

Nutritive regime of grey forest soil at application of different fertilizer systems of soya bean

Vasylenko M.¹, Dushko P.²

Institute of agroecology and natural management of NAAS, Metrolohichna Str., 12, Kyiv, 03143, Ukraine; e-mail: ¹m_draga@hotmail.com, ²pdushko@hotmail.com

The purpose. To probe influence of different fertilizer systems of soya bean on nutritive regime of grey forest soils. **Methods.** Field experiments with soya bean were spent on grey forest soils by B.A. Dosphehov's technique with observance of demands GOST 10106-87 «Field experiments field with fertilizers. Order of their holding». Size of sowing plot was 25-30 m², frequency — 4-times. Phosphoric and potassium fertilizers were deposited in the autumn under the basic soil cultivation, nitrogenous — in the spring during presowing cultivation. During vegetative period of soya bean in field experiments they carried out observation, account and laboratory researches. Laboratory analyses of soil and plants were realized according to conventional techniques. Economic efficiency of growing soya bean was determined by technique of NSC «Institute of economy of NAAS» (1999). Mathematical-statistical analysis of the gained results was spent by B.A. Dosphehov's method with the use of state-of-the-art computer programs. **Results.** Application of the designed organic-mineral fertilizer system of soya bean ensured optimum conditions for accumulation of vegetative mass by plants of soya bean, tall indexes of assimilatory surface of plants of soya bean in the phase of swelling of beans, promoted biological fixation of nitrogen. The given fertilizer system of soya bean improved fertility of grey forest soils of Right-bank forest-steppe of Ukraine. Ploughing under of collateral products of the predecessor, sowing green manure crops, importation of fertilizers in dose of N₁₅P₃₀K₃₀, application of microelements, microbiological specimens, treatment of seeds and dabbling sowings by growth stimulants of plants ensured sufficient balance of nutrients of soil. **Conclusions.** Scientifically justified agroecological fertilizer system of soya bean for grey forest soils of Right-bank forest-steppe heightened their fertility: the content of hydrolyzable nitrogen was increased by 11,5 mg/kg, of mobile phosphorus — on 43, and of potassium — on 8 mg/kg. At use of such organic-mineral fertilizer system positive balance of nutrients was formed: nitrogen — 26,1 kg/hectare, phosphorus — 53,7, potassium — 49,8 kg/hectare of soil.

Key words: soil, fertilizers, collateral products, growth regulators of plants, microbiological specimens, content of nutrients.

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Improving the productivity of agricultural crops, improving the quality of products to a large extent depends on the level of supply of soil elements of nutrition. One of the important components of the technology, which has the greatest impact on the achievement of high yield and production efficiency of soybean seeds, is the development of a system of deficit and balanced nutrition of the crop. To obtain high yields of agricultural crops, it is necessary to provide them with all necessary factors of life in the optimal ratio (1–9).

Soil fertility is the ability to provide optimum conditions for high productivity of crops. The introduction of the most optimal doses of fertilizers that ensure the preservation of humus in soils is an important problem in agro-ecological science and production. It is associated with the economic, energy, and social problems of the present. Afterall, the reduction in the number of cattle causes the deficit of organic fertilizers, and because of the high cost of fuel and lubricants, their transportation is disadvantageous because transportation costs are not reimbursed by an additional harvest (5, 8).

The purpose of the experiment: To determine the influence of different soybean fertilizer systems on gray forest soils on the nutrient regime of the soil.

Materials and methods of research: Field experiments with soybeans were conducted on gray forest soils of the experimental field of the Institute of Agroecology and Environmental Management of the National Academy of Agrarian Sciences of Ukraine and the scientific research farm "Chabany" of the NSC "Institute of Agriculture of NAAS".

Scheme of experiments is given in Figures 1 and 2.

