Effect of Seed Pretreatment with Plant-Based Preparations on Cotton Growth and Development

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Abstract. Scientifically substantiated resource-saving technology of agricultural crops cultivation includes preparation of seed material, choice of elements and technique of their cultivation. Many stimulators have been tested in the republic. Among them, the most stable effect in increase of crop yields stands out Mival, Vitavaks 200FF, T-86, TJ-85, HC-2, Nitrolin, Roslin, Unum, etc. The introduction of new growth regulators requires finding the optimum doses, timing and methods of their application. And also there is a need to find new biopreparations of domestic and foreign production. In the experimental farm of CBSPARI experiments on the effect of biopreparations on field germination, dynamics of seedlings emergence, growth and development of seedlings of above-ground and below-ground parts were conducted. Seeds of cotton varieties Sultan and Andizhan-36 of 2020 crop were treated with biologically active preparations, Uglin, Gledan, Roslin, control - seeds without treatment. Growth of seedlings was determined on the 4th day. Total seedling length of seeds treated with the biopreparation Gledan in the variety Sultan was 1.9 mm higher than control, and in the variety Andijan-36 by 0.7 mm. The difference in growth between the seedling aboveground and underground parts did not exceed 1 mm in favor of the aboveground part. Key words: plant growth stimulants, polysaccharides, lignans, cotton, germination, seedlings, growth, fruits, flowers, bolls.

1 Introduction

One of the ways of increasing crop yields in agriculture is the use of biologically active preparations. The environmentally friendly and non-toxic to the environment growth-regulating preparations created in recent years on the basis of natural raw materials, which have simultaneously several types of regulatory activity, open up new approaches to controlling the processes of plant metabolism and allow solving the problems of crop production more effectively [1].

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The development of digital technologies [2-8] and the application of various kinds of legislative acts [9-15] have a significant impact on the creation of biologically active drugs. The guarantee of high yield and marketable quality of agricultural products is a science-based resource-saving technology of crop cultivation, which includes the preparation of seed material, the choice of elements and techniques of their cultivation [16, 17].

For this purpose the methods of stimulation of physiological and biochemical processes of growth and development of seedlings through seed treatment based on the natural biological ecologically safe agro preparations, non-traditional agro-ore materials, such as bentonites, glauconites, serpentinite and others together with biostimulants - donors of microelements and bioactive ligands, affecting physiological and biochemical processes in plants, promoting cotton resistance to phytopathogens.

In studies by Godziashvili B.A. and Chebotarev M.V. it was established that application of organic matter and its waste along with agrochemicals containing various biogenic elements can to some extent replace mineral fertilizers and play an essential role in ecologization of agriculture in Georgian humid subtropics [18]. Seed pre-treatment has a significant impact on crop yields and, consequently, on food production volumes. Seed-borne diseases that appear in the early stages of plant growth can have a huge, devastating impact on the crop [19, 20]. Much work has been done by researchers to study the effect of growth regulators on the formation of total raw cotton yield, increasing the proportion of homegrown crop, improving fiber quality, oil content, protein and carbohydrate metabolism [21].

Many stimulants have been tested in the country. Among them the most stable effect in increase of a crop stands out preparations Miwal, Vitavax 200FF, T-86, TJ-85, HC-2, Roslin, Unum, etc. [22-26]. Quite a number of tasks in plant growing practice are solved with the help of plant growth regulators, therefore, in the future, in order to increase the yield and improve the quality of agricultural products, great importance should be given to growth regulators. Compounds of polysaccharide nature are known among the substances with growth-stimulating properties. For example, the activity of extracts from some species of macroalgae has been known for a relatively long time and is used in agricultural practice [27, 28]. Growth-stimulating activity for higher plant pectins has been described in the literature [29, 30]. Of great practical interest are also galactomannans, which are widely used in various industries [31]. Stimulating the functional activity of cells and increasing the energy of seed germination make plant polysaccharides substances of interest as growth-regulating agents [32-34]. Preparations based on humic-like substances by oxidative hydrolytic processing of plant wastes are widely used in crop production practice. A large amount of plant lignocellulosic waste of medicinal plants, formed in the production of low-molecular-weight physiologically active substances from medicinal plants in pilot production of IHRV and is a by-product of production.

The objective of this study was to investigate the effect of seed treatment of cotton seeds with preparations on the basis of plant substances - Gledan and Uglin - on growth and development of cotton plants.

