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Prashant Kumar Singh
 Department of Plant
 Pathology, College of
 Agriculture, RVSKVV,
 Gwalior, Madhya Pradesh,
 India

Jagdish Kumar Patidar
 Department of Plant
 Pathology, College of
 Agriculture, RVSKVV,
 Gwalior, Madhya Pradesh,
 India

Reeti Singh
 Department of Plant
 Pathology, College of
 Agriculture, RVSKVV,
 Gwalior, Madhya Pradesh,
 India

S Roy
 Central Potato Research
 Station, Gwalior, Madhya
 Pradesh, India

Bhagyashree Singh
 Department of Plant
 Pathology, College of
 Agriculture, RVSKVV,
 Gwalior, Madhya Pradesh,
 India

Corresponding Author:
Prashant Kumar Singh
 Department of Plant
 Pathology, College of
 Agriculture, RVSKVV,
 Gwalior, Madhya Pradesh,
 India

Occurrence and distribution of black scurf of potato in different districts of Madhya Pradesh

Prashant Kumar Singh, Jagdish Kumar Patidar, Reeti Singh, S Roy and Bhagyashree Singh

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Abstract

Rhizoctonia solani Kuhn (Teleomorph: *Thanatephorus cucumeris* Frank Donk) causing black scurf and stem canker on potato crop is a economically important diseases. The Rhizoctonia disease complex is common and occurs in potato production areas throughout the world. A survey was conducted during Rabi 2015-16 and 2016-17 in the farmer's field of the five districts of Madhya Pradesh viz., Gwalior, Bhind Morena, Shivpuri and Datia to find out the incidence and severity of black scurf of potato. Surveyed results indicated the prevalence of disease at all the surveyed area. Maximum disease incidence and severity was recorded at Sheopur district (25.23 and 13.84% respectively), while minimum disease incidence (45%) was observed at Bhind district (13.81 and 8.17% respectively). At individual localities, the highest mean disease incidence and severity of 36.82 and 18.53 per cent respectively was found at Ajapura, while the minimum disease incidence and severity of 9.28 and 6.24 per cent respectively was found at Sonpura.

Keywords: Survey, black scurf, disease incidence and disease severity

Introduction

Potato (*Solanum tuberosum* L.) is an annual, herbaceous and dicotyledonous plant belonging to genus *Solanum* and family Solanaceae, a major vegetable crop of India, grown on an area of 2179 thousand hectares with an annual production of 48605 thousand tonnes (Anon., 2017) [5]. Potato belongs to one botanical species *Solanum tuberosum* but it comprises of thousands of varieties that vary in their characteristics. Potato's origin is from South America Andes. Chile and Peru fight over its origin (Anon., 2008) [4]. Potato is exported from India to other countries like, Pakistan (50.2%), Nepal (24.6%), Sri Lanka (10.3%), Maldives and Singapore (Anon., 2011) [7]. In India, the main potato growing states are Uttar Pradesh followed by West Bengal, Bihar, Punjab, Gujarat and Madhya Pradesh. In Madhya Pradesh, potato is covering an area over, 156 thousand hectares with a production of 3134 thousand MT and productivity of 10.06 MT/ha. (Anon., 2017) [6]. Potato crop is having serious and major pathological threats during recent years, soil-borne and seed-borne diseases have turned out to be a major threat to this crop (Ahmad *et al.*, 1995) [3]. Among the various fungal diseases of potato crop, black scurf of potato is a serious disease of worldwide including India and is responsible for 10-25% yield loss in India (Sharma, 2015) [20], up to 30% the Canada and yield losses up to 50% in other countries, thereby affecting in potato production severely (Banville, 1989; Woodhall *et al.*, 2008 and Keiser, 2008) [10, 25, 13]. The disease causes defacing of tuber with the deposition of sclerotia. As a result, farmers have to bear 5-7% economic loss (Shekhawat, *et al.*, 1993 and Singh and Shekhawat 1994) [21-22]. This disease is major potential threat to the fast developing seed potato cultivation in Indian plains. It is distributed in India in different regions at different levels of severity and is a major disease problem in fields where potato is cultivated year after year in the same field (Khurana *et al.*, 1998; Arora 2011; Arora, 2012) [16, 18, 9]. It is claimed that there is hardly any plant species, which cannot be infected by *R. solani*. Further, the fungus has worldwide distribution (Ogoshi, 1987) [18] and isolates of *R. solani* are highly variable in aggressiveness. In Madhya Pradesh, status of black scurf is not documented. This paper reports the results of a wide-scale study undertaken in the major potato-growing districts of Madhya Pradesh to determine the incidence and distribution of the black scurf of potato.

