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# DYNAMICS OF THE ACCUMULATION OF THE GALACTOMANNANS OF *Gleditsia macracantha* AND THEIR INFLUENCE ON THE GROWTH OF COTTON SEEDS

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*The dynamics of the accumulation of galactomannans (GMs) in the seeds of* Gleditsia macracantha *have been studied. Their maximum content was observed during dormancy. It was found that with the development and growth of the fruit the yield and characteristic viscosity of the GMs and the amount of mannose in them increased.*

Of the carbohydrates of the *Gleditsia* genus, the galactomannans, which exhibit an intense biological activity [1, 2], deserve attention. We have shown previously that the seeds of *G. macracantha* contain galactomannans (GMs) [3,4], but there is no information on their accumulation. We have now studied the accumulation of GMs, their monosaccharide composition, and their viscosity as functions of the growth and development of the plant. The results of analysis are given in Table 1.

The polysaccharides isolated consisted of a white amorphous fibrous powder. All the samples of GMs (1—7) were readily soluble in water and they gave no color reaction with iodine, which showed the absence of a glucan of the starch type. By PC and GLC, galactose and mannose were detected in the products of the acid hydrolysis of the WSPSs, which means that they were galactomannans [3, 4].

It can be seen from Table 1 that with the development and growth of the seeds the amount of GMs increased from 5.8 to 17.2%, the characteristic viscosity rose simultaneously, and the amount of mannose in the galactomannans increased, the ratio of galactose to mannose reaching 1:5.0 during the period of dormancy. The study of the dynamics of the accumulation of GMs in the seeds showed that their maximum level was reached in the stage of the full ripeness of the seeds. The GMs were localized in the seed endosperm, fulfilling the function of an energy reserve and a water balance regulator during the germination of the seeds [5].

Experiments were performed to determine the amount of GMs consumed in the germination of the seeds. *Gleditsia* (honey locust) seeds are very hard and therefore they had to be scalded before sowing. The seeds were grown in sterile sand at room temperature with good natural illumination.

We have previously isolated galactomannans from *G. macracantha* seed coats with a yield of 21% [6]. As can be seen from Table 2, the amount of GMs in the seed coats fell to 14%, the characteristic viscosity of solutions of the GMs decreased appreciably, and the ratio of the monosaccharides changed.

This means that the polysaccharides are used by the living cells as stores of energy, being readily converted when necessary into monosaccharides serving as a direct source of energy [7]. Galactomannans possess valuable physicochemical properties: they form viscous solutions in very low concentrations, they retain considerable amounts of water, and they form gels and pastes [1].

It is known that one of the conditions for obtaining high crop yields is the density of the stand of seedlings. This depends on a combination of factors, but the quality of the material for sowing may be decisive.

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TABLE 1. Dynamics of the Accumulation of GMs in the Seeds of *G. macracantha* and their Comparative Characteristics

| Sample No | Date of collection of the raw material | Yield of GMs, % | $\eta_{char}$ (*c* 0.5%; $H_2O$) | Gal:Man ratio |
|---|---|---|---|---|
| 1 | 15.07 | 5.8 | 5.94 | 1:3.96 |
| 2 | 01.08 | 10.2 | 6.77 | 1:3.98 |
| 3 | 15.08 | 13.6 | 7.18 | 1:4.25 |
| 4 | 01.09 | 14.8 | 7.26 | 1:4.56 |
| 5 | 15.09 | 16.6 | 7.34 | 1:4.66 |
| 6 | 01.10 | 16.9 | 7.48 | 1:4.68 |
| 7 | 15.10 | 17.2 | 7.54 | 1:5.0 |

TABLE 2. Characteristics of the GMs before and after the Germination of the Seeds

| GMs | Yield of GMs, % | $\eta_{char}$ (*c* 0.5%; $H_2O$) | Gal:Man |
|---|---|---|---|
| Before germination | 21.0 | 7.54 | 1:5.0 |
| After germination | 14.0 | 4.10 | 1:2.14 |

