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GLYCYRHYRZIN ACID COMPLEXES IN COTTON UNDER SALINITY CONDITIONS (Gossypium barbadense L.) INFLUENCE ON SEED FERTILITY

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RESUME

Glycyrrhizin acid (GA): Supramolecular complexes of phytohormones (PH) (PH: indole-3-acetic acid (IAA); indole-3-butyric acid (IBA); naphthalene-1- acetic acid (NAA) and kinetin) (100 µM) of cotton in laboratory conditions « Sultan » It was found that the intensity and amount of water-soaking dynamics of the variety seeds were significantly increased compared to the control, and the germination energy and germination level of the seeds were optimized under experimental salinity conditions (NaCl=200 mM). The obtained results show the high prospects of using supramolecular complexes of GA: phytohormones in agricultural practice to optimize the process of germination and development of plants under conditions of stress factors, including salinity.

Keywords: Glycyrrhizic acid; phytohormones; supramolecular complexes; cotton variety; level of ignition, energy of ignition.

Introduction

Globally, due to the intensive use of land resources, the increase of crop productivity and the excessive use of chemical preparations in the system of combating plant diseases, as well as the use of unscientific agromelioration measures, the level of salinity of the soil of cultivated areas is increasing [1]. This has a negative impact on the growth and development of plants, as well as on the productivity and quality of the harvest [2] Accordingly, the selection of salt-resistant varieties of agricultural plants or the improvement of resistance indicators is noted as one of the urgent scientific issues.

A wide variety of natural and artificial preparations have been recommended according to the results of researches related to increasing salt tolerance properties of plants. Many of them have been put into practice until today. In this case, the prospects of using phytohormones, which perform the function of mediators of external signals in plant tissue cells, are highly appreciated [3,4]. Some results on increasing the level of resistance and the most important biological indicators in the stages of growth and development of agricultural crops with the help of bioregulators under the influence of salinity are recorded [5,6].

Clarifying the importance of phytohormones in the formation of resistance mechanisms in the plant organism under the influence of various stress factors, developing optimization technologies, methods and approaches is a theoretical/practical issue [7].

In this work, the supramolecular complexes of PH with PH (IAA; IBA; NAA and kinetin) under experimental salinity conditions in cotton (*Gossypium barbadense L.*) studies were carried out to study the effect of the seed on germination indicators.

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Materials And Methods

Research objects

In the experiments, in order to study the biological activity of auxins (IAA; IBA; NAA) and kinetin and GA:PH supramolecular complexes, which are important in the process of growth and development of cotton, cotton «Sultan» variety was selected.

Licorice plant (*Glycyrrhiza glabra* L.) extraction/chemical identification of GK from roots and synthesis of GA:PH supramolecular complexes

In the experiments, the preparation of root extract of licorice plant (Glycyrrhiza glabra L.) and extraction of GA from its contents, chemical identification, synthesis of GA:PH supramolecular complexes based on standard methods, "PerkinElmer Spectrum IR" (Germany; version 10.6.1) It was carried out using an IR-Fure spectrometer [8-10].

Cotton's «Sultan» study of germination parameters of the seed of the variety in laboratory conditions

Cotton seeds 5 min. during NaClO (2% li) solution [11] or $KMnO_4$ (1% li) solution or 2 min. during sterilization using ethanol solution (70%) [12], washed in a stream of distilled water in the next step and collected in a Petri dish [13]. Petri dishes were sterilized using ethanol solution (70% alcohol). 100 seeds per cup were cut into the size equal to the diameter of the Petri dish and placed on filter paper soaked in distilled water (10 mL) [6,14].

Filter papers "Vitamin №1" ("Sigma-Aldrich"; Germany) and D=110 ("Khimreaktivkomplekt"; Russia) were used in the experiments.

Germination of cotton seeds was carried out for 10 days (240 hours) in the dark, in a thermostat at a temperature of +22°C. After 24 hours, the germination process begins in the seeds [15].

