INFLUENCE OF THE APPLICATION OF STIMULANTS TO SOYBEANS SOWN IN FIELDS FREED FROM WINTER WHEAT ON SEEDLING EMERGENCE AND GRAIN YIELD

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In the context of global climate change, drought, and extreme weather conditions, the effectiveness of applying stimulants to soybean crops after winter wheat has been determined for the effective use of land, growing two harvests per year, meeting the population's demand for food products and livestock for feed, preserving and increasing soil fertility.

The most favorable temperature for intensive growth and development of soybeans is around 20-25 ^{0}C, however, it can grow well even in the temperature range of 25-30 ^{0}C. In the experimental area, the average air temperature in July was 31.2-33.3 ^{0}C, the highest air temperature was 42.2-44.8 ^{0}C, at such a high temperature, the soybean plant is under stress and the possibilities of growing a high yield are limited. To ensure the intensive growth and development of soybeans and obtain high yields, the use of Uzgumi and Ma'suda stimulants in various doses before sowing seeds and during the growing season was studied.

When treating soybean seeds sown repeatedly after winter wheat with the Uzgumi stimulant at a rate of 0.6 l/t^{-1} and the Ma'suda stimulant at a rate of 3.0 l/t^{-1}, it accelerated by 4.9-6.8%, and germination was observed 1-2 days earlier.

When Uzgumi was applied to soybean seeds at a rate of 0.6 l/t^{-1}, at 3-5 leaves at a rate of 0.2 l/ha^{-1}, at budding at a rate of 0.3 l/ha^{-1} and at flowering at a rate of 0.4 l/ha^{-1}, the plant height increased by 2.5 sm, the number of pods increased by 2.5 pieces, when Ma'suda stimulant was applied to soybean seeds at a rate of 3.0 l/t^{-1}, at 3-5 leaves at a rate of 6.0 l/ha^{-1} and at budding at a rate of 9.0 l/ha^{-1}, the plant height increased by 1.5 sm, the number of pods increased by 2.2 pieces.

When treating repeated soybean crops with Uzgumi and Ma'suda, the dry mass increased by 1.79-2.93 g and more biomass accumulated.

When using the stimulants Uzgumi and Ma'suda, the grain yield of soybeans was 2.02-2.11 t/ha^{-1}, and the grain yield increased by 0.31-0.40 t/ha^{-1}.

Keywords. Winter wheat, repeated crop, soybean, seedling, germination, stimulator, application rate, timing, growth, development, dry weight, pod, weight of 1000 grains, grain yield

Input

Global climate change on Earth, constant population growth, and industrial development, in turn, lead to an increase in demand for agricultural products. Currently, the area under soybean cultivation worldwide is 130.5 million hectares, and 381.2 million tons of grain have been harvested.

Unfavorable weather conditions, drought, and water scarcity negatively affect the steady increase in crop yields. Therefore, it is advisable to develop a technology for the use of stimulants for obtaining high and quality yields of soybeans sown after winter wheat, as well as to expand the scope of scientific research on increasing the volume of food and fodder production by preserving soil fertility and the efficient use of land.

Currently, research is being conducted worldwide on the development of optimal rates for the use of humic preparations before sowing and during the growing season, which ensure rapid germination of agricultural crop seedlings, increase their resistance to unfavorable environmental conditions, improve plant growth and development, do not have a negative impact on the environment, and convert mineral elements into a form favorable for plant assimilation. This creates a basis for the development of factors for obtaining high and quality yields of agricultural crops, providing the population with food products, livestock with feed, and increasing the economic efficiency of farms.

When sown seeds are provided with sufficient temperature and water for germination, the seed coat ruptures and sprouts appear. Seedlings use the nutrients stored in the seeds until they begin active growth [Szczerba et al., 2021].

Early seedling emergence involves a complex physiological process under the influence of various biotic and abiotic factors [Miransari & Smith, 2014]. Low temperatures significantly affect the rate of seed germination, growth, and development [Reed et al., 2022].

There is optimal soil moisture and temperature for the germination of each seed [Lei, C. et al, 2021].

Each crop requires a specific optimal temperature for its biological processes [Steinmaus et al., 2000],

In addition, several studies have shown that biostimulants have a positive effect on improving abiotic stress, including low and high temperatures [Etesami et al., 2023; Hassan et al., 2023].
Phytohormones play an important role in the development and growth of plants and their response to environmental influences [Ullah, A. et al., 2018].
Salicylic acid (SA) helps plants adapt to abiotic stress [Torun, H. 2019].
Humine-like biostimulants have been found to stimulate growth by regulating cell membrane permeability [Blomster et al., 2011], increase chlorophyll content and photosynthetic activity [Haghighi et al., 2013], and activate carbon and nitrogen metabolism [Jannin et al., 2012]. Seaweed (Ascophyllum nodosum (L.) Le Jolis) mitigated the negative impact of heat stress on crops [Repke et al., 2022].

Soybean (Glycine max L.) seaweed extract improved cell permeability, transpiration, carboxylation efficiency, and antioxidant enzyme activity under heat stress [Repke et al., 2022].

Biostimulants containing fulvic acid accelerate cell division, root growth, and nutrient uptake under stress conditions [De Pascale et al., 2017; Shah et al., 2018; Qin & Leskovar 2020].

In the conditions of soybean cultivation, the influence of soil temperature on seedling emergence is very important [Haj Sghaier et al., 2022; Jianing et al., 2022].

Although soybean seedlings can germinate at cold soil temperatures (around 12-18 °C), the process is slow, resulting in uneven seedling emergence and crops becoming weak [Borowski & Michałek, 2014]. To solve such problems, it is recommended to use natural and synthetic biostimulants to ensure uniform germination of agricultural crop seeds [Qiu et al., 2020; Makhaye et al., 2021; Cardarelli et al., 2022].

Since soybeans are heat- and moisture-loving crops, they require a large amount of moisture for germination; therefore, dry conditions reduce germination [O.V. Syrmolot, 2014].

Pre-sowing seed treatment with biostimulants not only ensures uniform germination of early seedlings, but also increases their resistance to unfavorable conditions [Yildirim et al., 2000].

Treatment of seeds with biostimulants before sowing increases the stress resistance of plants [Cardarelli et al., 2022].

