Institute of Soil Science and Plant Cultivation
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# Effect of meneral fertilization and microbial preparation on the productivity of Lentil (*Lens culinaris* Medic.)

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## INTRODUCTION

Lentil (*Lens culinaris* Medic.) plays an important role in healthy human nutrition, the production of high-quality feed, and maintaining soil fertility. Its cultivation enriches the soil with nutrients by increasing the content of nitrogen, carbon and organic compounds that are derived from plant residues. The seeds of this plant is a source of protein, macro- and microelements, vitamins and biologically active compounds. The biological role of lentil as an ecologically friendly protein sources and soil nitrogen accumulator is closely related to the vital activity of nodule bacteria of the genus *Rhizobium leguminosarum*. The effectiveness of symbiosis between legumes and rhizobia is determined by a complex of factors and conditions, the most important of which are the complementarity of plant genotypes and nitrogen-fixing bacteria, and nutrient content with the needs of nitrogen-fixing symbionts. The deficiency of any one mineral nutrient can not only disrupt the symbiosis between legumes and nodule bacteria, but also negatively affect the yield formation. The aim of the study was to determine the effect of mineral fertilizers and microbial preparation on the formation of lentil productivity.

## MATERIAL and METHODS

The research was conducted in 2019–2020 under the conditions of a two–factors field experiment, in the Poltava Research Agricultural Station named M.I. Vavylov of the Institute of Pig Breeding and Agroindustrial Production of the National Academy of Agricultural Sciences. The research scheme consisted of 2 factors: A - application of microbial preparation Rizogumin based on nitrogen-fixing nodule bacteria *Rhizobium leguminosarum* (2.0 kg $t^{-1}$); B - application of mineral fertilizers at doses of $N_0P_0K_0$, $N_{16}P_{16}K_{16}$, $N_{32}P_{32}K_{32}$, $N_{48}P_{48}K_{48}$. These variants were compared with the control, in which there was no fertilization and seed inoculation.

## RESULTS

The results showed that the processes of growth and development of vegetative and reproductive organs were largely determined by plant nutrient supply. With an improvement in the mineral supply to plants, the rate of growth of vegetative mass and linear growth of plants in height increased. They were most intense in the variant of application $N_{48}P_{48}K_{48}$. When the nutrient regime deteriorated, the growth processes of the aboveground part of lentil plants were inhibited. In the variants of application $N_{32}P_{32}K_{32}$ and $N_{16}P_{16}K_{16}$, the weight of the aboveground part of the plants and their height decreased. The activity of nodule bacteria is largely dependent on the supply of energy and carbon, as products resulting from photosynthesis. At the same time, the functioning of the photosynthetic apparatus is largely controlled by nitrogen supplied by nodules. The substances and products of nitrogen fixation resulting from the absorption of photosynthetic active radiation are used by the plant to build organic biomass. An important role in this process is played by the supply of mineral nutrients to plants.

The combination of mineral fertilizers and microbial preparation improved the conditions for the formation of elements of plants productivity. They were most favorable in the variant $N_{48}P_{48}K_{48}$ + Rizogumin. In this variant, the values of the number of pods per plant and seeds in them, the weight of 1000 seeds were the highest, and the yield of lentil seeds increased by 1.81 t $ha^{-1}$ compared to control.

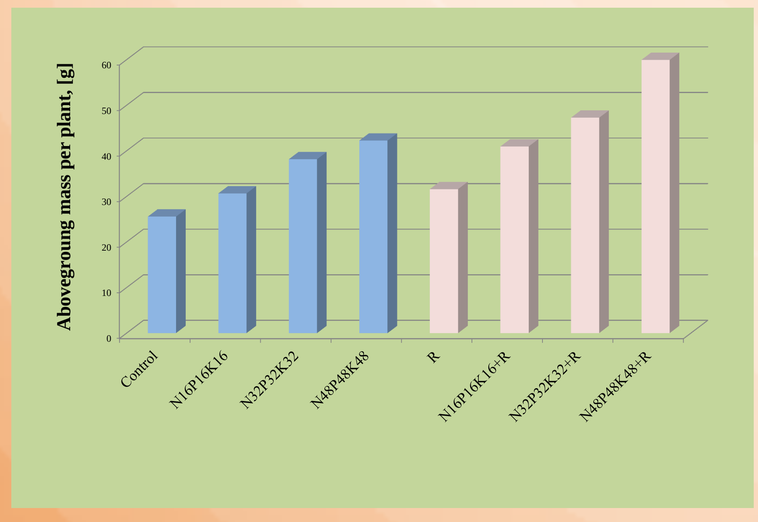


Figure 1. Aboveground mass per plant of lentil depending on the seed inoculation with Rizogumin (A) and fertilization (B) (Tukey test $p$=0.05)

