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Effect Of Sulfur Micronutrient On Symbiotic Activity Of “Orzu” Variety Of Soybean

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ABSTRACT

In this article, the data are given about mineral fertilizers and sulfur microelements activate the symbiotic activity of soybean variety "Orzu", averaging 32.4-42.3 million nodules per hectare, the number of nodules due to the background of mineral fertilizers increased by 13.6%, and there was an increase of 19.4-23,4% due to sulfur, as well as an average weight of nodules was 6.46-9.56 c / ha, the weight of nodules increased by 5.3% due to mineral fertilizers, and 17.1-32.4% due to sulfur. During the application period, 6.46-9.56 c / ha of nodules mass was accumulated per hectare according to the studied variants, which contributes to the increase of nitrogen and organic matter in the soil and a slight increase in biological efficiency.

KEYWORDS

Micronutrient, mineral fertilizer, nodule bacteria, “Orzu”, soybean, sulfur, suspension, symbiotic activity.

INTRODUCTION

Nowadays, when protein deficiency is prevalent all over the world, the protein richness of soybeans, the presence of all the

amino acids useful for humans in the protein content, is of particular importance, further increasing the nutritional value of soybeans. It

should be noted that the advantage of soybean is comparable to a number of foods in terms of richness in lysine, methionine, arginine, leucine and other essential amino acids.

In many countries where soybeans are grown, this crop is the only source of protein, which also provides livestock with nutritious food and increases its productivity. Soybeans contain 30-52% protein, 17-27% oil and 20% carbohydrate water. The prevalence of soybean crop on earth is related to the quality of grain and protein.

Based on the positive biological properties of soybeans in the country, it is necessary to study the norms of micronutrients on the background of mineral fertilizers, to determine the optimal ones in the creation and improvement of technology for growing soybeans as a primary and secondary crop.

Soybean is a plant demanding to nutrients. 124 kg of nitrogen, 22 kg of phosphorus, 102 kg of potassium, 34 kg of calcium, 23 kg of sulfur, 191 g of zinc, 18 kg of magnesium, 207 g of manganese, 865 g of iron and 75 g of copper are extracted from the soil at a grain yield of 24 c / ha per hectare. This shows that in addition to macronutrients, micronutrients are also necessary for the growth and development of soybean.

Micronutrients optimize plant nutrition [11], increase resistance to stress, stimulate growth [12]. Such cases are also observed in the soybean plant [9, 15].

According to the biological potential of modern soybean varieties, it is possible to grow 3.5-4.4 t / ha of seeds, but in practice, this is very difficult to achieve [4].

Sulfur promotes the formation of certain amino acids, namely protein. Sulfur is involved in the formation of chlorophyll, and soy absorbs a lot of sulfur during this period. Sulfur in the seeds yields 27–66% relative to the total amount. Kazakh scientists have studied the importance of sulfur and recommended the use of sulfur-containing nanopreparations to increase the germination of soybean seeds and increase the overall yield and quality. Among the various preparations, a good result was obtained from the dry nanopreparation [10].

Micronutrients are less absorbed by the soybean plant than nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur. Nevertheless, their importance is not small, the lack of microelements in the soil slows down the growth rate of the plant, the yield is reduced.

Zinc activates enzymes, participates in plant nitrogen metabolism and protein formation.

Iron is a component of chlorophyll and is important in respiration and photosynthesis.

Symptoms of calcium deficiency: slow development of meristem tissue of the stem, leaf and root tips. Due to the slow mobility of calcium, its deficiency is first seen in young leaves and growth points.

Manganese, barium, and molybdenum do not form seeds in legumes unless they are sufficient. At the beginning of the application period, molybdenum and barium have a positive effect on the plant [3].

Magnesium deficiency begins with yellowing of the veins of aged leaves. The yellowing of the leaves begins at the bottom and reaches the young leaves as the deficiency intensifies.

Symptoms of magnesium deficiency are similar to those of potassium, iron, or manganese.

In iron deficiency, chlorophyll production stops abruptly. The interstices of young leaves turn yellow. As the deficit increases, the leaf veins also turn yellow and the leaf turns completely white. Brown spots appear on the edges of the leaves.

