Assessment of the effect of organomineral protective-stimulating complexes of various modifications and methods of their application on the yield and quality of grain beans

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Abstract. In a model experiment in soil culture, the influence of protective-stimulating complexes of various modifications and methods of their application on the yield of grain beans was studied. As a result of the study, it was revealed that the effectiveness of protective-stimulating complexes depends on the method of their application and component composition. It has been established that the use of protective-stimulating complexes PSC-Zn when adding it to the soil can significantly increase the average yield of plants due to an increase in the number of grains per plant. When using PSC-Mo by spraying vegetative plants, plant productivity increased as a result of an increase in the weight of 1000 grains.

1 Introduction

In modern conditions of agricultural production, one of the most pressing problems that need urgent solution is obtaining high yields of the main and by-products of agricultural crops, in particular grains and legumes. To increase yields and improve quality indicators, it is necessary to use mineral fertilizers [1, 2]. However, today it is especially important to develop innovative organomineral fertilizers that can act as protective and stimulating complexes [3,4]. Such complexes can not only stimulate plants to grow and develop, including under stressful conditions, but also activate the outflow of assimilates towards the productive organs of plants, allowing for higher yields. Microelements included in such complexes play a significant role in activating the protective and stimulating mechanisms of plants [5, 6].

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2 Materials and methods

A vegetation experiment was conducted with grain beans of the Rubin variety. The plants were grown under phytotron conditions, where favorable light, temperature and humidity conditions for crop cultivation were maintained [7].

The experiments were carried out in soil culture conditions. High-moor neutralized peat was used as a substrate [8] in accordance with generally accepted methods [9].

Sowing was carried out with dry seeds, 3 pieces per vessel. Plants were grown in Mitscherlich vessels. The capacity of the vessels is 2.5 kg of peat.

Fertilizer Aviva NPK(S) 10:26:26(2) produced by PhosAgro LLC was used as background mineral nutrition. During the flowering phase, mineral root feeding was carried out with Diammophoska NPK(S) 10:26:26(2). The studied protective-stimulating complexes [10] were added; applied to the soil in the form of a concentrated solution at the rate of 80 ml/kg, and also by spraying with 10% aqueous solutions of concentrated ZSK at the rate of 200 ml/vessel. During the growing season, optimal water supply conditions were created.

Harvesting was carried out when the plants reached full grain ripeness. After harvesting, the grain weight was determined, and the yield structure indicators were also assessed [11, 12].

3 Results and discussion

The conducted studies made it possible to establish that the use of protective-stimulating complexes makes it possible to influence certain indicators of the morpho-biometric characteristics of plants. The effect varied depending on the component of the complex used, as well as on the method of its application.

Figures 1 and 2 show the length of the above-ground part of the plant and pods when protective-stimulating complexes are introduced into the soil.

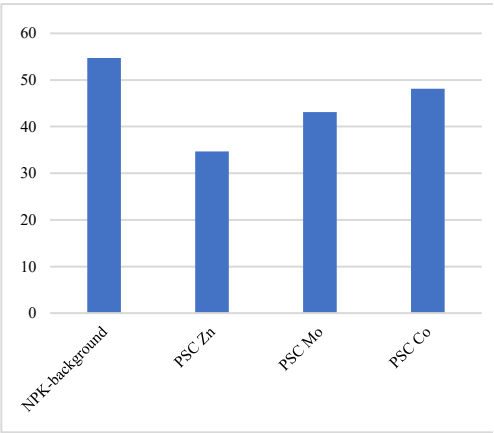

Fig.1. Length of bean plant stems when protective and stimulating complexes are added to the soil