Modern biostimulants are complex mixtures obtained from a wide variety of raw materials, including food and paper industry waste, which are considered environmentally safe and have high biological activity [Bulgari et al., 2019].

K.M.Tadzhiev [2020], K.M.Tadzhiev et al. [2020] showed that when treating soybean seeds before sowing with the Uzgumi stimulant at a rate of 0.6 l/t^{-1}, at 3-5 leaves at a rate of 0.2 l/ha^{-1}, at budding at a rate of 0.3 l/ha^{-1} and at flowering at a rate of 0.4 l/ha^{-1}, when treating seeds with the Ma'suda stimulant at a rate of 3.0 l/t^{-1}, at 3-5 leaves at a rate of 6.0 l/ha^{-1} and at budding at a rate of 9.0 l/ha^{-1}, compared to the untreated variant, the soybean height increased by 1.5-2.5 sm, the number of pods by 2.2-2.5 pieces, and the dry weight of one plant by 1.8-2.9 g [K.M.Tadzhiev et al.; 2020], which positively influenced the increase in the number and weight of beans on one plant and increased the grain yield by 0.31-0.40 t/ha^{-1} [K.M.Tadzhiev; 2021].

Research methods.

Experiments on the study of growth regulators were conducted under the conditions of takyr-meadow soils of the Surkhandarya experimental station of the Research Institute of Irrigation and Water Supply of Surkhandarya Region, located in the southern part of the Termez district of Surkhandarya region. The soil of the experimental field is non-saline, the humus content is 0.669-0.597%, total nitrogen 0.059-0.054%, phosphorus 0.124-0.100%, exchangeable potassium 125-125 mg/kg. Groundwater is located at a depth of 1.5-2.0 m. In terms of mechanical composition, it is heavy loamy soil.

The experiments were conducted in accordance with the recommendations "Methods of Conducting Field Experiments" (UzPITI Tashkent, 2007), "Methods of Field Experiments with Cotton" (1981). Methods of agrochemical, agrophysical and microbiological research in irrigated cotton regions (2005), use of chemical preparations "Brief methodological guidelines for conducting state tests of plant growth regulators" (1984), "Methodological guidelines for testing insecticides, ascaricides, biologically active substances and fungicides" (1994) were conducted.

For the agrotechnical characteristics of the soil, the amount of humus was determined by the Tyurin method, total nitrogen, phosphorus by K.E.Ginzburg, M.Sheglova, and E.K.Vulfius, the amount of nitrate nitrogen was determined by the ionometric method, mobile phosphorus by B.P.Machigin, and exchangeable potassium by Protasov using a flame photometer.

Statistical analysis of the experimental data was carried out according to the method of B.A.Dospekhov.

The object of the research is the medium-ripening, high-yielding soybean variety "Nafis," the vegetation period of which is 115-120 days, the plant height is 145-150 sm. The lower pods are located at a height of 14-16 sm, the number of pods on one plant is 120-130, on one pod there are 2-4 grains. In the experiment, the preceding crop was winter wheat. The experimental plot - 24 m^2, was placed in four repetitions. Field experiment variants were arranged in 4 rows. The row spacing between the crops was 60 cm, and the variant area was 24 m^2 . Soybean seeds were sown by hand at a distance of 10 sm, 4 pieces (60 x 10-4) to a depth of 3-4 sm, 60 kg per hectare.
Before sowing, the seeds were treated with Uzgumi and Ma'suda preparations. Treatment of plants was carried out using the AIDA handsprayer.

A brief description of the studied preparations is provided.
The Uzgumi preparation contained biologically active substances, potassium and sodium humates, humic and fulvic acids, essential amino acids and trace elements, as well as other natural compounds.

The active ingredient of the Ma'suda preparation is NPK, salts of humic and folic acids, a dark liver-colored liquid stimulant. Applied to seeds of agricultural crops and plants during developmental stages.

Weather conditions of the experimental area.
Surkhandarya region is the southernmost region of Uzbekistan. The average annual air temperature is +21.0°C; the average temperature in January is +2.8°C, the average temperature in July is +31.4°C. The absolute minimum temperature is -21°C, the absolute maximum temperature is +48°C. The driest month is July, with

0 mm of precipitation. The highest precipitation occurs in March with an average of 42 mm.

July is the warmest month with an average temperature of 29.9 °C. The lowest average annual temperature is in January, at around 3.9 °C.

The average annual precipitation in the district is 440-480 mm (the bulk of precipitation falls in spring and autumn). The growing season lasts 225-266 days.

The duration of frost-free days in Termez is 234 days. The first autumn frosts are observed on November 2-24 (in Termez and Sherabad), the last spring frosts end on March 2-12. In Termez, the sum of effective temperatures at the lower boundary equal to 10° is 3306°C.

In the Surkhan-Sherabad oasis, the hot and dry "Afghan" wind will blow in a southwesterly direction, bringing sand and dust, with wind speeds reaching 15-20 m/s and blowing continuously for several consecutive days. After the wind stops, the air temperature will drop by 2-3°C. This wind has a devastating effect on flowering trees and agricultural crops. Winds blow mainly in spring and summer. In spring, forced irrigation is required because these winds quickly dry out the plowed soil layer. These winds during the summer months sharply reduce the relative humidity of the air, increase the evaporation of water by plants, and lead to the loss of fruit.

Atmospheric precipitation is distributed unevenly throughout the year and falls relatively heavily in February, March, and April, and practically does not fall in June, July, August, and September.

Research objective.
Development of a technology for the use of stimulants for obtaining high and quality yields of soybeans sown repeatedly after winter wheat, as well as achieving economic efficiency in agricultural production by maintaining soil fertility and increasing the volume of food and fodder production through efficient land use.

Research results.
During the years of the experiment, the average monthly air temperature in July was 31.2-33.3^{0}C, and the highest air temperature was 42.2-44.8^{0}C. The prolonged persistence of extremely hot air temperatures in July and the frequent blowing of hot winds led to the loss of a significant amount of fruit elements on the plants.

The high air temperature in August of the year was 45.6^0C, a slight decrease in relative air humidity, which created favorable conditions for the growth and development of repeated crops.

