Study of technological properties of aqueous solutions of polyacrylamide and fcl-1 with different concentrations

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Abstract. The quality and preparation methods of cotton seeds play a crucial role in increasing crop yield. Seed swelling capacity, germination energy, and laboratory germination are essential characteristics for precision sowing. The excessive fibrous covering on cotton seeds necessitates linting and delinting processes to ensure uniform distribution during sowing. However, existing methods have drawbacks, and none can be considered perfect. The results of a study on the structures, compositions, and physicochemical properties of polyacrylamide and other ingredients are presented. The potential utilization of these substances in the development of composite chemical preparations for cotton seed treatment is demonstrated. Based on the research findings, it is evident that the concentration of PAA significantly affects the viscosity, density, and water retention of the solutions. Choosing the right PAA concentration allows for the targeted regulation of the technological parameters of the solutions.

1 Introduction

Cotton, the leading agricultural crop in Uzbekistan, is affected by numerous diseases. Obtaining high-quality and sustainable yields is impossible without implementing comprehensive measures to protect plants from crucial diseases such as gummosis and root rot. Root rot of cotton is a widespread disease that occurs universally and causes significant damage to cotton production in the Republic. Each year, crop rotations or replanting of crops are carried out on an area of 200-300 thousand hectares.

Pre-sowing seed disinfection for the purpose of protecting them from diseases and pests is one of the most essential plant protection measures. Since ancient times, people have attempted to safeguard sowing materials from harmful organisms using various substances such as ashes, olive extracts, crushed cypress leaves, saltwater, Glauber's salt, copper and arsenic compounds, and etc.

Mechanical seed preparation methods (cleaning, sorting by density, size, electrostatic separation, etc.) are universally used in all systems, preceding physical and chemical treatment methods [1].

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In the study of K. Ruzmetov [2], it is noted that seed quality and preparation methods play a significant role in increasing cotton crop yield. When evaluating the sowing characteristics of seeds prepared by different methods, their swelling capacity is of great importance, along with indicators of germination energy and laboratory germination. It is important for precision sowing when seeds are sown in a dry state. Studies have shown that the water absorption rate of cotton seeds is closely related to their degree of exposure.

One of the problems in cotton farming is pre-sowing seed preparation. The issue is that years of experience have shown that it is not possible to sow immediately after ginning, i.e., after separating the cotton fiber from the seeds during cotton processing, due to significant seed agglomeration. Mechanical sowing results in uneven distribution, with more than a dozen seeds ending up in a single hole, leading to excessive seed consumption. Sowing completely bare seeds under unfavorable weather conditions can result in rotting and the need for reseeding, leading to additional seed expenses and delayed harvest.

Therefore, to remove the excessive fibrous covering on the surface of cotton seeds, they undergo linting and delinting processes, which involve mechanical, physical, chemical-mechanically, chemically, or other combined methods to remove the residual fibrous covering from the seeds. Unfortunately, none of the existing methods can be considered perfect, as each has its drawbacks.

2 Materials and methods

The question of the biological significance of hairs on cotton seeds is still unclear. Fibers and fuzz cannot serve as adaptations for seed dispersal by wind since they are relatively heavy and lack the necessary buoyancy. A.K. Orudzhev and M.B. Kuliev (1962) found that delinted seeds have a greater swelling capacity than undelinted seeds. While undelinted seeds absorb 29.14% of water in the first 4 hours at a temperature of 100°C, delinted seeds absorb 37.64%. As the water temperature increases, the swelling rate of both undelinted and delinted seeds accelerates, but the advantage remains with the delinted seeds [3].

However, pre-soaking seeds can lead to undesirable consequences in certain cases. Inclement weather conditions such as precipitation or sudden temperature drops that require delaying sowing for an indefinite period can cause the soaked seeds to germinate, significantly affecting their sowing quality.

In agricultural production, chitosan and its derivatives are widely used as biostimulants, providing increased crop yield and combating nematodes, root and stem rot, rust, and serving as inducers of plant defense responses [4].