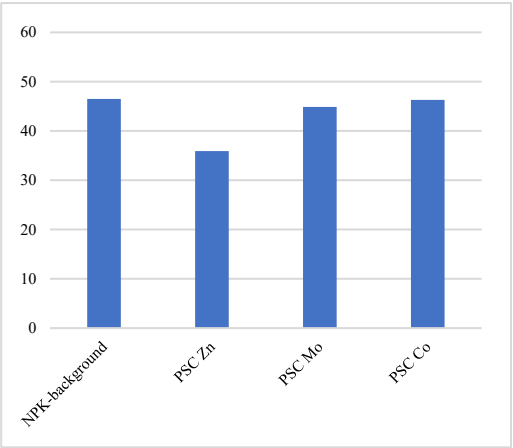

Fig. 2. Length of bean plant pods when protective and stimulating complexes are added to the soil

The research results showed that the use of all the studied protective-stimulating complexes makes it possible to direct the flow of plant assimilates to optimize the growth processes of the productive part of the plants instead of building up a large vegetative mass.

It is important to note the effect of specific complexes. Thus, the average length of bean plants when PSC-Zn was added to the soil turned out to be 37% shorter than the plants of the background variant, but the average length of the pod in plants of this variant was 77% longer compared to the background variant. This is due to the role of zinc in the formation of the reproductive sphere of plants, which was also shown in experiments with other crops [13,14].

The use of protective-stimulating complex-Mo gives average results when applied by adding it to the soil, while maintaining the trend of dynamics when using protective-stimulating complexes. The average length of plants of this variant is 21% less than the average length of plants of the background variant, and the average length of the pod is 72% greater than that of plants of the background variant.

It should be noted the effect of the PSC-Co. The use of this complex made it possible to optimize the growth processes of both the productive part of plants - pods, and the vegetative part. At the same time, the change in the mass of the aboveground part of the plants was directed towards an increase in its productive part. The average length of plant stems is 12% less than the background values, and the average pod length is 87% greater.

To determine the yield indicators of bean plants, depending on the complexes used and methods of their application, two indicators were taken into account: the average number of grains per plant and the average weight of grains per plant (Figures 3,4).per plant (Figures 3,4).

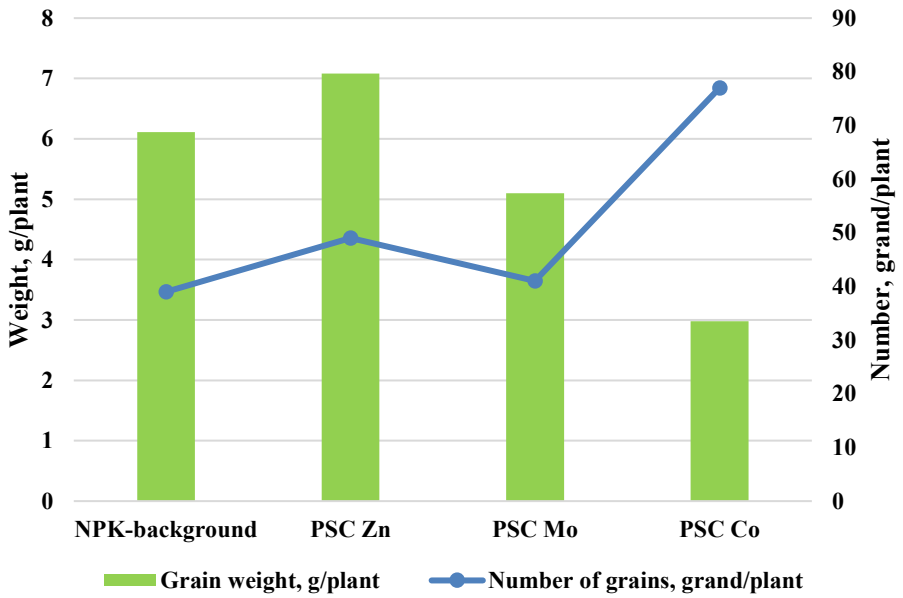

Fig. 3. Productivity of bean plants when a protective-stimulating complex is added to the soil.

From Figure 3 it follows that the use of PSC-Zn, PSC-Si and PSC-Co by adding it to the soil can significantly increase the average amount of grain per plant. When using PSC-Zn in plants of this variant, the number of grains per plant increased by 26% compared to the control option without the addition of PSC. When using PSC-Co and PSC-Si, the number

of grains per plant increased almost twofold. At the same time, the number of grains per plant when using PSC-Mo was only 5% compared to the background option.