Materials and Methods

An intensive roving survey was conducted during *Rabi* 2015-16 and 2016-17 in the farmer's field of the five districts of Madhya Pradesh *viz.*, Gwalior, Bhind Morena, Sheopur and Datia to find out the incidence and severity of black scurf of potato. In each district, a minimum of three villages and in each village five fields were examined. A total of 45 fields were surveyed at the time of harvesting. Five place were selected for each field and 100 tubers were examined and black scurf infected and healthy tubers were counted. Disease incidence was determined by using following formula

$$\text{Disease Incidence} = \frac{\text{No of infected tubers}}{\text{Total tuber observed}} \times 100$$

Tubers were harvested at plant senescence and washed and each tuber was scored for black scurf according to a visual tuber surface cover score ranging from 0 to 5 disease rating scale developed by Ahmad *et al.* (1995) [2].

$$\text{Disease severity} = \frac{\text{Sum of individual rating}}{\text{No. of tubers examined} \times \text{Max disease rating}} \times 100$$

Where

0 = no symptoms on potato tubers; 1 = less than 1% tuber area affected; 2 = 1-10% tuber area affected; 3 = 11-20% tuber area affected; 4 = 21-50% tuber area affected; 5 = 51% or more tuber area affected.

Results

A survey was conducted during *Rabi* 2015-16 and 2016-17 in the farmer's field of the five districts of Madhya Pradesh *viz.*, Gwalior, Bhind Morena, Shivpuri and Datia to find out the incidence and severity of black scurf of potato. Surveyed results indicated the prevalence of disease at all the surveyed area *viz.*, Amargarh, Madanpur. Taluk, Kathaa, Akoun, Sonpura, Nainpuri, Chandpur, Barawali, Saroda, Ajapura, Andhupura, Dhirpur, Bhadurpur and Dholagarh (Fig. 1 and 2). The aboveground parts of potato plants showed aerial tubers, rolling of leaves and chlorosis before harvesting while the most obvious symptoms of the black scurf were observed as sclerotial masses on tubers after harvesting of crop.

In year 2015-16, maximum disease incidence and severity was recorded in Sheopur district (26.84 and 14.62% respectively), followed by Morena (25.93 and 14.37% respectively), Datia (20.52 and 11.69% respectively) and Gwalior (16.37 and 9.63% respectively) [Fig. 3 and 4], while minimum disease incidence and severity was recorded in Bhind district (14.20 and 8.03% respectively). Among the villages, maximum disease incidence and severity was recorded in Ajapura (37.83 and 19.07% respectively) followed by Andhupura (32.33 and 17.70% respectively) and Dholagarh (30.33 and 17.63% respectively), [Table 1], while minimum disease incidence and severity was recorded in Saroda (10.37 and 7.08% respectively) followed by Sonpura (10.83 and 7.32% respectively) and Madanpur (12.33 and 7.58% respectively),

In year 2016-17, highest disease incidence and severity was observed in Sheopur (23.61 and 13.07% respectively) followed by Morena (17.74 and 11.44% respectively), Datia (15.51 and 9.62% respectively) and Bhind (13.41 and 8.31% respectively), while minimum disease incidence and severity was recorded in Gwalior (12.48 and 7.28%

respectively). Among individual visited sites, maximum disease incidence was observed in Ajapura (35.80 and 17.99% respectively) followed by Andhupura (26.37 and 15.55% respectively) and Dholagarh (25.77 and 15.23% respectively) [Table 1], while minimum disease incidence and severity was recorded in Sonpura (7.73 and 5.16% respectively) followed by Saroda (8.67 and 5.66% respectively) and Madanpur (8.93 and 5.79% respectively) [Fig. 1 and 2].

