УДК 631.81.095.337:633.11.“324”:631.53.01

4.1.1. Общее земледелие и растениеводство

ОЦЕНКА ЭФФЕКТИВНОСТИ ИСПОЛЬЗОВАНИЯ МИКРОЭЛЕМЕНТОВ ПРИ ПРЕДПОСЕВНОЙ ОБРАБОТКЕ СЕМЯН СОИ

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Предпосевная обработка семян сои сорта "Уника" микроудобрением MnSO4 с концентрацией Mn 0,01 % привела к улучшению лабораторной всхожести, энергии, скорости и дружности прорастания по сравнению с контрольным вариантом. В то же время, обработка семян CoSO4 не дала положительного результата в сравнении с контролем. В случае сои сорта "Виола", обработка семян микроудобрением ZnSO4 значительно улучшила лабораторную всхожесть, энергию, скорость и дружность прорастания по сравнению с контрольным вариантом, тогда как обработка раствором CuSO4 не привела к улучшению этих показателей для данного сорта относительно контрольного варианта

Ключевые слова: СОЯ, МИКРОЭЛЕМЕНТЫ, СЕМЕНА, ПРЕДПОСЕВНАЯ ОБРАБОТКА, МАРГАНЕЦ, КОБАЛЬТ, МОЛИБДЕН, МЕДЬ

http://dx.doi.org/10.21515/1990-4665-194-028

UDC 631.81.095.337:633.11.“324”:631.53.01

4.1.1. General agriculture and crop production

EVALUATING THE EFFECTIVENESS OF MICRONUTRIENT USE IN PRE-SOWING TREATMENT OF SOYBEAN SEEDS

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Presowing treatment of soybean seeds of Unica variety with MnSO4 with Mn concentration of 0.01% resulted in improvement of laboratory germination, energy, speed and friendliness of germination compared to the control variant. At the same time, treatment of seeds with CoSO4 did not give a positive result compared with the control. In the case of soybean of the variety "Viola", treatment of seeds with microfertilizer ZnSO4 significantly improved laboratory germination rate, energy, speed and friendliness of germination compared with the control variant, while treatment with CuSO4 solution did not improve these indicators for this variety compared with the control variant

Keywords: SOYBEAN, MICROELEMENTS, SEEDS, PRE-SOWING TREATMENT, MANGANESE, COBALT, MOLYBDENUM, COPPER

Soybeans are one of the most widespread and economically important crops in many countries around the world. Soybeans are used to produce soy milk, tofu, soybean meal and other products that are widely used in the food industry.

In Russia, the area of arable land under this crop is about 2,900 thousand hectares, the yield and gross yield are approximately 16.0 c/ha and 4,300 thousand tons, respectively. In Kuban, the sown areas occupy a little less than 160 thousand hectares, the yield was just over 19.0 c/ha, showing a gross harvest of 98 thousand tons [1, 2].

It is worth noting that growing soybeans is of great importance for the sustainable development of agriculture and improves the soil due to its nitrogen-fixing properties, which in turn has a positive effect on the growth and productivity of other crops.

Soybean crops are known to have high economic value in many agricultural regions. Soybeans can be used as a source of vegetable protein and oil for the food industry, as well as animal feed. In addition, growing interest in healthy lifestyles and environmental sustainability makes soybean crops even more attractive to consumers and investors [3].

Despite the importance and wide distribution of soybean crops, their cultivation is accompanied by such problems as incompatibility with some agricultural crops and the possibility of development of weeds and pests. In addition, soybean is a moisture-loving plant, and, therefore, reacts very quickly to soil drying out [4].

New methods for growing soybeans are being developed as part of modern agricultural research that aims to solve problems associated with increasing yields, improving grain quality and reducing production costs.

Purpose of research. See how microelements will affect the growth and development of soybeans, and evaluate the prospects for using the nutrients used to improve the quality of seeds.

