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IDENTIFICATION OF DROUGHT-RESISTANT COTTON SAMPLES AND THEIR APPLICATION IN THE MAS PROGRAM

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Abstract

In this study, the drought tolerance of 9 local cotton (Gossypium hirsutum L.) varieties was assessed based on morphological and biometric parameters. During the experiment, normal (50 ml) and water deficit (25 ml) conditions were established, and growth and physiological traits, including shoot length, root length, leaf weight dynamics, water transpiration and re-uptake capacity, as well as stem and root system development, were analyzed. Water stress significantly affected shoot length, root length, relative water content of leaves, and the dynamics of transpiration and re-uptake. Percentage changes relative to the control were calculated, and promising varieties were recommended for inclusion in the marker-assisted selection (MAS) program.

Keywords: Cotton, drought, water deficit, biometric analysis, root system, MAS, SSR markers.

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INTRODUCTION

Globally, climate change has led to an increasing demand for water resources. The reduction of freshwater reserves worldwide continues to pose a significant threat to the agricultural sector. This situation contributes to increased water consumption and, consequently, to the expansion of drought-affected areas. One of the primary solutions is considered to be the development of plant varieties tolerant to water deficiency. In cotton (Gossypium hirsutum L.), it is important to identify varieties resistant to water deficit conditions, study their genetic polymorphism, and incorporate them into modern breeding programs. The present study aims to evaluate the tolerance level of local cotton varieties to water deficit stress under laboratory conditions. On March 20, 2025, nine local cotton varieties were selected for the study:

Andijon-35, Andijon-36, Andijon-37, Xorazm-127, C-6524, Ravnaq-1, Ravnaq-2, Buxoro-6, and Porloq-1.

Morphological and biometric changes during the experimental period were analyzed:

MATERIALS AND METHODS

The study was conducted at the Center of Genomics and Bioinformatics of the Academy of Sciences of the Republic of Uzbekistan, in the Department of Personalized Agriculture Crops Research. As research objects, nine widely cultivated local cotton varieties in Uzbekistan were selected. Each variety was grown in two groups (control and water-deficit conditions) with five biological replicates. All samples were irrigated equally until the emergence of true leaves. After true leaf formation, plants in the control group received 50 ml of water per plant, whereas plants grown under water deficit conditions received 25 ml per plant. Throughout the experiment, soil conditions, climate parameters, and fertilization remained constant for both control and stress groups. Water regime was considered the main factor, while variety, soil-climate conditions, and

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fertilization were treated as sub-factors. This irrigation regime was maintained for 12 days. Afterward, all plants were uprooted and evaluated under both normal and water deficit conditions based on the following criteria:

- Morphological and biometric parameters of plants
- Leaf weight of cotton varieties under different irrigation conditions.

RESULTS AND DISCUSSION

Table 1. Changes in leaf weight under different irrigation conditions (g)

Variety	Condition	Initial	1 hour	4 hours	24 hours
Andijon-35	Normal	0.56	0.43	0.47	0.60
Andijon-35	Stress	0.34	0.33	0.27	0.67
Andijon-36	Normal	0.64	0.55	0.52	0.63
Andijon-36	Stress	0.30	0.30	0.28	0.50
Andijon-37	Normal	0.52	0.40	0.38	0.60
Andijon-37	Stress	0.22	0.19	0.18	0.38
Xorazm-127	Normal	0.55	0.45	0.40	0.69
Xorazm-127	Stress	0.44	0.40	0.37	0.64
C-6524	Normal	0.48	0.41	0.39	0.70
C-6524	Stress	0.37	0.37	0.35	0.44
Ravnaq-1	Normal	0.52	0.45	0.43	0.71
Ravnaq-1	Stress	0.35	0.33	0.30	0.58

Table 1 presents the initial leaf biomass indicators of the varieties under normal and water deficit conditions. A decrease in biomass was observed in all varieties under water deficit conditions.

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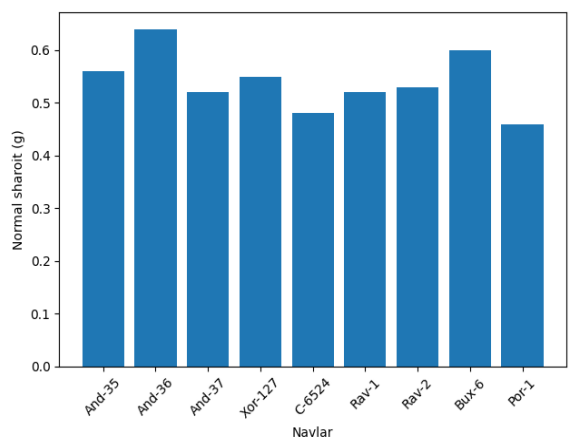

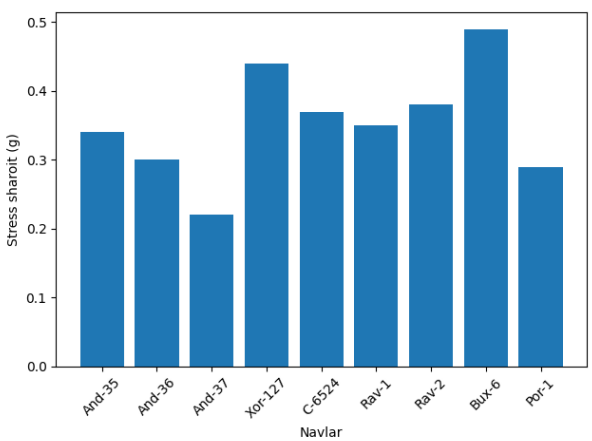

Figure 1. Leaf weight under normal conditions

Figure 2. Leaf weight under water deficit conditions

Table 2. Mean values of stem and root parameters under different irrigation conditions (n = 5)

