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Straw In Panicum Fertilizer System In The Conditions Of The Forest-Steppe Of The Middle Volga Region.

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ABSTRACT

The paper presents results of application of straw as an organic fertilizer and ways of its efficiency improvement in the technology of panicum cultivation in the conditions of the Volga forest-steppe. It was established in field tests that the yield of panicum was on average 2,97 t / ha within a 3 year period, exceeding the control by 12% in case of using straw in combination with the biopreparation Baikal EM-1 and additional nitrogen (10 kg of N per 1 t of winter wheat straw), mineral fertilizers – 3,87 t / ha (by 46%).

Keywords: panicum, fertilizer system, straw, biopreparation, yield.

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INTRODUCTION

Panicum is one of the oldest cereal crops in the world [1, 2, 3]. It is appreciated for high taste qualities of grain (millet), which contains mineral salts of potassium, sodium, calcium, magnesium, phosphorus, zinc, copper, organic acids and vitamins. Panicum fields occupy about 40 million hectares in world agriculture, in Russia - 1 million hectares. The potential yield of panicum is higher than that of wheat. However, its actual yield in recent years does not exceed 1,0 t / ha.

The application of fertilizers is one of the most effective ways to increase crop yield as well as an obligatory element in cultivation technology of any crop. As for panicum, it grows well on a wide variety of soils, including black soils, chestnut, podzolic, alkaline, solonetz and meadow- boggy soils. However, it prefers well-structured soil with a high content of readily soluble nutrients [4]. It also responds well to application of organic fertilizers, the most appropriate of which is straw in the current conditions of agricultural production.

Straw is 85% composed of organic matter, valuable for improving soil fertility. Cellulose, pentosans, hemicellulose and lignin (up to 80%) are carbonaceous energy materials for soil microorganisms. In addition, the long lasting straw decomposition in the soil does not contaminate it with high concentrations of nitrate nitrogen, which is advisable from an environmental point of view. Unlike other organic fertilizers (manure, siderates), straw does not immediately display its positive effect due to the peculiarities of its chemical composition. One of the possible ways to accelerate its decomposition in the soil and increase the release of nutrients in a form accessible to plants is the usage of straw together with preparations that activate the activity of soil microorganisms. The latter fact determined the purpose of our study.

METHODOLOGY OF RESEARCH

The work is based on 3 summer (2014 - 2016) field experiments and laboratory studies of soil and plant samples. The objects of study were: soil - typical black soil medium-heavy medium loamy slightly humic with humus content of 4,7%, with high availability of mobile phosphorus (196 mg / kg, according to Chirikov) and very high potassium (206 mg / kg), reaction of a soil solution close to neutral (pH_{KCl} 6,3 – 6,7); panicum variety Orlovskoe - 82; straw of the forecrop (winter wheat); mineral fertilizers: calurea, azofosca, potassium chloride; biopreparation Baikal EM-1. The scheme of the field test included, in addition to the control, 11 systems of panicum fertilizing using straw, biopreparation, mineral fertilizers - both separately and in various combinations: 1. Without fertilizers (control); 2. The straw of the forecrop; 3. Straw + 10 kg of N / t of straw (N_{10}); 4. Straw + biopreparation (Baikal EM-1); 5. Straw + N_{10} + biopreparation; 6. Biopreparation; 7. $N_{129}P_{34}K_{54}$ (NPK, ground); 8. NPK + straw; 9. NPK + straw + N_{10}; 10. NPK + straw + biopreparation; 11. NPK + straw + N_{10} + biopreparation; 12. NPK + biopreparation. The experiment was carried out in 4-fold replication. The sowing area of one plot is 120 m^2 (6 × 20), the record area is 72 m^2 (4 × 18), the location of the plots is random. Chemical analyzes of the samples were performed in the testing laboratory of "Ulyanovsk State Agricultural Academy" (№ Russ. RU.0001.513748) and the certified laboratory of the FSBI "Station of Agrochemical Service Ulyanovskaya" (№ RA.RU.510251) according to the corresponding State Standards.

RESULTS AND ITS DISCUSSION

The yield of panicum for the years of research is presented in the table.

When analyzing the results of the research, first of all is seen that despite the different weather conditions of the vegetation period, panicum is able to steadily form the grain yield at the level of 2,50-3,00 t / ha without applying fertilizers on the typical black soil of the Middle Volga region. Its cultivation with the usage of mineral fertilizers for the planned yields can increase crop yield by more than 30%.