Research methodology. To measure the quality of seeds, such as laboratory germination, energy, compactness and germination rate, a standard method was

used, described in GOST 12038-84 - “Crop Seeds. Methods for determining germination" [5]. To treat the seeds, the method of immersing them in aqueous solutions of microelements (MnSO4, CoSO4, ZnSO4 and CuSO4) with different concentrations of Mn, Co, Zn and Cu (0.01%, 0.001%, 0.0001%, 0.00001%, 0.000001%). Next, according to the method, soybean seeds were placed in Petri dishes and loaded into a thermostat. Then we continued to observe the seedlings in the roll culture.

*Results of the experiment.*As a result of the research, it was found that the treatment of soybean seeds on the Unika variety with an aqueous solution of Mn with a concentration of 0.01% had a positive effect on the quality of seeds and increased laboratory germination by 5.32%, germination energy by 6.67%, speed germination at 0.9 days. and germination rate by 1.3 pieces/day. compared to control. The concentration of MnSO4 aqueous solution 0.001% showed only a slight positive trend towards improved performance. Other concentrations had no significant effect on soybean seeds (Table 1).

Table 1 - Effect of microfertilizers on the sowing qualities of soybean seeds varieties "Unika"

Option	Laboratory germination	Energy germination	Speed germination, days	Friendship germination, pcs/day
	%			
MnSO4				
Control	94	90	2.2	4.5
Mn 10-2%	99	96	1.3	5.8
Mn 10-3%	94	90	3.0	5.3
Mn 10-4%	94	89	3.0	4.2
Mn 10-5%	93	89	3.2	4.0
Mn 10-6%	92	87	3.4	3.7
NSR05	4.34	5.48	1.42	1.45
CoSO4				
Control	95	91	2.2	4.8
Co 10-2%	94	90	2.3	4.5
Co 10-3%	94	89	2.3	4.3
Co 10-4%	93	90	2.9	4.0
Co 10-5%	92	89	3.1	3.2
Co 10-6%	92	88	3.3	3.0
NSR05	2.17	1.89	0.85	1.30

The use of an aqueous solution of CoSO4 for pre-sowing treatment of soybean seeds did not lead to an improvement in performance at all concentrations studied (Figure 1).

Figure 1 – The influence of different concentrations of microelements on the sowing qualities of soybean seeds of the “Unika” variety

The study revealed that aqueous solutions of microfertilizers ZnSO4 and CuSO4 with different concentrations of zinc and copper for soybean seeds of the Viola variety influenced key parameters of seed quality (Table 2).

The results of the study showed that treating soybean seeds with an aqueous solution of zinc with a concentration of 0.0001% led to an improvement in quality indicators. In particular, zinc treatment increased laboratory germination by 5.32%, germination energy by 5.56%, germination rate by 0.8 days and germination density by 1.0 pcs/day, compared with the control.

Table 2 - Effect of microfertilizers on the sowing qualities of soybean seeds varieties "Viola"

Option	Laboratory germination	Germination energy	Germination rate, days.	Germination rate, pcs/day.
	%			
ZnSO4				
Control	94	90	2.3	4.7
Zn 10-2%	93	89	2.7	4.6
Zn 10-3%	93	88	2.9	4.5
Zn 10-4%	99	95	1.5	5.7
Zn 10-5%	94	90	3.2	4.5
Zn 10-6%	94	89	3.0	4.0
NSR05	4.05	4.45	1.11	1.01
CuSO4				

Control	95	91	2.4	4.3
Cu 10-2%	95	90	2.4	4.4
Cu 10-3%	95	91	2.3	4.4
Cu 10-4%	93	89	3.0	4.0
Cu 10-5%	93	88	3.2	3.8
Cu 10-6%	92	87	3.2	3.3
NSR05	2.38	2.93	0.77	0.77

When treating soybean seeds with an aqueous solution of Zn with a concentration of 0.00001%, there was a slight tendency to improve laboratory germination and germination energy, but the effect was insignificant. At the same time, there was a negative effect of lower and higher zinc concentrations, which led to a decrease in seed quality.

