

DOI No.: <http://doi.org/10.53550/EEC.2023.v29i06s.046>

Influence of soil parameters and planting depth on black scurf development in Potato

Amanpreet Singh Sran¹, Jasvinder Kaur Sran³, Tannu², Neha², Virender Singh Pahil¹,
Bihari Singh³ and Bahaderjeet Singh^{1*}

¹College of Agriculture, Guru Kashi University, Talwandi Sabo, Bathinda, Punjab, India

²Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala, Haryana, India

³Department of Environmental Science, Nalanda Open University, Patna, Bihar, India

(Received 21 May, 2023; Accepted 27 July, 2023)

ABSTRACT

Solanum tuberosum is an important vegetable crop worldwide. Among various diseases, black scurf disease caused by *Rhizoctonia solani* Kuhn as emerged as a major problem and is known to cause qualitative and quantitative losses in potato. The management of *R. solani* causing black scurf is complex due to its soil-borne nature and high level of survival and poses a challenge for the eco-friendly management of the disease. The existing fungicides control measures are neither economical nor environment friendly; therefore sustainable effective disease management strategy is required. Available information on management of black scurf (*R. solani*) disease is scanty. The present investigation was carried out in the Agricultural Research farm (Vegetable Science), Guru Kashi University, Talwandi Sabo during rabi seasons, 2021-22 and 2022-23. The 'Kufri Pukhraj' infected potato tubers were planted during 15th November in both respective years under field conditions with three replications at different depth of planting (soil depth: 15, 20 and 25 cm). Results revealed that per cent disease incidence and severity increased with increase in depth of planting during both the years. Black scurf incidence and severity showed a positive correlation with morning soil temperature and soil moisture whereas, a negative correlation with evening soil temperature (ST_e). The optimization in depth of planting can be a good eco-friendly and economic alternative for the management of black scurf of potato.

Key words: Potato, Black scurf, Depth, *Rhizoctonia solani*. Soil.

Introduction

Solanum tuberosum belongs to Solanaceae family and is categorized as tuberous underground stem crop. This is one of the most important crop ranked 4th all over the world after rice, wheat and maize. According to FAO (2019). The total world potato production is estimated at 370 MT and total worldwide planted area of 17th MH. Potato crop suffers from various biotic and abiotic stresses which may cause crop failure and yield losses depending on their severity. In Punjab, the area under cultivation of po-

tato crop is decreasing for the last 10 years. This is due to the fact that the alternate Rabi crop of wheat is more profitable as the potato crop is more vulnerable to several biotic and abiotic stresses. The key factors affecting potato cultivation are (a) biotic stresses including diseases like early blight, late blight, powdery scab of potato, pink rot, bacterial wilt, soil and tuber-borne diseases, insect-pests like aphids, whiteflies, thrips, mites, hoppers, potato tuber moths, viruses and potato cyst nematodes (Singh *et al.*, 2020); and (b) abiotic stresses like heat, drought, nutrient deficiency, salinity, and cold/frost

(Handayani *et al.*, 2019). Among various phyto fungus diseases, the black scurf disease incited by *Rhizoctonia solani* Kuhn (*Thanetophorus cucumeris*) has emerged as a main problem in potato cultivation in recent years which affects its quality and quantity and lowers its market value. The soil micro-climate has a great influence on disease severity percent as soil temperature and moisture are the keys diverse for the growth of soil-borne pathogens (Hwang *et al.*, 2000). Adams and Stevenson (1990) reported that, excessive percentage of soil moisture can harm potato tubers causing enlarged lenticels and increased susceptibility to tuber-borne infections. Shallow planting at 5.0 cm soil-depth recorded least value of necrotic stems and disease severity in comparison with the greatest value when infected (*R. solani*) potato seed tubers were planted at 20 cm soil-depth (Singh *et al.*, 2005). Contamination by pesticides like fungicides in environment is a major global food safety issue, posing a serious threat to human health as well as other biodiversity. Protecting the ecosystem from the degrees of harmfulness of contaminated food chain with pesticides has become a daunting task and an environmental risk has emerged as a key problem for the country. Therefore, the essential need of the hour is to find suitable management strategy that will decrease inoculum level in the soil. The cultural approaches can prove to be promising one in reducing the amount of inoculum level in soil and the tubers. Keeping in view, the present investigation was carried out to find out influence of soil temperature, moisture and planting depth under field conditions on development of black scurf disease of potato aiming to minimize the negative effect of fungicides on environment, development of alternative strategies to control black scurf.

