

Захист рослин

UDK 633.11/.14:632.4:632.937:632.952 (477.42)

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EFFICIENCY OF BIOLOGICAL PREPARATIONS FOR WINTER TRITICALE AGAINST FUNGOUS DISEASES IN UKRAINIAN POLISSIA

*The most widely spread diseases of winter triticale in Polissia, Ukraine are: powdery mildew (agent – *Blumeria graminis* (DC.) f. sp. *tritici* Speer.), brown leaf rust (*Puccinia recondite* Dietel & Holw.), *Septoria spots on leaves* (*Mycosphaerella graminicola* (Fuckel) Schroeter, *Phaeosphaeria nodorum* (Mull.) Hedjar.), root rot (*Bipolaris sorokiniana* (Sacc.) Shoem., *Fusarium* spp., *Rhizoctania* spp.). We have investigated influence of treatment of winter triticale crops with biological preparations and their mixtures with fungicide Soligor 425 EC, KE on growth of main mycosis and productivity of farm ecosystems. It was ascertained that among biological preparations Agat 25-K was the most effective and guaranteed decrease of the growth of fungous diseases at 34,8-47,4% level. Spraying biological preparation Agat 25-K, 0,03 kg with fungicide Soligor 425 EC, KE, 0,75 l/ha on winter triticale crops guarantees: technical efficiency against powdery mildew at 95,5 level, brown leaf rust – 83,9, *Septoria spots on leaves* – 76,0 and root rot – 86 %; increase of number of photosynthesis units from 653,9 to 713,1 and crop yield – by 0,58 tons/ha.*

Key words: winter triticale, fungous diseases, biological preparations, fungicide, photosynthesis, crop yield.

Setting of a problem

Modern agrarian policy and national doctrine of Ukraine in the sphere of agro-industrial production are targeted at achievement of food safety of the state, creation of conditions for the development of highly efficient production and finding solution to the problem of social infrastructure [11]. Exactly grain farming is the most efficient and strategic branch of domestic economy [3].

Recently, among various grain crops increasing attention is paid to the extension of winter triticale acreage in Polissia Ukraine as the least soil-demanding and high-yielding crop to be used for satisfaction of food requirements [1]. However, annual losses of winter triticale grain due to diseases are amounting to 20 % of potential yield, caused by the influence of nuisance organisms widely spread in its farming ecosystems, especially, agents of fungous diseases: *Puccinia recondite*, *Blumeria graminis*, *Mycosphaerella graminicola*, *Pyrenophora tritici-repentis*, *Microdochium nivale*, *Fusarium* spp., *Pseudocercospora herpotrichoides*, *Rhynchosporium secalis* [1, 2, 5, 10, 15].

Scientific community and society overall arrive to the conclusion that use of pesticides to protect crops from pathogenic agents to some extent solves the problem of harvest protection, but leads to deterioration of the state of the environment. Moreover, constantly growing application of pesticides leads to the emergence of steady strains and population of pathogenic agents, which frequency of emergence outpaces creation of new agricultural chemicals. In view of the aforesaid, we consider it currently important to regulate progress and extension of diseases in farm ecosystems by means of application of biological natural-agents-based preparations [7, 8, 17].

Analysis of the latest discoveries and publications

Biological preparations applied to grain crops plantations are able to regulate progress of plant diseases, though, they act much slower than chemical and their efficiency to a greater extent depends on weather conditions and farming standards [9, 13, 18].

Moskalets V. V. in his researches ascertained [9] that microbiological preparations – Diazobacterin and Albobacterin – nitrogen-fixing *Azospirillum brasilense* and phosphate-mobilizing *Achromobacter album* 1122 microorganisms influence intensification of growth processes of triticale crops. At the same time, certain cultivars of winter triticale responded to microbiological preparations in different ways.

Kutsak M. M. [6] informs that biological preparation Agat 25-K with 30 ml/ha application rate is effective for protection of oats from crown rust. We are also aware of the results [16] of the highest increment of winter triticale grain – cultivar Amphidiploid 52 (0,83 t/ha) after the treatment of seeds with biopreparations Planriz and Stimros and foliar fertilizing with Stimros during boot stage.

Biological preparations are being constantly modified and improved due to emergence of new demands to farm crops growing technologies and use of effective pesticides for promising varieties production, [13], consequently, relative researches in the sphere of protection of exactly triticale from diseases are scarce.

Aim, task and methods of research

The aim of the research was: to ascertain effectiveness of biological preparations and their complex application with fungicide Soligor 425 EC, KE in protection of winter triticale from main diseases, their influence on photosynthesis activity of plants and formation of crop yield in Polissia.

Researches were conducted on plantations of Polianske – cultivar of winter triticale – in field stationary crop rotation at the Research Farm “Polissia” of the National Academy of Agricultural Science of Ukraine (Zhytomyr region, Korosten district) within 2012–2015.

For the research we used the following biological preparations: Agat 25-K, Azophosphoryn, Gaubsin and Phytodoctor; fungicide Soligor 425 EC, KE and mixtures of consistent application of chemical preparation (decreased dose) first and, then, biological preparation.

