# Effective stimulator for rice yield improvement

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**Abstract.** As a result of the conducted research, an effective stimulant was found - a natural sesqui terpenoid, which, with a single presowing treatment, allows increasing the yield of rice by 5 c / ha more than the drugs used.

## 1 Introduction

To obtain high and stable crop yields, it is necessary to introduce highly effective plant growth regulators that meet modern technology and environmental protection requirements.

The use of plant growth regulators along with the use of fertilizers, chemical and biological plant protection agents is one of the most promising ways to increase crop productivity.

Various methods of regulating the growth and development of crops using natural and synthetic biologically active substances such as auxins, gibberellins, cytokinins, etc. are known [1]. Treatment of seeds with brassinolide, petroleum growth agent, cresacin and oxygumate is also known to increase rice yield by 3.6-7.9 c/ha [2-4]. However, some of these substances are expensive (e.g., brassinolides), while others have not found wide application due to insufficient stability or relatively high toxicity (e.g., auxins). Therefore, the task of creating and using cheap, non-toxic natural preparations acting, like phytohormones, in ultra-low concentrations is relevant today. This problem is also relevant for rice cultivation, since rice is one of the main foods of the inhabitants of Southeast Asia, including Uzbekistan. The most optimal method is application of plant growth biostimulants during pre-sowing treatment of seeds, which allows to increase seed germination energy, get fast and friendly sprouts, increase root system development and plant biomass, leaf surface area and chlorophyll content, increase yields.

In dry years, rice has ceased to be sown in the region. At the same time, under the conditions of changing natural, climatic, environmental conditions, the deterioration of the reclamation state of irrigated lands and the aridization of the climate, it became necessary to improve the existing agricultural technology for cultivating rice and introduce a new agricultural technology for water-saving rice varieties in the ecological conditions of Karakalpakstan to obtain an environmentally friendly product. Rice is considered the main food product of Central Asia. Rice is of great economic importance, primarily as a food crop. The achievement of real sovereignty by the Republic of Uzbekistan put on the agenda

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the issue of a sharp turn towards grain farming, including rice growing, including the revival of the centers of this industry in the Republic of Karakalpakstan and other regions of Uzbekistan.

However, the production of this water-intensive crop creates significant difficulties in providing it with water in dry years. The processes may be aggravated in the future as a result of climate warming, reduction of water resources and deterioration of its quality [1].

Another problem is the rise in the level of groundwater, swamping and salinization of lands, the accumulation of toxic substances on the soil surface and in groundwater over a large area, in particular in the lower reaches of the Amu Darya. This is due to the lack of perfect types of drainage in the field, modern equipment and technology for irrigating crops. High-yielding ecologically clean varieties of rice and advanced, modern agricultural technologies that increase the yield of rice are still insufficiently introduced. For example, in China, rice is consistently harvested at 110 centners per hectare, and rice is cultivated in Spain, with the world's highest yield of 220 centners per hectare. In recent years, there has been a significant decline in the gross harvest of rice in the lower reaches of the Amu Darya, as well as rice yields by 2-2.5 times. This affects the socio-economic, environmentally sustainable development of the region, the income level of agricultural workers and farmers.

Consequently, the need to increase the yield of traditional rice varieties cultivated in the lower reaches of the Amu Darya, to introduce modern agricultural technologies, with a decrease in the use of mineral fertilizers and pesticides, is the most urgent problem of the Aral Sea region. On the other hand, water-saving rice varieties, local varieties and the introduction of new varieties cultivated in other countries of the world, as well as varieties of the World Rice Institute, should be used.

## 2 Methods

At present, among biostimulants approved for use in agriculture in Uzbekistan, Edagum SM (produced in Russia) is used to increase rice yield [5].

"EdagumSM is a natural humic biostimulator of plant growth and development obtained from environmentally friendly raw materials - lowland peat. Edagum® SM contains a sum of humic and fulvic acids.

Application of Edagum SM to increase rice yield is seed dressing: 2000 ml (or 200 g dry powder) Edagum SM + 10 liters of water = 1 ton of seeds, the 1st dressing in the phase of tillering - 400 ml/ha (or 40 g dry powder) of the drug in 50-300 liters of water; 2nd dressing in the phase of the beginning of earing - 400 ml/ha in 50-300 liters of water; the 3rd dressing in the phase of the beginning of grain filling 0.4-0.5 l/ha give an increase in yield of 4-6 c/ha.