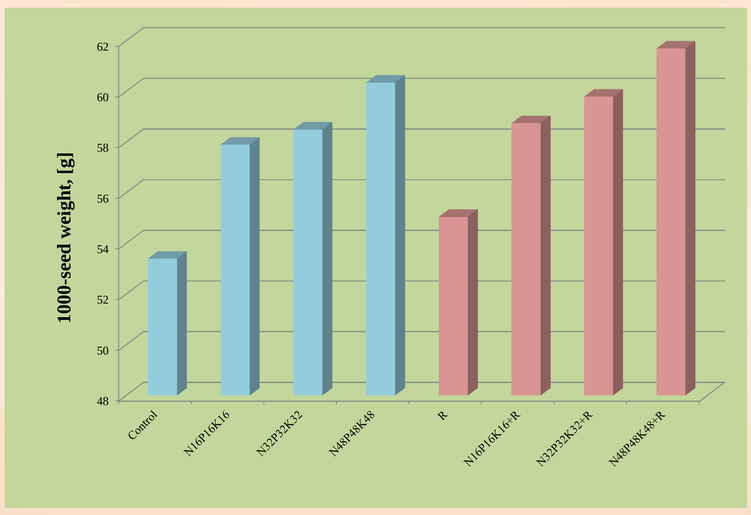


Figure 2. 1000-seed weight of lentil depending on the seed inoculation with Rizogumin (A) and fertilization (B) (Tukey test $p$=0.05)

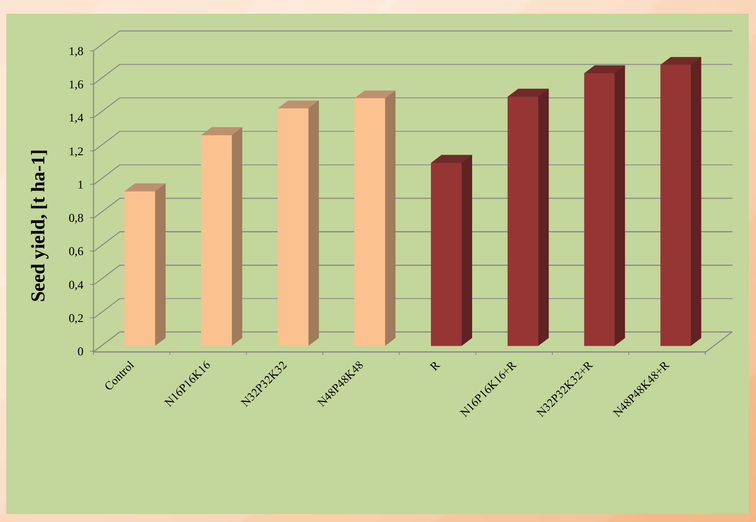


Figure 3. Seed yield of lentil depending on the seed inoculation with Rizogumin (A) and fertilization (B) (Tukey test $p$=0.05)

## CONCLUSIONS

**The combination of seed inoculation with the microbial preparation Rizogumin and the application of mineral fertilizers at a dose of $N_{48}P_{48}K_{48}$ improves the conditions for plant growth and development and the formation of lentil productivity.**

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# Productivity formation of leguminous crops depending on the use of humic preparations

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## INTRODUCTION

In solving the problem of stabilization of grain production with a high content of protein with a balanced amino acid composition, which is used for food, technical and fodder purposes, the formation of high-yielding agrocenoses of leguminous crops by improving the cultivation process is important.

A promising element of the cultivation technology is the use of biologically active substances of humic nature, which have a regulatory effect on metabolic processes occurring in plants, as well as contribute to the enhancement of adaptive properties to adverse environmental factors, and are an important reserve for improving the conditions of crop formation and increasing crop productivity.

