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STUDYING DROUGHT RESISTANCE AND SOME TECHNOLOGICAL INDICATORS OF FIBER OF COLLECTION VARIETIES COTTON

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Abstract. The purpose of the study was to study the adaptive ability to drought of collection varieties of cotton of the species *G.hirsutum* L. and *G.barbadense* L. with subsequent assessment of the technological properties of the fiber. An analysis of stress-depression of seed germination in a sucrose solution was used as an indicator of plant resistance to drought. The technological properties of the fiber were analyzed using the HVI (High Volume Instrument) electronic system in accordance with the unified international classification. It was established that, with the same intensity of the extreme factor, varieties of the same type of cotton differed significantly in the amplitude of changes in the physiological indicator, which made it possible to identify drought-resistant samples. Varieties Agdash-3, Ganja-2, AF-16, Karabakh-11, Zafar, Akala 1517 of the species *G.hirsutum* L. and varieties S-6002, 5230-V, Aspero, S-6022, AP-154, Agdash-21, Termez-74 of the species *G. barbadense* L. were characterized by drought resistance. All drought-resistant varieties of the species *G. barbadense* L. are characterized by a complex of positive fiber quality indicators. The variety Zafar within the species *G.hirsutum* L. was superior to other genotypes in this indicator. These cotton varieties are recommended to breeders for use in various breeding programs.

Keywords: *Cotton, G.hirsutum L., G.barbadense L., drought, resistant, technological indicators of fiber.*

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1. Introduction

In the mid-30s of the twentieth century, the Canadian scientist Selye (1972) was the first to show that various adverse effects cause a nonspecific response in the animal's body. In later works, Selye (1982) combined the terms "stress" and "general adaptation syndrome", using them as synonyms. In the middle of the twentieth century, the theory of stress was transferred to the plant organism.

There are many different types of stress. According to Kuznetsov and Dmitrieva (2011) it is more correct to call external factors acting on a biological system and causing stress stressors. Stressors are divided into three main groups: physical (high and low temperature, illumination, lack or excess of moisture, radioactive radiation, mechanical

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stress), chemical (increased concentration of arbon dioxide, accumulation of salts in the soil, air and water polluted by industrial and household waste, high concentrations of xenobiotics (herbicides, fungicides, insecticides), biological (damage by pathogens or pests, negative influence of animals, starvation, etc.).

Among the unfavorable conditions that cause stress in plant organisms, abiotic factors should be highlighted. Abiotic stresses vary in nature, but the nature of plant physiological responses to them is the same. This physiological response to stress, occurring both in an individual cell and in the whole organism, is dynamic in nature and consists of successive phases (irritation, damage and adaptation), which have their own significant characteristics (Kul *et al*., 2020). The adaptation process occurs constantly and "tunes" the body to changes in the external environment within the limits of natural fluctuations in factors. These changes can be both nonspecific and specific. The impact of abiotic factors on a plant leads to a number of nonspecific responses, which are the result of the "switching on" of nonspecific signaling systems in the cell by stressors (Koshkin, 2010). Nonspecific are the same type of reactions of the body to the action of different stressors or different organisms to the same stress factor. Specific responses include responses that differ qualitatively depending on the active factor and plant genotype (Terletskaya, 2012). The study of plant responses to the specific action of a negative factor allows us to more fully and accurately determine the content of the trait of resistance to unfavorable environmental factors (Munns, 2000; 2005). The totality of data accumulated in the literature allows us to speak about the functioning of general mechanisms of resistance in plants (Kuznetsov, 2001; Chaves *et al*., 2009; Wahid *et al*., 2007; Singh *et al*., 2021).

The functioning of general resistance mechanisms allows the plant to avoid enormous energy costs associated with the need to form specialized adaptation mechanisms in response to any deviation of the organism's living conditions from normal. To study the general mechanisms of resistance, of particular interest is the response of plants to drought, salinity, low and high temperatures and other factors that induce a number of physiological, biochemical and molecular genetic mechanisms that ensure plant adaptation to changing environmental conditions. Much attention is paid to the study of these aspects of plant resistance to stress (Aslan *et al*., 2015; Gupta & Huang, 2014; Bray *et al*., 2000; Wang *et al*., 2003). For a more in-depth study of plant resistance to changing environmental conditions, various plant objects are used (Brahti & Chaudhary, 2019; Mammadova *et al*., 2015).

Cotton, belonging to the genus *Gossipium* L. which in Latin means "tree that produces fiber") of the family *Malvaceae* Juss., according to the currently accepted classification by F.M. Mauer, includes 35 species of which five are used in culture: *G.hirsutum* L., *G.barbadense* L., *G.arbareum* L., *G.herbaceum* L., *G.tricuspidatum* L.

The species *G.hirsutum* L., originating from Central America (Mexico), is the most common in culture. The species *G.barbadense* L., originating from South America (Peru), is less common in cultivation, mainly because it is later ripening.