The results of an experiment on treating soybean seeds with an aqueous solution of CuSO4 of various concentrations showed a negative effect of the microelement on the sowing qualities of the seeds. Only Cu concentrations of 0.01% and 0.001% showed some positive trend, but it was not significant enough to conclude a positive effect on soybean seeds (Figure 2).

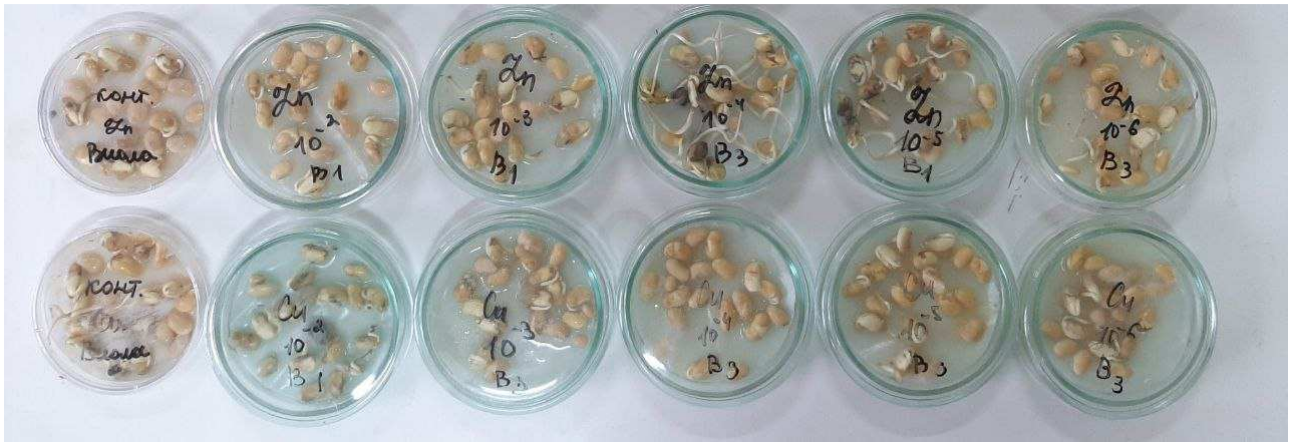


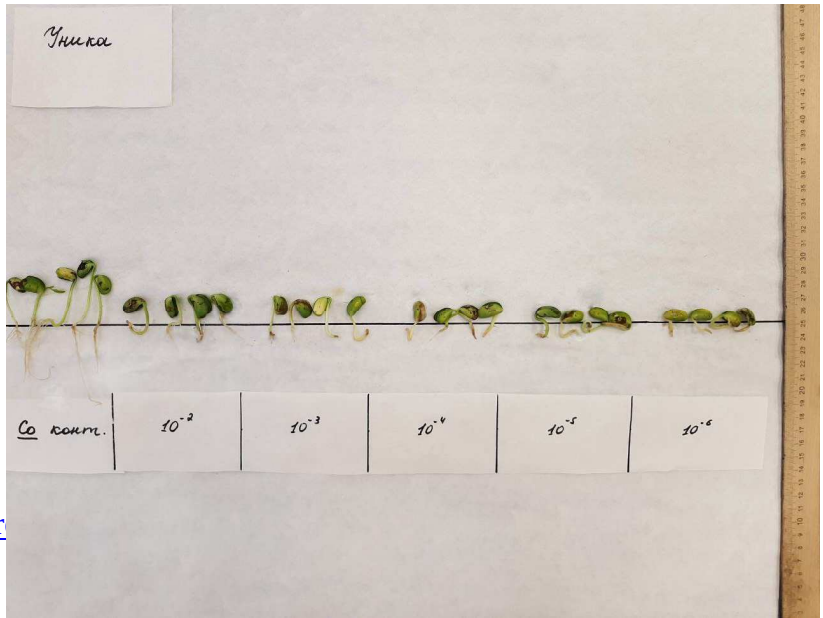
Figure 2 - Effect of different concentrations of microelements on the sowing qualities of soybean seeds of the “Viola” variety

The final stage was a 10-day germination of soybean seedlings of the Unika and Viola varieties in a roll culture, followed by measurement of biometric indicators.