TABLE 3. Influence of the Polymeric Compounds on the Germination of Cotton Seeds

| Variant | Concentration, % | Germination in 5 days. % | Deviation, % |
|---|---|---|---|
| Control | Without example | 60.4 | - |
| GMs | 0.5 | 64.9 | +4.5 |
| GMB | 0.5 | 66.3 | +5.9 |
| Nitrolim+GMB | 0.5+0.5 | 73.2 | +12.8 |

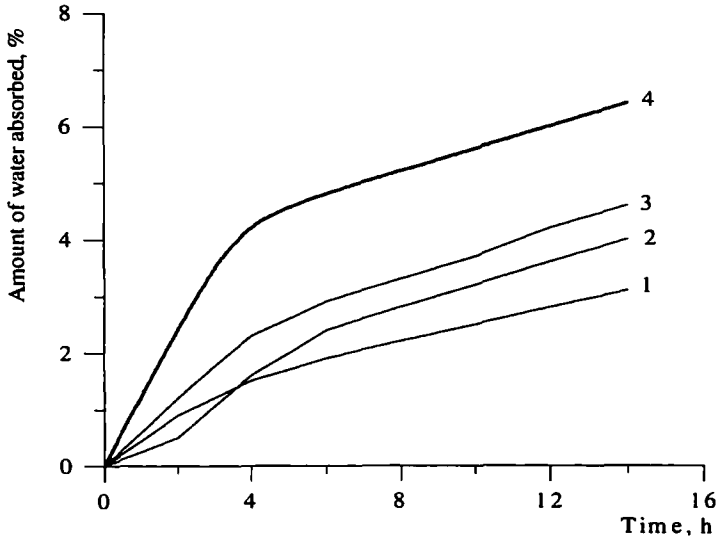


Fig. 1. Influence of polymeric compounds on the absorption of water by cotton seeds: *1*) control (untreated seeds); *2*) GMs; *3*) GMB; *4*) NGMB.

In order to improve the sowing quality of cotton seeds of the variety S-6524, we used as a growth regulator GMs isolated from seed coats and also samples of polysaccharides isolated from whole seeds, which consist of GMs containing 48% of proteins (GMB), and a composition of nitrolim with GMB (NGMB) in a ratio of 0.5:1. The polymeric compounds (0.5% solution) were used mainly for the presowing treatment — coating — of cotton seeds. Under laboratory condition the hydrophilicity of the seeds was determined gravimetrically, while the stimulating activity of the preparations was established in the light of the germinating capacity of the seeds during five days' germination.

The results of the investigations showed that the best composition for raising the hydrophilicity of the seeds was NGMB, which was capable of increasing the rate of penetration water into the interior of the seeds by a factor of approximately 2 in comparison with the control. The maximum swelling set in after 12 h, while, in the control variant, although an increase in the amount of water passing into the seeds directly proportional to the time was observed, the amount of water absorbed by the seeds reached only 30% after 18 h (Fig. 1).

It can be seen from Fig. 1 and Table 3 that the GMs, the GMB, and, particularly, the composition NGMB promote an intensified absorption water by the seeds. This is apparently connected with the rate of dissolution of the polymers in water. The timely saturation of the seeds with water creates the necessary conditions for an intensive development of biochemical transformations in the protoplasm that are capable of accelerating the starting mechanism and the growth of the seeds.

Thus, an increase in the hydrophilicity of seeds and, consequently in their germinating capacity under the action of polymeric compounds and compositions based on them has been shown.

## EXPERIMENTAL

Samples of *G. macracantha* seeds were gathered in the F. N. Rusanov Botanical Garden of the Academy of Sciences of the Republic of Uzbekistan. The galactomannans were obtained by a method described previously [3]. Conditions of hydrolysis and PC and GLC procedures are described in [3, 4]. The seeds were scalded by boiling (3—4 min), sown in sand, and watered daily.

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