Soil of research plots – sod-podzol clayly sandy loam soils, humus level – 1,27 %, total nitrogen – 0,064 %, labile phosphorus – 8,4, exchange potassium – 10,1 mg for 100 g of soil, pH sal. – 5,0, hydrolytic soil acidity – 2,25 mg.-ekv./100 g of soil.

Size of accounting plots – 10 m² each, frequency – five times.

Spraying of crops at 29 and 60 stages of organogenesis of plants (according to BBCH-scale).

Diseases of triticale were recorded according to generally accepted methodologies [12, 14]. Photosynthetic rate measured with N-tester.

Results of the researches

It was ascertained that in Polissia the most widely spread diseases of winter triticale are: powdery mildew (agent – *Blumeria graminis*), brown leaf rust (*Puccinia recondit*), Septoria spots on leaves (*Mycosphaerella graminicola*, *Phaeosphaeria nodorum*), root rot (*Bipolaris sorokiniana*, *Fusarium spp.*, *Rhizoctania spp.*), etc. Septoria spots on leaves and brown leaf rust dominated among others during the whole period of research (see Table 1).

Table 1. Progress of diseases of winter triticale depending on the treatment of crops with biological preparations and their mixtures with fungicide

Soligor 425 EC, KE, 2012–2015

Variants of experiment	Progress of diseases, %			
	powdery mildew	brown leaf rust	septoria spots on leaves	root rot
Control (water treatment)	8,9	11,8	14,6	5,7
Soligor 425 EC, KE, 0,9 l/ha	0,6	2,9	3,7	1,4
Soligor 425 EC, KE, 0,75 l/ha	1,6	4,4	5,2	2,1
Agat 25-K, 0,03 kg/ha	5,8	7,6	8,2	3,0
Azophosphoryn 1,0 l/ha	(9,3)*	(11,7)*	(9,9)*	(5,0)*
Gaubsin, 5,0 l/ha	7,6	9,5	10,8	4,9
Phytodoctor, 2,0 l/ha	6,1	8,5	7,3	4,1
Soligor 425 EC, KE, 0,75 l + Agat 25-K, 0,03 kg/ha	0,4	1,9	3,5	0,8
Soligor 425 EC, KE, 0,75 l + Azophosphoryn, 1,0 l/ha	(1,4)*	(3,0)*	(4,2)*	(1,6)*
Soligor 425 EC, KE, 0,75 l + Gaubsin, 5,0 l/ha	1,0	3,4	4,6	1,4
Soligor 425 EC, KE, 0,75 l + Phytodoctor, 2,0 l/ha	0,7	2,3	2,9	1,2
<i>HIP</i> ₀₅	2,1	1,8	2,3	1,7

Note: * – results for 2012–2014

According to our previous researches [5, 15] and investigations of other scientists [4, 5, 9, 11, 13, 15, 17] at present attention is being increasingly focused on diseases progress control in farm eco-systems by means of decrease of fungicides utilization rate and emerging role of biological preparations for obtaining ecologically safe products.

Results of accounting the development of the most common diseases of triticale (table 1) show different effect of spraying crops with biological preparations and their mixtures with fungicide Soligor 425 EC, KE (table 2).

Application of the chemical Soligor 425 EC, KE to the full extent furthered decrease of the powdery mildew from 8,9 to 0,6, brown leaf rust – from 118 to 2,9, Septoria spots on leaves – from 14,6 to 3,7 and root rot – from 5,7 to 1,4 %. However, the decrease of fungicide utilization rate from 0,9 to 0,75 l/ha did not allow to control progress of the disease at the sufficient level and technical efficiency of such treatment of the crops decreased depending on the disease from 74,7–93,3 to 62,7–82,0 %.

Table 2. Technical efficiency of treatment of winter triticale crops with biological preparations and their mixtures with fungicide Soligor 425 EC, KE, 2012–2015

Variants of experiment	Technical Efficiency, %			
	powdery mildew	brown leaf rust	septoria spots on leaves	root rot
Control (water treatment)	-	-	-	-
Soligor 425 EC, KE, 0,9 l/ha (etalon)	93,3	75,4	74,7	75,4
Soligor 425 EC, KE, 0,75 l/ha	82,0	62,7	64,4	63,2
Agat 25-K, 0,03 kg/ha	34,8	35,6	43,8	35,1
Azophosphoryn 1,0 l/ha	(-4,5)*	(0,9)*	(32,2)*	(12,3)*
Gaubsin, 5,0 l/ha	14,6	19,5	26,0	14,0
Phytodoctor, 2,0 l/ha	31,5	28,0	50,0	35,1
Soligor 425 EC, KE, 0,75 l + Agat 25-K, 0,03 kg/ha	95,5	83,9	76,0	86,0
Soligor 425 EC, KE, 0,75 l + Azophosphoryn, 1,0 l/ha	(84,3)*	(67,0)*	(70,2)*	(71,9)*
Soligor 425 EC, KE, 0,75 l + Gaubsin, 5,0 l/ha	88,8	71,2	68,5	75,4
Soligor 425 EC, KE, 0,75 l + Phytodoctor, 2,0 l/ha	92,1	80,5	75,3	79,0

Note: * – results for 2012–2014.