During the experiment, it was noted that seedlings grown at a Mn concentration of 0.01% maintained a positive trend towards better growth and development. In addition, on variants using manganese concentrations of 0.001% and 0.0001%, plants developed better than on the control variant, which was not noted during their germination in Petri dishes. Biometric indicators in other variants did not exceed the control values (Figure 3a).

Soybean seedlings of the “Unika” variety, on variants using CoSO4, with further development in a roll culture, also showed a negative trend in growth and development, as during the experiment with pre-sowing treatment (Figure 3b).

A)



b)

Figure 3 – Seedlings of soybean plants of the “Unika” variety when determined aftereffects of microelements (a – manganese, b – cobalt)

According to the results of observations, soybean plants of the “Viola” variety in all variants with pre-sowing treatment (POT) with zinc, except for the variant with a Zn concentration of 0.01%, improved their development compared to the control. A significant difference in biometric indicators was found on plants with the after-effect of PIC with a ZnSO4 solution at a Zn concentration of 0.0001% (Figure 4a).

An improvement in the growth and development of seedlings was also observed, in comparison with the control, only in the Cu 0.00001% variant. The remaining options were not significantly better than the control (Figure 4b).

A)

b)

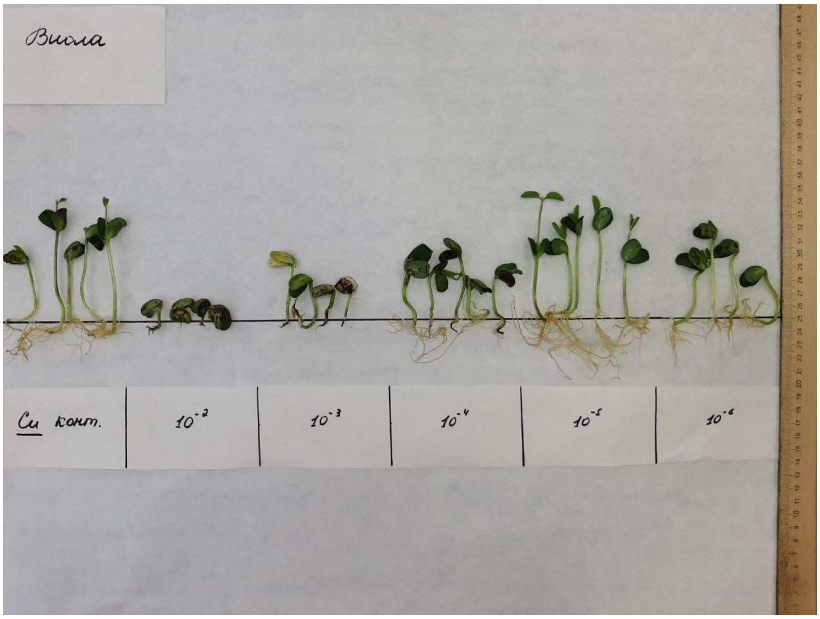


Figure 4 – Seedlings of soybean varieties “Viola” when determined aftereffects of microelements (a – zinc, b – copper)

From the results of the experiment it is clear that manganese 0.01% had the best effect on the Unika variety compared to the control variant. The average length of the stems was 9.75 cm, and the roots - 8.68 cm, which is almost 2 times better than the control (4.80 and 5.15 cm, respectively). Also, a positive growth trend was set by Mn concentrations of 0.001% and 0.0001%; the excess of the average length of the stems compared to the control was 2.33 cm and 0.53 cm, respectively. The average length of the roots of the studied variants was not significantly greater than the control variant - by 0.40 cm and 0.15 cm. Other variants did not show significantly positive values in comparison with the control (Figure 5).