Iron deficiency is common in soils with a soil environment pH greater than 7. Soybean varieties have different approaches to iron deficiency. In resistant varieties, iron assimilation begins in the root system, while in the developed root system, iron is assimilated from various root wastes. As the pH of the soil increases, the absorption of manganese becomes more difficult.

To support and activate physiological processes in the development of soybeans, it is recommended to feed soybean varieties with micronutrients during the period of deficiency of micronutrients outside the root (chelate feeding). Periods demanding to micronutrients: during the development of 4-6 leaves, during the period of branching and pod formation.

X.N.Atabaeva, F.B.Namozov, A.A.Kurbanov and S.Sh.Khayrullayev (2020), in their experiments in 2018-2020, found that when micronutrients affected soybean crops, micronutrients affected stem height, leaf and root development, root nodule formation, grain quality and yield, and provided high yields [13].

According to R.Juraeva, J.Tashpulatov, A.Iminov, H.Bozorov, Khatamov S.R, Khayrullaev S.Sh and L.Zaynitdinova (2020), in their experiments in 2015-2017, mineral

fertilizers and rhizobium were applied to soybeans. When exposed to strains of azotobacteria belonging to the group, it was observed that the yield increased by 12.6-12.8 c / ha compared to the control variant, [6; pp.72-79], [5; p.172].

According to Khayrullayev Sardor Shamsiddin ugli (2021), the application of micronutrients in the suspension method 2 times during the application period of soybean varieties in the conditions of meadow-swamp soils provides an increase in grain quality [8].

According to data of Atabayeva Khalima Nazarovna, Khayrullaev Sardor Shamsiddin o'g'li, and Usmonova Shohista Usmon qizi (2020), sulfur has a positive effect on the branching of soybean varieties on the background of mineral fertilizers, and in 2018 the number of branches in the variety "Orzu" increased by 0.8-1.3 compared to the control option due to the micro element sulfur. In the "Nafis" variety, this figure was 0.3-0.4, and good results were obtained from medium and high sulfur standards. In 2019, these indicators increased by 0.3-0.7 in the variants of sulfur compared to the control in the "Orzu" variety, increased by 0.1-0.3 in the "Nafis" variety, and good results were obtained from the medium and high standards of sulfur [2].

According to Iminov Abduvali Abdumannobovich, Khayrullayev Sardor Shamsiddin ugli, et al, Nitragine treatment of soybean and mung bean seeds before sowing had a positive effect on seed germination under both laboratory and field conditions, the germination rate of seeds in the laboratory under the conditions of cotton cultivation in the following year under the background of non-treatment by nitragine before sowing the seeds of soybean and mung bean crops grown as a secondary crop

after winter wheat was 0.3-1.3%, and field fertility was 0.2-0.8% higher. Also, it was found that the use of phosphorus and potassium fertilizers in soybean and mung bean crops grown as a secondary crop was 0.6-1.0% higher in the laboratory, and 0.6-0.7% higher in the field than in the control options without mineral fertilizers in studies [1].

According to Umarova Nigora Sadridinovna, Bo'riboyev Bekzod Yetmish ug'li, Khayrullayev Sardor Shamsiddin ug'li, Usmonova Shokhista Usmon kizi, & Turdaliyeva Shokhista Tulkinjon kizi, the demand of the soybean plant for mineral fertilizers, it was observed that when NPK and liquid fertilizer were used together, all the biometric parameters and yields of the plant increased by varieties compared to other methods. The use of mineral fertilizers in different ways in typical sierozem soil conditions affects the grain yield of local and foreign varieties. In other words, the average yield of medium-ripe soybean varieties "Nafis" was 43.4 c / ha, "Vilana" was 42.4 c / ha, and the best way to increase the yield is to apply fertilizers as NPK in combination with liquid fertilizer [14].