From scientific literature, it is known that the optimal temperature for good growth and development of plants is $+38^0$C, and higher temperatures change the natural hormonal structure of plants, i.e., the amount of growth-activating hormones auksin, cytokinin, gibberellin, natural growth stimulants phenol decreases, while the amount of abscisic acid and ethylene increases [Polevoy V.V.; 422-423 p.].

Treatment of seeds with stimulants before sowing is aimed at bringing them out of a dormant state, i.e., accelerating the processes of vital activity. This leads to an acceleration of enzymatic activity and a secondary disruption of the resting state.

In the experiment, the influence of various doses of growth-regulating substances on the germination strength and germination of soybean seeds under laboratory conditions was determined.

According to the results obtained, when sowing soybeans without seed treatment, the germination rate was 87%, and the germination rate was 93%. With pre-sowing treatment of seeds with the Uzgumi stimulant at a rate of 0.6 l/t^{-1}, the germination rate was 92%, germination rate 99%, which differed from the control by 5% and 6%, respectively.

With pre-sowing treatment of seeds with the Uzgumi stimulant at a rate of 0.7 l/t-1, the germination rate was 91%, and the germination rate was 97%, which differed from the control by 5 and 6%. In the variant with pre-sowing treatment of seeds with the Uzgumi stimulant at a rate of 0.6 l/t^{-1}, the germination vigor was almost the same, and the germination rate was 1% less.

Before sowing seeds with the Ma'suda stimulant, 2.0; 3.0; With treatment at a rate of 4.0 l/t^{-1}, the germination capacity was 90; 90; 89%, germination 96; 97; 95%, respectively from the control to the variants 3; 3; 2% and 3; 4; The difference was 2%.
Based on the results of the experiments, it was established that when treating soybean seeds with growth regulators before sowing, the germination vigor and viability increase by up to 5%.

It was established that the germination of soybean seedlings, repeatedly sown after winter wheat, studied in the experiment, depends on seed quality, soil moisture and temperature, as well as pre-sowing seed treatment with stimulants. The germination of seedlings was determined by counting the number of emerging seedlings.

In the control variant, seedling germination was 60.7%, with pre-sowing treatment of seeds with the Uzgumi stimulant at a rate of 0.6 l/t^{-1} - 67.5%, with pre-sowing treatment of seeds with the Uzgumi stimulant at a rate of 0.7 l/t^{-1} - 66.8%, with pre-sowing treatment of seeds with the Ma'suda stimulant - 2.0; 3.0 and 4.0 l/t^{-1} respectively - 64.9; 65.9; 64.5% (Table 1).

In particular, compared to the control, when treating seeds with the Uzgumi stimulant at a rate of 0.6 l/t^{-1} before sowing, it was 6.8%, when treating seeds with the Uzgumi stimulant at a rate of 0.7 l/t^{-1} - 6.1%, when treating seeds with the Ma'suda stimulant before sowing - 2.0; 3,0 and 4,0 l/t^{-1} respectively; 5.2; 3.8% more seedlings were observed.

Table 1
Influence of treatment with stimulants on the germination rate of soybean seedlings of repeated sowing

No	Experimental options	Seedtreatment, l/t^{-1}	Germination rate of seedlings, percent	Difference from control, ±
1.	Control	-	60.7	-
2.	Uzgumi	0.6	67.5	6.8
3.	Uzgumi	0.7	66.8	6.1
4.	Ma'suda	2.0	64.9	4.2
5.	Ma'suda	3.0	65.9	5.2
6.	Ma'suda	4.0	64.5	3.8

In the experiment, when treating soybean seeds with the Uzgumi stimulant at a rate of 0.6 l/t^{-1} and the Ma'suda stimulant at a rate of 3.0 l/t^{-1}, it accelerated by 4.9-6.8%, and germination was observed 1-2 days earlier.

When treating seeds with the Ma'suda stimulant at a rate of 3.0 l/t^{-1} before sowing, it was 5.2% more compared to the control.

In the experiment, the growth and development of soybeans sown repeatedly from winter wheat were determined. Soil tillage methods, salinity level, sowing dates, soybean varieties, fertilization, irrigation regimes, and other factors influence the growth and development of soybeans sown repeatedly from winter wheat.

First of all, it should be noted that the obtained scientific results on determining the influence of growth stimulants applied to seeds before sowing on the dynamics of seedling emergence are directly related to the growth of soybeans in subsequent periods of repeated sowing.

According to the results of studying the influence of treatment with stimulants on the duration of the growing season of soybeans sown in our experiment, the period of appearance of the first three leaves was 11-12 days, the first three leaves - the budding period was 11-12 days, the budding-flowering period was 17-18 days, the flowering-ripening period was 66-67 days, the total growing season was 104-108 days, and it was noted that these indicators differed by 1-2 days depending on weather changes during the experimental years (*Figure 1)*.

The data obtained in the experiment showed that in the control variant, from sowing to the first three-leaf stage, 12 days, from the first three-leaf stage to budding 12 days, from budding to flowering 18 days, from flowering to ripening 67 days, the total vegetation period was 108 days, and when treated with Uzgumi and Ma'suda stimulants, respectively, from sowing to the first three-leaf stage 11 days, from the first three-leaf stage to budding 11 days, from budding to flowering 17 days, from flowering to ripening 66 days, the total vegetation period was 104 days, which increased by 1-4 days, respectively, compared to the control.

