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NUTRIENT UTILIZATION COEFFICIENT FROM FERTILIZERS BY COMMON BEAN (PHASEOLUS VULGARIS L.)

Nasimova Maftuna Kurbanbayevna
Abu Rayhan Beruni University
Samarqand, O‘zbekiston
E-mail: maftunakurbanbayevna@gmail.com

Sanakulov Akmal Lapasovich
Samarkand State University
named after Sharof Rashidov
Samarqand, O‘zbekiston
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Abstract. The article presents data on how various preparations influence the utilization coefficients of nitrogen, phosphorus, and potassium fertilizers by bean plants during cultivation. In the conditions of the Samarkand region, the impact of various preparations containing complex micro-fertilizers—applied against a background of standard micro-fertilizer usage—has not been sufficiently studied. Consequently, improving the cultivation technology for grain legumes, particularly beans, is a matter of significant importance.

Keywords: beans, micro-fertilizers, preparations, grain composition, nitrogen, phosphorus, potassium, productivity.

Introduction. As the demand in the food industry grows for plants that are both nutritious for the human body and useful in preventing and treating various diseases, improving bean cultivation technology—and studying the crop's physiological and biochemical characteristics—has become a pressing issue for increasing the export of this economically important crop worldwide. Large-scale economic reforms in our country's agriculture—specifically the restructuring of fertile crop areas to meet market demands—have not only led to increased production volumes of vegetables and potatoes but have also expanded the variety and assortment of grains, legumes, vegetables, melons, fruits, and grapes. In this context, developing the physiological and biochemical foundations for using bioactive substances in common bean cultivation is a matter of significant importance [9, 12].

Currently, the common bean (Phaseolus vulgaris L.) is cultivated over vast areas worldwide; according to FAO data, it covers 25 million hectares, accounting for 17% of all legume crops. The widespread cultivation of Phaseolus vulgaris L. varieties is driven by two main factors: firstly, its valuable biochemical composition, and secondly, the fact that its cultivation does not require excessive agrotechnical interventions to meet market demand. Sunlight and fertile black soil (chernozem) constitute the most favorable abiotic conditions for the common bean. May is considered the optimal time for sowing bean seeds. In hot regions, the last ten days of April are considered the most critical period. The sowing depth is 3–4 cm; however, in soils lacking

sufficient moisture, planting should be done at a depth of 5 cm. The plant requires the most moisture during the flowering and fruiting stages [16].

Among legume crops, the common bean holds a significant place, distinguished by its high drought tolerance, adaptability, and the relative ease of cultivation and harvesting. Beans are considered a promising legume crop; their high resistance to drought and heat, combined with the high protein content of the seeds, ensures stable germination. Due to their strong root system and efficient moisture utilization, beans can be cultivated even in regions frequently prone to summer droughts [5, 6, 10].

The common bean is a widely cultivated agricultural crop globally. In our country, beans are grown on a small scale among vegetable crops. Improving selection and cultivation technologies plays a vital role in expanding the production of vegetable legumes. In modern conditions, breeding efforts for vegetable beans should focus on meeting processing requirements, as well as on expanding cultivation areas and the scope of their utilization [9, 11].

Enhancing the efficiency of fertilizer use is a crucial task for agronomists, agrochemical specialists, and staff at agricultural and research institutions. Comprehensive measures and methods regarding fertilizer application are vital for scientifically determining the appropriate quantities of each fertilizer type; furthermore, establishing the timing and methods of application is essential for boosting crop yields and soil fertility [7, 8].

Nitrogen (N) is an essential element for plant life; as a constituent of vital compounds—such as proteins, enzymes, nucleic acids, and others—it plays a critical role in plant growth and development, leaf area expansion, chlorophyll synthesis, root system strengthening, and the formation of flowers and young fruit sets [14].

S.N. Vinogradsky studied how leguminous plants assimilate atmospheric nitrogen via root nodule bacteria and examined the influence of agronomic practices on this process. M.V. Fedorov elucidated the biological, physiological, and biochemical foundations of atmospheric nitrogen assimilation by leguminous plants through root nodule bacteria. F.V. Turchin investigated the roles of biological and mineral nitrogen in agricultural practice; he provided scientific and practical substantiation that biological nitrogen—accumulated by root-dwelling nodule bacteria that fix atmospheric nitrogen—is both ecologically clean and highly effective [17].

Phosphorus (P) constitutes the energetic basis of the cell; its role as a component of lipids underscores its immense physiological significance. It plays a particularly crucial part in plant photosynthesis and respiration. Phosphorus is vital to the cell's energetic foundation, as it is a constituent of proteins, nucleic acids, phospholipids, sugar phosphates, nucleotides, high-energy compounds like ATP, vitamins, and other essential molecules within the plant. In general, a vast number of metabolic reactions in plants depend on phosphorus; no other element can substitute for it. When plants lack phosphorus, tissue breakdown processes intensify, whereas synthesis processes slow down or cease. Visible symptoms also manifest in the plant's appearance, specifically through stunted growth and development. Potassium (K) participates in carbohydrate and protein metabolism, enhancing sugar formation in leaves and facilitating the transport of sugars to other plant organs. Furthermore, potassium improves water flow into plant cells and reduces transpiration, thereby increasing the plant's drought resistance [14].