During the germination process, the germination energy was calculated on the 3 days (72 hours) and the germination level was recorded on the 10th day [14].

A root longer than half the length of the seed was considered as ripe [14].

Union energy– represents the percentage (%) of grains that have matured at a normal level during the past time (3 days) in relation to the total number of grains [16].

Degree of union- represents the percentage (%) of grains that have matured at a standard level compared to the number of seeds used in the general experiment [16].

In the experiments, the germination rate (GR; Germination rate) was calculated using the following formula [17]:

$$GR = x_1/D_1 + (x_2 - x1\,)/D_2 \ldots x_n - x_n - 1\,)/D_n$$

Here D represents the number of experimental days in which the calculation was made.

Experimental salinity model

In experiments, cotton (*Gossypium barbadense L.*) seed germination in the laboratory under experimental salinity conditions was analyzed using the universal method [18].

Experimental salinity was created using NaCl (200 mM) incubation [2,19,20] and distilled water was used in the control group.

In the experiments, solutions of NaCl ("Sigma-Aldrich"; Germany), glycyrrhizic acid (GA), indolyl-3-acetic acid (IAA), indolyl butyric acid (IBA), kinetin and GA:PH supramolecular complex were prepared by "Techniprot" (Poland; maximum 250 mg; accuracy level ±0.2 mg); JW-1 (200±0.2 g.; Acom; Korea) laboratory scales were used. To create an experimental salinity model, 0.117 g of NaCl was dissolved in distilled water (10 mL) (200 mM).

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Mathematical-statistical processing of the obtained results

Experiment results according to standard biometric methods [21], OriginPro v. 8.5 SR1 (EULA, USA) was mathematically and statistically processed using a special software package.

RESULTS OBTAINED AND THEIR ANALYSIS

In the experiments, the average weight of 1 cotton seed in the control option was 41.7 ± 2.4 mg, and after the soaking phase (72 hours) it increased by 47.5 ± 3.5% compared to the control, i.e. 61.5 ± 2, It was found to be 4 mg. In this case, it was noted that the intensity of dehydration is at a high level during the first 16-72 hours (1-3 days). Also, under the influence of GA:PH (PH: IAA; IBA; NAA and kinetin) supramolecular complexes (100 µM) during germination under laboratory conditions «9326-V» increase in the intensity and amount of water absorption dynamics of thin-fiber cotton seeds compared to the control, including the amount of water absorbed in 10 days, respectively – 28.4±2.5; 25.5±3.7; It was found to be 20.8±2.4 and 26.7±3.8 mg (Table 1).

Table 1

GA:PH (PH: IAA; NAA; IBA and kinetin) supramolecular complexes in laboratory conditions «Sultan» the effect of cotton seeds on the dynamics of water hyacinth (M±m)

Experience options	Weight dynamics during cotton seed germination(mg) Start time (hours)					Amount of water ingested(mg)
	6	16	24	72	240	
Control (distilled water)	48.5±3.6	51.3±2.7	54.4±3.8	58.5±3.7	61.5±2.4	19.8±3.2
GA: IAA (4:1) 100 µM	51.6±4.2	59.8±5.2*	67.5±3.5**	69.6±4.2**	70.1±3.6**	28.4±2.5
GA: NAA (4:1) 100 µM	49.3±3.4	52.5±4.2*	60.2±4.4**	65.8±5.3**	67.2±4.5**	25.5±3.7
GA: IBA (5:1) 100 µM	48.7±5.2	59.4±5.7*	60.8±2.5**	61.4±3.1*	62.5±4.4*	20.8±2.4
GA:Kinetin (4:1) 100 µM	50.6±2.6	55.4±4.1*	63.6±5.5**	67.6±4.8**	68.4±5.2**	26.7±3.8

Note:* – the difference of the values of the experimental group compared to the control has a statistical reliability level of r<0.05, ** – r<0.01.