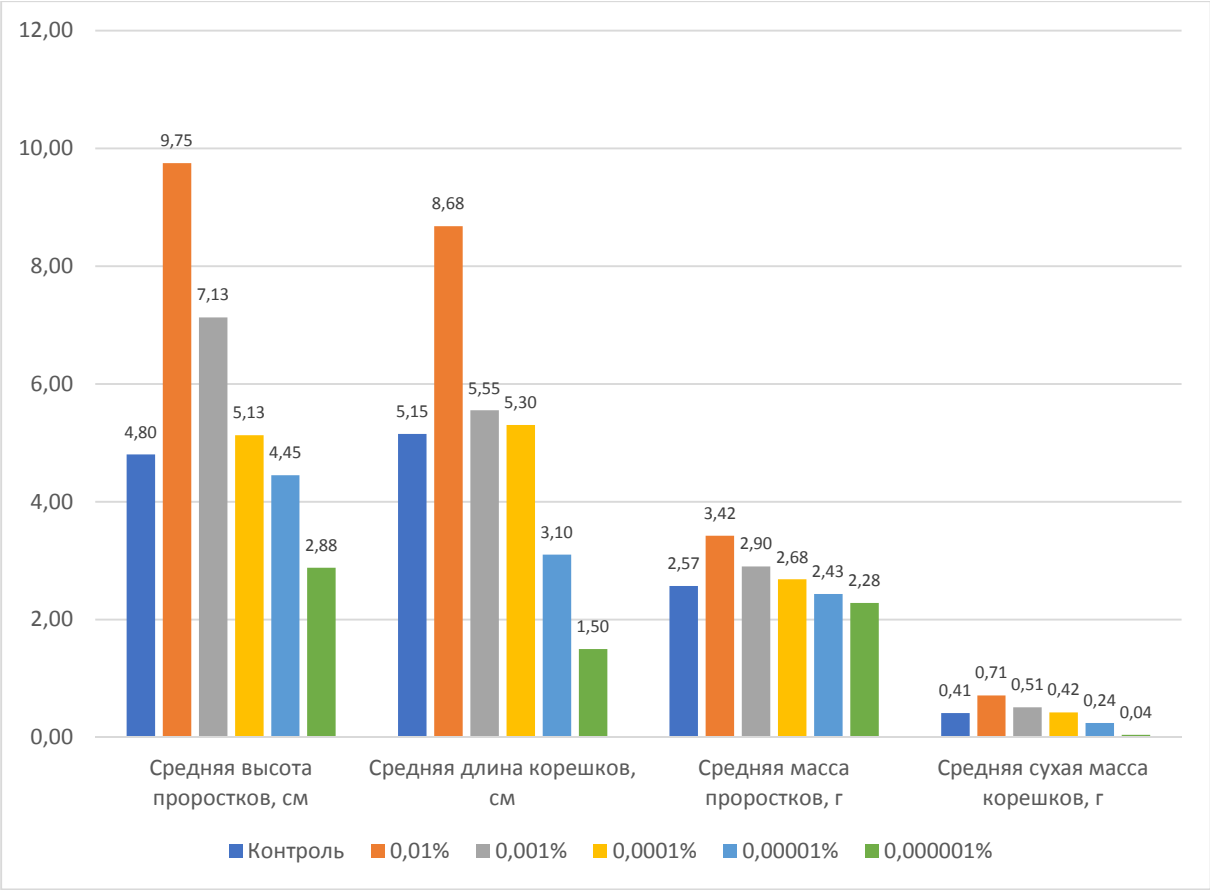


Figure 5 – Effect of different Mn concentrations on mass and length soybean sprouts of the “Unika” variety

The average above-ground mass of soybean plants in the variant with a Mn concentration of 0.01% showed the best result and amounted to 3.42 g, which is 0.85 g more than the control variant. Concentrations of 0.001% and 0.0001% were slightly higher than the control (by 0 .33 g and 0.11 g). The values of the average dry mass of roots of the remaining variants were less than the control.