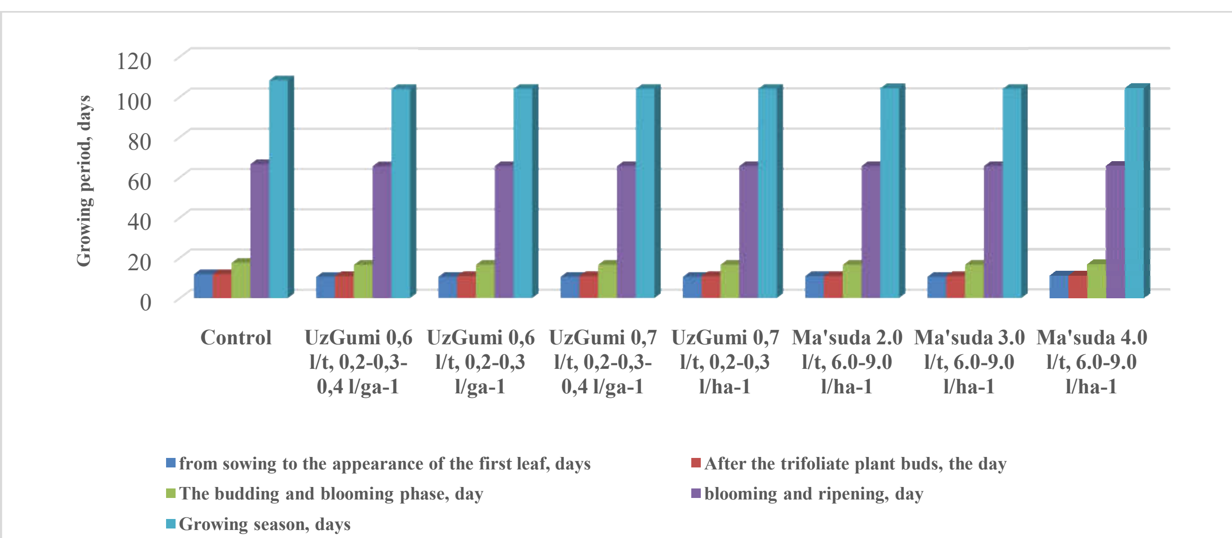

Figure 1. Influence of the use of stimulants on the intensity of the developmental periods of soybeans with repeated sowing

According to the results obtained during the ripening period of soybeans sown repeatedly, in the control variant, the plant height was 55.2 sm, the number of pods 32.8 pieces, when treating seeds with the Uzgumi stimulant at a rate of 0.6 l/t^{-1} before sowing, 0.2 l/ha^{-1} during the 3-5 leaf period, 0.3 l/ha^{-1} during budding and 0.4 l/ha^{-1} during flowering, the plant height was 57.7 sm, the number of pods 35.3 pieces, when treating seeds with the Uzgumi stimulant at a rate of 0.6 l/t^{-1} before sowing, 0.2 l/ha^{-1} during the 3-5 leaf period and 0.3 l/ha^{-1} during budding, the plant height was 56.8 sm, the number of pods 34.9 pieces, when treating seeds with the Uzgumi stimulant at a rate of 0.7 l/t^{-1} before sowing, 0.2 l/ha^{-1} during the 3-5 leaf period, 0.3 l/ha^{-1} during budding and 0.4 l/ha^{-1} during flowering, the plant height was 57.4 sm, the number of pods 35.1 pieces, when treating 3.0; 4.0 l/t^{-1}, at the 3-5 leaf stage 6.0; 6.0; 6.0 l/ha^{-1} and in the budding phase 9.0; 9.0; With a treatment rate of 9.0 l/ha^{-1}, the plant height was 56.0; 56.7; 56.1 sm, number of pods 34.6; 35.0; 34.4 units were found.

When comparing the obtained data with the control, when treating soybean seeds with the Uzgumi stimulant before sowing at a rate of 0.6 l/t^{-1}, at 3-5 leaves at a rate of 0.2 l/ha^{-1}, at budding at a rate of 0.3 l/ha^{-1} and at flowering at a rate of 0.4 l/ha^{-1}, the height increased by 2.5 sm, the number of pods increased by 2.5 pieces, when treating seeds with the Uzgumi stimulant before sowing at a rate of 0.6 l/t^{-1}, at 3-5 leaves at a rate of 0.2 l/ha^{-1} and at budding at a rate of 0.3 l/ha^{-1}, the height increased by 1.6 sm, the number of pods increased by 2.1 pieces, when treating seeds with the Uzgumi stimulant before sowing at a rate of 0.7 l/t^{-1}, at 3-5 leaves at a rate of 0.2 l/ha^{-1}, at budding at a rate of 0.3 l/ha^{-1} and at flowering at a rate of 0.4 l/ha^{-1}, the height increased by 2.2 sm, the number of pods increased by 2.3 pieces, when treating seeds with the Uzgumi 3.0; 4.0 l/t^{-1}, at the 3-5 leaf stage 6.0; 6.0; 6.0 l/ha^{-1} and in the budding phase 9.0; 9.0; 9.0 l/ha-1, respectively, the height was 0.8; 1.5; 0.9 sm tall, the number of pods is 1.8; 2.2; 1.6 units more were found.

From the above data, it can be concluded that when treating soybean seeds treated with the Uzgumi stimulant before sowing at a rate of 0.6 l/t^{-1}, during the 3-5 leaf stage at a rate of 0.2 l/ha^{-1}, during budding at a rate of 0.3 l/ha^{-1} and during flowering at a rate of 0.4 l/ha^{-1}, when treating seeds with the Ma'suda stimulant at a rate of 3.0 l/t^{-1}, during the 3-5 leaf stage at a rate of 6.0 l/ha^{-1} and during budding at a rate of 9.0 l/ha^{-1}, the soybean height increased by 1.5-2.5 sm, and the number of pods increased by 2.2-2.5 pieces compared to the control.

It is known that one of the main indicators determining plant productivity is its accumulation of dry matter. With the timely and high-quality implementation of the agrotechnology of cultivation of soybeans sown repeatedly after winter wheat, the proportion of productive organs increases, ensuring a high and quality yield.

In the studies, the accumulation of dry mass of soybeans sown repeatedly in fields after winter wheat was determined during the periods of germination, branching, flowering, and ripening.
According to the data obtained, in the studied variants, the accumulation of dry mass in the periods of germination and branching of soybeans with repeated sowing was close to each other. This can be attributed to the slow growth of plants at the beginning of their development due to low nutrient uptake.

Especially, significant differences were observed between the variants due to the acceleration of growth, development, and increase in the number and weight of vegetative and generative organs during the flowering period of soybeans sown repeatedly in fields after winter wheat.

