

Abstract

for dissertation work of SholpanSamandarovnaMuminova on the theme: "The effect of mineral fertilizers and biostimulants on the yield and technological qualities of intensive soybean varieties on the serozems of Southern Kazakhstan", recommended for Ph.D. degree (PhD) on the specialty 6D080800 - "Soil science and agrochemistry"

Relevance of the research topic

On irrigated fields of southern and south-eastern regions of Kazakhstan soybean growing belongs to priority crops and completely corresponds to soil and climatic conditions of these regions and possibilities of its growth and development.

In recent years, the demand for soybean production has been growing in the republic. The total volume of production of this crop in Kazakhstan does not meet the needs of the national economy in high-protein raw materials and covers only 15-20% of demand.

At present, the sown area of soybean crops in the Republic is increasing from year to year. Its sown area is about 140-150 thousand hectares, but the grain yield does not exceed 18-20 cwt/ha. With proper observance of all agronomic requirements, including a set of fertilizers and systematic use of biostimulators, it is possible to achieve a quality yield of up to 35-40 cwt/ha per hectare.

In the conditions of the southern region of Kazakhstan one of the actual problems is the development of growing technologies based on combined use of mineral fertilizers and biostimulators to increase the yield and improve product quality of different soybean varieties.

In addition, when solving this problem, the combined application of macro- and microfertilizers and biostimulators, allows to regulate the yield and quality of soybean grain.

The purpose of the dissertation research to study the effect of mineral fertilizers, trace elements and biostimulants on photosynthetic activity and productivity of intensive soybean varieties (Lastochka, Akku and Galina) in the conditions of gray-earth soils of Southern Kazakhstan.

Research objectives:

- To determine the growth and development characteristics of different varieties of soybean crops (Lastochka, Akku and Galina) depending on the application of mineral fertilizers and biostimulants;
- To study the effect of mineral fertilizers and biostimulants used to form photosynthetic apparatus and accumulation of dry matter in the plant of different soybean varieties;
- Determination of peculiarities of changes in productivity and product structure of soybean varieties as a result of using mineral fertilizers and biostimulants;
- Studying changes in technological parameters of soybean varieties quality as a result of using mineral fertilizers and biostimulants;

- Determination of economic and energy efficiency of using mineral fertilizers and biostimulants under different varieties of soybean grown on irrigated gray-brown soils of southern Kazakhstan.

Research methods

Biological research methods accepted in agrochemical science were used in the research. The research work was carried out on the basis of laboratory, field experiments and methods of laboratory analysis.

To determine the agrochemical indicators of the experimental dark grey soil and to study the chemical composition of different soybean varieties, soil and plant samples were taken at different growth phases.

The indicators determined in soil samples and methods of their determination: total forms of nitrogen, phosphorus, potassium in soil by the Ginzburg and Shcheglov methods, then nitrogen by Kjeldahl, phosphorus by colorimetric, potassium on a flame photometer; mobile forms of nitrogen, phosphorus, potassium - easily hydrolyzable nitrogen (Nl.g.) by Tyurin-Kononov, mobile phosphorus and exchangeable potassium in 1% ammonium carbonate solution according to Machigin B.A.; humus content according to Tyurin, granulometric composition of soil according to Kachinsky.

Indices determined from vegetative samples and methods of their determination: photosynthetic activity of soybean crops - Nichyparovich A.A. method; amount of dry matter from vegetative samples of soybean crops - by temperature-static weight method (drying at 105⁰C); protein content in soybean by Kjeldahl (MemST 10846-91). Grain and products of its processing. Protein determination method; amount of fat in grain by Soxhlet method (MemST 10852-96), (Kobyzeva L.N., Bezuglaya O.N.).

