

## Original Research Article

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## Thifluzamide 24% SC: A New Molecule for Potato Tubers Treatment against Black Scurf Disease of Potato Caused by *Rhizoctonia solani*

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### ABSTRACT

Black scurf of potato caused by *Rhizoctonia solani* is one of the most important disease in the category of soil and tuber borne disease especially in fungal group. Infested seed tubers are the main source of infection. Boric acid and pencycuron are the two chemicals which are frequently used by the Indian farmers to control black scurf of potato. New molecule: Thifluzamide 24% SC was evaluated for bio-efficacy and phytotoxicity effect against black scurf disease of potato during two consecutive years (2014-2016). Results revealed that Thifluzamide 24% SC @ 3.0 ml/10 kg seed was highly effective and resulted in reduction in disease incidence (95.69% during 2014-15 and 96.50% during 2015-16) and disease severity (97.39% during 2014-15 and 97.43% during 2015-16) with higher yield (42.93 t/ha) followed by Carboxin 37.5 + Thiram 37.5 WS @ 25 g/10kg tubers. The plant emergence percentage ranged from 90.22 to 97.39% at tested different doses of Thifluzamide 24% SC. No adverse effect on emergence (%) and on phytotoxicity parameters was observed when Thifluzamide 24% SC was tested at 2.5 ml/10 kg tubers. Thifluzamide 24% SC @ 2.0, 2.5 and 3.0 ml/10 kg seed tubers was effective against black scurf of potato by slurry treatment.

#### Keywords

Black scurf,  
Disease severity,  
Potato,  
*Rhizoctonia Solani*,  
Thifluzamide 24%  
SC.

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### Introduction

Black scurf of potato caused by the fungus *Rhizoctonia Solani* Kuhn (teleomorph *Thanatephorus cucumeris* [A.B. Frank] Donk) is a serious disease of potato in India and worldwide. It causes 10–25% yield loss in India depending upon growing regions potatoes i.e. hills and plain (Sharma, 2015), whereas up to 30% yield loss reported in Canada (Banville, 1989; Wood hall *et al.*, 2008), besides it also decreases the market acceptability by the consumers due to black sclerotial present on surface of the tubers. The

characteristic symptoms of black scurf viz., dark brown to black colored hard masses of sclerotia, irregularly shaped and superficial, varying from small, flat on tubers with tightly adhere and stem canker are the result of *Rhizoctonia* disease complex in potato (Tsrer, 2010). The *R. solani* may also attack and kill emerging sprouts in soil and results in reduced crop stand and thus cause more loss in yield (Lakra, 1992). Now days, sclerotial structure is also observed on roots of potato plants, besides surface of potato tubers. Black

scurf 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, 2012). Control measures through cultural practices and biological control are used but they are not completely effective and black scurf disease remains a persistent problem. Seed treatment with 3% boric acid as dip treatment before cold storage has been recommended by Central Potato Research Institute, Shimla, India as a safe and effective chemical treatment for the control of this disease (Anonymous, 1987; Somani, 1988; Singh *et al.*, 2002). The disease is also managed through seed treatment with benomyl, carbendazim, thiabendazole, pencycuron, penflufen 240 FS and Thiophinate methyl 45%+ pyaclostrobin 5 % FS (Banyal, 2002; Thind *et al.*, 2002; Lal *et al.*, 2014; Lal *et al.*, 2016). Two chemicals viz., Boric acid and Pencycuron are frequently used by Indian farmers to management black scurf of potato (Khurana *et al.*, 2001). Thifluzamide is comes under the chemical group of Thiazole-carboxamides and its target site is Succinate dehydrogease complex II in respiratory chain and affect the fungal respiration (FRAC, 2017). It belongs to code 7 under FRAC. This molecule is registered for use in rice, turf, potatoes, coffee and strawberries in Brazil, Mexico, Colombia, Venezuela, Japan, Korea, China and Vietnam (Kumar *et al.*, 2012). Thifluzamide 24% SC is registered on rice but not on potato. Therefore, in the present study a new molecule, Thifluzamide 24% SC was evaluated for its efficacy against black scurf of potato and phytotoxicity under field conditions.

## **Materials and Methods**

The field experiments were conducted at ICAR-Central Potato Research Institute Campus, Modipuram, Meerut (29.1o N,