When sowing soybeans with the Uzgumi stimulant before sowing at a rate of 0.6 l/t^{-1}, at 3-5 leaves at a rate of $0.2 l/ha^{-1}$, at budding at a rate of 0.3 l/ha^{-1} and at flowering at a rate of 0.4 l/ha^{-1}, 25.2 g, when sowing soybeans with the Uzgumi stimulant before sowing at a rate of 0.6 l/t^{-1}, at 3-5 leaves at a rate of 0.2 $l/hal/ha^{-1}$ and at budding at a rate of 0.3 l/ha^{-1}, 24.5 g, when sowing soybeans with the Uzgumi stimulant before sowing at a rate of 0.7 l/t^{-1}, at 3-5 leaves at a rate of 0.2 0 l/ha^{-1}, at budding at a rate of 0.3 l/ha^{-1} and at flowering at a rate of $0.4l/ha^{-1}$, 24.5 g, when sowing soybeans with the Uzgumi stimulant before sowing at a rate of 0.7 l/t^{-1}, at 3-5 leaves at a rate of $0.2l/ha^{-1}$ and at budding at a rate of 0.3 $l/hal/ha^{-1}$, 23.9 g, when sowing 3.0; 4.0 l/t-1, at the 3-5 leaf stage 6.0; 6.0; 6.0 l/ha-1 and in the budding phase 9.0; 9.0; 9.0 l/ha-1, respectively, 23.2; 24.1; 23.2 g of dry mass accumulated (*Figure 2.)*.

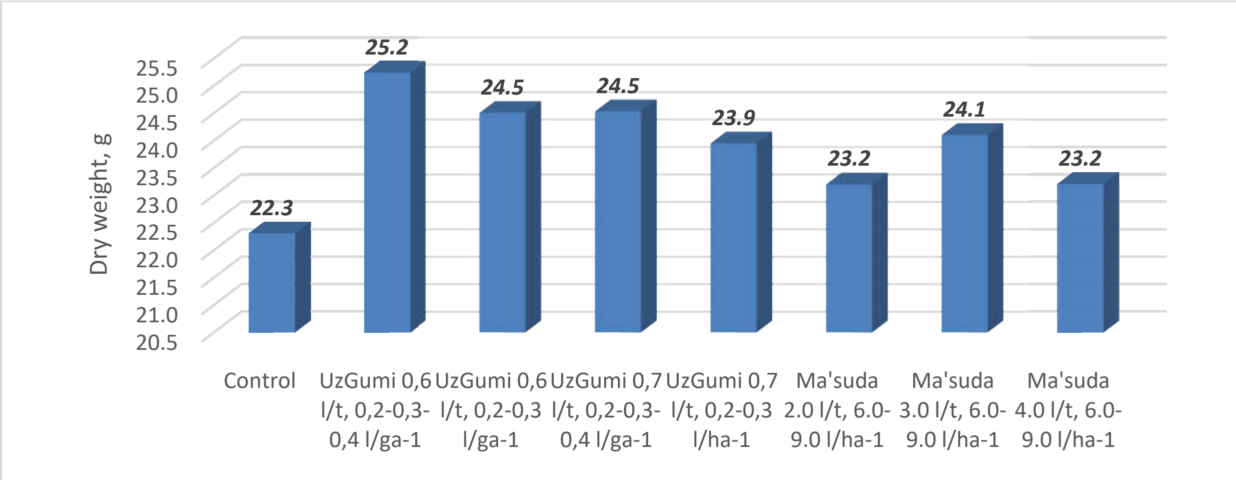

Figure 2. Influence of treatment of soybeans with stimulants on the dry mass

As can be seen from the data obtained, compared to the control variant, when treating seeds with the Uzgumi stimulant at a rate of 0.6 l/t^{-1} before sowing, 0.2 l/ha^{-1} during the 3-5 leaf stage, 2.9 g during budding at a rate of 0.3 l/ha^{-1} and 0.4 l/ha^{-1} during flowering, when treating seeds with the Uzgumi stimulant at a rate of 0.6 l/t^{-1} before sowing, 0.2 l/ha^{-1} during the 3-5 leaf stage and 0.3 l/ha^{-1} during budding, 2.2 g, when treating seeds with the Uzgumi stimulant at a rate of 0.7 l/t^{-1} before sowing, 0.2 l/ha^{-1} during the 3-5 leaf stage, 0.3 l/ha^{-1} during budding and 0.4 l/ha-1 during flowering, 2.2 g, when treating seeds with the Uzgumi stimulant at a rate of 0.7 l/t^{-1} before sowing, 0.2 l/ha^{-1} during the 3-5 leaf stage and 0.3 l/ha^{-1} during budding, 1.6 g, when treating seeds with the Ma'suda stimulant at a rate of 2.0 l/ 3.0; 4.0 l/t^{-1}, at the 3-5 leaf stage 6.0; 6.0; 6.0 l/ha^{-1} and in the budding phase 9.0; 9.0; With a treatment rate of 9.0 l/ha^{-1}, the dry weight of one plant was 0.9; 1.8; 0.9 g higher.

As a result, the increase in the dry mass of soybeans sown repeatedly during the ripening period is mainly associated with the increase in the weight of stems and pods, in the variants with the use of stimulants, especially when treating seeds with the Uzgumi stimulant at a rate of 0.6 l/t^{-1} before sowing, at a rate of 0.2 l/ha^{-1} during the 3-5 leaf stage, at a rate of 0.3 l/ha^{-1} during budding, and at a rate of 0.4 l/ha^{-1} during flowering, high results were obtained, and the dry mass of one plant was 2.9 g, when treating seeds with the Ma'suda stimulant at a rate of 3.0 l/t^{-1} before sowing, at a rate of 6.0 l/ha^{-1} during the 3-5 leaf stage, and at a rate of 9.0 l/ha^{-1} during budding, it was 1.8 g.

In our research, the proportion of nitrogen, phosphorus, and potassium in the dry mass of soybean seeds sown repeatedly in fields after winter wheat and treated with the Uzgumi and Ma'suda stimulants during the growing season was analyzed and studied under laboratory conditions at the end of the growing season (Table 2).