According to data of Khayrullayev Sardor Shamsiddin o'g'li and Usmonova Shokhista Usmon qizi, the location of the lower first pod in soybean varieties is 12.8-15.9 cm in Orzu variety, 3-3.1 cm in Radimax stimulator, 2.2-2.4 cm in Gummat stimulator, 2.1 cm in Tecamin stimulator and 3.1 cm in Algora stimulator was found to be high. The most effective results were observed in Radimax, Gummat and Algora bio-simulators, and the location of the lower first pod was detected 14.7-17.6 cm in the "Nafis" variety, which was 2.5-2.9 cm higher in the Radimax stimulator, 2.2-2.5 cm higher in the Gummat stimulator, 2.1 cm higher in the Tecamine stimulator, and 2.4 cm higher in the Algora stimulator than in the

control variant. The most effective results were observed in Radimax, Gummat and Algora biosimulators [7].

MATERIALS AND METHODS

The research was conducted in the experimental fields of the Rice Research Institute for 2018-2020. The Rice Research Institute is located in the south-eastern part of the Tashkent region, in the Chirchik oasis, 15 km from Tashkent, on the left bank of the Chirchik River. In terms of geographical location, the coordinates of the institute are bounded on the Greenwich scale by 69°018' east longitude and 41°020' north latitude. The topography of the area is flat, the soil in the experimental fields corresponds to the soil of the riverside areas, the soil layer of the area consists of meadow-swampy soil.

The reason for the emergence of this type of soil is mainly that the lands attached to the institute are located close to the banks of the Chirchik River, the surrounding farms are also engaged in rice cultivation, and there is an excess of moisture in the soil.

The soil layer in the experimental area is meadow-swampy, loamy sandy soil. It is known that sierozem soils are less stratified and are characterized by a lack of humus, which is also evident from the specific color that occurs in meadow-swamp soils.

The driving layer of the experimental farm of the Rice Research Institute is 0-30 and 0-40 cm, below the driving layer is a layer of gel 30-40 cm thick, at a depth of 60-70 cm there is a layer of sand and small stones.

The soil in the experimental farm was not saline (pH 7.1-7.3). According to its mechanical composition, heavy sand belongs to the soil type. The amount of physical mud in the driving layer was 40-60 percent.

The amount of humus in the driving layer was 1.63-1.95%, total nitrogen was 0.27-0.30%, phosphorus was 0.17-0.21%, and potassium was 0.71-0.76%.

There are no mineral salts due to the fact that the experimental area is partly sloping, the bottom layer of the soil consists of sand and small stones, and the groundwater flows from the northeast to the southwest. Groundwater varies at a depth of 0.5-1.0 meters during periods when rice plots are flooded. When the rice is not filled with water, the groundwater begins to deepen, which lasts until February at a depth of 1.5-1.6 m.

The experiments were conducted in an area free of rice. Field experiments showed that in 4 turns the plots were 20 m long, 2.4 m wide, 4 rows, the total area of each plot was 48.0 m², including 2 rows in the middle and 2 rows of protection rows at the edges. The options are placed by the randomization method.

Conducting field calculations, calculations and observations were carried out on the basis of "Methodological manual of the State Commission for Variety Testing of Agricultural Crops (1989)", "Methods of field experiments (UzPITI, 2007)" and B.A.Dospekhov's "Methodology of field experiment." Leaf area is determined by the method of A.A. Nichiporovich, by leaf cuttings, the number of stems and weight were determined by the method of G.S. Posypanov. To determine the weight of the roots, a monolith measuring 60x5x30 cm was dug. The roots were washed and weighed both wet and dry. Biometric

measurements were performed on the counted plants prior to harvest. The plant height, branching, number and weight of pods, number and weight of grains, weight of 1000 grains were determined. To determine the yield, the pods were collected, crushed, and pulled from the accounted area of the stalks. Yield was determined by converting the yield per hectare using the number of bushes per hectare. The results of the study were analyzed by variance according to the method of B.A.Dospekhov.

Description of "Orzu"cultivar of soybean planted in the experiment

"Orzu" is an early maturing variety, which takes 35-40 days from sowing to flowering, 110-120 days before ripening. The stem is branched. The stem grows upright, the stem is hollow. The height of the stem can be up to 50-70 cm. The leaves are trifoliate, large, light green. The leaves of the plant are average. The leaves are located symmetrically. The length of the leaf band is 10 cm. When they fully ripe, 75% of the leaves fall off. The flower is white, with 2-7 flowers in the inflorescence. Pods are gray, small, 2.4 cm long, and until 4.0 cm. The pods do not crack when ripe, forming an average of about 40 pods per bush. The average grain size is 120-130 g per 1000 grains. Grain yield is 32 c per hectare on irrigated lands. When sown as a secondary crop, 10-20 c of grain is obtained. The grain contains 25% oil and 36-38% protein. Authors: Rakhmanov A.R, Yunusov B.K, Tulaganov N, Burigina O.V.