Variations in the nutrient utilization coefficient for specific crop types and varieties depend on soil genesis, mechanical composition, nutrient and moisture availability, and climatic conditions. In soils of the same type and mechanical composition, this coefficient is also linked to the soil reaction (pH). Furthermore, the utilization of nutrients from soil and fertilizers depends on farming practices, varietal characteristics, and plant productivity, increasing alongside crop yields [2, 3, 7].

Microelements play a significant agrochemical and physiological role. They improve metabolic processes within the plant organism, ensure the normal course of physiological and biochemical processes, directly influence chlorophyll synthesis, and enhance the rate of photosynthesis. Under adverse environmental conditions—such as soil moisture deficits, temperature extremes (including low winter temperatures), and other stress factors—microelements help increase plant resistance to fungal and bacterial diseases. Molybdenum (Mo) serves as an essential biocatalytic component for nitrogen fixation, facilitating the symbiotic activity of *Azotobacter* and *Clostridium* bacteria with leguminous crops and their root nodules. Molybdenum plays a crucial role in the processes of nitrate nitrogen assimilation and nitrate reduction in plants. According to M. Qo‘chqorova, A. Toshtemirov, and A. Sanakulov (2014), the influence of molybdenum not only increases the number of nodules on the roots of legumes but also facilitates the reduction of nitrates to ammonia. Molybdenum promotes an increase in the levels of carbohydrates, carotene, and ascorbic acid within the plant. While protein content rises in all crops, it accumulates to a greater extent in legumes. Molybdenum also boosts chlorophyll levels and enhances the rate of photosynthesis. Molybdenum deficiency inhibits atmospheric nitrogen fixation; plant leaves turn pale or yellowish-green, stems take on a reddish-brown hue, and root nodules become smaller and turn gray or brown. Cobalt (Co) is currently considered an essential element for enhancing the nitrogen-fixation process of nodule bacteria. It is a component of Vitamin B12, which is found in the nodules. Cobalt positively influences the activity of the hydrogenase enzyme and also increases nitrate reductase activity in legume nodules [15].

Research object and methods used. The "Ravot" and "Mahsuldor" bean varieties served as the objects of our research. Field experiments were conducted based on generally accepted methodologies, specifically: "Methods of agrochemical analysis of soils and plants," "Methods of agrophysical research," and "Methods for conducting field experiments." Results obtained and their analysis. The experiments were carried out on a field belonging to the "Mukarram Ona" farm in the Payariq district of the Samarkand region.

Research results. An analysis of nutrient utilization coefficients from the fertilizers applied in experiments on irrigated meadow-gray soils in the Samarkand region showed that the "Ravot" variety yielded 20.4 centners/ha in the $N_{35}P_{60}K_{30}$ (background) variant without the additional preparation. The "Background + Uzgumi" variant resulted in an additional grain yield of 3.1 centners/ha compared to the variant without the preparation. Given that the nitrogen (N) content in the grain was 4.03%, the utilization coefficient for nitrogen fertilizers was determined to be 35.71%. In the "Background + Edagum CM" variant, the nitrogen fertilizer utilization efficiency was 39.63%—exceeding that of the "Background + Uzgumi" variant by 3.92%—while the "Background + Gumel Lyuks" variant showed an even higher figure of 8.76%. The utilization efficiency of phosphorus fertilizers was calculated using a method similar to that used for

nitrogen fertilizers, taking into account a phosphorus content of 1.43–2.02% in the grain. Calculations indicated that the utilization efficiency of phosphorus from the fertilizers ranged from 10.2% to 12.79% across the experimental variants. The highest phosphorus utilization efficiency was observed in the "Background + Gumel Lyuks " variant, reaching 12.79%. Similarly, the utilization efficiency of potassium from potassium fertilizers was determined, accounting for a potassium (K) content of 3.73–3.83% in the grain. Calculations indicate that the potassium utilization coefficient ranged from 39.37% to 48.51% across the variants, maintaining the general trend observed for nitrogen and phosphorus utilization. Thus, the application of complex micro-fertilizers alongside a macro-fertilizer background ($N_{35}P_{60}K_{30}$ kg/ha) during bean cultivation increases the utilization coefficient of nutrients contained in the fertilizers.

For the “Mahsuldor” variety—specifically in the variant with the $N_{35}P_{60}K_{30}$ background but without the additional preparation—an extra grain yield of 2 centners/ha was obtained compared to the corresponding variant of the “Ravot” variety, resulting in a total yield of 22.4 centners/ha. The nitrogen utilization coefficient was also higher, at 38.18%. In the “Background + Edagum CM” variant, the phosphorus utilization coefficient was found to increase by 0.44%. Due to the higher content of nitrogen (by 0.1%), phosphorus (by 0.1%), and potassium (by 0.04%) in the grain of this variety compared to the “Ravot” variety, the utilization coefficients were found to be higher by 3.8% for nitrogen, 1.34% for phosphorus, and 3.09% for potassium.

Conclusion. The results of our study indicate that the use of bioactive substances when cultivating beans on winter wheat stubble—under the conditions of irrigated typical grey-brown soils in the Samarkand region—increases the utilization efficiency of nutrients from macro-fertilizers. The study revealed superior results for the "Mahsuldor" variety compared to the "Ravot" variety; specifically, nutrient utilization rates ranged from 38.18% to 48.27% for nitrogen, 10.45% to 14.13% for phosphorus, and 40.96% to 51.60% for potassium, with the highest results observed in the "Mahsuldor" variety under the "Background + Gumel Lyuks" treatment variant.

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