The effect of organic fertilizers on the cellulolytic activity of the soil and rooting of cuttings of Ribes rubrum L

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Abstract. In a field experiment, the effect of organo-mineral fertilizers based on zeolites, peat and sapropel deposits of the Krasnoyarsk Territory on the biological activity of leached chernozem and rooting of lignified cuttings Ribes rubrum L. was studied as a test object of the bioecological state of the soil when fertilizers were applied as its cellulose-degrading ability. 4 months after fertilizing, a statistically significant positive effect on the destruction of cellulose in soil layers of 0 - 10 and 10 - 20 cm was exerted by the following organo-mineral fertilizers: peat + zeolite + 20% NPK, peat + zeolite + 30% NPK, peat + sapropel + 10% NPK, as well as diammofosk mineral fertilizer. The studied fertilizers did not have a statistically significant effect on the rhizogenesis of the cuttings of red currant.

In modern conditions of development of the agro-industrial complex of Russia we can notice a positive dynamics of the gardening development [1, 2]. The formation and promotion of the market of planting material is determined by the revival of horticulture at agricultural enterprises, the growth of private housing construction and emerging trends in the urban gardening market [3,4].

A criterion for the effectiveness of nursery farming is to obtain the output of high-quality planting material per unit area at the lowest cost [5]. In this regard, there is a need to optimize the elements of the technology of propagation of horticultural crops to increase the level of production efficiency of seedlings.

A distinctive feature of berry crops is the widespread use of vegetative propagation methods [3]. According to the researchers, the main methods ensuring high rhizogenesis of the cuttings are as follows: the optimal physiological state of the cuttings [6], effective root formation stimulants [1,7,8, 9], selection of substrate for rooting [10,11], use of fertilizers [1,12].

Studies conducted to assess the influence of agrochemicals on the efficiency of rooting of cuttings are not enough; in the soil and climatic conditions of Siberia, they are single and limited mainly to mineral tuks. Moreover, several works [13, 14] show that the systematic and one-sided application of mineral fertilizers affects the biological properties and soil fertility.

In order to reduce costs in the production of seedlings, to preserve and increase the biological activity of soils, it is advisable to focus on the production of organo-mineral fertilizers and ameliorates from local sources of agrochemical raw materials. In Siberia, there are broad prospects to produce organic-mineral fertilizers based on zeolites and peat.

In the experiment conducted during the rooting of lignified cuttings of red currant (Ribes rubrum L.), the effect of organic-mineral fertilizers obtained on the basis of the agrochemical resources of Siberia: zeolites, peat, sapropel on the cellulolytic activity of the soil was studied. We used zeolites of the
Sakhaptinskoye deposit, sapropel of the Small Kyzikul lake, peat of the Tigritsky deposit of the Krasnoyarsk Territory.

Scheme of experience: 1. Control (without fertilizers); 2. Zeolite; 3. Peat; 4. Sapropel; 5. NPK (diammofoska); 6. Peat + zeolite; 7. Peat + zeolite + 10% NPK; 8. Peat + zeolite + 20% NPK; 9. Peat + zeolite + 30% NPK; 10. Peat + sapropel; 11. Peat + sapropel + 10% NPK; 12. Peat + zeolite + 20% NPK. The dose of zeolite, peat-zeolite and peat-sapropel fertilizers - 2 t / ha; peat, sapropel - 60 t / ha; NPK (diammofoska) - 380 kg / ha in physical weight. The grade of currant is Krasnaya Andreichenko. The soil of the site is leached chernozem.

Lignified cuttings were planted in open ground according to the scheme of 45 x 8 cm. After planting and then every 4 days during the first month, irrigation was carried out at the rate of 10 l of water per 1 m2. In the following months - the conditions are dry.

The use of agrochemicals often leads to a deterioration in the quality of the environment for microbocenoses. Fertilizing and land reclamation should not lead the soil system beyond the limits of its adaptation capabilities. To assess the biological activity of the soil, its cellulose-degrading ability is used.

We studied the effect of fertilizers on the process of fiber destruction in dynamics, during the growing season on plots with red currant. The cellulolytic activity of the soil was analyzed by the application method for the decomposition of flax tissue in the soil [15].

