The influence of diet on the biological activity of the soil and the productivity of grain crops in the Prebaikalia

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Abstract. This article presents data on the general effect of foliar top dressing on the yield of cereals such as wheat, triticale, barley and oats on various backgrounds of mineral nutrition. The data on the biological activity of soils by the method of application analysis are also presented. The analysis of weather and agrochemical parameters of the soil, such as the amount of humus, the reaction of the soil solution, and the supply of nutrients that activate the activity of microorganisms and have a significant effect on the productivity of crops. During the research it was found that during the growing season, weather conditions and backgrounds of mineral nutrition had a significant impact on the rate of decomposition of linen. In addition, the influence of various species characteristics of crops on biological activity was noted. In the year of research, the logical effect of extra-root dressing on the studied cultures was not established. The maximum yield increase from the application of foliar top dressing was obtained on a variant of the experiment without the use of fertilizers.

1. Introduction
The study of zonal features of the technology of cultivation of grain crops in the soil and climatic conditions of the Prebaikalia was studied fragmentarily. To increase the production of feed and food grain, it is necessary to search for new ways to increase the yield of grain crops. A large role in solving this problem belongs to the biological potential of crops and varieties, as well as the optimization of mineral nutrition and other important factors of plant life in relation to specific agroecological conditions.

2. Conditions and methodology of the experiments
Experiments to study the influence of field crops and various backgrounds of mineral nutrition on the biological activity of the soil and the productivity of crops were carried out on the experimental field of the Irkutsk Research Institute of Agriculture in 2018 on dark gray forest loamy soil. The generally accepted technology for preparing the soil for sowing was used for the forest-steppe zone of the Irkutsk region. The predecessor was black steam. The plot area is 15 m², the repetition is six times. The placement of experience options is systematic. The seeding rate is 6 million germinating grains per 1 ha. Sowing was carried out at the beginning of the third decade of May. Grain harvesting was carried out by direct combination - in the first ten days of September, when the development phase begins, full ripeness. Crops and varieties that took part in the experiment: spring wheat cultivar Buryat spinovy, spring wheat cultivar Tulunskaya 11, spring tritium-kale cultivar Dobroe, spring barley culti-
var Biom, spring oats cultivar Rovesnik - are zoned in 11 regions. On all varieties, various foliar top dressings from four manufacturers were used. Foliar top dressing was used in a tank mix with Balerin herbicides of the August company and Puma super of the Baier company in the dose recommended by the manufacturer. Observations, accounting and data processing were carried out according to standard methods, according to GOST, mathematical processing of the results - using the Microsoft Office Excel program, analysis of variance by the method of B.A. Armor, determination of humus was carried out according to the method of I.V. Tyurin in the modification of B.A. Nikitin, actual acidity was determined by potentiometric method. Soil samples for the above studies were taken at the end of the growing season (first decade of September) from a depth of 0-20 cm. The biological activity of the soil was studied by the method of decomposition of linen, laid to a depth of 0-20 cm during the growing season [1, 2].

3. Research results
The weather conditions during the growing season were not very favorable for the growth and development of crops and for the microbiological activity of the soil. Abiotic factors significantly differed in temperature, the amount of precipitation for the spring-summer period, and average long-term indicators. The average daily air temperature during the growing season was 15.3 °C and the average summer temperature was 12.5 °C, i.e. perennial average values were below temperature in 2018. In June, July and August, heat supply was above normal. So, from May to September, the air temperature was 1.5° C higher than the long-term average; 5.1° C; 1.8° C; 3.8° C; 1.8° C, respectively. At the same time, precipitation fell extremely unevenly. In general, from May to September, only 276.2 mm of precipitation fell, which was 69.2 mm less than the mean annual values. The amount of precipitation from May to July was 83.3 mm lower than the long-term average. The amount of precipitation for August and September 2018 exceeded the long-term values by 4.9 mm and 9.2 mm, respectively. From the above it follows that the growing season of the study year was quite hot and arid, which did not allow the plants to reach potential yield.

The humus content in the soil layer with a depth of 0-20 cm was 5.0-5.1%, P2O5 and K2O, respectively, 16.0 and 9.20 mg / 100 g of soil, pH 4.7-4.9, total the absorbed bases of 24.0 mEq / 100 g of soil, the degree of saturation with exchange bases of 75.0%.

The rate of decomposition of cellulose is more dependent on moisture and nitrogen content in the soil, and this process is most active in spring and autumn. During the observation period, it was found that at the time of the first sampling to study the microbiological activity of the soil, after 30 days, a significant decomposition of flaxen linen was observed in the variant with barley when applying complex fertilizer. It amounted to 33.2%, while under the agrocenoses of other crops, this indicator ranged from 17.0 to 25.5%. Significant decomposition of flaxen linen fabric was recorded in the version with triticale when applying complex fertilizer - 25.5%. The lowest percentage of decomposition for the first selection period was noted in the variant with triticale without the use of fertilizers and amounted to only 0.68%. On average, the activity of cellulose-destroying microorganisms in the experimental variants without the use of mineral fertilizers amounted to 1.61%, against the background with N45 - 18.1%, against the background with N45P45K45 - 23.0%.

As a rule, during the tillering stage, the total number of microorganisms is minimal and reaches maximum values in the earing phase, which is associated with a change in the composition and amount of root secretions in plants that serve as a nutrition source for microorganisms [3].

At the time of the second selection (after 60 days), a significant destruction of flax tissue was observed in the variant with oats with the introduction of complex fertilizer - 72.2%. The lowest percentage of decomposition of flaxen linen in this period occurred in the variant with triticale without fertilizing, it amounted to 4.81%. The rate of cellulose decomposition in the experimental variants without the use of mineral fertilizers was 10.8%, against the background with N45 - 28.5%, against the background with N45P45K45 - 36.1%.

