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Efficiency of Fungicides in Winter Wheat Cultivation.

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ABSTRACT

In the context of farming in the Volga region of Russia winter wheat has a high potential of productivity due to effective use of autumn, winter and spring rainfall, it is very responsive to intensification elements, however often the amount of yield of this crop is limited by a number of factors, including a high number of harmful organisms. In recent years such winter wheat diseases as brown and leaf rust, Septoria blight, mildew and others have become widespread. High efficiency of seed treatment of winter wheat has been revealed, especially with a preparation containing triticonazole of 20 g/l + prochloraz of 60 g/l when using a complex protection of plants against diseases. The contribution of seed treatment to the formation of winter wheat cropping capacity was more essential, than the use of fungicides during vegetation. However the greatest efficiency of plant protection against diseases is obtained in joint use of seed disinfectants and fungicides during vegetation. We have established that the application of seed disinfectants and fungicides during vegetation improved physical values of grain properties (the weight of 1000 seeds, test weight of grain).

Keywords: seed disinfectant, fungicides, winter wheat, cropping capacity, quality of grain.

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INTRODUCTION

The most valuable and the most widespread grain crop on the globe is wheat. More than half of the population of Earth uses its grain as food. In Russia more than 50% of the acreage is sown to wheat among other grain crops [1].

Grain production is the most important area of plant growing development in Russia [2]. Variability of gross output of grain crops by years entails the intensity of development of animal husbandry and agrarian and industrial complex in general, has an impact on economy and social aspects of Russia's development [3]. The amount of winter wheat cropping capacity is limited by a complex of factors, including the diseases possessing high injuriousness.

In the context of the Volga region forest-steppe of Russia there is a large number of etiological agents of diseases in grain crops the spread of which often exceeds the injuriousness threshold that is explained by non-compliance with the crop rotation principles, minimization of the soil tillage, a lack of high-quality seeds, use of fungicides without specific structure of pathogenic organisms and other factors [4, 5]. Without any doubt that in this setting effective remedies of plant protection are an integral part of modern technology of grain crop cultivation and the most important factor of forming a harvest.

Against this backdrop the main types of pesticides used in Russia are still herbicides. There is a significant growth of the share of insecticides in a total amount of application, but the share of fungicides remains low. Fungicides are applied not regularly, selectively and not systemically, it is explained by their high cost and technological illiteracy of farmers [6].

The purpose of studies: to carry out an assessment of biological and economic efficiency of fungicide disinfectants and fungicides during vegetation in cultivation of winter wheat in the setting of the Volga region forest-steppe of the Russian Federation.

MATERIALS AND METHODS

The studies were conducted on the experimental field of the Ulyanovsk State Agricultural Academy (Russia, Ulyanovsk). The soil of the experimental field is leached black soil of medium thickness, average loam which is characterized by the following morphological features on the horizons. In the content of humus the soil of the experimental field belongs to low-humus - from 5,35 to 5,15%. Medium reaction in an arable layer of the soil is subacid, pH 6,0. The content of mobile phosphorus and exchange potassium is high 300 - 350 and 200 - 250 mg on 1 kg of the soil respectively. The soil base saturation degree is 96,4 - 97,9%.

The studies were carried out by doing a field experiment with the use of standard techniques [7, 8]. According to the Volga hydrometeorological service the average annual air temperature in the territory of the Ulyanovsk region is +4,0 °C with an average temperature of the coldest month (January) -14 °C and the warmest (June) +20 °C. Duration of the frost-free period - 130-150 days, the period with an average daily temperature over +10 °C - 142 days, with the sum of active temperatures of 2340 °C. The average annual amount of precipitation is 400-500 mm.

Two fungicide disinfectants were studied in the design of the experiment from 2012 to 2015 (Factor A):

A0 control (without treatment);
A1 triticonazole 80 g/l + pyraclostrobin 40 g/l (Inshur Perform, BASF)
A2 triticonazole 20 g/l + prochloraz 60 g/l (Kinto Duo, BASF)

By method of the split plots the second factor has been laid in the experiment – fungicides during vegetation (Factor B):

B0 control (without treatment);
B1 thiophanate methyl of 310 g/l + epoxiconazole 187 g/l – 0,6 l/hectare (Rex Touho, BASF);
B2 pyraclostrobin 62,5 g/l + epoxiconazole 62,5 g/l – 1,5 l/hectare (Abakus Ultra, BASF);