Data on the average height of seedlings and the average length of roots in all Co variants showed that the microelement had a negative effect on soybean plants relative to the control. In addition, the length of the roots of the control variant was significantly longer than the studied ones.

The weight of the seedlings and the dry weight of the roots were also significantly negative compared to the control (Figure 6).

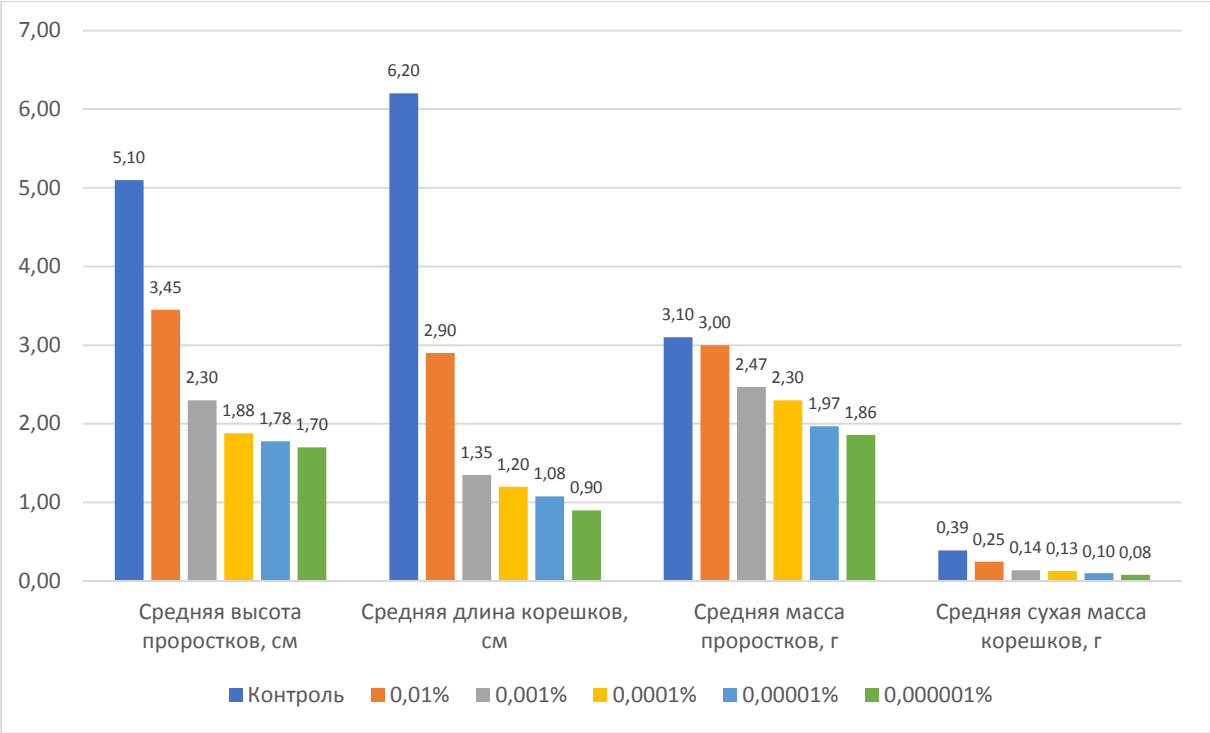


Figure 6 – Effect of different Co concentrations on mass and length soybean sprouts of the “Unika” variety

Analysis of the results obtained on the variety “Viola” on variants using Zn showed that all of them, except 0.01%, turned out to be better than the control. The best option was Zn 0.0001%. The average length of seedlings in this variant was 3 times longer than the control and amounted to 17.10 cm. The 0.000001% variant was slightly higher (by 0.8 cm). The average length of roots followed the same trend as the average height of seedlings (Figure 7).

