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THE EFFECT OF SOIL MOISTURE AND TEMPERATURE ON EFFICACY OF SEED DRESSING PREPARATIONS BIOCHIKOL 020 PC AND BAYTAN UNIVERSAL 19,5 WS IN CONTROL OF RHIZOCTONIA FUNGI ON WHEAT

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Abstract: The effect of biopreparation Biochikol 020 PC on linear growth of mycelia of two *Rhizoctonia* isolates was tested under laboratory conditions along with that of fungicide Baytan Universal 19,5 WS for comparative purposes. Complete retardation of mycelial growth of both isolates was observed in case the application of fungicide Baytan Universal 19,5 WS at the concentration of 0.1% and a considerable growth inhibition was stated at the temperatures of 10°C and 30°C.
The effect of seed dressing with the above mentioned preparations on plant infestation by *Rhizoctonia* fungi was tested in a greenhouse experiment on two cultivars of spring wheat: Banti and Ismena. Baytan Universal 19,5 WS reduced plant infestation especially at the highest soil moisture content of 20 kPa. Biopreparation Biochikol 020 PC and diversification of soil moisture levels did not result in a reduction of wheat infestation rate. This biopreparation stimulated the increase of root mass of both cultivars at moisture content of 20 kPa.

Key words: wheat, Rhizoctonia, Biochikol 020 PC, Baytan Universal 19,5 WS

INTRODUCTION

In Poland wheat infestation by fungi from genus *Rhizoctonia* reaches approximately 20% and to a large extent depends on weather conditions during the vegetation season and on the preceding crop (Korbas and Remlein 1996). High temperatures and low precipitation favour infection (Korbas and Remlein 1996; Smiley et al. 1994). It is not recommended in Poland to apply fungicides against fungi from genus *Rhizoctonia* found on wheat (Żółtańska 1997). Recently introduced biopreparations are recommended for the control of fungal diseases in cereal cultivation. Biochikol 020 PC containing 20 g chitosan per 1l of preparation exhibits a wide range of action spectrum against pathogens, strengthens the root system, stimulates growth and natural resistance of plants.

The aim of this study was to determine the effect of soil moisture content and temperature on the efficiency of biopreparation Biochikol 020 PC in protection of wheat against fungi from genus *Rhizoctonia.* For comparative purposes the efficiency of Baytan Universal 19,5 WS against these fungi was tested.

MATERIALS AND METHODS

The effect on mycelial linear growth of *R. cerealis* (RC 24) and *R. solani* (RS 47) of two preparations: biopreparation Biochikol 020 PC and fungicide Baytan Universal 19,5 WS at three concentrations (0.1%, 0.001% and 0.0001%) was tested under laboratory conditions on PDA medium at three temperatures: 10°C, 20°C and 30°C.

In the greenhouse experiment at three soil moisture levels (20, 30 and 40 kPa) set automatically using a tensiometer of Irrometer Company (Riverside, California, USA) the effect of these preparations applied as kernel dressing of two spring wheat cultivars, Banti and Ismena, was assessed on plant height, yield and root dry mass, as well as the percentage of infested plants and infestation rate in a 3-grade scale. Inoculum consisted of PDA medium discs overgrown with mycelia of tested fungal isolates from genus *Rhizoctonia*: RC 24 and RS 47, placed under kernels at sowing.

RESULTS

In the laboratory experiment after 6 days a complete growth inhibition was observed for mycelia of both isolates under the influence of fungicide Baytan Universal 19,5 WS at the concentration of 0.1% and a considerable reduction of growth occurred at 10°C and 30°C at lower concentrations (Tables 1, 2). Biochikol 020 PC at the concentration of 0.1% reduced growth of isolate RC 24 by half at 10°C and 20°C (Table 1) whereas growth of isolate RS 47 was only slightly reduced (Table 2).

The effect of applied preparations on growth of aboveground parts of wheat in treatments with two *Rhizoctonia* isolates was relatively slight. The smallest growth increase was found for plants of cv. Ismena in the treatments with fungicide Baytan Universal 19,5 WS and isolate RS 47 at the lowest soil moisture level of 40 kPa, while the highest in the treatments with isolate RC 24 and the same preparation at the highest soil moisture content, i.e. 20 kPa (Table 3).