Mean of two years data showed that, maximum disease incidence and severity was recorded at Sheopur district (25.23 and 13.84% respectively) followed by Morena (21.84 and 12.91% respectively), Datia (18.02 and 10.66%), while minimum disease incidence (45%) was observed at Bhind (13.81 and 8.17% respectively) followed by Gwalior (14.42 and 8.45 respectively). At individual localities, the highest mean disease incidence and severity of 36.82 and 18.53 per cent respectively was found at Ajapura followed by Andhupura (29.35 and 16.62% respectively) and Dholagarh (28.05 and 16.43% respectively) [Table 1]. The minimum disease incidence and severity of 9.28 and 6.24 per cent respectively was found at Sonpura followed by Saroda (9.52 and 6.37% respectively) and Madanpur (10.63 and 6.69% respectively) [Fig. 1 and 2].

Discussions

Survey provides the information about occurrence and distribution of disease. It is held to find out the disease free area for healthy seed production. Selected disease free area can be used for healthy seed production. Survey also provides the status of diseases prevalent in particular area. In the present investigation, five major potato growing districts of Madhya Pradesh were surveyed to find out the status of black scurf of potato. Surveyed results indicated the prevalence of disease at all visited areas. The aboveground parts of potato plants showed aerial tubers, rolling of leaves and chlorosis before harvesting while the most obvious symptoms of the black scurf were observed as sclerotial masses on tubers after harvesting of crop. Maximum disease incidence and severity was recorded at Sheopur district followed by Morena, Datia, while minimum disease incidence was observed at Bhind followed by Gwalior.

Khan *et al.* (1995) [15] conducted survey of potato growing areas of Swat valley during August, 1994 and determine the distribution and incidence of potato tuber diseases. Black scurf was prevalent in all locations except Mataltan and Ushu.

Black scurf, caused by *Rhizoctonia solani*, is becoming more common and serious disease in the potato fields of Multan region; may inflict enormous losses to the production of potato crop (Wharton *et al.*, 2007) [24].

Malik *et al.* (2014) [17] conducted survey of different locations *viz.* Narangaabad, Band Bosan, Kaian Pur, Kotla Abdul-Fateh and Dhillun to assess the prevalence of disease in Multan region. Maximum disease incidence and severity of 95.00% and 3.1 rating, was recorded in Kotla Abdul-Fateh respectively. Similarly survey conducted by Abdlla *et al.* (2017) [1] on the prevalence of stem canker and black scurf disease of potato grown. Under Organic cultivation, the regions of Ismailia, Behera and New Valley showed high frequencies of *R. solani* isolates (47.09%, 44.44 and 43.48% respectively), while the lowest frequencies were observed in Giza and Aswan (38.09 and 39.13 respectively).

Rauf *et al.* (2007) [19] reported that the highest mean disease prevalence, incidence and severity of 99.50%, 65.55% and 2.95 rating, respectively, was found in zone 2, comprising of the Punjab province. High prevalence of black scurf of potato in Punjab is due to the favorable environmental condition for the inoculum, extensive monocropping of highly susceptible cultivar Desiree, poor cultural practices and lack of quarantine measures for disease (Hooker, 1981; Khan and Naumann, 1989) [12, 14].