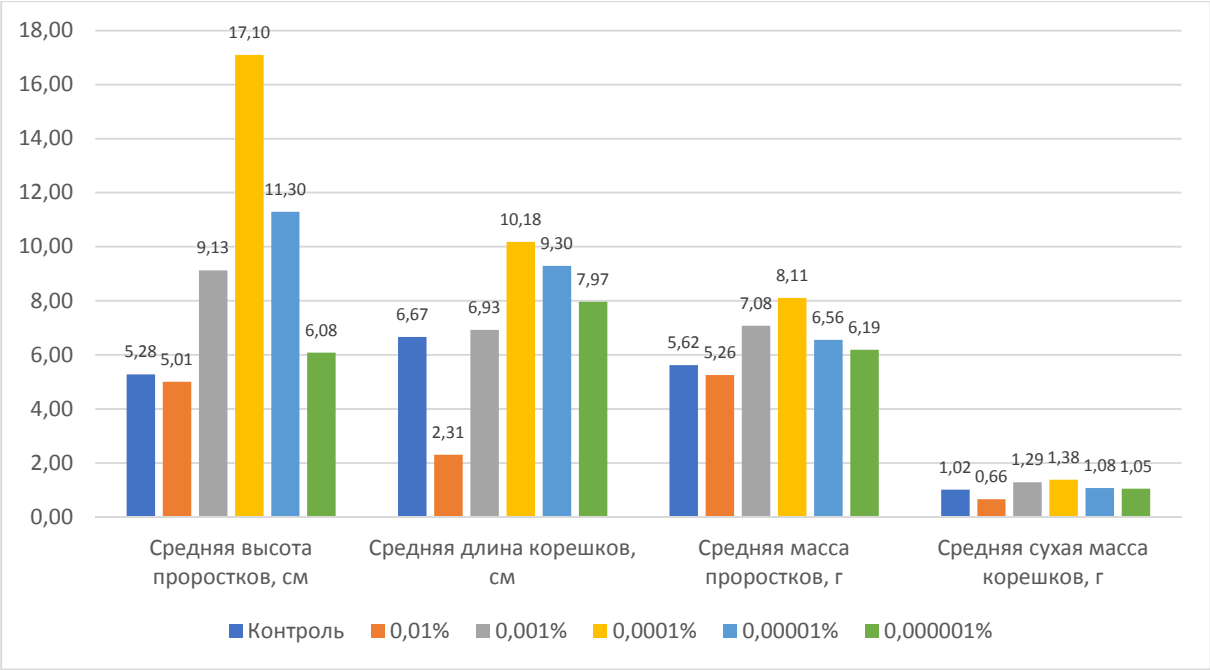


Figure 7 - Effect of different Zn concentrations on weight and length soybean sprouts of the “Viola” variety

Data on the average weight of seedlings showed that all options, except Zn 0.01%, were better than the control. The best option - Zn 0.0001% - was better than the control by 2.49 g. The average dry weight of roots was the same trend as the average weight of seedlings.

The results of the influence of various Cu concentrations on soybean seedlings show that only the Cu variant with a concentration of 0.00001% was significantly better than the control. The average height of the seedlings was slightly higher and amounted to 8.52 cm, which is 0.72 cm more than the control. However, the average length of the roots was almost 2 times longer (9.30 cm). The remaining options were significantly worse than the control (Figure 8).