The main disadvantage of biostimulator Edagum SM is the labor intensity of its application, which consists in multiple treatments of rice during the growing season to increase the yield, which is not economically viable.

In this regard, we have conducted research over the years to find and create a cost-effective, effective stimulant that increases rice yields [6].

The natural sesquiterpenoid 2-keto-8-hydroxy-5αα,6β,7α,11β(H)-gwai-1(10),3-dien-6,10-olide monohydrate (1) was found as a result of conducted researches. The source of this sesquiterpenoid is wormwood from the subgenus Seriphidium, widespread in Uzbekistan.

The growth-regulating properties of this sesquiterpenoid (Preparat 1), allow an effective increase in rice yield with a single pre-sowing treatment of rice. Below are the results of biological studies of the Preparat 1.

Growth regulating activity was determined by model experiments of laboratory screening on seeds of rice variety "Iskandar". In the course of laboratory screening, the optimal growth-activating concentration of the compound, its effect on seed sowing qualities and seedling growth were determined. Seeds treated with water were used as control.

## 3 Results and discussion

The preparation was applied in the form of aqueous solutions with concentrations of 50 g/t seed, 75 g/t seed, 100 g/t seed, and 125 g/t seed. Rice seeds were soaked in solutions in the above concentrations and in water (control). Treatment exposure was 1 h. After treatment, seeds were placed 100 pieces in Petri dishes on filter paper saturated with water. Then, seeds were placed in the thermostat for germination at 25C°. Germination energy was determined on the 4th day, germination - on the 7th day. To determine the effect of compound 1 on the intensity of seed germination, we determined the length of roots and sprouts per 100 seedlings. Repeatability in the experiment was 4 times. The results of the laboratory experiment are shown in Table 1.

**Table 1.** Determination of seed germination under laboratory conditions.

| № | Options for experiments | Number of seeds planted in Petri dishes | Average number of germinated seeds, units | Seed germination, % | Height of the plant, cm |
|---|---|---|---|---|---|
| 1 | Control | 100 | 91 | 91 | 8,7 |
| 2 | Preparation150 g/t seed | 100 | 96 | 96 | 9,6 |
| 3 | Preparation175 g/t seed | 100 | 96 | 96 | 9,6 |
| 4 | Preparation1100 g/t seed | 100 | 95 | 94 | 9,5 |
| 5 | Preparation1125 g/t seed | 100 | 92 | 92 | 9,1 |
| | Student'scoefficient P | | 2,8 | 2,9 | 0,05 |

Growth of plants was measured during observation. Thus, in the control variant the growth of plants was 8.7 cm, the greatest growth was observed in 2-3 variants - 9.6 cm. During the observation period in the laboratory conditions we found that the difference in plant growth was 0,4-0,9 cm.

The growth of regulatory activity was evaluated under the conditions of a shallow-field experiment.

Field experiments were carried out in 5 variants of 4-fold replication in the experimental fields of the laboratory of plant protection and agrochemistry of the Research Institute of Rice Breeding. Phenological observations over planted variety of rice "Iskandar" were carried out. Thus, from the field of each variant 10 plants were selected and growth was determined. At observation it was found that average growth of plants in the control variant was 10,5 cm, and in variant 2 - 11,5 cm (see Table 2).

**Table 2.** Determination of seed germination under field conditions.

| № | Options for experiments | Number of sprouted plants in 1 m of ²area, units | Seed germination, % | Plant growth, cm |
|---|---|---|---|---|
| 1 | Control | 256 | 51,2 | 10,5 |
| 2 | Preparation1 50 g/t seed | 281 | 56,2 | 11,5 |
| 3 | Preparation1 75 g/t seed | 279 | 55,9 | 11,2 |
| 4 | Preparation1 100 g/t seed | 280 | 55,7 | 10,8 |
| 5 | Preparation1 125 g/t seed | 261 | 53,0 | 10,7 |
| | Student's coefficient P | | 2,7 | 0,05 |

As can be seen from Table 2, this biostimulant has a great effect on the germination of rice seeds. Table 3 shows rice yield figures.

