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Research Paper

Fungicidal Management of Black Scurf (*Rhizoctonia solani*) of Potato in Gujarat

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A B S T R A C T

Black scurf (*Rhizoctonia solani*) disease of potato is becoming prominent in many potato growing districts of Gujarat state which reduce quality and market value of the produce, resulting in economic losses. The field experiment was conducted during *rabi* season of 2014-15 in naturally infested field with scurf pathogen at Potato Research Station, S. D. Agricultural University, Deesa (Gujarat) with the objective to find out suitable management strategies for black scurf pathogen through fungicides. Among different fungicides tested against black scurf, the treatment having tuber spray with pencycuron 22.9% SC @ 5 ml/lit recorded minimum disease incidence (4.33%) with the least disease index (0.27) as compared to other treatments. The same treatment gave maximum total tuber yield (342.00 q/ha) with highest income Rs. 2,67,750/ha. When price computed with healthy and diseased tuber yields among treatments, the maximum income variation was (Rs. 86,250/ha) recorded by the same treatment followed by the tuber spray with pencycuron @ 2.5 ml/lit (Rs. 71,120/ha). The treatment can provide an effective and economical management of black scurf of potato for cultivaters.

***Key words*:** Black Scurf, Potato, *Rhizoctonia solani,* Fungicides, Management

Potato (*Solanum tuberosum* L.) is world's third most important crop after rice and wheat and occupies an important place in the diet of many countries in the world. In India potato is largely consumed as vegetable while in most of the developed countries of the 40 world it is considered as staple food. India is an important potato producing country in the world. It ranks third in potato area (1.90 million/ha) after China and Russia and second in production (45 million tones) after China with average yield of 22.9 t/ha [1]. Food Agriculture Organization identified potato as a 'Food of Future' as it has potential of fighting hunger and poverty in very large part of the world. In this context year 2008-09 was celebrated as "International Potato Year" throughout the world. Gujarat is the fifth largest potato producing state in India after Uttar Pradesh, West Bengal, Bihar and Madhya Pradesh [2]. Gujarat also has the distinction of attaining the first rank for potato productivity in the country. The area under potato cultivation in Gujarat state was 71,500 hectares with total production of 17,89,200 million tones with an average yield of 25.02 t/ha during 2012-13 [3].

The crop suffers from large number of soil and tuber borne diseases such as black scurf (*Rhizoctonia solani* Kuhn), common scab (*Streptomyces scabies* Thaxter,), powdery scab (*Spongospora subterranean* Walker), dry rot (*Fusarium* spp.), *Sclerotium* wilt (*Sclerotium rolfsii* Sacc), *Verticillium* wilt (*Verticillium alboatrum* Reink' & Berth) and sclerotia stem rot (*Sclerotinia sclerotiorum* Lsib). Among these diseases, black scurf caused by *Rhizoctonia solani* Kuhn (*Thanatephorus cucumeris* (Frank) Donk.) is a serious disease of potato worldwide. 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 [4-5]. Although, the disease does not affect the yield quantitatively but it deteriorates the quality and acceptability of tubers for seed, consumers, industries and ultimately the market price. Black scurf is responsible for economic losses and significant reduction in potato quality especially for export-oriented potato [6]. Since, last few years, the disease has covered most of potato growing areas of Gujarat state due to continuous cultivation of potato year after year in the same piece of land by the growers with planting of black scurf infected tubers. Hence, it is now posing a serious threat for successful potato cultivation in the state.

Rhizoctonia solani Kuhn [teleomorph - *Thanatephorus cucumeris* (Fr.) Donk] is a destructive soil-borne plant pathogen [7] infecting a wide range of agricultural and horticultural crops, including legumes and worldwide causing several diseases [8-10]. Management of *R. solani* is difficult because of wide host range and its ability to survive through sclerotia under adverse environmental conditions. In practice, control of diseases caused by *R. solani* relies mainly on fungicides [11]. Seed treatment with chemical, biological or physical agents provides protection to seed and helps in the establishment of healthy crops. It provides good protection to the seed against seed and soil-borne pathogens during the

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germination period and supports early plant development. Therefore, in the present study efforts have been made to evaluate efficacy of different fungicides against the disease.

