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## **Efficiency of symbiotic activity of crops of soya bean in conditions of Polissya of Ukraine**

**Goal.** Determine the effect of seed inoculation and foliar nutrition on soil nutrient nitrogen and soybean yield. **Methods.** Agrochemical (for determining the chemical composition of soil, plants), mathematical (in particular, dispersive), biometric (for determining the formation and activity of the symbiotic apparatus and their relationship with the photosynthetic activity of the crops). **Results** The results of many years of research on the influence of the elements of the technology of cultivation on providing the soil with biological nitrogen and the yield of soybeans in the zone of sufficient moisture of the Polissya region of Ukraine are presented. The formation of tubers is shown depending on seed inoculation and foliar feeding. The amount of biological nitrogen and the equivalent of ammonium nitrate are calculated. **Conclusions** In the conditions of the Polissya of Ukraine it is necessary to conduct research to study the complex of technological elements (varieties, methods of sowing, seed rate, etc.).

*Key words: soybean, inoculation of seeds, foliar nutrition, tuber bacteria, biological fixation of nitrogen, yield.*

**Formulation of the problem.** Soya is a valuable protein and oilseed culture. It plays an important role in agriculture as a unique food, feed, medicine and technical culture. Soybean plants combine two important processes - biological fixation of nitrogen and photosynthesis. Thanks to this, soya provides its own need for nitrogen, while increasing the soil fertility.

Due to the nitrogen-fixing capacity, soy beans are used only for long-term bean crops - such as clover, alfalfa, and others. Due to the processing of soybean seeds before sowing with bacterial preparations, which are made on the basis of strains of bulbous bacteria, during the vegetation on the roots of plants, tubers are formed much more intense, through which nitrogen fixation occurs. Due to this property soya provides itself with 60 - 70% nitrogen [1]. Under favorable conditions soya can leave up to 310 - 320 kg / ha of nitrogen in the soil. On unlike mineral fertilizers, nitrogen, which leaves soy in the soil, does not pollute the environment, is better absorbed by other plants [4].

Biological fixation of nitrogen is due to symbiosis of the root system with bacterial cells, which contain lego-globin and enzyme complex. In this interaction, the main role belongs to the root system, through which water and nutrients come into the tubers. The part of the cornea system containing the tubers is called a symbiotic device [7].

**Analysis of recent research and publications.** A combination of photosynthesis and biological fixation of nitrogen from the air is necessary for favorable soy nutrition conditions. Therefore, it is important that these processes do not suppress each other [3, 5].

The researchers found that from the activity of the symbiotic apparatus the productivity of the crop, the fertility and nitrogen balance of the soil, and the productivity of the subsequent crops in the crop rotation depends. It is possible to obtain high yields of soya and without the use of inoculation, but, as shown by studies [3, 11], with the sharp increase in nitrogen removal from the soil. According to the data, up to 70% of the total consumption of nitrogen soybeans is obtained due to its biological fixation from the air due to symbiosis with tuberous bacteria. It is known that the formation of tubers is observed with the onset of photosynthetic activity, that is, with the appearance of the first leaves. The tubers influence the growth and development of soy plants by increasing the period of the functioning of the leafy apparatus and the accumulation of organic compounds, initially in the vegetative, and, finally, in the reproductive organs of

plants [6]. According to researches, nitrogen fixation occurs actively if the bottles in the autopsy have a pink color, and the plants are saturated in green. Since bulbous bacteria are living organisms, it should be remembered that their livelihoods depend on weather conditions. However, the environment affects the bacteria through the plant, because they live with it in the symbiosis. Thus, due to the lack of moisture, the intensity of photosynthesis in the plant decreases, and when reloading - the tubers lack oxygen. It is known that for the development of tuberous bacteria, the optimum humidity is 60-70% of the total moisture content of the soil, the minimum is 16% [3].