Low soil temperature, high moisture level together with zinc deficiency was the major factors favoring the development of disease in the surveyed locations (Ahmed *et al.*, 1995; Thongbai *et al.*, 1993) [3, 23]. Potato crop cultivated without

proper rotation tactics may lead to the encouragement of soil-borne diseases (Zanoni, 1991) [26]. In 1991, a survey in South Australia the most prevalent disease in all surveyed districts were target spot caused by *Alternaria solani*, and Rhizoctonia canker caused by *Rhizoctonia solani* (Dillard *et al.* 1993) [11].

Ahmad *et al.* (1995) [3] conducted survey on development of potato diseases in different potato growing areas of Pakistan. Stem canker and black scurf, *Verticillium* wilt, *Fusarium* wilt, common scab, and powdery scab (cause controversial) are major diseases and present in almost all production zones.

Table 1: Survey of black scurf of potato in districts of Madhya Pradesh

District	Village	Per cent disease incidence			Per cent disease severity		
		2015-16	2016-17	Mean	2015-16	2016-17	Mean
Gwalior	Amargarh	14.20	11.43	12.82	8.00	7.06	7.53
	Madanpur	12.33	8.93	10.63	7.58	5.79	6.69
	Taluk	22.57	17.07	19.82	13.30	8.99	11.14
	Mean	16.37	12.48	14.42	9.63	7.28	8.45
Bhind	Kathaa	14.60	11.17	12.89	8.78	6.97	7.88
	Akoun	17.17	21.33	19.25	8.00	12.78	10.39
	Sonpura	10.83	7.73	9.28	7.32	5.16	6.24
	Mean	14.20	13.41	13.81	8.03	8.31	8.17
Morena	Nainpuri	26.77	17.23	22.00	13.44	10.63	11.75
	Chandpur	22.30	14.17	18.24	12.88	10.54	11.99
	Barawali	28.73	21.83	25.28	16.79	13.16	14.97
	Mean	25.93	17.74	21.84	14.37	11.44	12.91
Sheopur	Saroda	10.37	8.67	9.52	7.08	5.66	6.37
	Ajapura	37.83	35.80	36.82	19.07	17.99	18.53
	Andhupura	32.33	26.37	29.35	17.70	15.55	16.62
	Mean	26.84	23.61	25.23	14.62	13.07	13.84
Datia	Dhirpur	17.33	11.33	14.33	9.03	7.57	8.30
	Bhadurpur	13.90	9.43	11.67	8.41	6.06	7.23
	Dholagarh	30.33	25.77	28.05	17.63	15.23	16.43
	Mean	20.52	15.51	18.02	11.69	9.62	10.66