MATERIALS AND METHODS

Evaluation of fungicides against black scurf disease of potato

The trial was conducted during rabi season of the year 2014-2015 in naturally infested field with scurf pathogen at Potato Research Station, S. D. Agricultural University, Deesa (Gujarat). Seven treatments including one safer chemical (boric acid) were evaluated in this experiment (Table 1). The experiment was conducted using black scurf infested seed potatoes (40-60 gm) of cv. Kufri Khayti having 100 per cent disease incidence (I), with average disease index (DI) 1.0 -2.0. The tubers were treated with respective fungicides and after drying used for planting. The seed tubers after the treatments were planted at 50 x 20 cm^2 spacing in 2.5 x 2.0 m^2 plots (5 rows with 10 tubers each). Each treatment was replicated three times in a randomized block design. Planting was done in the third week of November. All other recommended practices required for cultivation of the crop were followed. After 30 days of planting, per cent plant emergence was recorded. The crop was harvested ninety days after planting (DAP). The observations pertaining to per cent disease incidence and disease index were recorded on one hundred as well as fifty tubers each respectively, selected at random from each plot of replications. Observations on percent disease incidence and disease index (DI) were calculated by using the formula described by [12]. Disease was measured on a scale of 0-5 where 0 = healthy; 1 = up to 10; 2 = >10 to 25; 3 = >25 to 50; 4 = >50 to 75 and 5 = > 75 per cent tuber surface affected by scurf. Disease index (DI) was calculated by using formula described by [13]

$$\text{Disease index} = \frac{\text{Number of tubers} \times \text{their disease intensity grade}}{\text{total number of tubers} \times 100/\text{max. disease score}}$$

Observations on yield of healthy and diseased tubers as well as total tuber yield (q/ha) were recorded separately from different treatments and analyzed statistically. Income variation in healthy and diseased tubers yield of potato were also recorded.

RESULTS AND DISCUSSION

Evaluation of fungicides on black scurf of potato

The data presented in (Table 1) revealed that per cent plant emergence was non-significant among the treatments. It indicates that there is no any effect of different treatments and disease on germination. All the treatments found significantly superior to reduce per cent disease incidence and disease index as compared to control. Pencycuron and boric acid were found the most effective treatments for the management of black scurf as compared to others treatments. However, Treatment T_4 i.e., tuber spray with pencycuron 22.9% SC @ 5 ml/lit recorded minimum disease incidence (4.33%) with disease index (0.27). Treatment T_3 i.e., tuber spray with pencycuron 22.9% SC @ 2.5 ml/lit found second best treatment to reduce disease incidence (7.66 %) where disease index (0.48) was at par with tuber spray with pencycuron 22.9% SC @ 5 ml/lit. Tuber spray with 3% boric acid recorded 12.33 per cent disease incidence and 0.52 disease index. So far disease index is concerned the efficacy of 3% boric acid was at par with tuber spray with pencycuron 22.9% SC @ 5 ml/lit and 2.5 ml/lit.

Table 1 Evaluation of fungicides on black scurf disease of potato during 2014-15

Treatment details	Germination percentage*	Per cent disease incidence*	Disease index*	Tuber yield (q/ha)		
				Healthy	Diseased	Total
T_1: Control	71.41** (89.16)***	47.95** (54.66)***	3.06	117.40	219.00	336.40
T_2: Tuber spray with boric acid @ 3%	73.92 (91.66)	20.94 (12.33)	0.52	149.60	178.60	328.20
T_3: Tuber spray with Pencycuron 22.9% SC @ 2.5 ml/lit	76.69 (94.16)	16.55 (7.66)	0.48	166.60	173.60	340.20
T_4: Tuber spray with Pencycuron 22.9% SC @ 5 ml/lit	80.34 (95.83)	12.59 (4.33)	0.27	177.00	165.00	342.00
T_5: Tuber treatment with Carbendazim 12% + Mancozeb 64% @ 1 gm/kg + talk powder (5g)	74.79 (92.50)	25.69 (18.33)	1.28	124.00	211.20	335.20
T_6: Tuber spray with Carboxin 17.5% + Thiram 17.5% @ 0.5 ml/lit	75.82 (93.33)	22.63 (14.33)	0.87	136.20	196.40	332.60
T_7: Tuber treatment with Carboxin 37.5% + Thiram 37.5% @ 0.25 g/kg seed + talk powder (5g)	72.88 (90.83)	24.44 (16.66)	0.99	129.00	204.40	333.40
SE.m. ±	2.21	0.98	0.11	2.63	2.97	4.29
CD at 5%	NS	3.02	0.33	8.12	9.17	NS
CV%	5.10	6.96	17.12	3.19	2.68	2.21