Agrotechnics of the experiment

The technology of cultivation of meadow-swamp soils has been implemented in the Tashkent region. After the land was prepared, the experimental field was divided into plots based on a working program. Planting method

is wide, 60 cm between rows, 5 cm between bushes. The “Orzu” variety was planted in May. 500,000 seeds (62.5 kg / ha) were sown at a depth of 4-5 cm per hectare. Prior to planting, a program of mineral fertilizers was established, using 50 kg of nitrogen, 100 kg of phosphorus and 70 kg of potassium. The experimental field was irrigated 4 times and cultivated 3 times during the application period. According to the program, at the beginning of the mowing period (or at the development of 5-6 trifoliate leaves and the end of the flowering period - the beginning of budding) soybean was fed with micronutrients in 3 different doses (S1-1,17 kg/ha; S2-2,14 kg/ha; S3-3,21 kg/ha), extra-root (foliar application), suspension was used.

RESULTS AND DISCUSSION

In exchange for the symbiosis between strains of soybean varieties and specially active rhizobium bacteria, a certain amount of biological nitrogen accumulates in the soil, which increases soil fertility. In return, the yield of the crop planted after the soybean will increase, the yield will be cheaper, because mineral nitrogen fertilizers will be used less, and the ecological conditions of the environment will improve.

The presence of a symbiosis between soybean and rhizobium bacteria can be known through the developing live nodules. In general, the development of nodules is influenced by external environmental factors.

Development of nodules of “Orzu” in 2019. In the experiment, it was found that the number of nodules in the branching phase was 20.2 in the control variant, and 24.3 to 25.7 in the application of mineral fertilizers. No

micronutrients were used during branching period.

During the flowering period, the number of nodules increased significantly. At the same time, the number of nodules in the control variant was 46.2, in the background variant with mineral fertilizers - 58.1. Due to mineral fertilizers and trace elements, the number of nodules increased by 11.9-13.1. During the podded period, the number of nodules was 75.5 in the control variant and 89.5 in the background mineral fertilizer. It was found that the number of nodules increased by 14.5-19.9 due to mineral fertilizers and trace elements.

Thus, in the control variant of the experiment, 34.4 million nodules were developed per hectare. It was found to be 41.6 million pieces on the background of mineral fertilizers. When micronutrients are used in combination with mineral fertilizers, 41.6-45.6 million nodules are collected per hectare. Due to mineral fertilizers, the number of nodules increased by 17.3%, and due to micronutrients by 22.3-24.6%.

In the branching phase of 2020, the number of nodules in the Control variant was 19.4. It was found that the number of nodules increased by 20.2-20.7 units only due to mineral fertilizers due to the absence of micronutrients in this phase. During the flowering period, the number of nodules in the Control variant was 41.9. The number of nodules in the background variant using mineral fertilizers was 47.7, which was 5.8 units, namely is 12.2% higher than the Control variant. It was found that the number of nodules in the variants using the sulfur microelement was 49.3-63.3, which is 15.0-33.8% higher than in the Control variant.

Table 1
Influence of sulfur on the number of nodules of “Orzu” variety of soybean