77.92o E, 300 msl) during 2014-15 and 2015-16 crop seasons. Cent percent infested diseased seed tubers of cv. Kufri Bahar were used in this experiment. Thifluzamide 24% SC was evaluated at four doses (1.5, 2.0, 2.5 and 3.0 ml/10 kg tubers) for bio-efficacy and two doses (2.5 and 6.0 ml/10 kg tubers) for phytotoxicity against black scurf of potato. The efficacy was compared with Carbendazim 25% + Mancozeb 50% WS @ 7.0g/10kg and Carboxin 37.5 + Thiram 37.5 WS @ 25 g/10kg tubers. For each treatment, required water volume (200 ml of water/10 kg tubers) was used for making slurry with desired quantity of fungicides for seed tuber treatment. After treatment, tubers were shade dried before planting. The untreated tubers were kept as standard control. Planting of the experiments were carried out in the mid of November each year. The treated seed tubers were planted at 60 (row-row) x 20 cm (plant – plant) spacing in 3 x 3 m plot sizes. Each treatment was replicated three times and planted in Randomized Block Design (RBD). The crop was raised following the standard agronomic practices of the region. Emergence (%) was recorded at 25 days and 35 days of planting and other phytotoxicity parameters viz, leaf tip injury, chlorosis, necrosis, wilting, hyponasty and epinasty were also recorded (15 plants/replication) at 1, 3, 5, 7, 10 and 15 days after germination (starting from 25 days after planting). Haulms were cut > 100 days after planting and the crops were harvested 2 weeks after dehaulming. A total of 225 tubers (75 tubers/replication) were taken randomly from each treatment at harvesting for recording disease incidence and severity. Disease severity was calculated on 0-4 scale rating (0- no disease, 1: 1-25% surface areas covered, 2: 26-50% surface areas covered, 3: 51-75% surface areas covered and 4: >75% surface area covered). Disease incidence, disease severity, percentage disease control, and tuber yield (t/ha) were calculated at the time of

harvesting. The disease index was calculated as per the method of Somani (1986). The experimental data were analyzed with the help of IRRISTAT software (version 4.4.20030719).

## **Results and Discussion**

The emergence (after 35 days of planting) percentage ranged from 90.22 to 95.11% including in healthy control during 2014-15 whereas it was 90.22 to 97.78% during 2015-16 (Table 1). Both the years' emergence percentage of treated tubers with Thifluzamide 24% SC was statistically at par with emergence percentage in diseased (untreated) control. The data recorded on efficacy of fungicides revealed that Thifluzamide 24% SC was effective for control of black scurf (Table 1). The disease incidence was reduced from 92.89% in diseased (untreated) control to 4.0% in Thifluzamide 24% SC @ 3.0 ml/10 kg seed, 5.89% in Thifluzamide 24% SC @ 2.5 ml/10 kg seed, 7.56 % in Thifluzamide 24% SC @ 2.0 ml/10 kg seed, and 4.44% in Carboxin 37.5+Thiram 37.5WS used @ 25g/10kg seed tubers during crop season 2014-15. These treatments were statistically at par each other's.

Similarly, disease severity was reduced from 38.33% in diseased (untreated) control to 1.0% in Thifluzamide 24% SC @ 3.0 ml/10 kg seed, 1.89% in Thifluzamide 24% SC @ 2.5 ml/10 kg seed, 2.00 % in Thifluzamide 24% SC @ 2.0 ml/10 kg seed, and 1.11% in Carboxin 37.5+Thiram 37.5WS used @ 25g/10kg seed. The next best treatment was Thifluzamide 24% SC @ 1.5 ml/10 kg seed and Carbendazim 25%+mancozeb 50% WS @ 7g/10kg seed. During the crop season 2015-16, disease incidence was reduced from 88.89% in diseased (untreated) control to 3.11% in Thifluzamide 24% SC @ 3.0 ml/10 kg seed, 5.33% in Thifluzamide 24% SC @

2.5 ml/10 kg seed, 6.22 % in Thifluzamide 24% SC @ 2.0 ml/10 kg seed, and 5.78 % in Carboxin 37.5+Thiram 37.5WS used @ 25g/10kg seed tubers. The next best treatments were Thifluzamide 24% SC @ 1.5 ml/10 kg seed and Carbendazim 25%+mancozeb 50% WS @ 7g/10kg seed tubers. Similarly, disease severity was reduced from 51.89% in diseased (untreated) control to 1.33% in Thifluzamide 24% SC @ 3.0 ml/10 kg seed, 2.44% in Thifluzamide 24% SC @ 2.5 ml/10 kg seed, 2.56 % in Thifluzamide 24% SC @ 2.0 ml/10 kg seed, and 2.52% in Carboxin 37.5+Thiram 37.5WS used @ 25g/10kg seed.

None of the treatments could produce tuber yield equal to healthy control during 2014-15 and 2015-16. However, Highest tuber yield was recorded in Thifluzamide 24% SC @ 2.0 ml/10 kg seed during 2014-15, whereas, during 2015-16 highest tuber yield was recorded in Thifluzamide 24% SC @ 3.0 ml/10 kg seed. These are statically at par with other doses of Thifluzamide 24% SC, Carbendazim 25%+mancozeb 50% WS @ 7g/10kg seed and Carboxin 37.5+Thiram 37.5 WS @ 25g/10kg seed.

With regard to phytotoxicity, various parameter, viz., leaf tip injury, chlorosis, necrosis, wilting, hyponasty and epinasty was studied with two doses of Thifluzamide 24% SC @ 2.5 ml and 6.0ml /10 kg of seed. It was observed that only leaf tip injury was recorded at lower score in the higher dose of Thifluzamide 24% SC @ 6.0 ml /10 kg of seed. However, no phytotoxicity was observed in treatment Thifluzamide 24% SC @ 2.5 ml /10 kg of seed (Table 2).