Variety	Condition	Total length (cm)	Root length (cm)	Total weight (g)	Root weight (g)
Andijon-35	Normal	25.6	10.4	3.41	0.36
Andijon-35	Stress	27.7	13.3	2.28	0.20
Andijon-36	Normal	32.6	12.8	4.06	0.38
Andijon-36	Stress	33.3	16.3	1.38	0.19
Andijon-37	Normal	34.4	13.9	4.09	0.40
Andijon-37	Stress	28.4	10.2	1.02	0.15
Xorazm-127	Normal	31.5	13.2	3.75	0.49
Xorazm-127	Stress	32.4	13.3	2.18	0.24
C-6524	Normal	35.0	13.2	4.34	0.39
C-6524	Stress	30.5	12.3	1.57	0.20
Ravnaq-1	Normal	30.4	12.6	4.22	0.45
Ravnaq-1	Stress	28.0	11.6	1.86	0.27
Ravnaq-2	Normal	34.7	17.3	4.32	0.47
Ravnaq-2	Stress	27.8	13.2	2.44	0.25
Buxoro-6	Normal	32.5	13.2	4.12	0.34
Buxoro-6	Stress	28.6	12.0	1.68	0.27
Porloq-1	Normal	35.0	17.5	3.35	0.34
Porloq-1	Stress	26.1	12.6	1.53	0.19

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Table 2 shows the average morphometric parameters of the stem and root systems of nine local cotton varieties under normal and water deficit conditions (n = 5). The table compares total length, root length, total biomass, and root weight, which allows evaluation of the adaptability of the varieties to water deficit conditions.

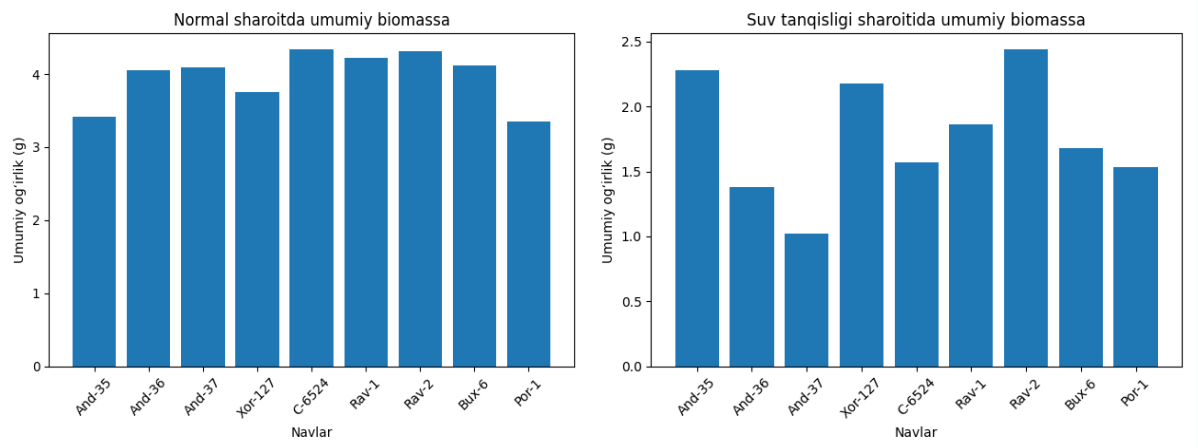

Figure 3. Total biomass under normal conditions (g)
Figure 4. Total biomass under water deficit conditions (g)

The results showed that under water deficit conditions, the total biomass significantly decreased in most varieties. However, in some varieties (e.g., Andijon-35 and Andijon-36), an increase in root length was observed. This indicates that under stress conditions, the root system tends to deepen, enhancing the plant's ability to search for water. In relatively stable varieties, the preservation of root length and root weight indicates their adaptability to drought conditions. Furthermore, comparison of leaf weights revealed that plants grown under normal conditions lost relatively more weight. This suggests that plants grown under water deficit conditions retain less water in their leaves, resulting in reduced transpiration. Based on these findings, preliminary selection of drought-tolerant varieties can be performed, and these varieties can be recommended for further molecular-genetic analysis using SSR markers.

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CONCLUSION

In this study, the effects of water deficit stress on morphological and biometric traits of nine local varieties of Gossypium hirsutum were evaluated. The results demonstrated that water deficit conditions led to a decrease in total biomass and leaf weight across all varieties. However, an increase in root length was observed in certain varieties, indicating adaptive mechanisms to stress conditions. Comparative analysis revealed that Xorazm-127, Andijon-35, Buxoro-6, and partially Ravnaq-2 maintained relatively stable performance under water deficit conditions and can be considered drought-tolerant genotypes. The relatively well-developed root systems and lower biomass loss in these varieties confirm their adaptability. Based on the obtained results, these varieties are recommended as promising initial material for further molecular-genetic studies, particularly for assessing genetic polymorphism using Simple Sequence Repeat (SSR) markers and for incorporation into marker-assisted selection (MAS) programs. The findings of this study have important scientific and practical significance for the development of high-yielding, drought-tolerant cotton varieties.

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