Table 1. The effect of Baytan Universal 19,5 WS and Biochikol 020 PC on linear mycelial growth increase of *Rhizoctonia cerealis* isolate RC 24 after 6 days of experiment

Treatments	Daily growth [mm]*					
	Baytan Universal			Biochikol		
	Temperature [°C]			Temperature [°C]		
	10	20	30	10	20	30
Check	2.5 f	7.2 h	0.0 a	2.5 c	7.2 e	0.0 a
0.1%	0.0 a	0.0 a	0.0 a	1.7 b	3.2 d	0.0 a
0.001%	0.6 c	3.8 g	0.2 b	1.8 bc	6.5 e	0.0 a
0.0001%	1.1 d	3.4 g	1.9 e	2.3 bc	6.9 e	0.0 a

* means in columns followed by the same letter do not differ at 5% of significance

Table 2. The effect of Baytan Universal 19,5 WS and Biochikol 020 PC on linear mycelial growth increase of *Rhizoctonia solani* isolate RS 47 after 6 days of experiment

Treatments	Daily growth [mm] *					
	Baytan Universal			Biochikol		
	Temperature [°C]			Temperature [°C]		
	10	20	30	10	20	30
Check	2.9 e	7.8 f	0.6 b	2.9 c	7.8 fg	0.6 a
0.1%	0.0 a	0.0 a	0.0 a	3.2 cd	7.3 f	0.7 ab
0.001%	0.4 b	1.6 c	0.6 b	3.4 d	8.0 g	0.9 b
0.0001%	1.3 c	2.2 d	0.5 b	3.9 e	7.9 fg	0.8 ab

* means in columns followed by the same letter do not differ at 5% of significance

Table 3. The effect of isolates *Rhizoctonia cerealis* and *R. solani* on growth of two spring wheat cultivars in conditions of seed dressing with analyzed preparations at different soil moisture levels

Treatments	Growth of wheat [cm] *					
	Banti			Ismena		
	Check	Baytan Universal	Biochikol	Check	Baytan Universal	Biochikol
RC 24						
20 kPa	96.9 cd	103.7 d	104.2 d	73.5 cde	89.7 i	76.4 defg
30 kPa	95.9 cd	100.2 cd	98.3 cd	86.2 ghi	86.2 ghi	85.2 fghi
40 kPa	80.9 ab	84.2 b	75.1 a	63.0 ab	60.2 a	69.2 bcd
RS 47						
20 kPa	93.9 c	104.2 d	97.3 cd	86.9 hi	81.7 efghi	83.9 fghi
30 kPa	93.9 c	99.7 cd	102.9 cd	79.2 efgh	84.9 fghi	89.9 i
40 kPa	80.9 ab	74.9 a	78.5 ab	74.0 de	64.7 abc	75.8 def

* means in columns followed by the same letter do not differ at 5% of significance

A significant reduction of yield was found for cv. Banti under the influence of both fungal isolates in treatments with the tested preparations at the lowest soil moisture of 40 kPa. In cv. Ismena the highest yield decrease was found in treatments with isolate RS 47 and fungicide Baytan Universal 19,5 WS at higher soil moisture levels: 20 and 30 kPa (Table 4).

Dry weight of roots was lowest in cv. Banti in treatments with isolate RS 47 and two applied preparations, irrespective of the varied soil moisture content. The significantly highest root mass was found in cv. Ismena after the application of Biochikol 020 PC in the experimental variant with isolate RS 47 at the highest moisture level (Table 5).

The percentage of plants of cv. Banti infected by isolate RS 47 was significantly lowest after the application of Baytan Universal 19,5 WS at higher soil moisture levels and in cv. Ismena in the treatment with Biochikol 020 PC at the highest moisture content of 20 kPa. In cv. Ismena the percentage of plants infected by isolate RC 24 was the highest after the application of Baytan Universal 19,5 WS at the lowest soil moisture content of 40 kPa (Table 6).

The mean infestation rate of cv. Banti by isolate RS 47 was significantly lowest after the application of Baytan Universal 19,5 WS, irrespective of the soil moisture level. Infestation rate for cv. Ismena by isolate RC 24 was significantly lower after the application of seed dressing with Baytan Universal 19,5 WS at higher soil moisture levels, i.e. 20 and 30 kPa (Table 7).