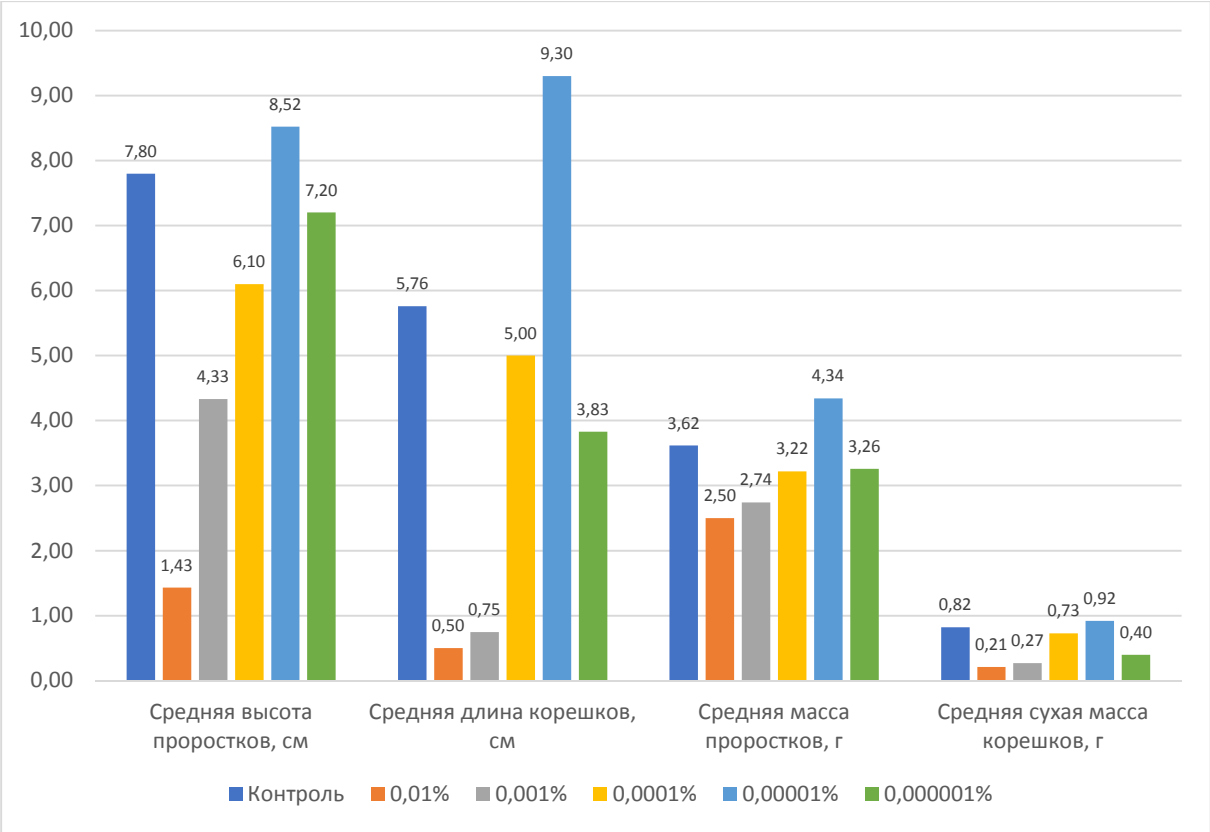


Figure 8 – Effect of different Cu concentrations on mass and length soybean sprouts of the “Viola” variety

Analysis of data on the average weight of seedlings and the average dry weight of soybean roots for all variants, except for Cu 0.00001%, showed a negative value relative to the control. The Cu 0.00001% variant was 0.72 and 0.10 g, respectively, better than the control.

*Conclusion.*The results of the study showed that the seed of soybean plants of the Unika and Viola varieties responded differently to pre-sowing treatment with microelements. This may be due to the needs of plants for different nutrients, as well as to different physiological characteristics of the varieties.

Treatment of soybean seeds of the "Unika" variety with an aqueous solution of MnSO4 with a Mn concentration of 0.01% was the most effective. This may indicate that manganese was the most deficient nutrient for this variety, and its deficiency led to a general weakening of the plant. In addition, it is worth noting that the increase in vegetative and root mass of plants was also positively affected by concentrations of 0.001% and 0.0001%. However, treating seeds

with a cobalt solution did not produce a significant effect. This may indicate that at this stage of development the need for cobalt was not critical.

On the Viola variety, the microelement zinc at a concentration of 0.0001% turned out to be more effective. This is probably due to the fact that zinc plays an important role in protein formation and nitrogen metabolism. Treatment of seeds with a copper solution did not lead to a significant improvement in performance and, in some concentrations, even worsened the results compared to the control. This may also indicate that at this stage of plant development, copper was not a deficient nutrient necessary for soybean seed germination.

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