Incidence of salinity on the number of nodules of Giza variety of soybean					
№	Options	Developmental phases			Number of nodules, million/ha
		Branching, gramm	Flowering, gramm	Podded, gramm	
2019					
1	Control	20,2	46,2	75,5	34,4
2	Background-N ₅₀ P ₁₀₀ K ₇₀	24,3	58,1	89,5	41,6
3	Background+S ₁	24,7	58,4	93,6	44,3
4	Background+S ₂	25,7	59,3	95,4	45,6
5	Background+S ₃	25,5	58,5	95,3	44,6
2020					
1	Control	19,4	41,9	68,3	30,3
2	Background-N ₅₀ P ₁₀₀ K ₇₀	20,2	47,7	75,4	33,3
3	Background+S ₁	20,5	49,3	77,3	36,0
4	Background+S ₂	20,7	63,3	82,1	39,0
5	Background+S ₃	20,5	61,7	80,4	37,8
Average					
1	Control	19,8	44,1	71,9	32,4
2	Background-N ₅₀ P ₁₀₀ K ₇₀	22,3	52,9	82,5	37,5
3	Background+S ₁	22,6	53,9	85,5	40,2
4	Background+S ₂	23,2	61,3	88,8	42,3
5	Background+S ₃	23,0	60,1	87,9	41,2
S ₁ -1.07 kg/ha, S ₂ -2.14 kg/ha, S ₃ -3.21 kg/ha					

S₁-1.07 kg/ha, S₂-2.14 kg/ha, S₃-3.21 kg/ha

Thus, in the control variant of the experiment, 30.3 million nodules were developed per hectare. 33.3 million units on the background of mineral fertilizers. When micronutrients are used in combination with mineral fertilizers, 36.0-39.0 million nodules are collected per hectare. Due to mineral fertilizers, the number of nodules increased by 9.0%, and 15.8-22.3% due to micronutrients.

When analyzing the results obtained on average two years, in the Control variant of Soybean plant, the number of nodules during the branching period was 19.8. Due to the absence of micronutrient effects in the

branching phase, the number of nodule bacteria in exchange for mineral fertilizers was found to be 11.2-14.7% higher than in the Control

variant. During the flowering period, the number of nodules increased in 44.1 in the control variant, 52.9 in the background variant of mineral fertilizers and 53.9-61.3 in the sulfur variant.

Thus, in the control variant of the experiment, 32.4 million nodules were developed per hectare. It was found that 37.5 million nodules were developed on the background of mineral fertilizers. When micronutrients are applied in

combination with mineral fertilizers, 40.2-42.3 million nodules are collected hectare per. Due to mineral fertilizers, the number of nodules increased by 13.6%, and 19.4-23.4% due to micronutrients (Table 1).

So, in conclusion, it can be said that this created the basis for the accumulation of biological nitrogen in the soil.

When analyzing the symbiosis process, in addition to the number of nodules, its weight is also determined. This means that the symbiosis goes well when the nodules are large and a lot of nitrogen accumulates in the nodules. In the 2019-2020 experiments, the following data were obtained for the “Orzu” cultivar (Table 2).

During the branching period, the nodules are still smaller, so the weight of nodules weighed 0.79 grams in the control variant and 1.30-1.35 grams in all variants using mineral fertilizer. In exchange for mineral fertilizers, the nodules weight gained by 0.51-0.56 grams.

During the flowering period, the nodules number and size also increased, so in the control variant, it was 1.17 g, in the background of mineral fertilizers - 1.42 grams. In exchange for sulfur, the weight of the nodules was 1.46-1.48 grams, an increase of 0.01-0.05 grams, i.e 19.9-20.9%. In the control variant in the podded phase, the nodules weighed 1.77 grams, which was 0.11 grams higher than in the background of mineral fertilizers. It was found that the weight of the nodules increased by 0.34-0.39 grams due to the trace element sulfur.

Thus, the Control variant was 8.06 c / ha. Due to mineral fertilizers, the weight increased by 7.8%, and 19.3-22.1% due to sulfur. During the validity period, according to the studied

variants, the mass of nodules was 8.06-10.34 c / ha per hectare, which contributed to the increase of nitrogen and organic matter in the soil.

In 2020, during the branching period, the weight was 0.52 grams in the control variant, and 0.58-0.72 grams in all variants using mineral fertilizers. In exchange for mineral fertilizers, the nodules weight gained by 0.06-0.2 grams.

During the flowering period was 0.90 g in the control variant, 0.91 g in the background of mineral fertilizers. In exchange for sulfur, the weight of the nodules was 0.98-1.50 grams, an increase of 0.08-0.6 grams, i.e 8.2-40.0%. In the control variant in the podded phase, the nodules weighed 1.10 grams, which was 0.01 grams higher than in the background of mineral fertilizers. It was found that the weight of the nodules increased by 0.1-0.75 grams due to the trace element sulfur.