*Average of three replications,
**Arc sin transformed values,
***Original values

When total tuber yield computed all the treatments were found non-significant, while healthy and diseased tuber yields calculated (Table 2), the data indicated significant difference among the treatment. Maximum healthy tuber yield (177.00 q/ha) and minimum diseased tuber yield (165.00 q/ha) were recorded in treatment T_4 i.e., tuber spray with pencycuron 22.9% SC @ 5 ml/lit followed by tuber spray with pencycuron 22.9% SC @ 2.5 ml/lit before sowing. The maximum income of total tuber yield was Rs. 2,67,750/ha obtained in treatment T_4 (Table 2). When price computed with healthy and diseased tuber yields among treatments, the maximum income variation was recorded by the treatment T_4 i.e., tuber spray with pencycuron @ 5 ml/lit (Rs. 86,250/ha) followed by the treatment T_3 i.e., tuber spray with pencycuron @ 2.5 ml/lit (Rs. 71,120/ha). Among different fungicides tested, pencycuron {N-{(N-cyclopenty1-N' –phenylurea (C.A.) a phenylurea - based fungicide is known to exhibit high and specific activity against *Rhizoctonia solani*. The efficacy of pencycuron alone and/or in combination with boric acid against black scurf of potato has been reported earlier workers also [14-21]. Seed tuber treatment with pencycuron @ 0.057% a.i. or boric acid 3% as spray on the seed tubers prior to planting could control the disease effectively without affecting crop emergence and thus were efficient and economical options available for the control of black scurf [22].

Table 2 Income variation in healthy and diseased tuber yield of potato

Treatment details	Healthy tuber yield (q/ha)	Income of healthy tuber (Rs. /ha)	Diseased tuber yield (q/ha)	Income of diseased tuber (Rs./ha)	Income of total tuber yield (Rs./ha)	Income variation in healthy and diseased tuber yield (Rs./ha)
T_1: Control	117.40	1,17,400	219.00	1,20,450	2,37,850	-3,050
T_2: Tuber spray with boric acid @ 3%	149.60	1,49,600	178.60	98,230	2,47,830	51,370
T_3: Tuber spray with Pencycuron 22.9% SC @ 2.5 ml/lit	166.60	1,66,600	173.60	95,480	2,62,080	71,120
T_4: Tuber spray with Pencycuron 22.9% SC @ 5 ml/lit	177.00	1,77,000	165.00	90,750	2,67,750	86,250
T_5: Tuber treatment with Carbendazim 12% + Mancozeb 64% @ 1 gm/kg + talk powder (5g)	124.00	1,24,000	211.20	1,16,160	2,40,160	7,840
T_6: Tuber spray with Carboxin 17.5% + Thiram 17.5% @ 0.5 ml/lit	136.20	1,36,200	196.40	1,08,020	2,44,220	28,180
T_7: Tuber treatment with Carboxin 37.5% + Thiram 37.5% @ 0.25 g/kg seed + talk powder (5g)	129.00	1,29,000	204.40	1,12,420	2,41,420	16,580

Price of healthy tubers Rs. 1000 /q and diseased tubers Rs. 550/q.

CONCLUSIONS

In recent years cultivation of potato has been decreased due to major constraint of black scurf disease. In our study, in potato cv. Kufri Khyati, tuber spray with pencycuron 22.9% SC @ 5 ml/lit was observed to be an effective treatment which reduced black scurf incidence and index as compared to other treatment as well as untreated control under field conditions. It can be recommended to the cultivators of potato for enhancing the yield and income.

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