Field experiments were carried out using the method of B.A. Dospikhov (10) with the observance of GOST 10106-87 "Field experiments with fertilizers: the order of their conduct". The size of the sown area is 25-30 m², repetition – 4 times. The soybean technology recommended for the zone was used. Phosphate and potassium fertilizers were introduced during the main tillage, nitrogen – in the spring during pre-sowing cultivation.

In the experiments of the NSC "Institute of Agriculture of NAAS", they used soybeans of the Chernyatka variety, the Institute of Agroecology and Environmental Management of the NAAS – Gorlytsya variety. The Chernyatka variety is an early ripeness with the duration of the vegetation period in the conditions of the Kyiv region 108-110 days. It was entered in the Register of Plant Varieties of Ukraine in 2001. The Gorlytsya Variety is middle-early ripeness, with the duration of the vegetation period in the conditions of the Kyiv region 120-122 days, entered in the Register of Plant Varieties of Ukraine since 2006.

During the soybean vegetation period in field experiments, appropriate observations, records and laboratory studies were conducted.

Laboratory analysis of soil and plants was carried out according to generally accepted methods: humus content according to Tyurin (DSTU 4289-2004), easily hydrolyzed nitrogen according to Kornfeld, mobile phosphorus and mobile potassium according to Chirikov (DSTU 4115-2002), RHHCL – ionometrically (GOST 26483-85); the hydrolytic acidity – according to Kappen (GOST 26212-91), the amount of absorbed bases in accordance with GOST 27821-88, cellulose-destructive activity – by the Kristensen method. In plant samples of grain and by-products, nitrogen was determined by photometric method with a Nessler reagent, phosphorus – by Trugor; potassium – on a fiery photometer.

The economic efficiency of soybean cultivation was determined by the methodology of the NSC "Institute of Economics of NAAS" (1999). Mathematical-statistical analysis of the obtained results was carried out for B.A. Dospikhov (1985) using modern computer programs.

Research results. Developing resource-saving fertilizer systems for soybeans, it is necessary, first of all, to bear in mind that this is a rather intense culture, which requires a significant amount of nutrients for the formation of a complete harvest. To grow 1 t of seeds and the corresponding amount of vegetative mass requires 6.5-7.5 kg of nitrogen, 1.3-1.7 phosphorus and 1.8-2.2 kg of potassium [3]. On the soils studied, the intensity of nutrient balances should be at least 105% for nitrogen, 150 for phosphorus and 120% for potassium [4].

The main source of input into the soil of plant biomass agroecosystems of soy in the course of the technological cycle of its cultivation was the byproduct of the precursor culture, the green mass of the sedge culture, as well as the part of the commodity part of the soybean crop (Fig. 1).

With by-products and after-harvested residues of the predecessor culture in soybean agroecosystems 4.5 t/ha of dry biomass was delivered, the sedge re-plowing increased its inputs by 4.85 t/ha, and due to the non-consumable part of the soybean crop - by 4.04-5.44 t/ha.

