BLACK SCURF (*RHIZOCTONIA SOLANI)* INFLUENCE ON POTATO YIELD USING DIFFERENT AGRICULTURAL PRACTICES

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RESEARCH ARTICLE

Abstract

Black scurf and stem canker on potato caused by Rhizoctonia solani Kuhn is a seed and soil born disease of potato with high level of survival. Managing it is a difficult task. Field experiments (using crop rotation and monoculture) were conducted with various fungicides along with treated and untreated checks at NIRDPSB Brasov, Romania.. Two different varieties, Brasovia and Cezarina, were planted in 19, respectively 25 April 2018.

Field experiments conducted to evaluate the efficacy of various fungicides showed that Sercadis (300 g/l fluxapiroxad), Serenade (1015.1 g/l Bacillus subtilis strain QST 713), Prestige Extra 370 FS (pencicuron 250 g/l + imidacloprid 120 g/l), Amistar (250 g/l azoxistrobin) and Ortiva (200 g/l azoxistrobin + 125 g/l difenoconazol) provide control of the disease.

The tubers were harvested 9 September, graded and placed into storage at 4-10°C.

Total yield with different black scurf degree of attack was between 12.48 t/ha to the untreated variant and 20.32 t/ha to Prestige variant on monoculture field and between 12.00 t/ha to the untreated variant and12.38 t/ha to Serenade 8.0 l/ha variant .

On 25 October, 100 tubers from the 35-55 mm and >55 mm size category were selected and assessed for presence of sclerotia.

High prevalence of black scurf is due to the favorable climatic condition for the inoculum, monocropping and poor cultural practices. Low soil temperature and high moisture level was the major factors favoring the development of disease in the monoculture.

The results confirm that black scurf reduces progeny tuber quality and marketable yields.

Keywords: potato, black scurf *(Rhizoctonia solani)*, fungicides, control, production
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INTRODUCTION

Black scurf and stem canker on potato caused by *Rhizoctonia solani* Kuhn (teleomorph: Thanathephorus cucumeris Frank Donk) is one of the most common and oldest diseases of potato affecting stem, stolons and tubers. Is a serious and commonly observed disease with the characteristic symptoms of black scurf (dark brown to black colored hard masses of sclerotia, irregularly shaped and superficial, varying from small, flat, barely detectable blotches to large and raised lumps adhering tightly to the skin) on tubers and stem canker (Tsror, 2010). The two main pathosystems, stem canker and black scurf areclearly separated in term of simptomatology. Stem canker results in quantitative losses by sprout, stolon and root infection, mainlyearly in the season, affecting tuber size and number, whereas black scurf developsduring plant senescenceand is associatedwith the formation ofsclerotia on progeny tubers and their malformation (Das et al, 2014). *Rhizoctonia* potato disease accounts for significant marketable yield losses of up to 30% (Carling et al., 1989, Kanetis et al., 2016).

After the plants emerge, the frequency and intensity of the attack decrease. Sometimes a white-gray collar appears at the base of the stems, made up of the mycelial hyphae of the perfect stage *Thanatephorus cucumeri*s (Frank) Donk. on which basidospores are formed. At this stage the fungus is saprophytic (Plămădeală, 1987).

Black scurf disease increases gradually as level of inoculum increases and sclerotia may develop on tuber surface even under primary low inoculum level, resultantly the control through fungicidal chemistries is not always useful especially when levels of initial inoculum are high (Kyritsis & Wale, 2002).

Currently, the disease is managed by cultural practices, such as crop rotation with grains, and methods that minimize prolonged contact of the plant or tubers with the pathogen, such as planting in warmer, drier conditions to promote rapid sprout emergence and promptly removing

tubers from the field (Secor and Gudmestad, 1999).

The incidence and severity of the disease are substantially reduced in the case of rotations application as against planting potato in monoculture. The previous crop of colza, barley or sweet corn substantially reduces the level of rhizoctoniosis and also ensures a high quality of potato production (Larkin and Honeycutt, 2006).

