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The Use Of Silicon-Containing Agro Ores For Increasing The Productivity Of Agricultural Crops.

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ABSTRACT

The article presents the results of studies on the effect of different doses of diatomite and fertilizers on the grain yield of agricultural crops. As shown in the studies conducted in the experimental field of the training and production center of Penza State Agrarian University (Russia), the use of different rates of diatomite from 2.0 to 8.0 t / ha against the background without fertilizers increased crop yields by 8.9-18.4 %. The use of manure at a rate of 48 t / ha against the background of different doses of diatomite increased the yield of the first crop — winter wheat by 69.8–86.3%; the yield of the second and third crop from 13.7 to 26.5%.

Keywords: silicon-containing agro ores, diatomite, organic and mineral fertilizers, yield.

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INTRODUCTION

One of the most important tasks of agrochemical science is the creation of such fertilizer systems for field crops, which, ensuring high plant productivity, determine the stability of soil fertility [4, 10].

Today, it is common to use new, non-traditional methods to increase crop yields in agriculture [4]. First of all, we mean diatomites - a sedimentary rock consisting of shells of diatom algae. This rock is also called diatomaceous earth, mountain flour [1, 5, 6, 7].

Diatomite belongs to the group of silica rocks of organogenic origin, formed from the shells of diatoms and spicules of silicon sponges. Diatomite is a white, light gray, very light rock consisting of weakly cemented particles [8].

Studies on the role of silicon and its compounds in soil processes expanded the range of possible applications of natural silica in agriculture. Silicon minerals are considered as a source of soluble silica, which plays an important role in the formation of soil fertility, increasing plant productivity and plant resistance to diseases and pests [5, 6, 9, 11, 12, 13, 14]. V.M. Dyakov and his colleagues refer to the experience of using diatomites as fertilizers, which application into the soil increased its buffering capacity and adsorption properties, and also helped to reduce iron and aluminum intoxication of plants, which was especially important for acidic soils. However, the mechanism of action of diatomites and their participation in soil processes was not sufficiently studied [3].

In Russia, large deposits of diatomite are located in Ulyanovsk region and Penza region, as well as in the Urals and Siberia [2]. On the territory of the Penza region (Russia), 3 deposits of diatomites (Akhmatovskoe, Kholenevskoye and Korzhevskoye) were identified with the amount of raw materials of 3.5, 2.8 and 5.5 million m3, respectively [12]. In this light, the perspective of using local diatomite mined in Penza region (Russia, Penza region, Nikolsky district, Korzhevskoye field deposit) to improve soil fertility and productivity of cultivated crops becomes especially interesting.

MATERIALS AND METHODS OF RESEARCH

To solve these tasks, in 2014-2017 field studies were carried out on the experimental field of the training and production center of FSBEI HE Penza State Agrarian University (Russia, Penza region, Mokshan district) with the rotation of winter wheat - spring wheat - pea according to the following scheme:

Factor A - the norms of diatomite: 1. Without diatomite (control); 2. Diatomite 2 t / ha; 3. Diatomite 4 t / ha; 4. Diatomite 6 t / ha; 5. Diatomite 8 t / ha.

Factor B - Application rates for manure and mineral fertilizers: 1. Without fertilizers (control) - background 1; 2. Manure 16 t / ha of arable crop rotation - background 2; 3. NPK is equivalent to 16 t / ha of manure annually - background - 3.

Variants in the experiment were placed by the method of randomized repetitions. The repetition was fourfold. The total area of the plot was 36 m2. Accounting area was 25 m^2.

The studies were conducted on leached medium-humus medium-heavy heavy-loamy black soil. The humus content in the 0–30 cm layer was 6.11–6.48%, the content of lightly hydrolysable nitrogen was 115.0–125.0, of the mobile phosphorus — 74.0–81.0, and of the mobile potassium — 125.0-133.0 mg per kg of soil, the reaction of the soil solution was acidic and weakly acidic (4.8-5.02), hydrolytic acidity was 5.85-6.57 mEq. per 100 g of soil, the amount of absorbed bases - 35.4-38.2 mg-eq. per 100 g of soil.

In the experiment a manure rate of 16 t / ha of cropland was used (from the calculation of manure after-effect for 3 years, the rate was 48 t / ha). The mineral fertilizers used in the experiment were ammonium nitrate fertilizer, diammophoska, potassium chloride. The norms of mineral fertilizers were equivalent to the content of nitrogen, phosphorus and potassium in 16 t / ha of crop rotation of arable land of manure and constitute N80P40K96 (annually).