Course of the experiment:

1. Control (without disinfectants and fungicides during vegetation);
2. Treatment of plants with thiophanate methyl of 310 g/l + epoxiconazole 187 g/l – 0,6 l/hectare;
3. Treatment of plants with pyraclostrobin 62,5 g/l + epoxiconazole 62,5 g/l – 1,5 l/hectare;
4. Treatment of seeds with triticonazole 80 g/l + pyraclostrobin 40 g/l - 0,5 l/hectare;
5. Treatment of seeds with triticonazole 80 g/l + pyraclostrobin 40 g/l - 0,5 l/hectare + Treatment of plants with thiophanate methyl 310 g/l + epoxiconazole 187 g/l – 0,6 l/hectare;
6. Treatment of plants with pyraclostrobin 62,5 g/l + epoxiconazole 62,5 g/l – 1,5 l/hectare + treatment of plants with pyraclostrobin 62,5 g/l + epoxiconazole 62,5 g/l – 1,5 l/hectare;
7. Treatment of seeds with triticonazole 20 g/l + prochloraz 60 g/l - 1,5 l/hectare;
8. Treatment of seeds with triticonazole 20 g/l + prochloraz 60 g/l - 1,5 l/hectare + treatment of plants with thiophanate methyl of 310 g/l + epoxiconazole 187 g/l – 0,6 l/hectare;
9. Treatment of seeds with triticonazole 20 g/l + prochloraz 60 g/l - 1,5 l/hectare + treatment of plants pyraclostrobin 62,5 g/l + epoxiconazole 62,5 g/l – 1,5 l/hectare.

Replication of the experiment is triple, the area of a plot of the first order – 45x100 m (4500 sq.m), the second order – 15x100 m (1500 sq.m). Winter wheat was sown on complete fallow, the variety "Biryuza", the seeding rate is 5,5 million pieces/hectare.

At the time of sowing nitroammophoska was applied - 50 kg/hectare,– ammonium nitrate of 100 kg/hectare was applied in the spring. Except the studied means of plant protection, the insecticidal treatment and application of herbicides (general background) was carried out to control the number of pests throughout the whole experiment.

RESULTS AND THEIR DISCUSSION

It is necessary to introduce a systemic approach in contemporary farming to develop the concept of plant protection that connects the use of immune varieties, adapted agrotechnical practices, methods of biological control and spot application of chemicals as a whole [9]. The role of fungicides in forming cropping capacity and quality of winter wheat grain is not fully established.

The study of the phytosanitary condition of winter wheat crops has shown that plants were affected by pathogenic fungi of the genera Fusarium sp. and Helminthosporium sativum. While assessing biological efficiency of seed treatment it has been established that efficiency of the combination triticonazole 20 g/l + prochloraz 60 g/l in relation to the specified agents (seed and soil infection) was 79,0%, application of triticonazole 80 g/l + pyraclostrobin 40 g/l – 70,0%.

Table 1 – Yielding capacity of winter wheat depending on application of fungicides (for 2012-2015), t/ha

Variant	2012	2013	2014	2015	On average in studied factors (for 4 years)			Deviation from control
					AB	A	B	
A_0B_0	2,98	3,56	4,57	4,31	3,86	4,12	4,19	-
A_0B_1	3,36	3,68	4,88	4,65	4,14		4,41	+0,28
A_0B_2	3,42	3,86	5,31	4,81	4,35		4,64	+0,49
A_1B_0	3,54	4,05	5,05	4,62	4,32	4,52	-	+0,46
A_1B_1	3,61	4,42	5,40	4,55	4,50			+0,64
A_1B_2	3,64	4,48	5,91	4,92	4,74			+0,88
A_2B_0	3,55	3,97	5,14	4,92	4,40	4,61	-	+0,54
A_2B_1	3,63	4,04	5,67	5,01	4,59			+0,73
A_2B_2	3,84	4,22	6,15	5,12	4,83			+0,97
LSD_{05} $LSD_{A и B}$	0,44 0,25	0,11 0,06	0,35 0,20	0,26 0,15	0,14	0,08	0,08	-

Data of the table show that the combined use of the disinfectant **triticonazole 80 g/l + pyraclostrobin 40 g/l** and fungicides during vegetation increased the winter wheat cropping capacity by 0,64, - 0,88 t/hectare or 16,5 – 22,8%.