Chemical fungicides are often used when losses from *R. solani* are great (Parry, 1990). However, current cultural and chemical controls are not completely effective and black scurf disease remains a persistent problem.
Management through fungicidal chemistries is only effective when the levels of initial inoculum were not high as the quantity of Rhizoctonia solani on tubers increases, the effectiveness of fungicides decreases (Tsror and Peretz, 2005).

Sprouts from seed tubers are attacked before emergence resulting in the subsequent killing of sprout tips, a symptom called 'nipping off'. Sprout 'nipping off' affects plant emergence and results in production of weak plants with few stems of uneven height and thickness (El Bakali and Martin, 2006).

Before being planted, seed potatoes are commonly treated with fungicides either by dusting, spraying or dipping in fungicide solutions (Welsh, 1996). Fungicides can also be applied in-furrow at the time of planting (Wicks et al., 1995). Seed tuber and in-furrow treatments can each be used alone, but enhanced disease control can be obtained when both types of treatments are applied (Atkinson et al., 2011).

MATERIAL AND METHOD

Two field experiment were conducted in 2018 to the NIRDPSB Brasov on a cambic chernoseum soil. The study included a trial in monoculture (potato after potato) and a trial in rotation (potato after wheat). Two different varieties were planted in April, 19, Brasovia variety (with yellow skin) and in April, 25, Cezarina variety (with red skin). Trials were carried out in 4 replicates plots in a randomized complete block, 4 rows each with 29 plants (75 cm between rows and 30 cm between plants on row).

Five fungicides (Ortiva – 1 l/ha, Sercadis – 0,3 l/ha, Amistar -3 l/ha, Serenade in three different doses – 8 l/ha, 5 l/ha and 2,5 l/ha and Prestige - 0,5 l/ha) were applied in furrow at the planting time.

Two weeks after plantation the first symptoms of the disease were observed, first of all the delayed in plants growth.
The tubers from two central rows of each four row plot were lifted in September 18 and the samples were separated into three categories (<35 mm, 35-55 and >55 mm). After, 100 tubers are placed into storage at 4-10°C. On October 24, 2018, the tubers from the 35-55 mm size category Brasovia variety and tubers >55 mm size category Cezarina variety were selected from each plot and assessed for presence of sclerotia. Both size of the tubers were examined and the disease level was estimated using the below scale (Table 1).

Table 1

Scale for sclerotia assessment

Disease level	Percentage Coverage
Trace	0% - 1%
Light	>1% - 5%
Moderate	>5% - 10%
Severe	>10%

RESULTS AND DISCUSSIONS

During the vegetation period (April - August) the air temperature was higher by 2.7 ^{o}C, compared to the MAA. Between April 1st and August 31st, the total rainfall exceeded the MAA value by 16.6 mm, noting that the distribution of rainfall was very uneven.

Table 2

Air temperature and rainfalls during the experiment

Year	Month					
	May	**June**	**July**	**August**	**September**	
	Air temperature (°C)					**Average**
2018	16.3	18.1	18.8	20.2	14.7	17.6
MMA	13.6	16.5	18.1	17.5	13.6	15.9
	Amount of rainfall (mm)					**Total**
2018	34.8	204.8	133.6	46.6	43.4	463.2
MMA	82.0	96.7	99.8	76.4	52.5	407.4

Since the month of May with 34.8 mm (42.4% compared to the MAA), the start up of potato crops was difficult, also the vegetation started with difficulty. In June and July, the thermo-hydric conditions were favorable for potato crops. The water necessary for the development of plants and for potato production accumulation was provided even in the unirrigated regime, from the abundant precipitations of 204.8 mm realized in June (211.8% compared to MAA) and 133.6 mm in July (133.9% versus MAA). In August, the air temperature was 2.7°C higher than MAA and less precipitation (46.6 mm, only 61.0% compared to MAA) hastened the drying of the foliage and the tubers maturation. Slightly higher temperatures by 1.1°C and lower precipitation (43.4 mm, 82.7% compared to MAA) in September allowed potato to be harvested in good conditions (Table 2).

Plants emergence was measured in the two central rows. When any visible green portion of the potato plant was see was conted as emerged. The number of emerged plants was converted to a precentage based on the number of seed planted per plot and was establised the density in thousands hills (Table 3).