Thus, the Control variant was 4.87 c / ha. Due to mineral fertilizers, the weight increased by 0.41%, and 12.9-44.6% by sulfur. During the validity period, according to the studied options, the mass of nodules was 4.87-8.79 c / ha per hectare, which contributed to the increase of nitrogen and organic matter in the soil.

Table 2
Influence of sulfur on weight of nodules of “Orzu” variety of soybean

Developmental phases					
№	Options	Branching, gramm	Flowering, gramm	Podded, gramm	Weight of nodules, c/ha
2019					
1	Control	0,79	1,17	1,77	8,06
2	Background-N ₅₀ P ₁₀₀ K ₇₀	1,32	1,42	1,88	8,74
3	Background+S ₁	1,35	1,46	2,11	9,99
4	Background+S ₂	1,34	1,48	2,16	10,34
5	Background+S ₃	1,30	1,47	2,14	10,22
2020					
1	Control	0,52	0,90	1,10	4,87
2	Background-N ₅₀ P ₁₀₀ K ₇₀	0,72	0,91	1,11	4,89
3	Background+S ₁	0,58	0,98	1,20	5,59
4	Background+S ₂	0,67	1,50	1,85	8,79
5	Background+S ₃	0,64	1,34	1,63	7,66
Average					
1	Control	0,66	1,04	1,44	6,46
2	Background-N ₅₀ P ₁₀₀ K ₇₀	1,01	1,17	1,50	6,82
3	Background+S ₁	0,97	1,22	1,66	7,79
4	Background+S ₂	1,00	1,49	2,00	9,56
5	Background+S ₃	0,97	1,41	1,89	8,94
S ₁ -1.07 kg/ha, S ₂ -2.14 kg/ha, S ₃ -3.21 kg/ha					

S₁-1.07 kg/ha, S₂-2.14 kg/ha, S₃-3.21 kg/ha

When analyzing the results obtained on an average of two years, in the Control variant of the Soybean plant, the nodules weighed 0.66 pieces at the time of branching period. Due to the absence of micronutrient effects in the branching phase, the number of nodules in exchange for mineral fertilizers was found to be 0.97-1.01 grams higher than in the Control variant. It was found that the number of nodules during the flowering period was 1.04 grams in the control variant, in the background variant of mineral fertilizers, this figure increased by 1.17 grams and in the variants using sulfur by 1.22-1.49 grams. The

control variant weighed 1.44 grams at the time of podded period. In the Background, where

mineral fertilizers were applied, the figure was 1.50 grams, which is 0.06 grams higher than the Control option. Sulfur-containing variants were found to be 13.3–28.0% higher than the control.

Thus, in the control variant of the experiment, an average of 6.46 c / ha was collected per hectare. Mineral fertilizers accumulated in the background of 6.82 c / ha, which was 0.36 c / ha higher than in the control option. When sulfur is applied in combination with mineral

fertilizers, 7.79-9.56 c / ha is accumulated per hectare.

CONCLUSION

Mineral fertilizers and sulfur microelements activate the symbiotic activity of the soybean variety "Orzu", averaging 32.4-42.3 million pieces per hectare, the number of nodules due to the background of mineral fertilizers increased by 13.6%, and found to have increased 19.4-23.4% due to sulfur. Also, the average weight of nodules was 6.46-9.56 c / ha, due to the background of mineral fertilizers the weight of nodules increased by 5.3%, and 17.1-32.4% due to sulfur. During the validity period, according to the studied variants, the mass of nodules was accumulated at 6.46-9.56 c / ha per hectare, which contributes to the increase of nitrogen and organic matter in the soil and a slight increase in biological efficiency.