Table 2
Amount of basic nutrients in the composition of a repeated soybean plant, as a percentage

No	Nitrogen					phosphorus					potassium				
	stem	leaf	root	pod	grain	stem	leaf	root	pod	grain	stem	leaf	root	pod	grain
1.	0.460	3,140	0.410	0.460	3.290	0.550	1.120	0.370	0.550	2.120	0.750	0.750	0.050	1.260	1.260
2.	0.640	3,680	0.600	0.710	3,800	0.880	1.430	0.650	0.940	3.320	1.005	1.005	0.510	1.725	1.725
3.	0.620	3.580	0.530	0.660	3,780	0.820	1.430	0.600	0.880	3.160	1.005	1.005	0.510	1.725	1,500
4.	0.570	3,480	0.510	0.640	3,680	0.820	1,500	0.550	0.760	2.360	1.005	1.005	0.255	1.725	1,500
5.	0.570	3.380	0.510	0.620	3.580	0.760	1,300	0.460	0.700	2.360	1.005	0.750	0.255	1,500	1,500
6.	0.510	3,140	0.460	0.530	3.380	0.550	1.240	0.400	0.600	2.120	0.750	0.750	0.050	1,500	1.260
7.	0.530	3.220	0.480	0.570	3.580	0.550	1.240	0.430	0.650	2.240	0.750	0.750	0.255	1.725	1.260
8.	0.480	3,140	0.450	0.480	3.290	0.550	1.180	0.370	0.550	2.120	0.750	0.750	0.050	1,500	1.260

The results of the analysis showed that at the end of the growing season in the control variant, the amount of nitrogen in the stem was 0.460%, in the leaves 3.140%, in the roots 0.410%, in the pods 0.460%, in the grain 3.290%, the amount of phosphorus in the stem 0.550%, in the leaves 1.120%, in the roots 0.370%, in the

pods 0.550%, in the grain 2.120%, the amount of potassium in the stem 0.750%, in the leaves 0.750%, in the roots 0.050%, in the pods 1.260%, in the grain 1.260%.

When treating seeds with the Uzgumi stimulant before sowing at a rate of 0.6 l/t^{-1}, at 3-5 leaves at a rate of 0.2 l/ha^{-1}, at budding at a rate of 0.3 l/ha^{-1} and at flowering at a rate of 0.4 l/ha^{-1}, the amount of nitrogen in the stem was 0.640%, in the leaves 3.680%, in the roots 0.600%, in the pod 0.710%, in the grain 3.800%, the amount of phosphorus in the stem was 0.880%, in the leaves 1.430%, in the roots 0.650%, in the pod 0.940%, in the grain 3.320%, the amount of potassium in the stem was 1.005%, in the leaves 1.005%, in the roots 0.510%, in the pod 1.725%, in the grain 1.725%, when treating seeds with the Uzgumi stimulant at a rate of 0.6 l/t^{-1}, at 3-5 leaves at a rate of 0.2 l/ha^{-1}, at budding at a rate of 0.3 l/ha^{-1}, the amount of nitrogen in the stem was 0.620%, in the leaves 3.580%, in the 3.0; 4.0 l/t-1, at the 3-5 leaf stage 6.0; 6.0; 6.0 l/ha^{-1} and 9.0; 9.0; With a treatment rate of 9.0 l/ha^{-1}, the amount of nitrogen in the stem was 0.510; 0.530; 0.480%, in leaves 3.140; 3.220; 3.140%, in the root 0.460; 0.480; 0.450%, in the pod 0.530; 0.570; 0.480%, in the grain 3.380; 3.580; 3.290%, phosphorus in the stem 0.550; 0.550; 0.550%, in leaves 1.240; 1.240; 1.180%, in the root 0.400; 0.430; 0.370%, in the pod 0.600; 0.650; 0.550%, in grain 2.120; 2.240; 2.120%, potassium in the stem 0.750; 0.750; 0.750%, in leaves 0.750; 0.750; 0.750%, in the root 0.050; 0.255; 0.050%, in the pod - 1,500; 1.725; 1,500%, in grain 1.260; 1.260; 1.260%.

As a result, when using the Uzgumi stimulant at a rate of 0.6 l/t^{-1}, at 3-5 leaves at a rate of 0.2 l/ha^{-1}, at budding at a rate of 0.3 l/ha^{-1}, and at flowering at a rate of 0.4 l/ha^{-1}, the nitrogen content in the stem was 0.180%, in the leaves 0.540%, in the roots 0.190%, in the pods 0.250%, in the grains 0.510%, in the stems 0.330%, in the leaves 0.310%, in the stems 0.310%, in the stems 0.310%, in the leaves 0.310%, in the stems 0.310%, in the stems 0.310%, in the leaves 0.310%, in the stems 0.310%, in the leaves 0.310%, in the stems 0.310%, in the leaves 0.310%, in the stems 0.310%, in the stems 0.310%, in the stems 0.310%, in the leaves 0.310%, in the stems 0.310%, in the leaves 0.310%, in the stems 0.310%, in the stems 0.310%, in thein the stem at a rate of 0.280%, in the pod at a rate of 0.390%, in the grain at a rate of 1.200%, potassium in the stem at a rate of 0.255%, in the leaf at a rate of 0.255%, in the root at a rate of 0.460%, in the pod at a rate of 0.465%, in the grain at a rate of 0.465%, when treated with the Uzgumi stimulant at a rate of 0.6 l/t^{-1}, in the 3-5 leaf period at a rate of 0.2 l/ha^{-1}, in the budding phase at a rate of 0.3 l/ha^{-1}, in the stem at a rate of 0.160%, in the leaf at a rate of 0.440%, in the root at a rate of 0.120%, in the pod at a rate of 0.200%, in the grain at a rate of 0.490%, in the grain at a rate of 0.270%, in the leaf at a rate of 0.310%, in the root at a rate of 0.230%, in the pod at a rate of 0.330%, in the grain at a rate of 1.040%, in the stem at 3.0; 4.0 l/t^{-1}, at the 3-5 leaf stage 6.0; 6.0; 6.0 l/ha^{-1} and 9.0; 9.0; With a treatment rate of 9.0 l/ha^{-1}, the amount of nitrogen in the stem was 0.050; 0.070;

0.020%, on the leaves 0.0; 0.080; 0.0%, in the root 0.050; 0.070; 0.040%, in the pod 0.070; 0.110; 0.020%, in the grain 0.090; 0.290; 0.0%, phosphorus in the stem 0.0; 0.0; 0.0%, in leaves 0.120; 0.120; 0.060%, in the root 0.030; 0.060; 0.0%, in the pod 0.050; 0.100; 0.0%, in grain 0.0; 0.120; 0.0%, potassium in the stem 0.0; 0.0; 0.0%, on the leaves 0.0; 0.0; 0.0%, in the root 0.0; 0.205; 0.0%, in the pod 0.240; 0.465; 0.240%, in grain 0.0; 0.0; 0.0% more.