Table 3

Plants emergence % and density to cv. Brasovia and cv. Cezarina

No.	Product	Brasovia		Cezarina	
		Emergence %	**Thousands hills /ha**	**Emergence %**	**Thousands hills /ha**
1	Untreated(control)	98,7a	45,8a	50,2 de	23,3 de
2	Sercadis	98,3a	45,6a	23,9f	11,1f
3	Ortiva	96,1a	44,6a	38,6ef	17,9ef
4	Serenade (8 l/ha)	99,1a	46,0a	61,0bcd	28,3bcd
5	Serenade (5 l/ha)	93,1a	43,2a	73,1b	33,9b
6	Serenade (2,5 l/ha)	97,8a	45,4a	67,2 bc	31,2bc
7	Prestige	96,1a	44,6a	53,2 cde	24,7 cde
8	Amistar	98,7a	45,8a	44,4 e	20,6e
	Mean	**97,3**	**45,1**	**51,5°**	**23,9°**
	LSD 5% (variant*loc)			**15,0%**	**6,9**

Differences among treatments for emergence were not observed to Brasovia variety, but to Cezarina variety the differences between variants was high. To the Sercadis variant, there were fewer plants that emergence from the control. Also to the Ortiva variant the number of emerge plants was low, the highest number of plant being to all variants where Serenade were applyied.

To Brasovia variety the average number of steams were not significant different but between plants height there were difference, the tallest been restered to Serenade product (8 l/ha and and 2,5 l/ha) and the smallest to Ortiva and Sercadis products. To Cezarina variety the plants height was uniform, no difference except Sercadis variant at which the plants were at half the height of the others. Regarding the steam number, the difference was higher, most steam being to Serenade – 8l/ha and the fewest to variant with Sercadis (Table 4).

Table 4

Plants height and average number of stems

No.	Product	Brasovia		Cezarina	
		Plant height (cm)	Stem no.	Plant height (cm)	Stem no.
1	Untreated (control)	29.1bc	6.3a	26.7a	2.9ab
2	Sercadis	28.7c	5.8a	11.8b	1.7c
3	Ortiva	28.2c	5.6a	25.3a	2.8ab
4	Serenade (8 l/ha)	30.9a	5.9a	28.2a	3.3a
5	Serenade (5 l/ha)	28.5c	5.8a	27.9a	3.0ab
6	Serenade (2,5 l/ha)	30.9a	5.8a	26.1a	3.0ab
7	Prestige	29.7abc	5.9a	26.2a	2.7ab
8	Amistar	30.4ab	5.9a	25.5a	2.4b
	Mean	**29.6**	**5.9**	**26.3**	**2.9**
	LSD 5% (variant*loc)	**1.1**	**0.44**	**2.9**	**0.46**

Table 5

Correlations of products value with potato stems

	Brasovia		Cezarina	
	IPL	NRV	IPL	NRV
IPL Pearson correlation	1.000	.130**	1.000	.370**
Sig. (2-tailed)		.000		.000
NRVPearson Correlation	.130**	1.000	.370**	1.000
Sig. (2-tailed)	.000		.000	

** correlation is significant at the 0.01 level

A significant positive correlation is observed in both varieties at the level of the number of steams, 0.130** in the Brasovia variety and 0.370** in the Cezarina variety (Table 5).

Tuber number with attack did not vary much in the Brasovia variety, attacked tubers being recorded in all variants. The lowest number of attacked tubes was recorded to Ortiva variant (5 tubers) compared to the control one (8 tubers). In the Cezarina variety, the lowest number of attacked tubers was in the Sercadis variant (5 tubers) compared to the control (9 tubers), while in the Serenade (5 l/ha) variant was recorded. the highest number of attacked tubers.