Main provisions (proven scientific hypotheses and other results being a new discovery)

1. Features of growth and development of different soybean varieties due to the application of mineral fertilizers, microelements and biostimulants: laboratory and field germination of soybean varieties; stable density and rooting ability of soybean plants; defeat of soybean crops by diseases and pests depending on feeding conditions.
2. Changes in photosynthetic activity of soybean plants depending on feeding conditions: formation of the photosynthetic apparatus of soybean plants when using mineral fertilizers and biostimulants; influence of fertilizers and biostimulants on dry matter accumulation in soybean plants.
3. Change of productivity and technological quality of soybean yield due to the use of mineral fertilizers and biostimulants: structure of soybean yield; change of productivity and quality of soybean yield due to the use of fertilizers and biostimulants.
4. Economic and energy efficiency of the use of mineral fertilizers and biostimulants under intensive soybean varieties on irrigated gray soils of Southern Kazakhstan

Characteristics of the main results of the study

The average value of laboratory germination of soybean varieties Lastochka, Akku and Galina in the control variant (R₆₀K₄₅) was 94.0-96.3%, and against the background of phosphorus-potassium fertilizers, trace elements Mo, B, biostimulants Epin 50 ml /ha and Vuksal universal 2.5 l /ha, these indicators increased within 94.7-97.0%. Field germination of soybean in the variety Lastochka was 61.7-71.7% in variants with the use of mineral fertilizers, trace elements and bioregulators. In the variety Akku it was 69.0-73.7%, and in the variety Galina it was 68.7-73.3%.

The application of mineral fertilizers in combination with micronutrients and biostimulants had a positive effect on soybean plant growth. The plants of "Lastochka" variety in variant with phosphorous-potassium fertilizers and microelements were 2.2 cm higher than control variant, the plants of "Akku" and "Galina" varieties - by 5.5 and 1.8 cm. The application of phosphorous-potassium fertilizers and biostimulant "Epin" in an amount of 50 ml/ha promoted plant growth in the cultivar "Lastochka" by 5.3 cm, in the cultivar "Akku" by 6.3 cm, and the cultivar "Galina" increased by 4.1 cm compared to control.

The lowest FP was determined in the branching phase and the highest in the flowering phase in all varieties during the growing season. In practice upon application of phosphorous-potassium fertilizers and microelements Mo, B photosynthetic potential of variety "Lastochka" was 706.6 thousand m²/ha, variety "Akku" - 735.9, variety "Galina" - 673.6 thousand m²/ha by 7.8%, 4.7 and 8.5% above control respectively. Combined application of phosphorous-potassium fertilizers and biostimulants "Epin" and "Vuksal universal" increased photosynthetic potential of variety "Lastochka" by 71,8-82,0 thousand m²/ha or 11,0-12,5%, "Akku" by 56,0-67,8 thousand m²/ha or 9,7-10,9% above control.

In the experiment, the highest yield of all soybean varieties 33.7 c/ha in the "Lastochka" variety, 39.2 c/ha in the "Akku" variety and 38.3 c/ha in the "Galina" variety was provided by the biostimulator "Vuksal universal" 2.5 l/ ha, introduced against the background of phosphorus-potassium fertilizers (R₆₀K₄₅). The average three-year yield is 32.1-32.7 c/ha for the "Lastochka" variety in variants with trace microelements (Mo, B) and the biostimulants Epin 50 ml/ ha, for the "Akku" variety - 38.4-38.7 c/ha and for the "Galina" variety - 36.2-38.1 c/ha.

The results showed that the macrofertilizers, micronutrients and biostimulants used increased the protein and fat content in soybean seeds. The application of micro nutrients Mo, B together with phosphorous-potassium mixture (P₆₀K₄₅) increased the protein content in variety "Lastochka" by 32.2%, in variety "Akku" by 32.12%, and in variety "Galina" by 37.12% or 6.46; 6.35 and 10.24% higher compared to control.

The highest protein content was observed in the variety "Lastochka" - 50.97%, in the variety "Akku" - 51.77% and in the variety "Galina" - 51.76%, in the variant with the biostimulants "Vuksal universal" 2.5 l/ha on phosphorus-potassium background.