In the phases of exit into the tube and earing, the proportion of cellulose-degrading microorganisms increased. The activity of cellulose-degrading microorganisms is insignificant in the young root zone,
their number increases with aging, which is apparently due to the fact that these microorganisms do not live due to plant exosmosis, but take an active part in the decomposition of dead horse residues [4].

Within 90 days, the greatest cellulose-degrading activity was observed in the variant with oats with the introduction of nitrogen and complex fertilizers and amounted to 84.3 and 76.0%. The lowest decomposition rate was in the control variant without fertilizers in barley crops and amounted to 22.6%. The rate of cellulose decomposition in the experimental variants without the use of mineral fertilizers was 10.8%, against the background with $N_{45}$ - 28.5%, against the background with $N_{45}P_{45}K_{45}$ - 36.1%.

By the end of the growing season, after 90 days, the biological activity of the soil in the experimental variants without the use of mineral fertilizers was 22.9%, against the background with $N_{45}$ - 54.1%, against the background from 45.9%.

It is well known that the introduction of mineral fertilizers into the soil not only improves the nutrition of plants, but also changes the conditions for the existence of soil microorganisms, which also need elements of mineral nutrition.

Thus, comparing the biological activity of the soil in all agrocenoses, it was noted that the greatest degradation of flaxseed was in barley crops, after 30 days, when complex fertilizer was applied, and after 60 and 90 days, this indicator became higher in the version with oats. Probably, the rate of decomposition of flaxen linen was affected by an increase in soil moisture and the development of the rhizosphere zone of plants. The biological activity of the soil affects the development of crops, and therefore their productivity.

The influence of the background of mineral nutrition and foliar feeding on the yield of grain crops is reflected in figure 1. From the data obtained it follows that the highest yield was in triticale. On all backgrounds of mineral nutrition, it was above 20.0 c/ha. Wheat cultivar Buryat spisty also provided high yields on the experimental variants for all backgrounds of mineral nutrition, but it was lower than that of the triticale Dobroe. In other crops, productivity was lower, but it gradually increased with an increase in the background of mineral nutrition. Oats reacted best to the application of mineral fertilizers. If in the control variant of the experiment its yield was 9.73 c/ha, then in the background with $N_{45}$ it was 18.6 c/ha, with $N_{45}P_{45}K_{45}$ it was 21.5 c/ha, which was 1.9 and 2.2 times higher a variant of the experiment on which mineral fertilizers were not applied. A similar tendency was also recorded in the crops of wheat of the Tulunskaya 11 variety - a gradual increase in crop productivity was observed with an increase in fertilizers in the soil. So, against the background without fertilizers, the oat yield was 12.6 kg/ha, against the background with $N_{45}$ - 13.8 kg/ha, against the background with $N_{45}P_{45}K_{45}$ - 16.4 kg/ha. It should be noted that wheat of the Tulunskaya 11 variety in comparison with the Buryat spisty and Triticale Dobroe showed the lowest yield. Perhaps this is due to the fact that Tulunskaya 11 has a less developed root system than the above cultures and a shorter growing season [5].

![Figure 1. Cereal productivity by the background of mineral nutrition, kg / ha, 2018.](image-url)
In Biome barley, the highest yield was recorded by background with N_{45} - it amounted to 17.7 c/ha. In the background with N_{45}P_{45}K_{45}, productivity was 1.6 c / ha, while in the experiment without fertilizers it was 4.1 c / ha lower. The average yield increase from foliar top dressing is shown in figure 2.

**Figure 2.** The average yield increase for mineral nutrition backgrounds, taking into account the average effect of foliar top dressing for all preparations in %.

The regular effect of foliar top dressing on the studied cultures has not been established. It follows from the figure that the largest increase in yield for different backgrounds of mineral nutrition was provided by the Buryat wheat spinata variety: 77.0%, against the background with N_{45}P_{45}K_{45}, 51.6%, against the background with N_{45} and 39.7% against the background without fertilizers. The opposite pattern was observed in wheat of the Tulunskaya 11 variety, the oats of the Rovesnik variety, and the triticale of the Dobroy variety. The maximal yield increase was obtained on the variants of the experiment with foliar top dressing on the background without fertilizers. In wheat of the Tulunskaya 11 variety, it amounted to 27.0%, in oats - 18.9%, in triticale - 39.9%. When using N_{45} and N_{45}P_{45}K_{45}, the yield increase in wheat was lower by 25.2%, 10.7%, in triticale by 34.1%, 19.9%, respectively. In oats, with an increase in the background of mineral nutrition, foliar top dressing significantly reduced productivity. The maximal yield increase on barley crops was provided by the experiment option with a full background of mineral nutrition and foliar top dressing - 39.7%. The results of the influence of foliar feeding on the studied cultures are presented in figure 3.

**Figure 3.** The average increase from extra-root dressing in crops for all backgrounds of mineral nutrition in %.

The largest increase in the crop was provided by foliar feeding on wheat Buryat spinovy - 56.1%, the increase in triticale Dobroe and barley Biome were lower - 30.7% and 25.1%, respectively. The smallest increase was in Tulunskaya wheat 11 - 19.8%, which is also evident from the yield of this...
crop. Oats on average for all backgrounds of mineral nutrition showed a negative increase of foliar feeding of -26.9%.

Thus, a preliminary conclusion can be drawn that foliar top dressing can provide a significant increase in yield of up to 10-60%, primarily, in the background without the use of mineral fertilizers for the main application of mineral fertilizers.

The introduction of mineral fertilizers into the soil enhances the intensity of microbiological processes occurring in the soil; in this connection, the transformation of mineral and organic substances is conjugated, which ultimately affects the productivity of grain crops.

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