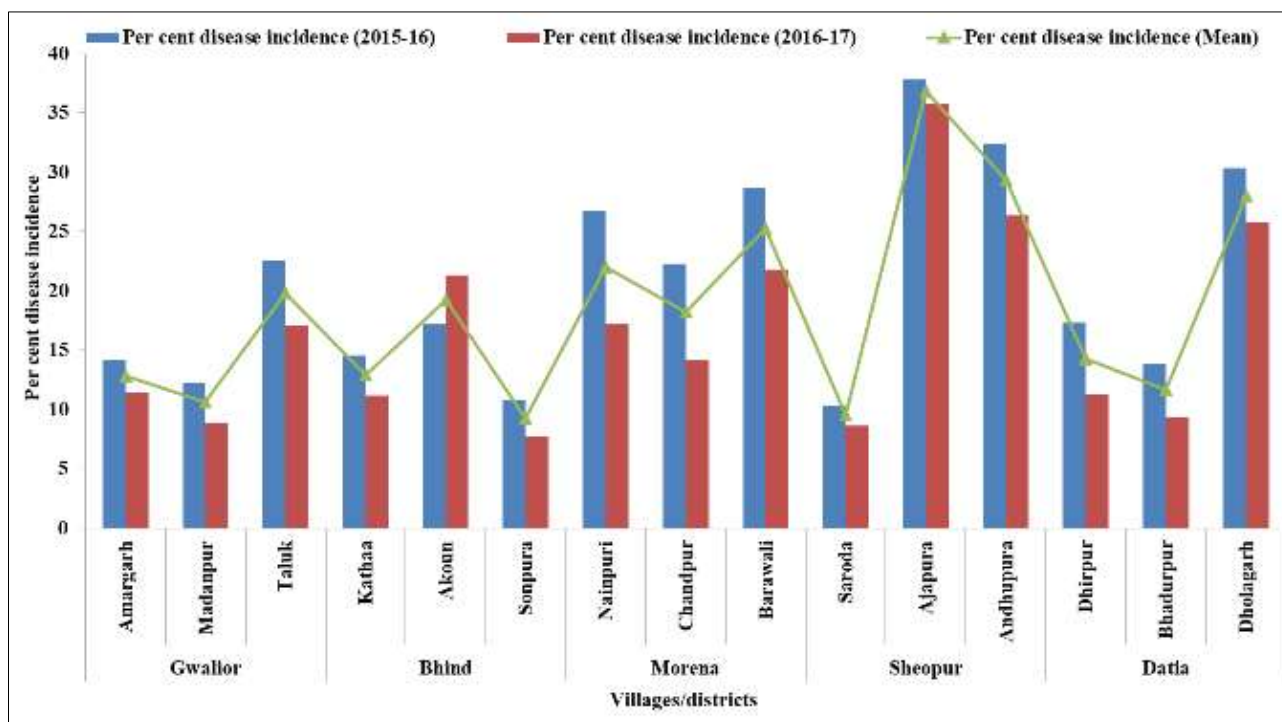


Fig 1: Per cent disease incidence of black scurf of potato at surveyed districts during 2015-16 and 2016-17

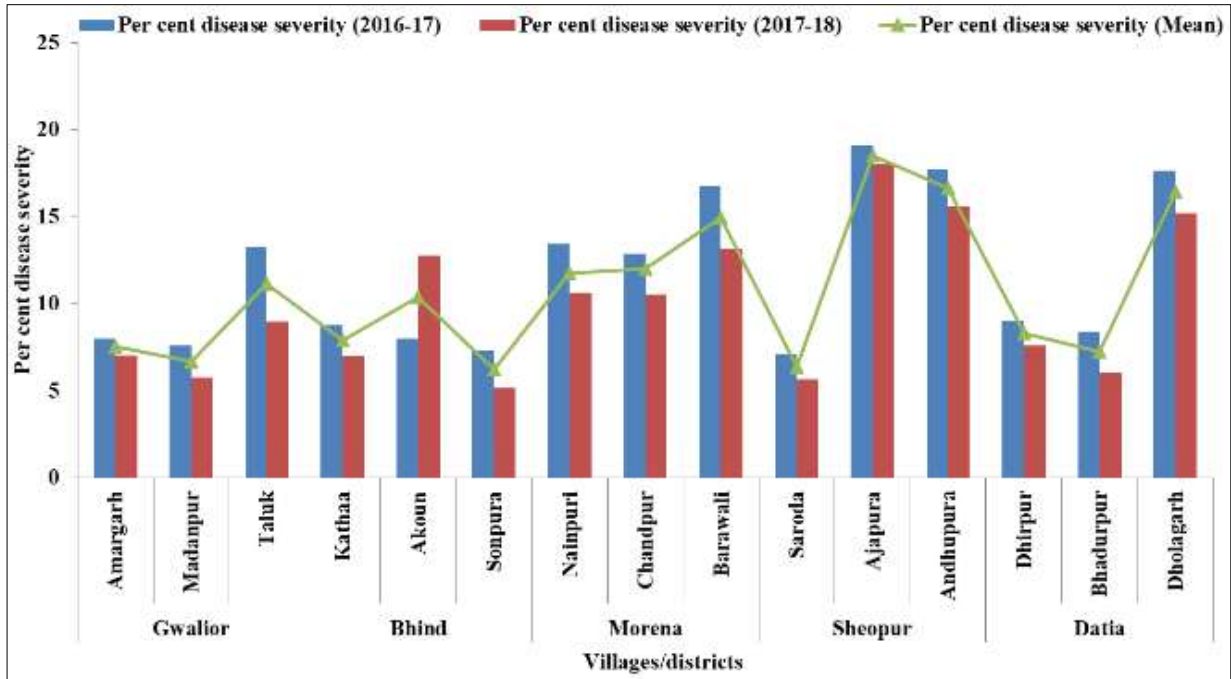


Fig 2: Per cent disease severity of black scurf of potato at surveyed districts during 2015-16 and 2016-17