Cotton was brought to Azerbaijan from neighboring Iran, where, according to some historical documents, cultivation began already in the УI st century BC. Initially, cotton growing in Azerbaijan was slightly developed and was based exclusively on local varieties of cotton – guzy (local name "kara-goa" *G.herbaceum* L.). Cotton growing based on guz was low-yielding, guz fiber was short, coarse and did not meet the requirements of the textile industry. Subsequently, old local varieties were replaced by more productive and high-quality cotton varieties of the species *G.hirsutum* L. and in some areas with the warmest and longest growing season - varieties of fine-fiber cotton of the species *G.barbadense* L.

Drought is the most common unfavorable environmental factor affecting cotton, which by worsening the nutritional conditions of plants, leads to a slowdown in the development of cotton, a change in the quality of raw cotton and fiber, reducing its length and strength, resulting in a significant reduction in plant productivity (Zafar *et al*., 2023). Of significant interest is the study of changes in resistance and the processes that accompany them in the initial period of influence of unfavorable factors on plants, since it is during this period that events occur that largely determine the entire subsequent course of resistance formation.

Productivity is a complex integral indicator that reflects the manifestation of the genetic potential of varieties under changing environmental conditions. The study of such a trait as resistance to abiotic environmental factors, along with length, fiber yield, early ripening and productivity, makes it possible to purposefully solve the problem of optimal selection of parental forms, create highly resistant hybrid combinations, breeding material and new varieties of cotton.

At the Institute of Genetic Resources of the Ministry of Science and Education of Azerbaijan, where they collect, preserve and study various plants (Aliyev & Akperov, 2002), the cotton collection numbers more than 1.500 samples. The presence of a sufficient gene pool of stress-resistant varieties to unfavorable environmental factors, combined with positive productivity qualities, is an important element of the successful development of cotton growing.

The purpose of this study was to study the adaptive ability of collection cotton varieties under drought conditions with subsequent assessment of the technological properties of fiber in stress-resistant samples.

2. Materials and methods

Collection samples of cotton species G.*hirsutum* L. and *G. barbadense* L. were taken as research material. Considering the fact that cotton is particularly sensitive, and therefore least resistant at the germination stage and at a young age (Akparov *et al*., 2006; Kul *et al*., 2020; Zahid *et al*., 2021), germination and stress-depression of germination in a sucrose solution simulating drought were used as indicators of plant resistance to drought (Udovenko, 1988; Lu *et al*., 2022).

Testing of the quality characteristics of the fiber of the studied cotton samples was carried out using an electronic system HVI (High Volume Instrument), in accordance with US Universal Standards, which are accepted by all cotton countries as an international standard. In accordance with the international classification of characteristics, the quality components of the fiber are: mean length (ML); upper half mean length (UHML); uniformity index (UI). Micronaire (Mic) – characterizes both the fineness and maturity of cotton fiber; strength (Str) is determined by the force that can cause a fiber to break; elongation (Elg) is the elongation or resilience and elasticity on which the ability of a fiber to withstand force before breaking depends.

3. Results and discussion

It is known that differences between varieties in terms of the level of resistance are genetically conditioned and are hereditarily preserved in a number of generations. And although the absolute value of the resistance of a variety depends on the accompanying conditions of its cultivation and changes significantly under their influence, the relative differences between varieties of different levels remain the same (Goncharova, 2002).

The physiological reaction to stress is an emergency mobilization of adaptive potential, providing temporary experience of adverse effects and therefore, having adaptive significance. An assessment of the responses of different cotton varieties to stress revealed differences in the nature of changes in physiological parameters. The response of plants to the influence of an unfavorable environmental factor made it possible to roughly divide cotton samples into groups within the species, determining different degrees of comparative resistance and identifying drought-resistant genotypes (Figure 1).

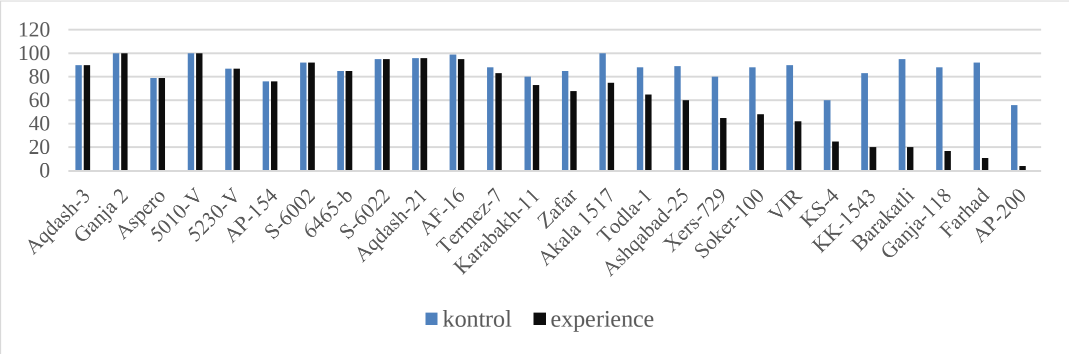

Figure 1. Germination of seeds of cotton varieties under drought

Thus, cotton varieties of the species *G.hirsutum* L. Agdash-3, Ganja-2, AF-16, Karabakh-11, Zafar, Akala1517 when germinating seeds in a sucrose solution were identified as drought-resistant. In the species *G.barbadense* L. varieties 5010-V, S-6002, 5230-V, Aspero, S-6022, AP-154, Agdash-21, Termez-7 turned out to be drought-resistant.These samples are characterized by the absence of stress-depression of seed germination under drought conditions.