AV Podobedov, VI Tarushkina and V.F. Saiko found that 20 g / ha of crop yields and use of preparations based on nitrogen-fixing bacteria absorbs soy from air at about 100 kg N per hectare and 50-60 kg - in cultivars [6]. According to O. Kirichenko, when the outbreak is fed, the plant forms 15-20% more of the vegetative mass, while consuming 20% less moisture, and yields increase by 15 - 24% [9]. Reindeer nutrition of soybeans should be carried out in the most critical phases of development: budding - the flowering and the formation of beans. Thanks to foliar feeding the plants receive all the necessary nutrients in a balanced ratio. The trace elements in sufficient quantities contribute to a better development of the plant in general and, consequently, to increase yields. Also soy plants become more resistant to external stress factors (temperature drop, drought or overflow, various diseases). According to the results of studies, the introduction of micronutrients against the background of inoculation increases soy yield by 0.2 - 0.26 g / ha [2].

According to the results of field research conducted in Central India on chernozem soils with nitrogen, phosphorus, potassium, sulfur and zinc deficiency, it was established that the balanced use of NPKSZn fertilizers in the normal range of N25P60K2O and S20 + Zn5 kg contributed to an increase in yield soya for 30-35% compared to the usual system of delivery [8].

The purpose of the research is to determine the effect of seed inoculation and foliar nutrition on the provision of soil with biological nitrogen and soybean yield.

The experimental research methodology was conducted during 2012-2014 at the experimental field of the Zhytomyr National Agroecological University in Chernyakhivskiy district of Zhytomyr Oblast, analytical research was carried out at the ZNAMEU Crop Production and Processing Plant Technology Technology Department.

The test is laid out in a 4-fold repetition, the placement of variants is systematic. The area of the sown area is 31.2 m<sup>2</sup>, the accounting area is 25.3 m<sup>2</sup>.

The soil of the experimental site is light gray, the soil density is 1.17-1.3 g / cm<sup>3</sup>, the total porosity is 48-51.6%, the content of the mobile forms of nitrogen is 61.6 mg / kg, P<sub>2</sub>O<sub>5</sub>-160, K<sub>2</sub>O - 65 mg / kg, pH = 5.9.

In the field experiment, the placement, number and weight of the tubers on the roots of the plants were determined by the GS method. Posipanova [7]. According to research results, soybeans belong to a group of cultures in which the tubers are placed compactly around the root at a depth of 10 - 12 cm with a radius of 12 cm.

Before sowing, seeds were treated with an inoculum Risogumin containing specific viral active strains of *Bradirisobium japonicum* tuber bacteria to improve the symbiosis of plants with tuberous bacteria. During the budding period, complex fertilizers were added on chelating base crystalline universal in the norm of 2 kg / ha containing N18P18K18 and a complex of trace elements.

To determine the presence of tubers on plant corn in different phases of growth and development, we chose soil monoliths in diameter 50 cm and depth 0-20 cm. The soya roots were washed under water on sieve with a diameter of 1 mm. The available clayey soil layers were distributed with a soft brush under running water over the screen. After the whole root of the fullness was released from the soil, the tubers were dried with filter paper and separated from the roots, weighed and determined with legemoglobin and without it.

Research results. Tubers are formed predominantly on the main root, where they are larger in size and mass, and also a certain percentage is formed on the side roots. The bulk of their mass is located in an arable layer of soil. It has been established that in favorable conditions on one plant an average of 21-80 bulbs and more than 10 [10] are formed. The tubers become visible on the roots of soy within 7 - 10 days after the emergence of the seedlings, ie, during the formation of the first three-time leaf. Approximately 15 to 25 days after their formation, the process of nitrogen fixation begins and lasts until the aging of the plant. In the initial stages of the development of soy, nitrogen deficiency occurs poorly, and subsequently its activity

increases dramatically, reaching its maximum during the flowering and infusion of beans. After it, it decreases as the maturity approaches.

As can be seen from Table. 1, in variants with the same amount of NPK application and the use of different biologics, the number of tubers per plant is different. Compared to the control, the best was the seed treatment with inoculum and the application of foliar nutrition on the background of the N60P60K60. By the phase of pouring beans, the number of tubers on indigenous plants increased both in the control version and in the variant with the use of biopreparations on the background of NPK. However, in the control version, this figure was 1.5 - 2 times lower.

