plant obtained better shoot length in case of vermicompost and neem cake when applied alone or combination with *Trichoderma harzianum.* The observation on tuber per plant indicates that vermicompost and neem cake also gave better performance in formation of tubers per plant when applied alone and combination with *Trichoderma harzianum*. In the case of seed size there was no significance difference among the treatments as well as over control maximum tuber size of progeny 4.53 (in inches) was observed when vermicompost was applied alone as soil application (figure. 2).

The stolon canker incidence was also minimum (22.54 and 18.77 %) as in Fig. no.7 (C). when vermicompost was applied as alone and in combination with *Trichoderma harzianum* respectively. Maximum stolon canker (42.07 %) was observed in the case of *T. harzianum* + *P. flourescens* and minimum was when Bavistin was applied with combination of *Trichoderma harzianum* as seed treatment. The sclerotia formation (Black Scurf) on tuber were higher (1.82 and 1.15 **BSDI**) when FYM was applied alone and in combination with *Trichoderma harzianum.* The table indicates that Neem cake has synergistic effect in reducing the sclerotia formation (0.27 BSDI) when applied in combination with *Trichoderma harzianum* as compared to applied alone (0.53 BSDI).

Fig. 7. Different plant parts of potato crop form the infected field; (A) Infected and healthy plant with the stem canker, (B) Tuber showing the typical symptoms of Black Scurf with the whitish growth of fungus, (C) Stolon canker and (D) Canker on stem

DISCUSSION

Application of organic amendments is old practices for the management of plant diseases. The use of organic amendments allows changes in soil environment i.e. Physical, chemical and biological changes. These changes influence many plant diseases due to decomposition of organic matter present in amendments. Organic amendments may influence the soil and the incidence of the soil borne diseases in one or more way like alternation of soil structure, biotic environment and biochemical effect on the plant

pathogens as Scholte *et al.,* (1998) Used the Farm Yard Manure (FYM) alone and with a combination of white mustard as a soil amendment in already infested soil and found that organic amendment reduced the disease severity and increased the population of mycophagous soil organisms. Effect of different treatments on different growth parameter of potato crop in field condition. Results indicates that the application of biological agents, chemicals and organic amendments alone or in combination with *Trichoderma harzianum* and *Pseudomonas fluorescens* have no effect on sprouting of tubers and while the vermicompost alone and in combination with *T. harzianum* has batter in improving tuber formation, increasing the size of the tubers as well as reducing the incidence of stolon canker as well as sclerotia formation on tuber. Neem cake obtained second position in improving the growth parameter as well as crop health in field trial over other treatment. Several study of researcher were found to similar as described by Singh *et al.,* (1972) Used various oil cakes with the combination of fertilizers and reported that all the treatments which used as the organic amendments caused significance reducing in black scurf of potato caused by *Rhizoctonia solani.* Hazarika *et al.,* (2000), Rauf *et al.,* (2003), Dey *et al.,* (2004), Mamta *et al.,* (2005), Al-Mughrabi (2006), Larkin *et al.,* (2008).

REFERENCES

1. Graves, L.G. & Taber, C.W., A dictionary of food and nutrition. F.A. Davis, Philadelphia. Also available on www. Potatoes.co.za/ home.asp? pid=14 30; 1942.
2. Shekhawat, G. S., B. P. Singh and M. D. Jeswani. *Soil and tuber borne diseases.* Tech. Bull No. 41, Central Potato Research Institute, Shimla, H.P. India. 1993; 47.
3. Singh, Rajpal and G. S. Shekhawat., Status of soil and tuber borne diseases of potato in U.P. In: *Potato, present and future* (G. S. Shekhawat*et al.,* Eds.), pp. 211-15. Indian Potato Association, Shimla, India, 1994a.
4. Ahmad, I., S. Iftikhar, M.H. Soomro, S. Khalid and A. Munir. Diseases of potato in Northern areas during 1992. CDRI-PSPDP, PARC, Islamabad, Pakistan, 1995; 38.
5. Singh, R.S., Chaube, H.S. and Singh N., Studies on the control of black scurf of potato. *Indian Phytopath.* 1972; **25**: 343.
6. Scholte, K, Lootsma, M., Effect of farmyard manure and green manure crops on populations of mycophagous soil fauna and Rhizoctonia stem canker of potato. *Pedobiologia*; 1998; **42**(3): 223-231.
7. Hazarika, D.K., Phookan, A.K., Das, K.K., Dubey, L.N., Das, B.C., Biological management of black scurf of potato. Potato global research and development Proceedings of the Global Conference on Potato, New Delhi, India, 2000; **1**: 401-404.
8. Rauf, C.A., Rahman, F., Effect of bio-pesticides on mycelial growth of Rhizoctonia solani and management of black scurf of potato. Mycopath (Pakistan). 2003; **1**(2): 131-135.
9. Dey, T.K., Bari, M.A., Saha, A.K., Rahman, M., Ayub, A., Effectiveness of organic amendments and chemicals in controlling black scurf disease of potato *Bangladesh-Journal-of-Plant-Pathology.* 2004; **20**(1/2): 17-20.
10. Mamta, Jha, M.M., Sanjeev Kumar., Influence of organic manure, irrigation interval and cropping sequence on the yield and black scurf disease of potato. *Annals of Agri. Bio. Research;* 2005; **10**(1): 61-64.
11. Al Mughrabi, K. I., Antibiosis ability of aerobic compost tea against foliar and tuber potato diseases *Biotechnology.* 2006; **5**(1): 69-74.
12. Larkin, R.P., Relative effects of biological amendments and crop rotations on soil microbial communities and soil borne diseases of potato. *Soil-Biology-and-Biochemistry*.; 2008; **40**(6): 1341-1351.
13. Elad, Y., I. Chet, P. Boyle and Y. Henis., Parasitism of *Trichoderma* spp. on *Rhizoctonia solani* and *Sclerotium rolfsii* –Scanning electron microscopy and fluorescence microscopy. *Phytopathology* 1983; **73**: 85-88.
14. Cook, R.J., Twenty-five years of progress towards biological control. In: Hornby (Eds.), Biological Control of Soil-Borne Pathogens. C.A.B. International, Wallingford, UK, 1990.
15. Campbell, R., Biological Control of Microbial Plant Pathogens. Cambridge University Press, Cambridge, Great Britain, 1989.
16. Kundu, P.K., Nandi, B., Control of Rhizoctonia disease of cauliflower by competitive inhibition of the pathogen using organic amendments in soil. *Plant Soil* 1985; **83**: 357–362.
17. Chernin, L., Chet, L., In: Burns, R.G., Dick, R.P. (Eds.), Enzymes in the Environment. Activity, Ecology and Applications. Marcel Dekker Inc., New York, Basel, 2002.

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