Table 4. The effect of isolates *Rhizoctonia cerealis* and *R. solani* on yields of two spring wheat cultivars in conditions of seed dressing with analyzed preparations at different soil moisture levels

Treatments	Yield of wheat plants [g/plant] *					
	Banti			Ismena		
	Check	Baytan Universal	Biochikol	Check	Baytan Universal	Biochikol
RC 24						
20 kPa	0.87 de	0.66 bc	0.73 cd	0.61 a	0.71 a-e	0.58 a
30 kPa	0.99 e	0.63 bc	0.62 bc	0.82 cde	0.79 b-e	0.83 de
40 kPa	0.67 c	0.44 a	0.60 bc	0.63 ab	0.56 a	0.59 a
RS 47						
20 kPa	1.65 g	0.68 c	0.93 e	0.83 cde	0.56 a	0.88 e
30 kPa	1.22 f	0.74 cd	0.97 e	0.90 e	0.64 abc	0.82 cde
40 kPa	0.88 de	0.52 ab	0.59 bc	0.63 ab	0.56 a	0.68 a-d

* means in columns followed by the same letter do not differ at 5% of significance

Table 5. The effect of isolates *Rhizoctonia cerealis* and *R. solani* on dry mass of roots of two spring wheat cultivars in conditions of seed dressing with analyzed preparations at different soil moisture levels

Tretments	Dry mass of roots [g/plant] *					
	Banti			Ismena		
	Check	Baytan Universal	Biochikol	Check	Baytan Universal	Biochikol
RC 24						
20 kPa	1.27 gh	0.74 bcde	1.08 efg	0.99 b	1.08 bcd	1.32 cdef
30 kPa	0.74 bcde	0.70 bcd	0.75 bcde	1.38 def	1.21 bcde	1.14 bcde
40 kPa	0.56 ab	0.51 ab	0.41 a	0.67 a	1.03 bc	1.08 bcd
RS 47						
20 kPa	2.50 i	0.96 defg	1.20 fgh	1.38 def	1.28 bcde	1.77 g
30 kPa	1.48 h	0.62 abc	0.88 cdef	1.33 cdef	1.47 efg	1.63 fg
40 kPa	1.33 gh	0.36 a	0.50 ab	1.24 bcde	1.40 def	1.45 efg

* means in columns followed by the same letter do not differ at 5% of significance

Table 6. Percentage of infected by *Rhizoctonia* spp. wheat plants in conditions of seed dressing with analyzed preparations at different soil moisture levels

Treatments	Percentage of infected plants [%] *					
	Banti			Ismena		
	Check	Baytan Universal	Biochikol	Check	Baytan Universal	Biochikol
RC 24						
20 kPa	78.79 cd	67.7 bc	78.69 cd	69.52 a-f	59.58 a	64.53 abc
30 kPa	79.68 cd	80.20 cd	86.79 d	65.61 a-d	58.92 a	67.73 a-e
40 kPa	80.00 d	74.56 bcd	78.81 cd	81.13 f	64.98 a-d	79.40 ef
RS 47						
20 kPa	83.33 cd	50.29 a	81.40 cd	74.33 c-f	74.84 c-f	60.69 ab
30 kPa	86.92 d	58.32 ab	80.76 cd	64.02 abc	72.84 c-f	76.96 def
40 kPa	83.86 cd	75.91 cd	71.50 bcd	71.93 b-f	72.89 c-f	81.41 f

* means in columns followed by the same letter do not differ at 5% of significance

Table 7. Mean degree of infection of wheat plants in conditions of seed dressing with analyzed preparations at different soil moisture levels