The application of forecrop straw as an organic fertilizer did not lead to a decrease of the grain yield, which significantly increased by 0,18 and 0,24 t / ha, respectively (by 8 and 9%), when used together with N_{10} and biopreparation Baikal EM-1. The latter fact proves that these techniques undoubtedly contribute to the acceleration of straw decomposition and the release of plant nutrients in an accessible form. The content of nitrate nitrogen in the plowing layer of the control variant before panicum sowing was 13,46 mg / kg on average for 3 years, whereas the application of straw made it possible to exceed the non-fertilized variant by 1,4 mg / kg. The addition of extra nitrogen to straw (N_{10}) and biopreparation increased the amount of nitrate

nitrogen available to plants by 3,9 and 3,8 mg / kg, accordingly. More noticeable positive changes in the nutrient regime of the soil were observed with the joint application of straw with an additional dose of nitrogen and Baikal EM-1, where the excess over the control was 5,5 mg / kg.

Effect of fertilizer systems on the yield of panicum grain, t / ha

Variant		2014	2015	2016	2014-2016	Deviation from the control	
						t/ha	%
1	Without fertilizers (control) (Factor A)	2,58	2,92	2,50	2,66	–	–
2	The straw of the forecrop (Factor B)	2,64	2,89	2,52	2,68	0,02	1
3	Straw + 10 kg of N / t of straw	2,82	3,12	2,63	2,86	0,18	8
4	Straw + biopreparation	2,95	3,06	2,68	2,90	0,24	9
5	Straw + N_{10} + biopreparation	2,98	3,21	2,73	2,97	0,31	12
6	Биопрепарат (Factor C)	2,85	2,99	2,60	2,81	0,15	6
7	$N_{129}P_{34}K_{54}$ (ground)	3,56	3,85	3,08	3,50	0,84	32
8	NPK + straw	3,64	3,93	3,21	3,59	0,93	35
9	NPK + straw + N_{10}	3,90	4,05	3,44	3,80	1,14	43
10	NPK + straw + biopreparation	3,97	3,87	3,38	3,74	1,08	41
11	NPK + straw + N10 + biopreparation	4,01	4,16	3,45	3,87	1,21	46
12	$N_{129}P_{34}K_{54}$ + biopreparation	3,60	4,11	3,20	3,64	0,98	37
HCP_{05}	Factor A	0,05	0,03	0,03	–	–	–
	Factor B	0,06	0,03	0,04	–	–	–
	Factor C	0,05	0,03	0,03	–	–	–

Similar positive changes of straw application as panicum fertilizer were observed in the content of available phosphorus and potassium compounds in the plowing soil layer. Simultaneously, the number of mobile phosphates increased in variants with straw by 3,5 mg / kg, straw + N_{10} - by 5,0 mg / kg, straw + biopreparation + N_{10} - by 8,5 mg / kg. Our data are consistent with the results of Barzegar A.R., Yousefi A., Daryashenas A. (2002) [5], Varinderpal-Singh, N.S. Dhillon, B.S. Brar (2006) [6], Magomedov K.G., Khaniev M.Kh., Khanieva I.M. and others (2008) [7].

As for available potassium, the highest increase in its content against a natural ground was observed in the variant of using straw, Baikal EM-1 biopreparation and 10 kg / t of straw, which was 16 mg / kg. The latter was observed due to activation of microorganisms that decompose straw, as a result of which potassium was released, its content in straw is 3 times more than in grain.

Undoubtedly, mineral fertilizers remain the main means of increasing the yield of agricultural crops [8]. Usage of nitrogen-potassium-phosphorus fertilizers in the technology of panicum cultivation allowed to increase the yield of grain on average for 3 years by 0,84 t / ha, or by 32%. However, their joint application with straw of the previous grain crop, additional nitrogen of 10 kg / t and biopreparation Baikal EM-1 ensured an increase in the yield of grain of more than one tonne per hectare (1,21 t / ha). Thus, the agronomic efficiency of straw usage together with N_{10} and biological preparation Baikal EM-1 increased by 14%.

CONCLUSION

The application of winter wheat straw as panicum fertilizer on average for 3 years contributed to an increase in the grain yield by 0,02 t / ha, when used together with nitrogen fertilizer in the dose of 10 kg per 1 tonne of straw - by 0,18 t / ha, with biopreparation Baikal EM-1 - by 0,24 t / ha (control – 2,66 t / ha). The usage of straw together with mineral fertilizers for the planned productivity of panicum grain of 4 t / ha ($N_{129}P_{34}K_{54}$) ensured an increase by 0,93 t / ha. The highest crop yield was formed on a variant with joint application of straw, nitrogen additive and biopreparation on NPK ground and, on average, it was 3,87 t / ha for 3 years, exceeding the control by 1,21 t / ha.

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