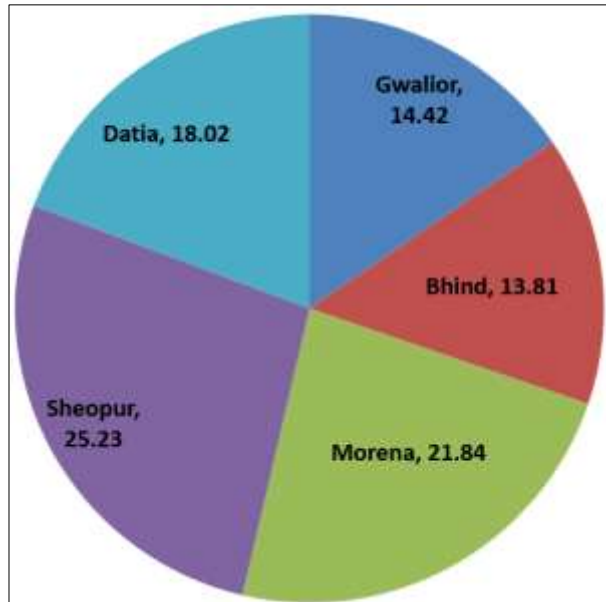


Fig 3: Disease incidence of black scurf in major potato growing district of Madhya Pradesh

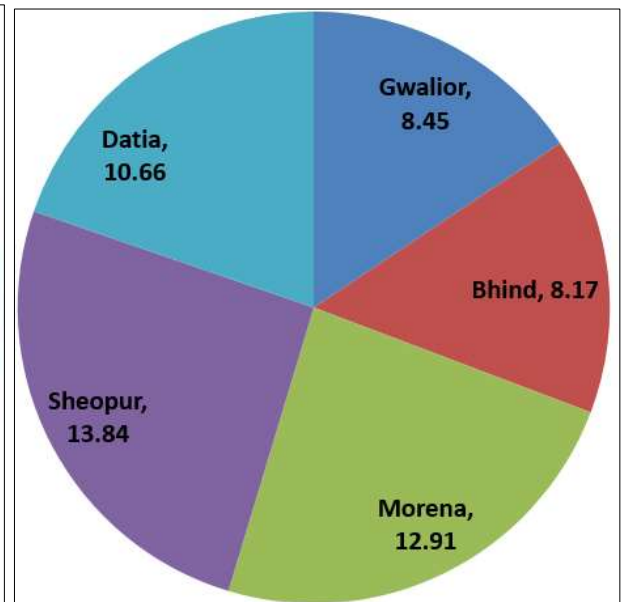


Fig 4: Disease severity of black scurf in major potato growing district of Madhya Pradesh

Conclusion

In article, the survey conducted across five districts of Madhya Pradesh revealed the widespread prevalence of black scurf disease in potato crops during the Rabi seasons of 2015-16 and 2016-17. The study identified various symptoms associated with the disease, including aerial tubers and sclerotial masses on tubers. Analysis of the data highlighted Sheopur district consistently exhibiting the highest disease incidence and severity, followed by Morena and Datia. Conversely, Bhind consistently exhibited the lowest disease incidence. Comparisons with previous surveys in other regions underscore the growing significance of black scurf, attributed to factors such as environmental conditions, cropping practices, and soil health. Understanding these dynamics is crucial for disease management strategies and ensuring sustainable potato production in the region.

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