The use of seed inoculation and extra-root nutrition on the background of the N60P60K60 also contributed to an increase in the mass of tubers (Table 2).

In the control phase, the bloom phase was 0.21 g, while in the variants N60P60K60 + and N60P60K60 + np + and, respectively, 0.46 g and 0.51 g. A similar situation was observed in the bean infusion phase. The mass of tubers on one plant in all phases of growth and development in variants using inoculation and foliar fertilization on the background of fertilizers in comparison with the control is 1.5-2 times higher.

Soy is capable of fixing nitrogen almost as much as it takes with the crop, but retains a large amount of it in the soil as part of the root remains and tubers.

From tabl. 3 shows that the maximum amount of nitrogen was recorded not only for the use of biological products, but also for the dose of nitrogen - N60. According to the data, we calculated the amount of ammonium nitrate, which is equivalent to fixed nitrogen by the symbiotic apparatus of soybean plants.

According to research results, it is established that the maximum area of the leaf surface increases during the period of bean production. Compared to the control, the highest index of the puffer surface was noted in variants with inoculation and foliar feeding on the background of N60P60K60, which is 0.54 and 0.65 higher than in the control version (Table 3).

The area of the leafy surface in the fertilizer application variants was 5.6-8.7 thousand m<sup>2</sup> / ha more compared to the control variant, with only inoculation and non-root nutrition applied - by 1.5 - 3.9 Thousands of m<sup>2</sup> / ha, while using N60P60K60 + and N60P60K60 + pp + and, respectively, 8.7 and 6.8 ths. m<sup>2</sup> / ha.

The increase in the yield of soybean seeds in the variant with mineral fertilizers at a dose of N60P60K60 followed by foliar feeding on the background of seed treatment with inoculum Risogumin was 1.1 t / ha.

The inoculation of soybean seeds provides for the development of tubers and the accumulation of biological nitrogen in the soil 32.9 kg / ha, which is equivalent to the equivalent of ammonium nitrate 96.8 kg / ha, in the monetary assessment - 3600 UAH. The complex application of mineral fertilizers in a dose of N60P60K60 with subsequent intranasal feeding with complex fertilizer, crystalline universal in the background of inoculation of the seed promotes the active development of the tubers and the fixation of biological nitrogen - 51.5 kg / ha, in an equivalent calculation, 151.5 kg of ammonium nitrate per 1 hectare, which helps to increase the soil fertility and save 1814 UAH / ha.

## **Conclusions**

Seed treatment with an inoculum Risogumin at a dose of 200 g / ton of seed promotes the development of bouillons and creates conditions for the development of the assimilation surface, respectively, for 17 bulbs and 1.5 thousand m<sup>2</sup> / ha compared with the control variant.

The use of pre-sowing seed treatment with an inoculum and the use of a foliar application with a complex fertilizer on a chelate basis, universal crystalline in a dose of 2 kg / ha, contributes to the intensive development of the tubers and the leaf surface, respectively, by 21 pc. tubers and 3.9 thousand m<sup>2</sup> / ha compared to control.

It was found that the investigated factors positively influenced formation symbiotic apparatus in plants. The introduction of N60P60K60 + and + nn does not inhibit the nitrogen fixing activity of microorganisms, and, conversely, contributes to the formation of the number of tubers in the root system - 56 pcs. compared to an unpatched background.

Creation of favorable conditions for the growth and development of soybean plants due to inoculation of the seed and extra-root feeding on the background of mineral fertilizer application (N60P60K60) contributed to the formation of the leaf area and was 8.7 thousand m<sup>2</sup> / ha more compared to the control.

Growth of the harvest of the early-stage KiVin with the application of N60P60K60 + and N60P60K60 + pp + and was, respectively, 0.9 and 1.1 t / ha.

In the conditions of the Polissya of Ukraine, medium-rich nutrition elements of light gray soils and the use of intensive technology elements allow the soil to be supplied with biological nitrogen corresponding to the equivalent of ammonium nitrate - 151.5 kg / ha.

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