Treatments	Degree of infection*					
	Banti			Ismena		
	Check	Baytan Universal	Biochikol	Check	Baytan Universal	Biochikol
RC 24						
20 kPa	1.97 def	1.14 bc	1.30 bcd	1.29 d-g	0.90 a-d	1.11 a-f
30 kPa	1.70 c-f	2.04 ef	1.87 def	1.23 c-g	0.85 ab	1.02 a-f
40 kPa	1.66 c-f	1.47 cde	1.68 c-f	1.31 efg	0.95 a-e	1.58 g
RS 47						
20 kPa	1.86 def	0.55 a	1.79 c-f	1.15 a-f	1.31 efg	0.80 a
30 kPa	1.83 def	0.75 ab	2.04 ef	0.88 abc	1.33 efg	1.34 fg
40 kPa	2.27 f	1.37 cd	1.28 bcd	1.27 d-g	1.17 b-g	1.36 fg

* means in columns followed by the same letter do not differ at 5% of significance

DISCUSSION

In laboratory tests the highest linear growth increase of the analyzed isolates was recorded at the temperature of 20°C, while at 10°C and 30°C the significantly lowest mycelial growth increase or a complete growth retardation were observed. Similar results were reported by Weber and Ździebkowski (1990), who found the maximum mycelial growth of *R. cerealis* and *R. solani* on PDA medium at 20–25°C. Baytan Universal 19,5 WS at the highest concentration of 0.1% exhibited a strong inhibitory action towards linear growth of the two analyzed isolates, whereas Biochikol 020 PC showed a weaker activity in reducing mycelial growth.

In the greenhouse experiment the most adverse effect on plant growth and root mass, as well as yields of two wheat cultivars was found for the lowest soil moisture level (40 kPa). Also Weber and Hryńczuk (2001) found that moisture deficiency during ear formation and at the beginning of stem formation lowers yielding of spring wheat. In the pot experiment only a slight effect of fungi from genus *Rhizoctonia* and the applied preparations was shown on grain yield of spring wheat, which confirms the opinion that rhizoctoniose does not cause losses of economic importance (Pokacka and Wojtaszek 1977). In field tests higher intensity of the incidence of rhizoctoniose was reported in years with high temperatures and low precipitation levels (Pokacka and Wojtaszek 1977; Smiley and Uddin 1993). Baytan Universal 19,5 WS reduced the percentage of plants infested by *Rhizoctonia* fungal isolates and resulted in a decrease in infestation rate. A similar action of Baytan Universal 19,5 WS was found by Gołębniak et al. (1993) for wheat cv. Emika, in which infestation by *R. solani* was reduced from 30.5% to 2.7%.

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POLISH SUMMARY

OCENA WPŁYWU WILGOTNOŚCI PODŁOŻA I TEMPERATURY NA SKUTECZNOŚĆ ZAPRAW NASIENNYCH BIOCHIKOL 020 PC I BAYTAN UNIVERSAL 19,5 WS W OCHRONIE PSZENICY PRZED GRZYBAMI Z RODZAJU *RHIZOCTONIA*

W warunkach laboratoryjnych badano wpływ dwóch zapraw nasiennych: biopreparatu Biochikol 020 PC i fungicydu Baytan Universal 19,5 WS w trzech stężeniach: 0,1%, 0,001% i 0,0001% na izolaty grzybów *Rhizoctonia cerealis* (RC 24) i *R. solani* (RS 47). Doświadczenie przeprowadzono w trzech temperaturach: 10°C, 20°C i 30°C. Oceniano przyrost liniowy grzybni dwóch izolatów grzybów z rodzaju *Rhizoctonia* na pożywce AGZ.

W doświadczeniu szklarniowym zastosowano trzy poziomy wilgotności podłoża (20, 30 i 40 kPa) oraz powyższe preparaty w kombinacjach z izolatami grzybów z rodzaju *Rhizoctonia* dla dwóch odmian pszenicy jarej: Banti i Ismena. Badano wpływ wilgotności podłoża na skuteczność preparatów w ograniczaniu porażenia pszenicy przez izolaty RC 24 i RS 47. Ustalano wysokość siewek, procent porażonych roślin i stopień porażenia w skali 3-stopniowej oraz wysokość dojrzałych roślin, plon i suchą masę korzeni.

Stwierdzono ograniczające działanie preparatów w stężeniu 0,1% na wzrost grzybni obu izolatów, przy czym Biochikol 020 PC w mniejszym stopniu hamował ten wzrost niż Baytan Universal 19,5 WS. Największy przyrost grzybni zanotowano w temperaturze 20°C.