Application of seed disinfectants has shown positive influence on plant emergence in the field. So, on variants with seed treatment there were 348-347 pieces/sq.m of plants that it was more than in the control one by 9-14 pieces/sq.m.

Seed treatment of winter wheat with fungicide disinfectants led to an increase in the winter wheat cropping capacity (tab. 1).

Application of the disinfectant triticonazole 20 g/l + prochloraz 60 g/l with the subsequent fungicide treatment during vegetation led to an increase of the winter wheat yielding capacity by 0,73 - 0,97 t/hectare or 18,9 - 25,1%, with an advantage of the fungicide pyraclostrobin 62,5 g/l + epoxiconazole 62,5 g/l – 1,5 l/hectare. On average for the years of studies the greatest yielding capacity of wheat has been noted in the variant - seed treatment with triticonazole 20 g/l + prochloraz 60 g/l - 1,5 l/hectare + treatment of plants with pyraclostrobin 62,5 g/l + epoxiconazole 62,5 g/l – 1,5 l/hectare and was 4,83 t/hectare that above the control variant by 25,1%.

The analysis of variance has allowed us to assess a contribution of each factor to the formation of yielding capacity of winter wheat. Calculations have shown that from 42,6 to 75,6,0% (an average of 63,0%) of yielding capacity changes, in different years, have been associated with seed treatment and 22,0 - 56,2% (an average of 33,0%) – using fungicides during vegetation. Thus it is necessary to apply a disinfectant in cultivation of winter wheat in this zone– it provides a big increase of the harvest, than the use of fungicide during vegetation. However the greatest efficiency of plant protection against diseases is reached in joint use of disinfectants and fungicides during vegetation.

Formation of the winter wheat yielding capacity was determined by the action of seed disinfectants and fungicides during vegetation the application of which limited the spread of diseases in roots and elevated parts of plants during vegetation that finally had an influence on the harvest amount.

The greatest increase of the winter wheat yielding capacity has been obtained in application of two-component seed disinfectants and double treatment by fungicides during vegetation.

Under production conditions grain quality values of wheat [10] are important. The evaluation of the winter wheat grain quality on parameters - vitreousness, protein content, gluten content has shown that distinctions throughout the variants were not observed, however the improvement of gluten quality was noted.

The analyses of grain have shown that with the use of fungicides the weight increase of 1000 seeds and grain units (tab. 2) was observed.

Table 2 – Dynamic pattern of grain units (above the line, g/l) and the weight of 1000 seeds (below the line, d) of winter wheat depending on the use of fungicides

Factor A	Factor B			Grain units	M 1000
	B0	B1	B2		
A0	776/38,4	783/39,7	784/40,0	781	39,4
A1	785/39,3	785/40,0	789/39,9	786	39,7
A2	784/40,1	789/40,6	789/41,2	787	40,6
Grain units	782	786	787	-	-
M 1000	39,3	40,1	40,4	-	-

In the control variant the weight of 1000 seeds for the years of studies has averaged 39,4 g, in application of disinfectants and fungicides on vegetation this value went up till 39,7 - 40,6, the grain unit increased from 781 g/l up to 787 g/l.

CONCLUSIONS

- Seed treatment of winter wheat has shown a high efficiency of plant protection from root rot, especially a preparation containing triticonazole of 20 g/l + prochloraz of 60 g/l., at the same time

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biological efficiency has reached 79%. The application of fungicide disinfectants triticonazole 80 g/l + pyraclostrobin 40 g/l and triticonazole 20 g/l + prochloraz 60 g/l increased yielding capacity of crops by 0,46 t/hectare and 0,54 t/hectare respectively in comparison with the control variant. When using a complex protection of plants against diseases (disinfectant + fungicide) the increase of yielding capacity was 0,88-0,97 t/hectare.

- The contribution of seed treatment to the formation of the winter wheat yielding capacity has averaged 63,0% and the use of fungicides during vegetation - 33,0%. However the greatest efficiency of plant protection against diseases is obtained in joint use of disinfectants and fungicides during vegetation.
- It has been established that application of seed disinfectants and fungicides during vegetation improved physical values of grain properties (the weight of 1000 seeds, test weight of grain).

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