Materials and Methods

The present investigation was carried out in the Agricultural Research farm (Vegetable Science), Guru Kashi University, Talwandi Sabo during *rabi* seasons, 2021-22 and 2022-23. Talwandi sabo is situated in Bathinda, Punjab, India and geographical coordinates is at latitude of 29°59'N and longitude 75°5'E. The infected potato tubers of cultivar 'Kufri Pukhraj' were planted during 15th November, 2021 and 2022 under field conditions (plot size: 3.0 x 2.0 m; spacing: 60 x 40 cm) using CRD with three replications at different depth of planting (soil depth: 15,

20 and 25 cm). Observations of soil temperature and moisture were recorded at weekly interval after 50 days of planting till harvesting by using soil thermometer and gravimetric method, respectively. The disease incidence and disease severity index were recorded after harvesting of the potato tubers.

Statistical analysis

The data recorded in experiment was statistically analysed using WASP 1.0 statistical programme at Central Computer Laboratory, Guru Kashi University, Talwandi Sabo.

Disease incidence and Disease severity

The percent disease incidence (PDI) was assessed as follows:

$$\text{Eq. 1 Disease incidence (\%)} = \frac{\text{No. of tubers infected}}{\text{Total number of tubers observed}} \times 100$$

Disease severity was determined by using the method adopted by Kumar and Raj (2016) as following formula:

$$\text{Eq. 2 Disease Severity (\%)} = \frac{\text{Sum of individual rating scale}}{\text{No. of tubers observed Maximum disease rating}} \times 100$$

*Equation (Eq)

Results and Discussion

Influence of depth of planting on development of black scurf of potato

The effect of different soil depths of planting (15, 20 and 25 cm) of seed tubers on the development of black scurf disease of potato observed during the season 2021-22 and 2022-23 have been depicted in Table 1. The effect of different depths of planting (15, 20 and 25 cm) of potato seed-tubers on the development of black scurf (Table 1) revealed that per cent disease incidence and severity increased with increase in depth of planting during both years. Maximum per cent disease incidence (57.6 and 58.9%) and severity (27.2 and 27.1%) were observed when infected tubers were sown at 25 cm depth of soil, whereas minimum per cent disease incidence (44.1 and 44.9%) and severity (21.1 and 22.2%) was observed when infected tubers were planted at soil-depth of 15 cm in the respective years.

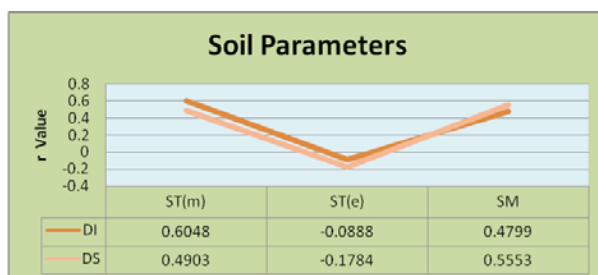
Table 1. Effect of depth of sowing, soil temperatures, soil moisture on disease incidence and severity (overall mean of three replications)

Year (cm)	Soil depth		Soil temperature (°C)	Soil moisture (%)	Disease incidence (%)	Disease severity (%)
	Morning	Evening				
2021 -2022	15	13.9	15.6	17.9	44.1	21.1
	20	14.1	15.1	18.7	50.8	25.3
	25	15.0	14.9	19.0	57.6	27.2
2022-2023	15	15.5	17.9	16.6	44.9	22.2
	20	16.8	17.4	17.4	53.4	25.0
	25	17.6	17.3	17.8	58.9	27.1