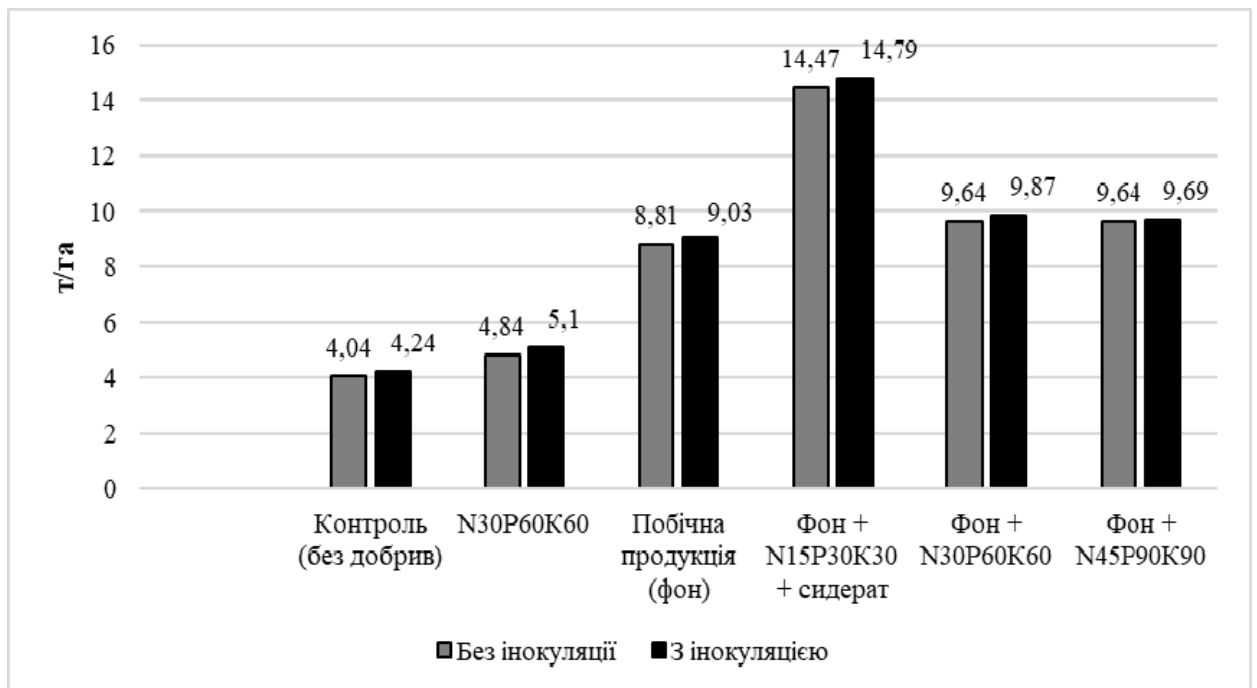


Fig. 1. Input to the soil of dry plant biomass in different soybean fertilizer systems, t/ha

The largest volumes of input in the agroecosystem of plant biomass were observed in fertilizer systems, which included the introduction of mineral fertilizers in a dose of $N_{15}P_{30}K_{30}$, plowing into the soil biomass byproducts of precursor and siltate, cultivating seeds with highly effective preparations of nodules bacteria and plant growth regulators. The volume of dry matter incidence of plants in this variant reached 14.79 t / ha, which exceeded the control 3.5 times, the background - 1.6 times, the single dose of fertilizers against the background of straw - by 50%, and one and a half dose - by 53% .

One of the important components of the technology that has the greatest impact on the achievement of high yield and efficiency of the production of soybean seeds is the development of a system of deficit and balanced nutrition of the crop.

Fig. 2 indicate that in variants with inoculation for the application of mineral fertilizers in a dose of $N_{30}P_{60}K_{60}$ both separately and with the plowing into the soil of by-products, the content of easily hydrolyzed nitrogen increased by 7.5 to 19.0 mg/kg, of mobile phosphorus – by 56,0-81,4 and moving potassium - by 10,0-5,0 mg/kg of soil. From the inoculation of seeds on the control the content of easily hydrogenated nitrogen increased by 0.2 mg/ kg of soil, of mobile phosphorus – by 2.3 and mobile potassium – by 0.5 mg/ kg of soil.