2 Materials and methods

Gledan preparation based on seed extract of Gleditsia triacanthos plant and its complex form containing the extract and Roslin called Uglin were tested as growth regulators. The main substance in the seed extract of the plant Gleditsia triacanthos is a polysaccharide called galactomannan. The substance forms a viscous solution when
dissolved in water. The monosaccharide composition of galactomannan consists of galactose and mannose in the ratio of 1:4 [35].

The complex form of growth regulator Uglin includes lignin-based growth regulator Roslin, which is derived from waste products of experimental drug production and the preparation Gledan in a 1:1 ratio.

Selection of plant wastes was carried out at the Experimental Production Facility of the Institute of Plant Chemistry of the Academy of Sciences of the Republic of Uzbekistan. The crushed wastes with size fraction of 5,0-1,0 mm and moisture content of 8-15% were used. Chemical composition of feedstock in percentage on absolutely dry matter: ash content - 5-18%, lignin 18-26%, hard-hydrolyzable polysaccharides (cellulose) - 29-41%, easy-hydrolyzable (hemicellulose) - 17-24%, extractive substances (acetone, benzene) - 2-6%.

Primary study of the action of the main component of the drug Gledan, galactomannan of the seeds of the plant Gleditsia triacanthos.

During the laboratory studies the current standards and methods were used. Determination of sowing and varietal qualities of seeds were carried out according to O’zDSt 663: 2017 "Cotton sowing seeds. Specifications"; O’zDSt 1080:2005 "Raw seed cotton and seed cotton seed. Sampling Methods", O’zDSt 1128:2006 "Cotton Seed Seeds. Methods for determination of germination" [36]

With the purpose of studying stress-protective activity of pure substance - galactomannan, cotton seeds of 65-24C variety have been soaked for 18 hours in 0,001% solution of this polysaccharide [37]. To carry out laboratory tests to establish cotton seeds resistance to salt stress, cotton seeds were placed in Petri dishes on filter paper and 2 ml of 1% NaCl solution were infused. To create an infectious background, 2 ml of aqueous suspension of spore material of the microscopic fungus Fusarium oxysporum Schrf. When conducting a fine-delivery experiment to study growth-stimulating activity of galactomannan, a synthetic preparation Vitavax as well as a natural preparation Uchkun created on the basis of polyisoprenoids were used as reference [38]. The experiment scheme included the following variants:

1. Control (no treatment);
2. Vitavax (reference) 5 l/t.s;
3. Uchkun (reference) 0.001%.
4. Galactomannan 0.001%.

Morphological parameters of plants were examined according to generally accepted methods. Plant height and the number of true leaves on the shoot were measured every 7 days.

Testing of the preparation Gledan and its complex form - Uglin.

The field work was carried out at the experimental plot of the Research Institute of Breeding, Seed Production and Agrotechnology of Cotton Cultivation. Agronomic techniques were common for the experimental plot: during the growing season, 6 times of cultivation, 3 times of irrigation, 2-3 times of mashing, and 3 times of mineral fertilizers application. [39, 40]

Mathematical processing of the yield data was carried out according to the method of B.A. Dospekhov, [41].

3 Results and discussion

Results of research on stress-protective activity of main component of Gleditsia triacanthos seeds extract - galactomannan, have shown, that under cotton seeds treatment, the root length (3.12 cm) was 73.3 % higher than control; stem length (0.85 cm) was 39.3 % higher than control; in reference version with Uchkun growth stimulator, these parameters were
lower and represented respectively 2.53 and 0.77 cm, which was 40.5 and 26.2 % higher than control.

**Table 1.** Effect of cotton seed presowing treatment on seedling growth under saline and infestation exposure.

<table>
<thead>
<tr>
<th></th>
<th>Salt background</th>
<th>Infection background</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Root length, cm</td>
<td>Stem length, cm</td>
</tr>
<tr>
<td>Control</td>
<td>1.80</td>
<td>0.61</td>
</tr>
<tr>
<td>Uchkun</td>
<td>2.53</td>
<td>0.77</td>
</tr>
<tr>
<td>Gledan</td>
<td>3.12</td>
<td>0.85</td>
</tr>
</tbody>
</table>

Under influence of infection background, active development of seedlings was also observed in the experimental version; the length of root and above-ground parts of seedlings was 1.72 cm and 1.65 cm, respectively, and was higher than control by 54.4% and 33.3%; when seeds were treated with preparation "Ukun", the length of seedlings was 1.83 cm and 1.75 cm and exceeded control by 63.6% and 41.7%, respectively.