One month after the planting of lignified cuttings of the crop (12.06) in the soil layer of 0-10 and 10-20 cm, the minimum percentage of decomposition of flax tissue was observed in the control and in plots with zeolite in its pure form (table 1).

| Experiment variants | Tissue decomposition, % |
|---------------------|------------------------|
|                     | 12.06 | 12.07 | 12.08 |
|                     | 0-10-20 | 0-10-20 | 0-10-20 |
| 1. control          | 6.3 | 6.5 | 43.3 | 57.1 | 68.3 | 75.1 |
| 2. zeolite          | 2.0 | 3.5 | 48.3 | 46.2 | 73.7 | 69.5 |
| 3. peat             | 19.0 | 22.4 | 65.3 | 88.5 | 72.5 | 85.0 |
| 4. sapropel         | 22.2 | 12.3 | 62.3 | 65.7 | 79.4 | 85.9 |
| 5. NPK              | 24.6 | 31.5 | 68.9 | 72.3 | 79.6 | 91.8 |
| 6. peat + zeolite   | 11.3 | 13.5 | 57.6 | 65.6 | 65.7 | 89.2 |
| 7. peat + zeolite + 10% NPK | 10.9 | 12.7 | 60.8 | 76.5 | 79.6 | 89.2 |
| 8. peat + zeolite + 20% NPK | 11.1 | 12.4 | 61.4 | 65.4 | 87.6 | 91.8 |
| 9. peat + zeolite + 30% NPK | 12.9 | 16.4 | 63.5 | 52.9 | 88.4 | 92.4 |
| 10. peat + sapropel | 15.5 | 13.7 | 51.3 | 60.3 | 70.6 | 92.1 |
| 11. peat + sapropel + 10% NPK | 21.3 | 17.3 | 50.3 | 58.8 | 79.5 | 96.7 |
| 12. peat + sapropel + 20% NPK | 21.8 | 19.2 | 57.5 | 63.9 | 77.0 | 89.6 |
| HCP05               | 11.6 | 12.3 | 14.0 | 13.7 | 11.2 | 15.1 |

Zeolite tuff, not enriched with nutrients, having a higher cation exchange rate than soil, uses mobile nitrogen to saturate its channels, being a competitor to the microbial community. The percentage of cellulolytic degradation increases in the version with peat by 3.0 times in relation to the control in the entire arable layer. But the most active activity of microbiota is expressed in the variant with mineral fertilizers. This is probably due to the greater availability of nutrients from fat.

In the middle of the growing season (12.07), in almost all variants of the experiment, the rates of fiber destruction are enhanced in relation to the plot without fertilizers. During this period, an enhanced process of soil cellulose decomposition is observed in the variant with pure peat and in experimental plots with a diammophos. So on plots with peat in the soil layer of 0-10 cm, this process is 21.92%; 10-20 cm is 30.71% more than in the control. The introduction of organic matter into the soil leads to an increase in aerobic nitrogen fixers, microorganisms that dissolve phosphates and sulfur as a result of the mineralization of these plant residues. The use of NPK increased the destruction of flax tissue by 25.6%
in the 0-10 cm layer, 14.5% in the 10-20 cm layer. There was no negative effect of increased doses of mineral fertilizers on peda fauna and soil ecology during this period.

With an increase in the NPK dose in peat-zeolite fertilizers, the cellulose-degrading ability of the soil in the layer of 0-10 cm is enhanced. So for the option peat + zeolite + 30% NPK, this figure is 63.5%. In a soil layer of 10–20 cm, the maximum destruction of cellulose among organo-mineral fertilizers is observed in the variant peat + zeolite + 10% NPK — 76.4%.

The surveys conducted in August showed that the cellulose-degrading ability in the soil layers of 0-10 and 10-20 cm significantly increases compared with the control option only on plots peat + zeolite + 20% NPK and peat + zeolite + 30% NPK. Moreover, with an increase in NPK dose, cellulose decomposition increases by 19.1% in the 0-10 cm layer, by 16% in the 10-20 cm layer for the peat + zeolite + 20% NPK variant; 26.05% in the 0-10 cm layer and 17% in the 10-20 cm layer for the peat + zeolite + 30% NPK variant relative to the control. The saturation of peat zeolite granules with mineral tuks contributed to a longer period of nutrient transfer from the granules to the soil, which caused an increase in the destruction of fiber. It should be noted that a block of variants with peat zeolites contributes more to the decomposition of cellulose than variants with peat sapropels. Also, a significant increase in microbiological activity occurs at a depth of 10-20 cm in the plot of the experiment with diammophos. The outbreak of the microbiological activity of the soil in the plots with peat in its pure form decays by the end of the growing season and does not significantly differ from the control indicator.

Redcurrant belongs to the group of crops that actively form subordinate roots on the shoots. The rooting rate of currant cuttings in the year of research is high: from 78.8% on unfertilized plots to 97.0% on options with sapropel (figure 1).

![Figure 1](image)

**Figure 1.** The effect of organic-mineral fertilizers on the rhizogenesis of cuttings Ribes rubrum L.

Option numbering is given in accordance with the scheme of experience.

When NDS = 18.23, there was no significant effect of the studied organic-mineral fertilizers on the rhizogenesis of cuttings in the year of research.

Based on the foregoing, we note that under the influence of new organic-mineral fertilizers, the activity of cellulytic degrades increases, which indicates a positive effect of the studied reclamation agents on the soil. No statistically significant effect of the studied fertilizers on the rooting of lignified redcurrant cuttings was recorded.

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