Based on bio-efficacy and phytotoxicity studies, it can be concluded that Thifluzamide 24% SC @ 2.0, 2.5, and 3.0 ml /10 kg of seed can be used for managing seed borne infection of *R. solani*.

**Table.1** Bio-efficacy effect of Thifluzamide 24% SC against black scurf of potato

Treatments	Dose ml or gm/10kg seed	2014-15						2015-16					
		Emergence (%)	Disease incidence (%)	Disease severity (%)	Reduction (%) in disease incidence over control	Reduction (%) in disease severity over control	Yield (t/ha)	Emergence (%)	Disease incidence (%)	Disease severity (%)	Reduction (%) in disease incidence over control	Reduction (%) in disease severity over control	Yield (t/ha)
Thifluzamide 24% SC	1.5 ml /10 kg (15ml/100 kg tubers)	92.44	10.67	3.22	88.52	91.59	28.07	90.67	9.78	5.22	89.00	89.94	39.74
Thifluzamide 24% SC	2.0 ml /10 Kg (20ml/100 kg tubers)	95.38	7.56	2.00	91.87	94.78	32.16	97.78	6.22	2.56	93.00	95.08	42.08
Thifluzamide 24% SC	2.5 ml /10 kg (25ml/100 kg tubers)	90.22	5.89	1.89	93.66	95.07	29.05	90.22	5.33	2.44	94.00	95.29	41.98
Thifluzamide 24% SC	3.0 ml /10 kg (30ml/100 kg tubers)	93.78	4.00	1.00	95.69	97.39	31.86	92.44	3.11	1.33	96.50	97.43	42.93
Carbendazim 25%+mancozeb 50% %WS	7.0 g /10 kg (70.0g/100Kg tubers)	92.85	21.78	8.89	76.56	76.81	29.48	92.44	17.78	9.78	80.00	81.16	40.96
Carboxin37.5+Thiram37.5 WS	25.0 g /10 kg (250g/100kg tubers)	90.22	4.44	1.11	95.22	97.10	29.14	91.56	5.78	2.52	93.50	95.14	40.91
Diseased (untreated)-control	100% diseased tuber	93.70	92.89	38.33	0.00	0.00	26.40	92.44	88.89	51.89	0.00	0.00	38.16
Healthy-control	100% healthy tuber	95.11	4.44	1.11	95.22	97.10	33.56	97.78	3.11	1.00	96.50	98.07	45.15
CD (0.05)		7.34	2.59	3.38			4.31	6.53	3.33	2.25			3.87

**Table.2** Evaluation of Thifluzamide 24% SC on phytotoxicity parameters (score 0-10)

S. N o.	Treatments	Formu-lation (ml/10kg)	Leaf tip injury				Chlorosis				Necrosis				Wilting				Hyponasty				Epinasty											
			At different days intervals																															
			1	3	5	7	10	15	1	3	5	7	10	15	1	3	5	7	10	15	1	3	5	7	10	15	1	3	5	7	10	15		
1	Thifluzamide 24% SC	2.5 ml /10 kg (25ml/100 kg tubers)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	Thifluzamide 24% SC	6 ml /10 Kg (60ml/100 kg tubers)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	(Untreated control)	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Score: Zero- No Phytotoxicity, 1: 0-10%, 2: 11-20%, 3:21-30%, 4:31-40%, 5:41-50%, 6:51-60%, 7:61-70%, 8:71-80%, 9:81-90%, 10:91-100%

Rauf *et al.*, (2007) reported that pencycuron was effective for management of black scurf disease of potato, which decreased stem girdling, sprout killing, stem canker, and black scurf prevalence among the three tested fungicides viz. mancozeb 75% WP, benlate and pencycuron. The present findings are in agreement with the results of Khanna *et al.*, (1991) reported that Carbendazim was quite effective for managing black scurf of potato. Thind *et al.*, (2002) reported that Carboxin 37.5+Thiram 37.5 WP was effective for reducing black scurf of potato than the Carboxin 75%WP alone. At present study Carboxin 37.5+Thiram 37.5WS was also found effective for reducing the black scurf of potato. Thifluzamide 24% SC was less effective against sheath blight of rice in vitro study (Kaur and Singh, 2016) and it was also less effective in field experiment against sheath blight of rice (Hunjan *et al.*, 2011). However, Kumar *et al.*, (2012) reported that Thifluzamide 24 % SC was found effective both as preventive and curative activity without any symptoms of phytotoxicity against sheath blight of rice. Difference in results, might be due to doses and time of applications. In the present investigation Thifluzamide 24 % SC was found effective for managing black scurf of potato, by slurry seed treatment; because in this method whole tubers were fully covered by the chemicals, thereby less chance of survive the inoculums present at surface of potato tubers.

In conclusion, the results revealed that the Thifluzamide 24% SC @ 2.0, 2.5 and 3.0 ml/10 kg seed were found equally effective by slurry method against black scurf disease of potato and no phytotoxicity was observed at these doses.

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