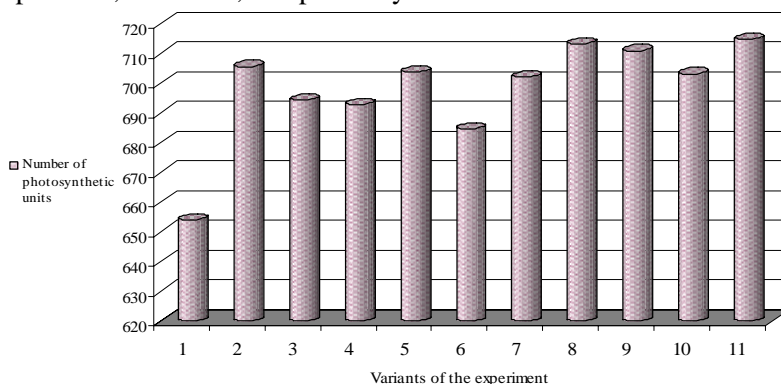
It was ascertained that Agat 25-K is the most effective of all biological preparations with utilization rate of 0,03 kg and Phytodoctor – 2,0 l/ha. However, the latter is marked with higher efficiency against Septoria spots on leaves (50,0 %).

Treatment of crops with biological preparation Azophosphoryn 1,0 l/ha furthered progress of the powdery mildew on plants, that, to our opinion, can be explained by the ability of bacteria *Azotobacter* – basis of this preparation, to bind atmospheric nitrogen. Exactly increase of nitric fertilization of plants facilitates intensive development of *Blumeria graminis*.

Conjoint application of biopreparation Agat 25-K and fungicide Soligor 425 EC, KE with utilization rate 0,75 l/ha allowed effective winter triticale diseases progress control.

Complex application of biological preparations and fungicides helped to increase photosynthetic activity of triticale (picture 1). Number of photosynthetic units increased from 653,9 to 714,6.

Spraying of crops with mixtures: Soligor 425 EC, KE 0,75 l + Agat 25-K 0,03 kg/ha and Soligor 425 EC, KE 0,75 l + Phytodoctor 2,0 l/ha favoured increase of figures up to 713,1 and 714,6 respectively.



Picture 1. Photosynthetic activity of winter triticale depending on treatment of crops with biological preparations and their mixtures with fungicide Soligor 425 EC, KE, 2012–2015

According to the obtained results of winter triticale crop yield (Table 3) figures were much higher when Agat 25-K was used separately or together with mixtures with Soligor 425 EC, KE.

Average increase of crop yield during years of research comprised 0,58 t/ha.

Table 3. Winter triticale crop yield depending on treatment of crops with biological preparations and their mixtures with fungicide Soligor 425 EC, KE, 2012–2015

Variants of experiment	Crop yield, t/ha	
	average	+,- prior to control
Control (water treatment)	4,18	-
Soligor 425 EC, KE, 0,9 l/ha (etalon)	4,58	+ 0,40
Soligor 425 EC, KE, 0,75 l/ha	4,55	+ 0,37
Agat 25-K, 0,03 kg/ha	4,46	+ 0,28
Azophosphoryn 1,0 l/ha	(4,42)*	(+ 0,24)*
Gaubsin, 5,0 l/ha	4,36	+ 0,18
Phytodoctor, 2,0 l/ha	4,39	+ 0,21
Soligor 425 EC, KE, 0,75 l + Agat 25-K, 0,03 kg/ha	4,76	+ 0,58
Soligor 425 EC, KE, 0,75 l + Azophosphoryn, 1,0 l/ha	(4,74)*	(+ 0,56)*
Soligor 425 EC, KE, 0,75 l + Gaubsin, 5,0 l/ha	4,66	+ 0,48
Soligor 425 EC, KE, 0,75 l + Phytodoctor, 2,0 l/ha	4,73	+ 0,55

HIP₀₅

0,02

Note: * – results obtained in 2012–2014.

Effect of biological preparation Agat 25-K is explained not only by fungicide effect, but growth encouraging abilities of the bacteria *Pseudomonas aureofaciens* and products of its metabolism.

Conclusions and perspective of further researches

1. The main mycosis of winter triticale spread in Polissia, Ukraine are: powdery mildew, brown leaf rust, Septoria spots on leaves, root rot.

2. Perspective and effective measures of treatment of diseases of triticale crops – spraying with biological preparations.

3. Treatment of winter triticale crops with Agat 25-K was the most effective among other biological preparations against main mycosis.

4. Use of mixtures of Agat 25-K, 0,03 kg with fungicide Soligor 425 EC, KE, 0,75 l/ha facilitates technical efficiency at the level of 83,9–95,5 %, significant increase of photosynthesis units from 653,9 to 713,1 and crop yield – 0,58 t/ha.

Further researches shall be targeted at improvement of biological protection of triticale against diseases of parasitic and non-parasitic origin under conditions of organic production.

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