Table 2. Correlation coefficient between soil parameters and disease incidence and disease severity (pooled)

Sr. No.	Parameters	Correlation coefficient (DI)	Correlation coefficient(DS)
1.	Morning soil temperature (°C)	0.6048	0.4903
2.	Evening soil temperature (°C)	-0.0888	-0.1784
3.	Soil moisture (%)	0.4799	0.5553

The different depth of planting and soil weather parameters differed significantly from each other with respect to per cent disease incidence and severity. The different soil parameters viz. soil temperature (morning and evening) and soil moisture affecting epidemic development under field conditions were considered. The findings showed that, soil temperature morning (STm) increased along with planting depth whereas soil temperature evening (STe) decreased in both years. In this investigation, revealed that correlation coefficient of per cent disease incidence (PDI) was significantly and positively correlated with morning soil temperature (0.6048) and soil moisture (0.4799) and same with percent disease severity (STm: 0.4903 and SM: 0.5553). Soil temperature evening was negatively correlated with PDI (-0.0888) as well as PDS (-0.1784). The data summarized in Table 2 and graphically presented in Fig. 1.

**Fig. 1.** Correlation coefficient between soil parameters and disease incidence and disease severity (pooled)

The findings of Singh *et al.* (2005), the black scurf incidence was significantly influenced at different depths of planting. The present results were also in conformity with the findings of Manoj *et al.*, (2018) who worked on the effect of various depths of planting (15, 20 and 25 cm) of potato seed-tubers on the development of black scurf, they evaluated that, per cent disease incidence and severity increased with the depth of planting during both years. Also noted that, soil borne fungal black scurf disease incidence and severity showed a negative correlation with soil evening temperature whereas a positive correlation with soil morning temperature and soil moisture.

Conclusion

In the current study, it could be concluded that at the shallow depth of planting, black scurf of potato disease incidence and severity was found minimum percentage as compared to deep depth of planting tubers. Black scurf incidence and severity showed a positive correlation with morning soil temperature and soil moisture whereas, a negative correlation with evening soil temperature (STe). Hence, sowing of potato tubers at 15 cm soil-depth under Malwa region of Punjab is an ecologically and economically viable option to control the black scurf, enhance the crop productivity and nutritional security which ultimately uplift the farmer community and reduce the environmental degradation.

References

- Adams, S.S. and Stevenson, W.R. 1990. Water management, disease development and potato production. *Am. Potato J.* 67: 3-11.
- Fao, 2019. Faostat. Food and agriculture organization of the United Nations, rome, italy. [Http://www.fao.org/faostat/en/](http://www.fao.org/faostat/en/).
- Handayani, T., Gilani, S.A. and Watanabe, K.N. 2019. Climatic changes and potatoes: how can we cope with the abiotic stresses? *Breed. Sci.* 69: 545-563.
- Hwang, S.F., Gossen, B.D., Turnbull, G.D., Chang, K.F., Howard, R.J. and Thomas, A.G. 2000. Effects of temperature, seeding date, fungicidal seed treatment and inoculation with *Fusarium avenaceum* on seedling survival, root rot severity and yield of lentil. *Can. J. Pl. Pathol.* 80: 899-907.
- Kumar, M. and Gupta, A. 2016. Effect of weather variables on whitefly (*Bemisia tabaci gennadius*) population in development of potato apical leaf curl virus disease. *J. Agrometeorol.* 18(2): 288-291.
- Manoj, K. and Anil, K. 2018. Influence of soil temperature, moisture and planting depth on black scurf development in potato (*Solanum tuberosum* L.). *J. Agrometeorol.* 20 (4): 342-344.
- Singh, A.K., Chakrabarti, S.K., Singh, B., Sharma, J. and Dua, V.K. 2020. Potato Science and Technology for Sub-Tropics. New Delhi: New India Publishing Agency.
- Singh, B., Lakra, B.S., Niwas, R. and Singh, M. 2005. Influence of depth of planting on development of black scurf of potato (*Rhizoctonia solani*). *Ann. Bio.* 21(2): 241-244.