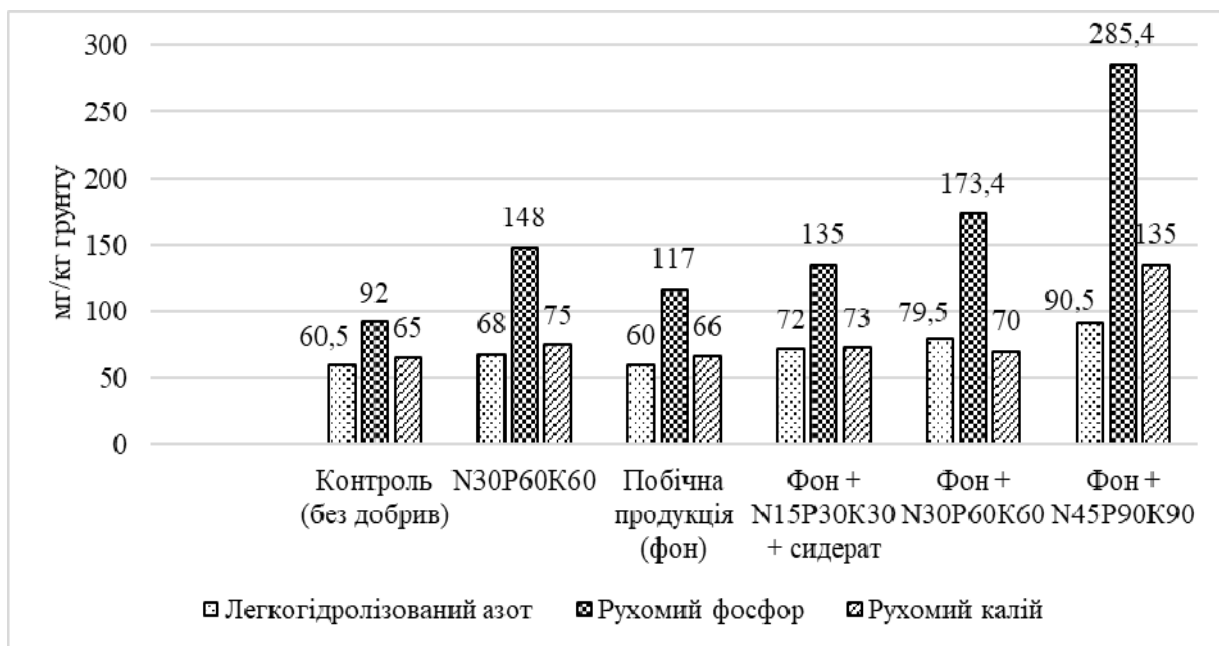


Fig. 2. Effect of fertilizer systems on the nutrient regime of the soil

In the variant with the use as fertiliser of biomass byproducts of precursor culture, sederal culture, as well as the input of mineral fertilizers in a dose N15P30K30 and the inoculation of seeds with nitrogen fixing preparations of the content of easily hydrolyzed nitrogen increased by 11.5 mg/kg, of mobile phosphorus – by 43,0 and moving potassium – by 8,0 mg/kg of soil.

In our research, we calculated the balance of nutrients for different fertilizer systems.