Studies of the effect of presowing treatment of cotton seeds with polysaccharide Gledan showed that as a result of polysaccharide treatment, acceleration of main stem growth and appearance of true leaves were observed.

Studies of the main stem growth dynamics and appearance of true leaves in the initial period of ontogenesis showed that in the period from May 20 to June 10 the growth of experimental plants was 15% higher than that of Vitavax control and reference plants, and slightly lower than that of Uchkun-treated plants (Fig.1). The emergence of true leaves also outpaced development. During this period, number of leaves in the control was 6.8 units, while with GM - 8.5. (Fig.2). Thus, as a result of the experiments it was found that for the study period the experimental plants were ahead of the control by 3-4 days.

Thus, we found that presowing moistening of cotton seeds with polysaccharide increases seed germination, accelerates appearance of true leaves, and activates main stem growth.

![Fig. 1. Dynamics of cotton growth. Time of surveys: 20 May, 27 May, 3 June, 10 June 2015 (1- Vitavax, 2- control, 3- Uchkun, 4- GM).](image-url)
We have conducted studies on cotton seed presowing treatment with complex polysaccharide formulation based on lignocellulosic wastes called Uglin on cotton growth and development under field conditions. Experimental farm CBSPARI was established to study the effect of biopreparation on field germination, dynamics of seedlings appearance, growth and development of above-ground and below-ground seedlings. Sowing was carried out on 20 April 2021 after precipitation. Scheme of sowing 60*20 with 5 seeds per hole, single-row plot of 20 meters in 4 swards.

Seeds of cotton varieties Sultan and Andijan-36 of 2020 crop were treated with Gledan and Uglin. The previously developed lignin-based preparation Roslin [7] was used as a reference; seeds without treatment were used as a control. Laboratory germination was determined on days 4 and 12, seedling length - on day 4.

As shown by laboratory studies, treatment of seeds with biopreparation contributed to an increase in seed germination. When exposed to the preparation Gledan at the time of plots germination of seeds Sultan exceeded control by 5%, when treated with the complex composition of Uglin on 4 day the figure was higher than the control variant by 3.5%, on 12 day by 3.0%. In the variety Andijan-36 treated with Gledan the indicators on the 4th and 12th day were higher than the control respectively by 2.9% and 3.4%, the treatment with charcoal by 2.3% and 2.2%.

The total length of seedlings treated with Gledan biopreparation in the variety Sultan was 1.9 mm higher than control, and in the variety Andijan-36 by 0.7 mm. The difference in growth between the sprouted above-ground and underground parts did not exceed 1 mm in favour of the above-ground part.

Counting of plants of emerged holes and plants in them, starting from 3 days after sowing and completed on day 13. Counting was done every 2 days. The data are given in table 1. Accumulated number of emerged wells was with seeds treated with Gledan biopreparation for Andijan-36-99% and for Sultan-98.5%. On average, 4.3 seedlings of the Andijan-36 variety and 4.5 seeds of the Sultan variety sprouted in each well. Field germination on seeds treated with Gledan biopreparation on variety Sultan was 89.4% and 8.3% higher than control, and on variety Andizhan-36 on 0.8% higher.

Sowing was carried out on 20 April 2021 after precipitation. Sowing scheme was 60x20 with 5 seeds in wells, plot one row20 meters in 4 replications.

It was determined that the seeds treated with Uglin and Gledan showed laboratory germination 5% higher than the control, and for the variety Andijan-36 by 3.4%. It should be noted that laboratory germination on both the 4th and 12th day was higher than control.
Table 2. Laboratory and field germination of cotton seeds treated with various biopreparations and dynamics of germination

<table>
<thead>
<tr>
<th>№</th>
<th>Options</th>
<th>Laboratory germination, %</th>
<th>Growth germination for 4 days</th>
<th>Sprouting dynamics, days from sowing</th>
<th>Field germination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>For 4 days</td>
<td>For 12 days</td>
<td>Total</td>
<td>under ground part</td>
</tr>
<tr>
<td>1</td>
<td>Control</td>
<td>86,4</td>
<td>92,0</td>
<td>7,8</td>
<td>3,6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Gledan</td>
<td>89,3</td>
<td>95,4</td>
<td>8,5</td>
<td>3,8</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Uglin</td>
<td>88,7</td>
<td>94,2</td>
<td>7,80</td>
<td>3,2</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Roslyn</td>
<td>90,0</td>
<td>95,1</td>
<td>8,1</td>
<td>3,4</td>
</tr>
<tr>
<td></td>
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</table>