## MATERIAL and METHODS

The research was conducted in 2020–2021 under the conditions of a two–factors field experiment, on the territory of the state enterprise "Experimental Farm "Stepne" of the Institute of Pig Breeding and Agroindustrial Production of the National Academy of Agricultural Sciences. During the laboratory studies, for pre-sowing treatment of the seed material of the studied crops, preparations of humic origin from Soil-Biotics (USA) "Seed treatment" were used at a dose of 3 kg $t^{-1}$ of seeds. This variant was compared to the control, where the seeds were applied with water. The scheme of the field experiment included a control variant where humic substances were not used, variants with pre-sowing seed treatment Seed treatment (3 l $t^{-1}$). Foliar fertilization of plants was carried out in the budding phase with Foliar concentrate at the rate of 2 kg $ha^{-1}$, and their combination. Accounting and observations were carried out according to standard methods.

## RESULTS

Seed treatment with a biologically active preparation based on humic acids had a stimulating effect on the germination processes and initial growth of legume plants. The activation of physiological and biochemical processes during seed germination increased the intensity of growth processes in the initial period of plant development, which was expressed in an increase in their size and weight. Under the pre-sowing treatment of seeds with humic preparation Seed treatment, the length of seedlings and embryonic roots increased by 2.5 and 2.2 cm in peas and by 5.1 and 2.1 cm in lentils compared to the control variant. At the same time, a distinct stimulating effect of the preparation on the accumulation of biomass by plants at the initial stages of development was noted. In the variants with the use of a biological preparation based on humic acids, the weight of seedlings and the weight of embryonic roots increased.


Figure 1. Condition of 10-day-old pea seedlings depending on the use of biologically active preparation Seed treatment A - without treatment, .


Figure 2. Condition of 10-day-old lentil seedlings depending on the use of biologically active preparation Seed treatment A - without treatment, .

During the research, the stimulating effect of humates on the processes of formation of the aerial part of plants and the supply of nutrients to the grain during its formation and filling was noted. The most effective in this regard was the combination of Seed treatment + Foliar concentrate, where the values of the number of beans and seeds in them, the weight of 1000 seeds were the highest. Depending on the method of application of biological preparations of humic nature, the grain yield increased. The values of this parameter were the highest in the variant Seed treatment+Foliar cnncentrate.

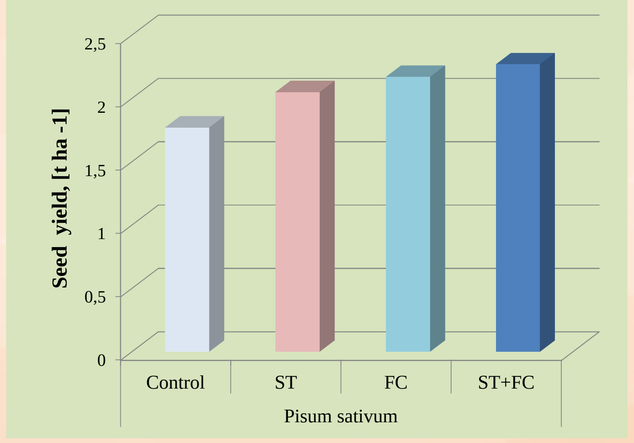


Figure 3. Seed yield of pea (*Pisum sativum* L.) depending on application with (A) - Seed treatment (ST) and (B) – Foliar concentrate (FC) (Tukey test $p$=0.05)

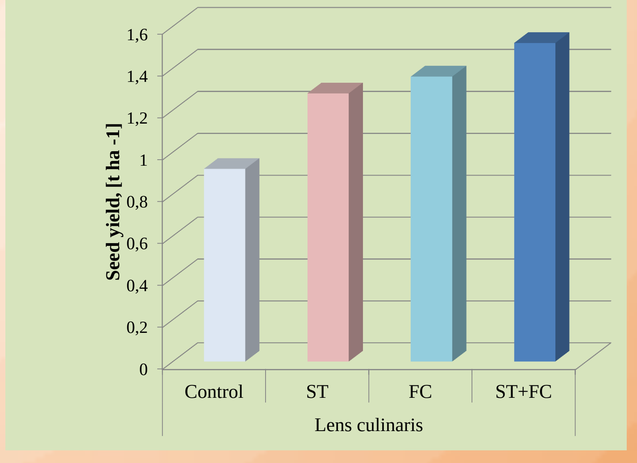


Figure 4. Seed yield of lentil (*Lens culinaris* Medic.) depending on application wiyh (A) – Seed treatment (ST) and (B) – Foliar concentrate (FC) (Tukey test $p$=0.05)

## CONCLUSIONS

**The use of biologically active substances based on humic acids is a promising agrotechnological technique that allows to improve the conditions of the main physiological and biochemical processes in legume plants and increase the level of their productivity**

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