Odmiana Ismena była porażona w mniejszym procencie przez grzyby rodzaju *Rhizoctonia* niż odmiana Banti. Najbardziej niekorzystny wpływ na plon obu odmian, wzrost roślin, masę korzeni miał najniższy poziom wilgotności – 40 kPa. Baytan Universal 19,5 WS ograniczał porażenie roślin przez grzyby zwłaszcza przy poziomie wilgotności 20 kPa. Biopreparat Biochikol 020 PC oraz wilgotność podłoża nie wpłynęły istotnie na zmniejszenie stopnia porażenia pszenicy. Preparat ten stymulował wzrost masy korzeni obu odmian przy wilgotności 20 kPa.

BOOK REVIEW

Szpaar D. [Spaar D.] (Ed.). 2005. Ekologizirovannaya Zashchita Rastenii v Ovoshchevodstve, Sadovodstve i Vinogradstve [Ecological Plant Protection in Vegetable-Growing, Horticulture, and Viticulture]. Innovatsionnyj Centr Zashchity Rastenii, Sankt Peterburg – Pushkin. Vol. 1, 333 pp., Vol. 2, 510 pp. ISBN 5-93717-030-X; UDK 632.9:631.58-BBK44.1.

This two-volume treatise has been prepared and published as a result of the German-Russian Cooperative Programme titled „Adaptation of Agricultural Education and Elevating Professional Qualifications in the Russian Federation" financed by the German Federal Ministry of Consumers Protection, Food and Agriculture.

The book editor Prof. Dieter Spaar invited the following well known specialists from Byelorussia, Germany, Russian Federation and Ukraine to contribute to this very comprehensive treatise: G. F. Backhaus, H. Bathon, N., Beljakova, U. Burth, V. Fedorenko, M. Fischer, B. Freier, H. Ganzelmeier, M. Hommes, J. Huber, F. Dshalilov, W. Jelkmann, A. Zacharenko, V. Isaitschev, W. Ismailov, M. Jahn, A. Kollar, S. Kuhne, G.-A. Langenbruch, A. Lysov, K. Naumann, A. Manko, W. Nadykta, I. Novikowa, K. Novoshilov, V. Pavljuschin, S. Popov, A. Postnikov, F. Ravenstein, W. Schkalikov, M. Shternshis, S. Soroka, R. Supranovitsch, and H. Vogt.

In the „Foreword" (p. 9–10) the Editor refers to the edited by him in 2004 the similar in character treatises titled „Plant Protection in the Sustainable Systems of Land Use" [Zashchita Rastenii v Ustoichivykh Sistemach Zemleispolzovanija] (see Journal of Plant Protection Research vol. 45 (2005), p. 266].

The presently reviewed two-volume book has five main chapters, twelve appendices and a voluminous part "Cited and Recommended Literature" that contains impressive number of 1173 cited references.

Chapter 1. „Importance of vegetables, fruits, and grapes – peculiarities of their growing and production" (p. 11–22).

Chapter 2 „Concept of managed integrated and biological (ecological) growing of vegetable and fruit crops" (p. 23–52).

Chapter 3 „Causes of non-infectious diseases, causative agents of infectious plant diseases, animal pests and weeds present in vegetable, fruit and grape plantations" (p. 53–153).

Chapter 4 „Peculiarities of protection of vegetables and fruits in integrated and in ecologically protected systems" (p. 154–170).

Chapter 5 „Plant protection treatments during vegetable, fruit and grape growing and production" (p. 171–331).

Volume 2 (p. 9–510) contains continuation of chapter 5 (p. 9–154) and twelve very informative and useful appendices (p. 155–439).

Appendix 1. "Taxonomic classification of vegetables, fruits, berries, grapes crops and species" (p. 155–161).

Appendix 2. "Fenological phases of development of vegetables, fruits, berries, grapes and weeds – BBCH codes" (p. 162–228) that contains tables and figures concerning several plant species.

Appendix 3. "Examples of documentation of performed agrotechnical field works and treatments (used fertilizers and/or performed plant protection treatments) in fields and plantations maintained according to principles of the integrated and ecological systems of production" (p. 229–235).

Appendix 4. "Symptoms in cultivated plants due to lack or excess of mineral macro- and microelements" (p. 236–239).

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