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The chemical composition of diatomite from the Korzhevsky field of the Penza region is the following: SiO2 - 78.8%; A12O3 - 6.9%; Fe2O3 - 3.8%; TiO2 - 0.48%; CaO - 0.39%; MgO - 0.89%; SO3 - 0.27%; Na2O - 0.30%; K2O - 1.8%; P2O5 - 0.04%. [16].

RESULTS OF RESEARCH

The yield of the cultivated crops depended on the chosen combination of using different doses of diatomite and fertilizers. In the variant without diatomite and fertilizers, the grain yield of winter wheat in 2015 amounted to 2.02 t / ha. Deviations from the control variant depending on the application rate of diatomite against the background without fertilizers amounted to 0.22-0.45 t / ha, against the background of applying manure in the rate of 16 t / ha of crop rotation cropland - 0.23-0.66 t / ha, and against the background of the use of mineral fertilizers - 0.17-0.36 t / ha. The highest gains were on options against the background of manure (Table 4). The increase in grain yield on options with the introduction of diatomite in the normal of 2 t / ha was insignificant. The highest grain yield of winter wheat was observed in the variants with the introduction of different norms of diatomite against the background of the use of manure.

Table: Crop yields depending on the use of diatomite and fertilizers

Options of the experiment	Урожайность культур, т/га		
	2015 – winter wheat	2016 – spring wheat	2017 – pea
Background 1 – without fertilizers			
1. Without diatomite	2,02	2,22	1,88
2. Diatomite 2 t/ha	2,24	2,46	2,09
3. Diatomite 4 t/ha	2,33	2,56	2,14
4. Diatomite 6 t/ha	2,40	2,64	2,17
5. Diatomite 8 t/ha	2,47	2,72	2,20
Background 2 – 16 t of manure/ha of crop rotation			
1. Without diatomite	3,43	2,45	2,18
2. Diatomite 2 t/ha	3,66	2,61	2,25
3. Diatomite 4 t/ha	3,96	2,83	2,40
4. Diatomite 6 t/ha	4,09	2,92	2,44
5. Diatomite 8 t/ha	3,98	2,84	2,41
Background 3 – NPK is equivalent to 16 t / ha of manure annually			
1. Without diatomite	3,30	2,75	2,63
2. Diatomite 2 t/ha	3,47	2,89	2,66
3. Diatomite 4 t/ha	3,60	3,00	2,78
4. Diatomite 6 t/ha	3,47	2,89	2,73
5. Diatomite 8 t/ha	3,66	3,05	2,86
HCP_{05}			
Factor A	0,22	0,23	0,17
Factor B	0,28	0,25	0,18
Options (A+B)	0,31	0,34	0,21

The increase in the yield of winter wheat compared to the control variant was 1.41-2.07 t / ha. This was mainly due to the fact that 240 kg of nitrogen, 120 kg of phosphorus and 288 kg of potassium were added to the manure rate of 16 t / ha of crop rotation for 3 years.

The yield of spring wheat grain on the variants of experiment in 2016 amounted to 2.22-3.05 t / ha. The yield increase using different standards of diatomite was 0.24-0.5 t / ha. The highest increases were observed on variants with mineral fertilizers. The yield on the variants with the annual use of mineral fertilizers with the norms of N80P40K96 ranged from 2.75 to 3.05 t / ha. On variants with the use of manure, the yield was lower than on variants with mineral fertilizers, but higher than on variants using different norms of diatomite, which was associated with the aftereffect of manure introduced into winter wheat.

The yield of peas ranged from 1.88 to 2.86 t / ha in the third year of fertilizer and diatomite introduction. The effect of mineral fertilizers on peas yield was more notable than the aftereffect of the equivalent manure rate. Deviations from the control variant were 0.75–0.98 t / ha.

The difference in the yield of pea grain from the aftereffect of different doses of diatomite was 0.21-0.32 t / ha.

CONCLUSIONS

The application of manure in the norm of 16 t / ha of crop rotation of arable land, depending on different doses of diatomite, increased the yield of the first crop (winter wheat) by 69.8-86.3%, the yield of the second crop (spring wheat) by 15.8-26.5% , and of the third crop (pea) by 13.7-22.0%. When using mineral fertilizers with the N80P40K96 standard, against the background of the use of diatomite, the grain yield of winter wheat increased by 63.4-66.3%, of spring wheat - by 27.2-30.5%, of peas - by 28.5-34.2 %. Different doses of diatomite without the use of fertilizers increased the yield of winter crops by 8.9-18.2%, of spring wheat by 9.7-18.4%, and of peas by 10.0-14.5%.

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