The obtained results are consistent with the existing literature data [6]. During the germination process of cotton seed, ~45–50% of its dry weight is transferred to the germination phase after soaking [6]. Studies have shown that during the germination of cotton seeds, the water absorption phase lasts ~2–6 hours, and in the next phase (~6–16 hours) water reaches the endosperm, during which enzymatic reactions are activated [22].

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During seed germination, PHs perform the most important physiological function as important endogenous regulators [6].

Studies have reported optimization of the permeability properties of the biological membrane under the influence of GA [23-25].

The obtained results can be explained by the optimization of permeability properties of biological membranes under the influence of GA:PH (PH:IAA, NAA, IBA and kinetin) supramolecular complexes (100 µM).

In the next series of experiments, in laboratory conditions of supramolecular complexes GA:PH (PH:IAA, NAA, IBA and kinetin) under experimental salinity conditions «9326-V» the effect of cotton seeds on germination indicators was analyzed.

In experiments, after 72 hours in laboratory conditions, the energy of grain germination was equal to 38.9±4.3% in the control variant, and decreased to 16.4±3.5% under experimental salinity conditions (NaCl=200 mM), in turn, under these conditions at a concentration of 100 µM Under the influence of GA:IAA (4:1), GA:NAA (4:1), GA:IBA (5:1) and GA:Kinetin (4:1) incubation, the value of this indicator was 36.4±7.3, respectively. %; 34.7±6.5%; 23.4±3.4% and 34.3±3.3% recovery was found (Table 2).

Also, in experiments, the rate of seed germination in laboratory conditions was equal to 86.4±5.7% in the control variant, and decreased to 43.7±4.2% under experimental salinity conditions (NaCl=200 mM), in turn, under these conditions, GA at a concentration of 100 µM :IAA (4:1), GK=A:NAA (4:1), GA:IBA (5:1) and GA:Kinetin (4:1) incubation, the value of this indicator was 84.2±6.5%, respectively ; 58.5±5.5%; 65.7±4.8% and 76.2±6.4% recovery was found (Table 2).

Table 2

GA:PH (PH: IAA, NAA, IBA and kinetin) supramolecular complexes in laboratory conditions «Sultan» the effect of cotton seeds on germination indicators (M±m)

Experience options	Seed germination energy(%)		Seed germination rate(%)	
	Control	NaCl (200 mM)	Control	NaCl (200 mM)
Control (distilled water)	38.9±4.3	16.4±3.5**	86.4±5.7	43.7±4.2**
GA (100 µM)	42.4±5.2*	25.9±4.8*	87.5±6.4*	51.5±4.4*
ISK (100 µM)	40.5±6.4*	35.6±5.5**	95.8±6.3**	80.5±6.6**
GA: IAA (4:1) 100 µM	48.3±5.3**	36.4±7.3**	96.3±6.5**	84.2±6.5**
GA: NAA (4:1) 100 µM	39.3±4.5*	34.7±6.5**	92.3±3.7**	58.5±5.5**
GA: IBA (5:1) 100 µM	24.6±4.2*	23.4±3.4*	90.4±3.5**	65.7±4.8**
GA:Kinetin (4:1) 100 µM	45.4±6.6**	34.3±3.3**	95.6±4.4**	76.2±6.4**

Note:* – level of statistical reliability compared to the control r<0.05, ** – r<0.01 (n=3–4).

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Many researchers have noted that cotton seed germination indicators decrease under the influence of salinity, and this condition is caused by a decrease in the osmotic potential value, an increase in the Na+ ion concentration, a cytotoxic effect, a slowing down of the transport process of stored nutrients in the grain, and a decrease in the level of seed water absorption (absorption) [26-28] , the K+/Na+ balance in the cell membrane is explained on the basis of such mechanisms as the disruption of the K+/Na+ balance and, in turn, the dysfunction of the embryonic development process [29], as well as the effects of genetic and other factors [30] together with the dysfunctions occurring in the biological membrane

In research, it is explained by the decrease of morphometric/functional parameters of cotton seeds during the germination of cotton seeds under the influence of salinity [31], disruption of ions-homeostasis in cells, cytotoxic effect due to the increase of [Na+]in content [32].