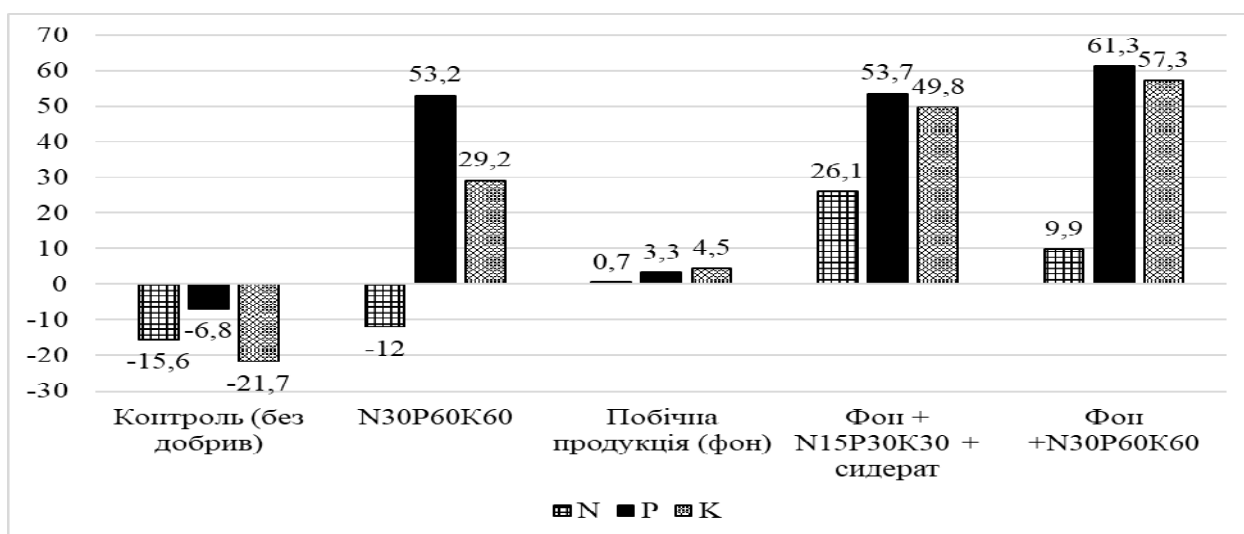


Fig. 3. Balance of nutrients in various soybean fertilizer systems, kg/ha

The balance of nutrients (Figure 3) on the control was negative both for nitrogen and for phosphorus with potassium and was 15.6, 6.8 and 21.7 kg/ha respectively. For the application of mineral fertilizers at a dose of N₃₀P₆₀K₆₀, the negative balance was only for nitrogen – 12.0 kg/ha. Plowing into the soil of byproducts of the precursor culture contributed to a slight positive balance. The high positive nutrient balance for all indices (NPK), respectively, was 26.1, 53.7 and 49.8 kg/ha of soil was observed using the organo-mineral fertilizer system, in which mineral fertilizers was input at a dose of N₁₅P₃₀K₃₀ and byproducts of precursor and biomass siderate was plowing into the soil.

By content of nitrogen, variants with plowing into the soil by-products of the precursor both separately and in combination with mineral fertilizers at a dose of $N_{30}P_{45}K_{45}$ and $N_{40}P_{60}K_{60}$, trace elements and growth stimulators of plants are characterized as optimal.

Thus, the application of the organo-mineral system developed by us provides the most optimal for the accumulation of vegetative mass of soybean plants – the dry matter of above-ground biomass, the highest indices of the assimilation surface of soya in the phase of pouring beans, which contributed to the biological fixation of nitrogen.

The scientifically grounded agro-economic fertilizer system of soybean for gray forest soils of the right-bank Forest-Steppe of Ukraine contributed to increasing their fertility, the content of easy hydrolyzed nitrogen increased by 11.5 mg/kg of soil, mobile phosphorus by 43.0 and moving potassium by 8.0 kg/ha. Under this organo-mineral fertilizer system a high positive balance of nutrients is formed: nitrogen 26.1 mg/ha, phosphorus 53.7 kg ha, potassium 49.8 kg ha of soil.

Conclusions

1. It has been proved that the organic-mineral fertilizer system developed by us provided the optimum conditions for the accumulation of soybean vegetative mass of plants – the weight of 1 plant was 39.0 g increase to absolute control - 13.5 g or 52.8%, dry matter above-ground biomass - 4.79 t/ha, increase to absolute control by 1.78 t/ha or 59.0%; The highest indices of the soybean assimilation surface in the phase of pouring bean as the area of the leaf surface, which contributed to the formation of the maximum photosynthetic potential of crops, increases the mass of active abiotic potential and biologically fixed nitrogen (132 kg/ha).

2. The scientifically grounded agroecological fertilizer system of soybean for gray forest soils of the right-bank Forest-Steppe contributes to increasing their fertility: the content of lightly hydrogenated nitrogen increased by 11.5 mg/kg of soil, of the mobile phosphorus by 43.0 and of the moving potassium by 8.0 mg/kg

3. Under such organo-mineral fertilizer system a high positive balance of nutrients is formed: nitrogen 26.1 kg/ha, phosphorus 53.7 and potassium 49.8 kg/ha of soil.

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