**Table 3**. Yield indicators.

| № | Options for experiments | Number of plants in 1 m², pcs. | Degree of bushiness | Growth of rasteni i, cm | Length of broom, cm | Weight of a grain per broom, (average), g | | Weight of 1000 pieces of grain, g | Bio-logical yield, g | Real yield, c/ha |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Main broom | Side broom | | | |
| 1 | Control | 240 | 1,12 | 127 | 25,3 | 1,8 | 0,8 | 28,9 | 698 | 55,9 |
| 2 | Edagum CM | 255 | 1,13 | 132 | 27,8 | 1,8 | 0,9 | 32,1 | 864 | 65,4 |
| 3 | Preparation 1 50 g/t seed | 262 | 1,12 | 135 | 27,9 | 2,2 | 1,0 | 33,3 | 880 | 70,4 |
| 4 | Preparation 1 75 g/t seed | 262 | 1,12 | 136 | 28,0 | 2,2 | 1,1 | 33,2 | 879 | 70,3 |
| 5 | Preparation 1 100 g/t seed | 258 | 1,10 | 137 | 26,7 | 2,2 | 0,8 | 32,9 | 851 | 69,1 |
| 6 | Preparation 1 125 g/t seed | 254 | 1,13 | 130 | 27,5 | 1,9 | 0,9 | 31,5 | 803 | 68,3 |

In the study, stacks were taken from the areas sown with rice and biometric analyses were carried out in the laboratory. Based on the analyses, we can see that in the control variant plant growth was 127 cm, length of the panicle was 25.3 cm, weight of the main panicle was 1.8 g, weight of lateral panicle was 0.8 g, and the yield was 55.9 centners per hectare. In the 2nd experiment variant (preparation Edagum SM), the plant height was 132 cm, the length of the branch - 27.8 cm, the weight of the main branch 1.8 cm, the weight of lateral branch 0.9 g, the yield was 65.4 quintals, which was 9.6 quintals higher compared to the control. In the 3-4 variants of field trials (Preparat 50**1** and 75 g/t seeds) plant growth was 135-136 cm, met length 27,8-27,9 cm, weight of main branch 2,2 cm, weight of side branch 1,0-1,1 g, yield was 70,3-70,4 centners, which was 14,4-14,5 centners higher compared to control (see Table 3).

According to FAO estimates, more than 600 million tons of rice are currently produced in the world, and by 2030, due to the growth of the world's population, more than 800 million tons will be needed. In the rice farms of the republic, a method of cultivating rice has been adopted, based on prolonged flooding of the field surface with a layer of water. With the technical level of modern rice irrigation systems, the actual cost of water for growing rice using this irrigation technology significantly exceeds the biological need of plants for it and reaches 20-25 thousand m3 per 1 ha. At the same time, during the growing season, depending on the soil and climatic conditions and the level of productivity, 6-8 thousand m of water is spent per 1 hectare of rice field for total water consumption. The rest of it (13-16 thousand $m^3$ and more) is spent on creating and maintaining a layer of water in the checks, filtration, flow and discharge. In this regard, the resulting large volumes of collector and waste water, the discharge of which pollutes the water intakes, create a tense ecological situation in the areas of traditional rice cultivation. However, a fundamentally different technology of rice cultivation is also possible, when the field occupied by it is not flooded with a layer of water.

The shortage of rice water needs with this irrigation technology is replenished through periodic irrigation. As a result, the cost of irrigation water for rice cultivation is reduced by 3-5 times compared to traditional technology, and the total water consumption approaches the biological water consumption of plants. This determined the direction of research chosen by us, connected with the development of a fundamentally new water-saving, highly efficient and environmentally friendly technology for irrigating rice by periodic irrigation.

It has been established that the increase in rice yield occurred due to the improvement of the ameliorative state of soils in rice fields. When using periodic flooding of rice before the tillering phase, the volume of water for the formation of 1 ton of crop is reduced by an average of 27% and with combined irrigation - 16% relative to shortened flooding. In the applied technologies, during the period of rice feeding, nitrogen mineral fertilizers are used, which are applied to the fields with the help of agricultural aviation. At the same time, the cost of rice grains increases.

## 4 Conclusion

The results of the tests indicate that the proposed preparation has**1** a high growth-regulating activity at low concentrations, which leads to an increase in rice yield, and thus, this product can be used in agriculture to increase the yield of rice.

Thus, pre-sowing treatment of rice seeds with the preparation has an**1**advantage over the used Edagum SM, because at a single pre-sowing treatment provides an increase in rice yield by 5 c/ha more.

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