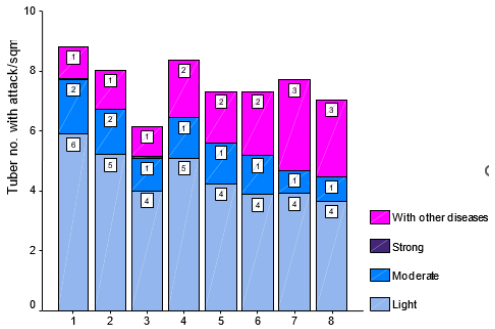

Figure. 1**. Brasovia (tub. 30-55mm)**

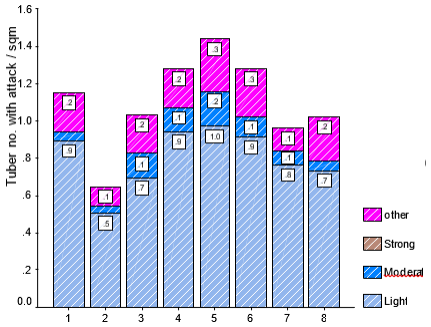

Figure. 2. **Cezarina (tub..>55 mm)**

The lowest reduction in yield is evident by treatment withand Serenade (8 l/ha) (Fig. 6). Treatment Serenade (2,5 l/ha) and Prestige were rated the second best in inhibiting yield reduction.

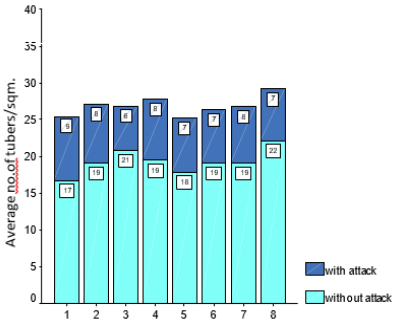

Figure. 3**. Brasovia variety**

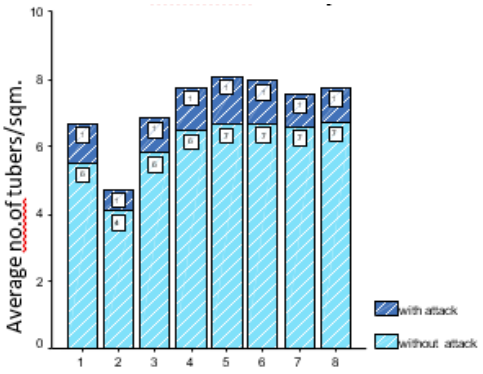

Figure. 4**. Cezarina variety**

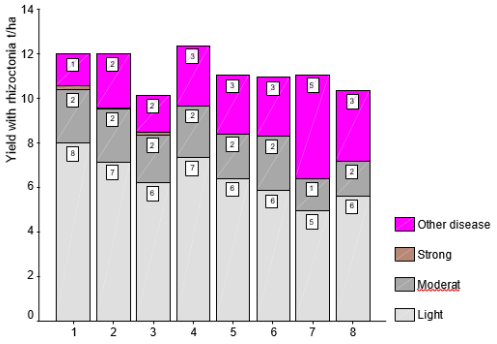

Figure. 5**. Brasovia variety**

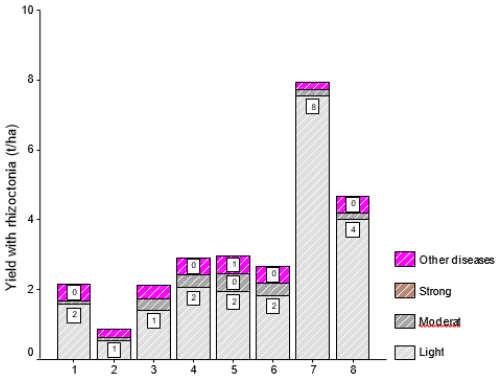

Figure .6**. Cezarina variety**

To the Brasov variety, the yield were around 12 tons in most variants. The weakest results were obtained in treatment with Ortiva and to the treatment with Prestige was observed the inability of the product to cope with other diseases during the vegetation period (especially with potato late blight attack) (Figure 5).

To the Cezarina variety the lowest reduction in yield is evident by treatment with Prestige. Treatment with Amistar was rated the second best in inhibiting yield reduction. The worst results were obtained in treatment with Secadis (Figure 6).

CONCLUSIONS

High prevalence of black scurf of potato is due to the favorable climatic condition for the inoculum, monocropping and poor cultural practices. Low soil temperature and high moisture level was the major factors favoring the development of disease in the second location. Potato crop cultivated without proper rotation tactics may lead to the encouragement of soil-borne diseases.

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