REFERENCES

1. ABDUMANNOBOVICH, I. A., UGLI, K. S. S., ERGASHBOYEVNA, K. D., UGLI, H. S. R., & TURSINALIEVICH, K. S. (2021). EFFECTS OF NITRAGINE AND MINERAL FERTILIZER RATES USED ON REPEATED LEGUME CROPS ON SEED GERMINABILITY. PLANT CELL BIOTECHNOLOGY AND MOLECULAR BIOLOGY, 22(35-36), 251-258. Retrieved from <https://www.ikprress.org/index.php/PCBM/article/view/6342>.
2. Atabayeva Khalima Nazarovna¹, Khayrullaev Sardor Shamsiddin o'g'li, and Usmonova Shohista Usmon qizi, "THE EFFECT OF SULPHUR ON THE BRANCHING OF SOYBEAN VARIETIES", STJITT, vol. 1, no. 2, pp. 4-6, Aug. 2020.
3. Babich A.A. - Soybeans in U.S.A (1987). Oil crops. № 6. P.33 - 34.
4. Basibekov B.O, Gusev V (1982). Scientific basis and recommendations on using fertilizers in Kazakhstan Olma - ota, Kaynar, p.74 - 77.
5. Iminov, A. A., Hatamov, S. R. O., & Khayrullaev, S. S. O. (2020). Effect Of Nitrage And Mineral Fertilizers On Soil Microbiological Properties In Planted As Secondary Legume Crops. The American Journal of Agriculture and Biomedical Engineering, 2(08), 169-172. <https://doi.org/10.37547/tajabe/Volume02Issue08-22>
6. JURAEVA, R., TASHPULATOV, J., IMINOV, A., BOZOROV, X., ZAYNITDINOVA, L., & KUKANOVA, S. (2020). EFFICIENCY OF SYMBIOTIC NITROGEN FIXATION OF SOY NODULE BACTERIA AFTER PRESERVATION. PLANT CELL BIOTECHNOLOGY AND MOLECULAR BIOLOGY, 21(61-62), 72-79. Retrieved from <https://www.ikprress.org/index.php/PCBM/article/view/5644>
7. Khayrullayev Sardor Shamsiddin o'g'li and Usmonova Shhista Usmon qizi, "THE EFFECT OF STIMULATORS ON THE LOCATION OF THE FIRST POD OF SOYBEAN VARIETIES", STJITT, vol. 1, no. 2, pp. 7-9, Aug. 2020.
8. Khayrullayev Sardor Shamsiddinugli. Effect Of Sulfur And Manganese Micro Nutrients On Grain Quality Of Soybean Varieties. ACADEMICIA: An International Multidisciplinary Research Journal <https://saarj.com>. Vol. 11, Issue 3, March 2021. DOI: 10.5958/2249-7137.2021.00582.6. P.63-68.
9. Kochurko V.I, Abarova E.E, (2014). Foliar application, №8, Farming,

10. Kurmanbaeva M.S, Burkitbaev M.M, Bachilova N.V, and others. Obtaining high germination of soybeans using new sulfur-containing nanocomposites and preparations. (Collection of scientific conference, 2019), Almata.
11. Lisina. K.I, Stepkin N.N, Kolesnik L.F, (1982). Soybean far from East. Forage crops. № 2, pp. 27-28.
12. Nagorniy V.A, Gubanov P.E, Panchenko Y.I, (2010). –The Volga region is a promising area for soybean cultivation. Farming. № 3. P.13-14.
13. Nazarovna, AK, Bakhromovich, NF, Alavkhonovich KA, Ugli KSS. Effects of Sulfur and Manganese Micronutrients on the Yield of Soybean Varieties. Agricultural Sciences, 2020;11: 1048-1059. <https://doi.org/10.4236/as.2020.1111068>
14. Umarova Nigora Sadriddinovna, Bo'riboyev Bekzod Yetmish ugli, Khayrullayev Sardor Shamsiddin ugli, Usmonova Shokhista Usmon kizi, & Turdaliyeva Shokhista Tulkinjon kizi. (2021). EFFECT OF MINERAL FERTILIZERS ON MORPHOPHYSIOLOGICAL CHARACTERISTICS OF LOCAL AND FOREIGN SOYBEAN VARIETIES. European Journal of Agricultural and Rural Education, 2(4), 39-42. Retrieved from <https://scholarzest.com/index.php/ejare/article/view/611>.
15. Vavilov P.P. Posypanov G.S, (1983). – Legume crops and problem of plant oil - M: Rasselxozizdat, 256 p.