The fat content in soybean seeds in variants with the application of microelements and biostimulants on the phosphorous-potassium background

increased in the range 21,33-25,74% in variety "Lastochka", 21,38-26,33% in variety "Akku" and 21,82-26,08% in variety "Galina", and in the control variant (P₆₀K₄₅) was 18,71%; 19,44% and 20,03% respectively.

Macrofertilizers, micronutrients and biostimulants applied to soybean crops showed high economic and energy efficiency. In application of phosphorous-potassium fertilizers (P₆₀K₄₅) in "Lastochka" variety a conditionally net profit 147887,5 tenge/ha was received, in "Akku" variety - 180578,3 tenge/ha and in "Galina" variety - 174394,2 tenge/ha, and in variant with usage of microelements Mo, B and biostimulants a sum of conditionally net profit received by these varieties accordingly: 148534.0 - 158005.4 tenge/ha; 192520.5 - 204320.3 tenge/ha and 185321.3-204370.6 tenge/ha.

The level of profitability of applied microfertilizers, microelements and biostimulants varied from 62.1 to 82.1%.

Analysis of bioenergy resources showed that application of fertilizers is energetically profitable. It was found that the energy stored in seeds was 3.27 times higher than the energy stored in the whole biomass by 5.73 times.

Substantiation of novelty and significance of the obtained results

For the first time the influence of mineral fertilizers and biostimulants on productivity and technological qualities of intensive soybean varieties (Lastochka, Akku and Galina) on grey soils of South Kazakhstan was studied. A laboratory evaluation of soybean was carried out in the course of the study. Application of fertilizers and biostimulants allowed developing soybean crops, obtaining environmentally friendly and competitive domestic products. The norms and types of mineral fertilizers and biostimulants were determined for the yield of 32.1 - 33.7 c/ha variety "Lastochka", 38.4-39.2 c/ha variety "Akku" and 36.2 - 39.2 c/ha variety "Galina" and protein content of 45-50%.

The dissertation data are used in the development of norms and standards of fertilizers and biostimulants types in the educational process of students studying on "Soil science and agrochemistry" of M.Auezov University in soybean farms, scientific institutions of Turkestan region. The results of the research were tested on 2 hectares of sowing areas in the conditions of LLP "O. Rakhat" Karatau district of Turkestan region and peasant farming "Bes tulik ". From application of mineral fertilizers and bioregulator "Vuksal universal" in the first farm compared with control the net profit was 3150 tenge/hectare from 1 hectare and 4300 tenge/hectare in the second farm.

Conformity to directions of development of science or state programs

Dissertation work was carried out in 2018-2020 in the framework of the program of target funding of LLP "Southwest Research Institute of Livestock and Crop Production" of the Ministry of Agriculture of RK in the section "Agriculture and crop production" "creation and introduction of high-quality soybean varieties in new, high-yield, stress-resistant conditions for different regions of the country using the world variety" (state registration number №01185RK01208).

Contribution of the doctoral student to each publication

While carrying out dissertation work doctoral student showed a high level of responsibility for the development of the research program and methodology, staging and conducting the experiment. She conducted the research with great interest. While conducting the research he fully mastered and excelled in field experiments with different varieties of soybean, methods of phenological observations and biometric measurements, laboratory analyses. All results and conclusions presented in the thesis were formulated with the direct participation of the applicant in accordance with the results of the research. The author was actively involved in discussions of the results, preparation and submission for publication in foreign journals.

According to the results of research work in accordance with the thesis theme, 7 scientific papers have been published, including 3 articles in scientific journals recommended by the Committee for Quality Assurance in Science and Higher Education of MSHE RK, 1 article in scientific journals included in the Scopus database, 3 articles in domestic scientific journals and articles in journals included in the RSCI database and recommendation for production.

The thesis volume and structure

The thesis consists of 111 pages; it contains an introduction, 7 sections, conclusion, recommendations for production, list of references and appendices.

Data of dissertation are supplemented with 21 tables and 22 figures. The reference list contains 271 references.