With the prolonged storage of cotton seeds, their germination significantly decreases. In this regard, the influence of one of the natural plant hormones, gibberellic acid, and oxigumate, obtained by chemical means, on the germination and initial growth processes of cotton seeds of the 108-F variety stored under normal conditions for 5 years has been studied [5].

3 Results and discussion

Study of the technological properties of aqueous solutions of polyacrylamide at different concentrations. It is known that polyacrylamide (PAA) is one of the components of composite chemical reagents used for the cultivation and cultivation of agricultural crops. The technological parameters of the obtained PAA solutions are directly dependent on its concentration [8].

Figure 1 shows the dependencies of viscosity, water retention, and density of aqueous solutions of PAA on its concentration.

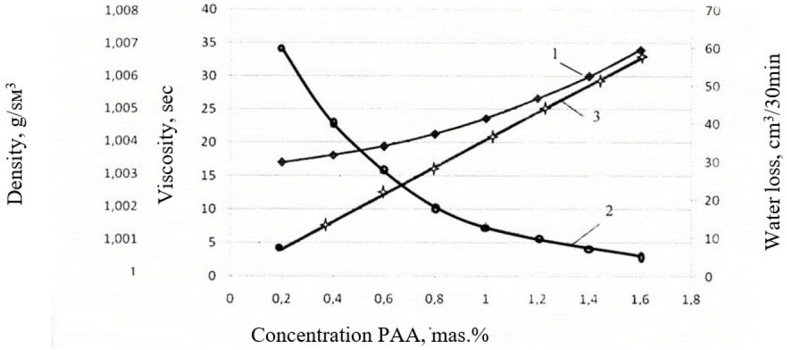

Fig. 1. Dependence of viscosity (1), fluid loss (2) and density (3) of aqueous solutions of PAA on its concentration.

From the course of the curves in Figure 1, it can be seen that the viscosity and density of the solutions increase with the increasing concentration of PAA, while the water retention decreases. This can be explained by the fact that PAA is a high-molecular-weight substance with a higher density compared to water. As it dissolves in water, the viscosity of the solution increases, and the water retention decreases, and vice versa. The data presented in Table 1 confirm these conclusions.

From the provided data, the following can be noted: the viscosity, density, and water retention of the solutions significantly depend on the concentration of PAA. For example, the viscosity of PAA solutions increases from 17 to 34 seconds. The density, on the other hand, changes slightly, and the water retention decreases from 60 to 6 cm3/30 min. Based on the research results, it can be concluded that by selecting the appropriate concentration of PAA, the technological parameters of the solutions obtained with its use can be purposefully regulated [9-11].

Table 1. Technological parameters of aqueous solutions of PAA at different concentrations.

Concentration PAA, mas.%	**Viscosity, sec**	**Density, g/sм^3**	**Water loss, cm^3/30min**	**pH**
0.2	17	1.0008	60	7
0.4	18.1	1.0017	40	7
0.6	19.4	1.0026	28	7
0.8	21.24	1.0035	18	7
1	23.6	1.0044	13	7
1.2	26.6	1.0052	10	7
1.4	30	1.0061	7	7
1.6	34	1.007	6	7

4 Conclusion

An analysis of literary sources and patent-licensing developments on the method of pre-sowing seed treatment for agricultural crops, organic and inorganic ingredients, and chemical agents for seed dressing, cultivation, and growth of cotton, wheat, and other agricultural crops has been conducted. Taking into account the analysis of literary sources, gossypol resin, caustic soda, calcined soda, alumak (a byproduct of non-ferrous metal processing),

carboxymethyl cellulose, hydrolyzed lignin, polyacrylamide, and reagent FHL-1 were selected as ingredients for developing effective compositions of composite preparations. Overall, this study sheds light on the importance of seed preparation methods, delinting processes, and the influence of various substances on cotton seed quality and crop yield. It also highlights the significant role of PAA concentration in determining the technological properties of solutions used in agricultural practices.

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