In the experiment, the influence of treatment with stimulants before sowing and during the growing season on the grain yield of soybean seeds sown repeatedly in fields after winter wheat was determined.

It should be noted that the obtained results show that in all variants of the experiment, the number of grains in one pod averaged 2.4-2.6 pieces. Consequently, the increase in grain yield in the studied variants varied depending on the number and weight of grains on one plant.

In particular, in the control variant sown without treatment, the number of grains in one pod was 2.4 pieces, the weight of grains in one pod was 0.239 g, the weight of 1000 grains was 103.9 g, when treating seeds with the Uzgumi stimulant at a rate of 0.6 l/t^{-1} before sowing, 0.2 l/ha^{-1} at 3-5 leaves, 0.3 l/ha^{-1} during budding and 0.4 l/ha^{-1} during flowering, the number of grains in one pod was 2.6 pieces, the weight of grains was 0.289 g, the weight of 1000 grains was 112.1 g, when treating seeds with the Uzgumi stimulant at a rate of 0.6 l/t^{-1} before sowing, 0.2 l/ha^{-1} at 3-5 leaves and 0.3 l/ha^{-1} during budding, the number of grains in one pod was 2.5 pieces, the weight of grains was 0.276 g, the weight of 1000 grains was 111.5 g, when treating seeds with the Uzgumi stimulant at a rate of 0.7 l/t^{-1} before sowing, 0.2 l/ha^{-1} at 3-5 leaves, 0.3 l/ha^{-1} during bud 3.0; 4.0 l/t^{-1}, at 3-5 leaves at a rate of 6.0 l/ha^{-1} and at budding at a rate of 9.0 l/ha^{-1}, the number of grains in one pod was 2.5; 2.5; 2.5 pieces, grain weight 0.276; 0.277; 0.278 g, weight of 1000 grains 108.3; 110.1; 109.2 g were observed.

As a result, compared to the control, when treating seeds with the Uzgumi stimulant before sowing at a rate of 0.6 l/t^{-1}, at 3-5 leaves at a rate of 0.2 l/ha^{-1}, at budding at a rate of 0.3 l/ha^{-1} and at flowering at a rate of 0.4 l/ha^{-1}, the number of grains in one pod was 0.3 pieces, the weight of the grain was 0.050 g, the weight of 1000 grains was 8.2 g, when treating seeds with the Uzgumi stimulant before sowing at a rate of 0.6 l/t^{-1}, at 3-5 leaves at a rate of 0.2 l/ha^{-1} and at budding at a rate of 0.3 l/ha^{-1}, one grain, 0.037 g, 7.6 g, when treating seeds with the Uzgumi stimulant before sowing at a rate of 0.7 l/t^{-1}, at 3-5 leaves at a rate of 0.2 l/ha^{-1}, at budding at a rate of 0.3 l/ha^{-1} and at flowering at a rate of 0.4 l/ha^{-1}, 0.3 pieces, 0.044 g, 6.7 g, when treating 3.0; 4.0 l/t^{-1}, at 3-5 leaves at a rate of 6.0 l/ha^{-1} and at budding at a rate of 9.0 l/ha^{-1}, these indicators were 0.2; 0.2; 0.2 pcs., 0.037; 0.038; 0.039 g, 4.4; 6.2; It was found that it increased by 5.3 g.

In particular, when treating repeated soybean seeds with the Uzgumi stimulant before sowing at a rate of 0.6 l/t^{-1}, at 3-5 leaves at a rate of 0.2 l/ha^{-1}, at budding at a rate of 0.3 l/ha^{-1} and at flowering at a rate of 0.4 l/ha^{-1}, and when treating seeds with the Ma'suda stimulant before sowing at a rate of 3.0 l/t^{-1}, at 3-5 leaves at a rate of 6.0 l/ha^{-1} and at budding at a rate of 9.0 l/ha^{-1}, relatively high indicators were obtained, which positively influenced the change in the number of pods on one plant, the number of grains on one pod, the weight of grains, and the weight of 1000 grains.

In the control variant, the grain yield was 1.71 t/ha^{-1}, with the treatment of seeds with the Uzgumi stimulant before sowing 0.6 l/t^{-1}, at 3-5 leaves 0.2 l/ha^{-1}, at budding 0.3 l/ha^{-1} and at flowering 0.4 l/ha^{-1} 2.11 t/ha^{-1}, with the Uzgumi stimulant before sowing 0.6 l/t^{-1}, at 3-5 leaves 0.2 l/ha^{-1}, at budding 0.3 l/ha^{-1} 2.01 t/ha^{-1}, with the Uzgumi stimulant before sowing 0.7 l/t^{-1}, at 3-5 leaves 0.2 l/ha^{-1}, at budding 0.3 l/ha^{-1} and at flowering 0.4 l/ha^{-1} 2.06 t/ha^{-1}, with the Uzgumi stimulant before sowing 0.7 l/t^{-1}, at 3-5 leaves 0.2 l/ha^{-1}, at budding 0.3 l/ha^{-1} 2.04 t/ha^{-1}, with the Ma'suda stimulant before sowing 2.0; 3.0; 4.0 l/t^{-1}, at 3-5 leaves at a rate of 6.0 l/ha^{-1} and at budding at a rate of 9.0 l/ha^{-1}, respectively, in the variants 1.94; 2.02; A grain yield of 1.93 t/ha^{-1} was obtained (*Figure 3)*.