The greatest effect on grain weight was obtained by adding PSC-Zn to the soil. The results of the average grain weight per plant were 16% higher than the background value.

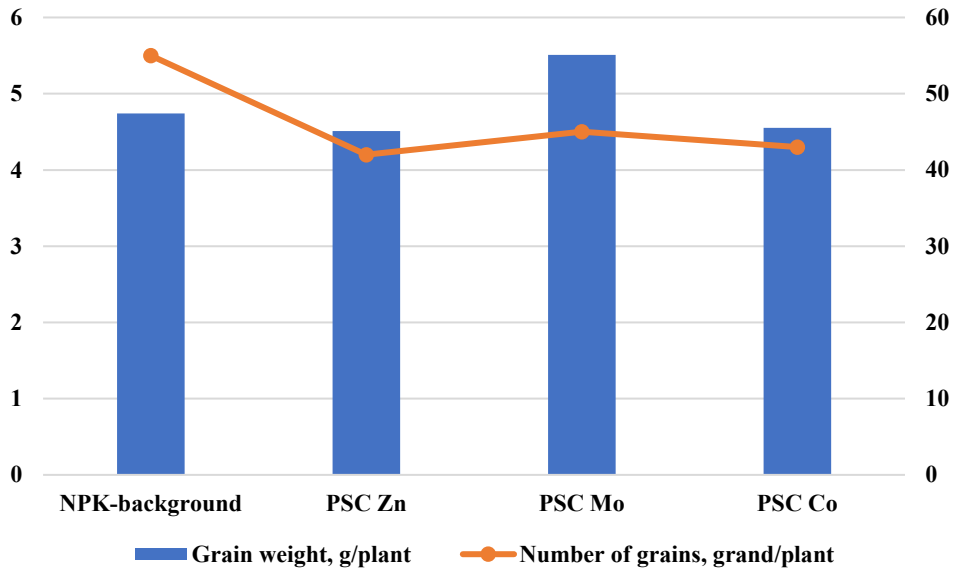

Fig. 4. Productivity of bean plants when spraying vegetative plants with protective-stimulating complexes.

When spraying vegetative plants with protective-stimulating complexes, their high effectiveness was revealed in assessing the yield of bean plants.

The greatest effect on the yield of bean plants was obtained when using PSC-Mo when applied by spraying vegetating plants. When using PSC-Mo, a decrease in the amount of grain per plant was observed compared to plants of the background variant by 18%. However, the grain mass turned out to be the greatest compared to other complexes and the background variant. The increase in grain weight was 16% compared to the control variant as a result of an increase in the weight of 1000 grains.

Thus, we can conclude that the effectiveness of protective-stimulating complexes depended on the component composition and method of its use. As a result of the research, it was established that PSC showed the greatest influence on the formation of the yield of bean plants when added to the soil, increasing both the quantitative and weight characteristics of the resulting grain. When using PSC-Mo by spraying vegetative plants, the largest increase in grain weight per plant was obtained, as a result of an increase in the weight of 1000 grains.

4 Conclusions

1. As a result of the conducted research, it was revealed that the use of all the studied protective-stimulating complexes makes it possible to change the direction of the production processes of bean plants.
2. It was established that the effectiveness of various protective-stimulating complexes depended on the method of their application.
3. It has been proven that the use of PSC-Zn and PSC-Co by adding it to the soil can

significantly increase the average number of grains per plant. When using PSC in plants of this variant, 26% more grains of one plant were obtained than in plants of the background variant. When using ZSK-Co, this figure almost doubled.
4. It was revealed that when PSC-Zn was added to the soil, the greatest increase in grain weight per plant was observed due to an increase in the number of grains per plant.
5. It has been established that the most effective way to use PSC-Mo is by spraying vegetative plants. At the same time, the increase in grain productivity of plants was achieved by increasing the mass of 1000 grains.

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