Studies have shown that PH (auskin et al.) increases the germination energy of cotton seeds [33], and the obtained results are consistent with the data of this literature.

Also, the normalization of the morpho-functional indicators of the root under the influence of PH in salinity conditions [32].

Considering that PH is important in the bioregulation of enzyme activity in plant seeds during germination [15], it is emphasized that the optimizing effect of PH in salinity conditions is related to the activation of functional enzymes [31].

The formation of a plant's resistance mechanism to stress-factors is considered a complex, multi-component process that includes specific/non-specific biochemical reactions [15], specific compensatory mechanisms are activated in the plant under the influence of stress-factors, and it is emphasized that phytohormones are considered one of the central functional components [4] .

Thus, it has been noted by many researchers that endogenous regulators have a positive effect on the germination parameters of cotton seeds under salinity conditions, increase the level of resistance to various abiotic stress factors, including salinity [34], and it is noted that the use of PHs in optimizing the germination parameters of cotton seeds under salinity conditions gives effective results. is done [31].

In the research carried out in the conditions of Uzbekistan, it was noted that GA and its derivatives isolated from the plant Glycyrrhiza L. and its roots optimize the fertility properties of the soil under salinity conditions, and have a positive effect on the growth and development and productivity indicators of agricultural crops [3].

In particular, studies have shown that GA reduces the level of salinity, increases the concentration of phenol compounds, increases the level of resistance of the plant to the effects of diseases, and has a positive effect on the indicators of germination and development of cotton [3].

so thatincreasing the yield and quality of agricultural crops, ensuring food safety is considered one of the strategic priority issues [6], and the prospects of using environmentally safe endogenous phytoregulators, which have the property of optimizing the germination and development indicators of agricultural crops, are highly valued in the solution of this issue [6].

The use of endogenous phytoregulators in agricultural practice has been proven to increase growth-development, productivity, as well as the level of resistance to the effects of various phytopathogens and stress-factors through the stimulation of complex biochemical/physiological processes in the plant organism [6].

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In the conducted experiments, GA:PH (PH: IAA, NAA, IBA and kinetin) supramolecular complexes (100 μM) during germination under laboratory conditions «9326-V» it was found that the intensity and amount of cotton seed waterlogging dynamics increased significantly compared to the control. Also, during germination in the laboratory, after 72 hours in the experimental salinity conditions (NaCl=200 mM), significant optimization of seed germination energy and germination rate was noted as the most important result. Under the influence of PH, the morpho-functional indicators of cotton seeds in the initial phase of ontogenesis are higher than the control can be explained on the basis of the fact that they are related to the metabolic-biochemical changes taking place at the cellular level. The obtained results show the high prospects of using GA:PH supramolecular complexes in agricultural practice to optimize the process of germination and development of plants under conditions of stress factors, including salinity.

CONCLUSION

It can be noted that the germination of cotton seeds and the development of the root system in an environment with a salinity level are primarily related to the indicators of salinity resistance of seedlings. Based on the results of the research, it can be noted that GA:PH (PH: indole-3-acetic acid; indole-3-butyric acid; naphthalene-1-acetic acid and kinetin) supramolecular complexes (100 μM) have a significant effect on the dynamics of water absorption of cotton seeds. significantly increases the intensity and quantity compared to the control. Under the conditions of experimental salinity (NaCl=200 mM), the germination energy and germination level of cotton seeds can be optimized under the influence of GA:PH. This situation allows to increase the indicators of biological development based on the formation of vegetative organs of cotton seedlings under salinity conditions. The obtained results show the high prospects of using GA:PH supramolecular complexes in agricultural practice to optimize the process of germination and development of plants under conditions of stress factors, including salinity.

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