At the same time, compared to the control, when treating seeds with the Uzgumi stimulant before sowing at 0.6 l/t^{-1}, at 3-5 leaves at 0.2 l/ha^{-1}, at budding at 0.3 l/ha^{-1} and at flowering at 0.4 l/ha^{-1}, the grain yield was 0.40 t/ha^{-1}, when treating seeds with the Uzgumi stimulant before sowing at 0.6 l/t^{-1}, at 3-5 leaves at 0.2 l/ha^{-1}, at budding at 0.3 l/ha^{-1} 0.30 t/ha^{-1}, when treating seeds with the Uzgumi stimulant before sowing at 0.7 l/t^{-1}, at 3-5 leaves at 0.2 l/ha^{-1}, at budding at 0.3 l/ha^{-1} and at flowering at 0.4 l/ha^{-1}0.35 t/ha^{-1}, when treating seeds with the Uzgumi stimulant before sowing at 0.7 l/t^{-1}, at 3-5 leaves at 0.2 l/ha^{-1}, at budding at 0.3 l/ha^{-1} 0.33 t/ha^{-1}, when treating seeds with the Ma'suda stimulant before sowing at 2.0; 3.0; 4.0 l/t^{-1}, at 3-5 leaves at a rate of 6.0 l/ha^{-1} and at budding at a rate of 9.0 l/ha^{-1}, respectively for the variants, an additional 0.23; 0.31; A grain yield of 0.22 t/ha^{-1} was obtained.

Based on the results obtained, it can be concluded that when treating soybeans sown repeatedly in fields freed from winter wheat with the stimulants Uzgumi and

Ma'suda, it positively influenced the increase in the number and weight of pods on one plant, and the grain yield increased by 0.31-0.40 t/ha^{-1}.

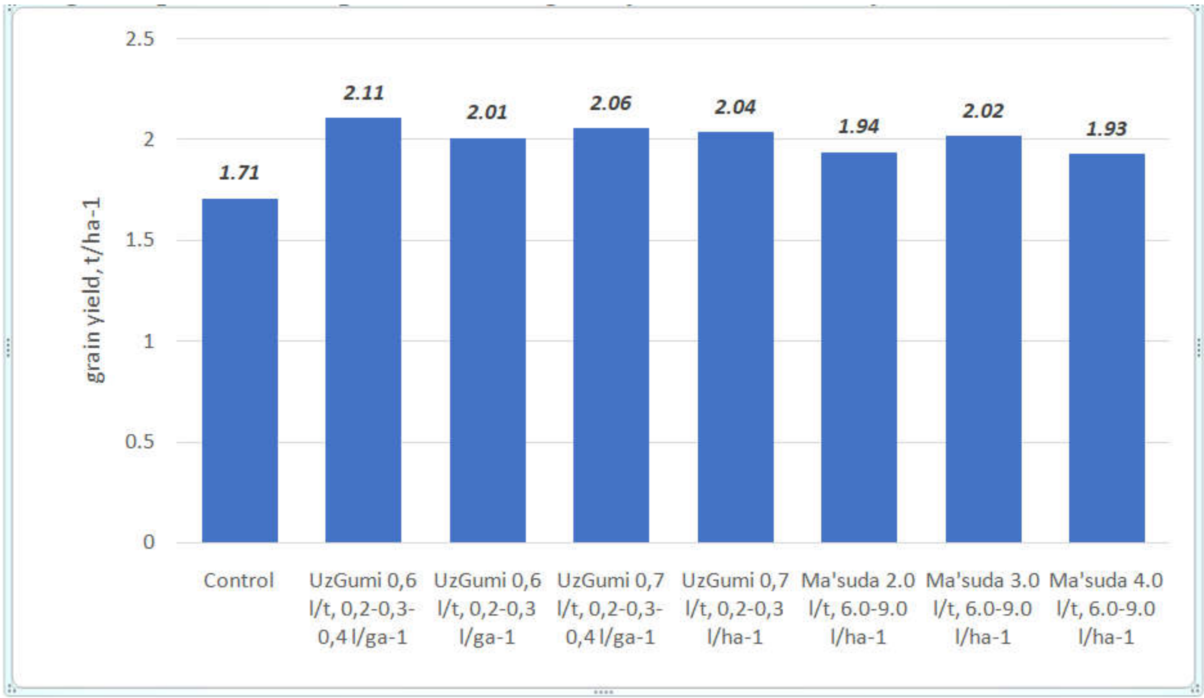

Figure 3. Influence of treatment of repeated soybean crops with Uzgumi and Masuda stimulants on grain yield

In particular, when treating seeds with the Uzgumi stimulant at a rate of 0.6 l/t^{-1}, at 3-5 leaves at a rate of 0.2 l/ha^{-1}, at budding at a rate of 0.3 l/ha^{-1}, and at flowering at a rate of 0.4 l/ha^{-1}, and when treating seeds with the Ma'suda stimulant at a rate of 3.0 l/t^{-1} before sowing, at 3-5 leaves at a rate of 6.0 l/ha^{-1}, and at budding at a rate of 9.0 l/ha^{-1}, a higher grain yield was obtained compared to other rates.

Conclusion

In the context of global climate change, drought, and extreme weather conditions, it has been established that the use of stimulants on soybeans sown after winter wheat is highly effective for the efficient use of land, growing two harvests per year, meeting the population's demand for food products and livestock for feed, preserving and increasing soil fertility.

When treating soybean seeds sown repeatedly after winter wheat with the Uzgumi stimulant at a rate of 0.6 l/t^{-1} and the Ma'suda stimulant at a rate of 3.0 l/t^{-1}, it accelerated by 4.9-6.8%, and germination was observed 1-2 days earlier.

When Uzgumi was applied to soybean seeds at a rate of 0.6 l/t^{-1}, at 3-5 leaves at a rate of 0.2 l/ha^{-1}, at budding at a rate of 0.3 l/ha^{-1} and at flowering at a rate of 0.4 l/ha^{-1}, the plant height increased by 2.5 sm, the number of pods increased by 2.5 pieces, when Ma'suda stimulant was applied to soybean seeds at a rate of 3.0 l/t^{-1}, at 3-5 leaves at a rate of 6.0 l/ha^{-1} and at budding at a rate of 9.0 l/ha^{-1}, the plant height increased by 1.5 sm, the number of pods increased by 2.2 pieces.

When treating repeated soybean crops with Uzgumi and Ma'suda, the dry mass increased by 1.79-2.93 g and more biomass accumulated.

When using the stimulants Uzgumi and Ma'suda, the grain yield of soybeans was 2.02-2.11 t/ha^{-1}, and the grain yield increased by 0.31-0.40 t/ha^{-1}.

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