The ability of seeds of drought-resistant samples to germinate under stress conditions reflects, on the one hand, the hereditary ability to germinate with relatively less water and on the other hand, the presence of a high suction force that ensures the absorption of the required amount of water. The high suction power of seeds determines not only better germination when there is a lack of moisture, but also the formation of a more powerful primary root system, which is important for the further life of plants during drought.

The greater resistance of cotton varieties to stress determines their ability to maintain a normal level of metabolism over a wider range of unfavorable factor intensity values and a greater rate of development of protective metabolic changes in them. Resistant plants, in comparison with unstable ones, most completely rearrange their vital functions towards adaptation to unfavorable environmental conditions. Unsustainable plants under the influence of negative environmental factors are more conservative and are not capable of quickly changing their vital functions, as a result of which they often die.

The main economically valuable characteristics that ultimately determine cotton as a valuable agricultural crop include the length of staple fiber and fiber yield, the productivity of raw cotton per plant, the weight of raw cotton per boll and others. Table presents the technological indicators of fiber of drought-resistant cotton varieties belonging to the *G.hirsutum* L. and *G. barbadense* L. species.

An important feature that determines the technological properties of the fiber and its value for spinning is the length of the fiber. In the varieties we studied that are characterized by resistance to drought stress, UHML ranges from 23.5-34.2 mm. The maximum length of fibers in the species *G. hirsutum* L., equal to 29.0 mm, was noted in the sample of the variety Zafar, in the species *G. barbadense* L. – in the sample of the variety S-6002 (34.2 mm).

All selected drought-resistant varieties related to *G. barbadense* L. species are characterized by a complex of positive fiber quality indicators. Among the drought-resistant varieties belonging to the *G.hirsutum* L. species, the Zafar variety was superior to other genotypes in terms of complex positive fiber quality characteristics.

4. Conclusion

Table 1. Technological indicators of fiber quality and drought resistance of cotton varieties

№	Name of varieties	Stress-depression germination of seeds during drought, %	Indicators of quality fiber components						
			Mean length, mm (ML)	Upper half mean length, mm (UHML)	Uniformityindex, % (UI)	Strength, g/tex (Str)	% Elongation, % (Elg)	Micronaire, Unit (Mic)	Fineness, m/tex (Fin)
G.hirsutum L.									
1.	Agdash-3	0	23.6±0.6	25.4±0.5	92.9±1.3	25.0±1.9	5.8±0.1	4.9±0.3	160±10.5
2.	Ganja-2	0	21.3±0.2	23.5±0.7	90.6±1.2	23.6±0.5	6.1±0.2	5.2±0.9	164±12.6
3.	AF-16	3.6	22.6±0.3	27.8±0.8	81.3±1.5	26.5±0.7	5.8±0.5	4.5±0.5	135±7.8
4.	Karabakh-11	8.5	25.4±0.5	27.3±1.2	93.0±0.8	28.3±0.9	6.6±0.7	5.0±0.8	162±14.6
5.	Zafar	20.2	28.3±1.3	29.0±1.6	97.8±1.3	31.2±0.4	6.2±0.4	4.9±0.1	157±11.6
6.	Akala-1517	25.0	25.5±0.2	27.6±1.3	92.4±0.9	25.1±1.5	6.4±0.1	5.0±0.3	168±10.9
G.barbadense L.									
7.	5010-V	0	30.2±0.3	31.6±0.2	95.8±1.0	32.0±0.5	6,8±0.8	4,8±1.9	152±14.3
8.	S-6002	0	32.7±0.1	34.2±0.1	95.6±0.2	38.7±0.6	6,6±0.7	4,9±0.8	152±12.7
10.	Aspero	0	31.0±0.6	32.9±0.3	94.3±0.4	33.0±0.4	6.6±0.7	4.4±0.7	129±8.1
11.	S-6022	0	28.4±0.4	31.2±0.5	90.9±0.5	37.0±0.2	6.4±0.3	4.6±0.7	138±7.1
12.	AP-154	0	28.9±0.5	31.4±0.2	92.3±0.3	32.1±0.3	6.3±0.4	4.5±0.5	134±5.4
13.	Agdash-21	0	29.7±0.6	32.4±0.1	91.6±0.2	32.4±0.1	6.6±0.2	4,8±0.6	147±9.8
14.	Termez-7	6.0	28.2±0.7	29.7±0.3	94.9±0.5	29.2±0.3	6.4±0.5	4.5±0.6	138±7.5

Thus, as a result of research, it has been established that with the same intensity of the extreme factor of a variety, varieties of the same species cotton plants differ significantly in the amplitude of changes in physiological indicators. The amplitude of physiological parameters under stress conditions depends on the level of plant resistance, which represents the heritable potential ability of the organism to adapt and is realized under conditions of extreme factors. Analysis of fiber technology allowed drought-resistant varieties, characterized by positive technological indicators of fiber, to be recommended to breeders for use in various breeding areas.

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