Variety Andijan-36

<table>
<thead>
<tr>
<th>№</th>
<th>Options</th>
<th>Laboratory germination, %</th>
<th>Growth germination for 4 days</th>
<th>Sprouting dynamics, days from sowing</th>
<th>Field germination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>For 4 days</td>
<td>For 12 days</td>
<td>Total</td>
<td>under ground part</td>
</tr>
<tr>
<td>1</td>
<td>Control</td>
<td>86,4</td>
<td>92,0</td>
<td>7,8</td>
<td>3,6</td>
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<td></td>
</tr>
<tr>
<td>2</td>
<td>Gledan</td>
<td>89,3</td>
<td>95,4</td>
<td>8,5</td>
<td>3,8</td>
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</tr>
<tr>
<td>3</td>
<td>Uglin</td>
<td>88,7</td>
<td>94,2</td>
<td>7,80</td>
<td>3,2</td>
</tr>
</tbody>
</table>
Table 3. Cotton growth and development in the 2020 seed treatment with biologically active substances under CBSPARI experimental farm conditions.

<table>
<thead>
<tr>
<th>№</th>
<th>Varieties</th>
<th>Options</th>
<th>01.06</th>
<th>01.07</th>
<th>01.08</th>
<th>01.09</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Height, cm</td>
<td>Number of true leaves</td>
<td>Height, cm</td>
<td>Quantity</td>
</tr>
<tr>
<td>1</td>
<td>Sultan</td>
<td>Control</td>
<td>12,8</td>
<td>5,9</td>
<td>29,9</td>
<td>3,2</td>
</tr>
<tr>
<td>2</td>
<td>Sultan</td>
<td>Uglin</td>
<td>14,9</td>
<td>6,3</td>
<td>33,5</td>
<td>3,7</td>
</tr>
<tr>
<td>3</td>
<td>Sultan</td>
<td>Gledan</td>
<td>14,2</td>
<td>6,4</td>
<td>34,2</td>
<td>4,0</td>
</tr>
<tr>
<td>4</td>
<td>Sultan</td>
<td>Roslyn</td>
<td>14,6</td>
<td>6,4</td>
<td>34,5</td>
<td>4,2</td>
</tr>
<tr>
<td>1</td>
<td>Andijon-36</td>
<td>Control</td>
<td>12,5</td>
<td>5,5</td>
<td>28,6</td>
<td>3,3</td>
</tr>
<tr>
<td>2</td>
<td>Andijon-36</td>
<td>Uglin</td>
<td>13,6</td>
<td>6,0</td>
<td>34,7</td>
<td>4,0</td>
</tr>
<tr>
<td>3</td>
<td>Andijon-36</td>
<td>Gledan</td>
<td>13,6</td>
<td>6,1</td>
<td>32,4</td>
<td>4,0</td>
</tr>
<tr>
<td>4</td>
<td>Andijon-36</td>
<td>Roslyn</td>
<td>13,2</td>
<td>6,0</td>
<td>31,6</td>
<td>3,8</td>
</tr>
</tbody>
</table>
As the research showed, the seeds treated with biopreparations showed field germination higher than that of the control. As of the first days of June, July, August and September, phenological observations of growth and development of cotton plants of seeds that were treated with biopreparations were carried out. On all dates of observations, plant height, number of sympodia, number of bolls, including opened bolls exceeded the control variant where seeds were untreated with biopreparations. Plants of seeds treated with Gledan biopreparation on September 1 exceeded the control in the variety Sultan by 7 cm, and treated with Uglin and Raslin respectively by 4.7 and 5.5 cm. For the variety Andijan-36 by 4.2 cm, 4.1 cm and 4.2 cm respectively.

Phenological observations as of June 1 revealed that the stem height was 2.1-1.8 cm higher compared to the control. By the number of bolls on September 1, seeds treated Gledan were ahead of the control in the variety Sultan and Andizhan-36 by 1.2, 1.4 and 2.4, respectively. The opened bolls were 0.8 and 1.1 higher, respectively.

4 Conclusion
Seed pre-treatment with bioactive preparations Gledan and Uglin had a positive effect on laboratory and field germination as well as on the growth and development of plants. The best results were obtained when using the preparation Gledan, the seeds treated with which exceeded the control on all dates of observation.

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