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INHERITANCE OF MORPHOLOGICAL TRAITS IN HYBRIDS OF EXTRA-LONG STAPLE COTTON VARIETIES

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Abstract
In F_1 combinations of extra-long staple cotton varieties, morphological traits were inherited primarily through positive superdominant. It was found that cytoplasmic genes, along with nuclear genes, also participate in the genetic control of these traits. As a result of studying the general combining ability of varieties, it was found that it would be effective to involve Termiz-32 in selection work to create high-yielding varieties.

Keywords: G. barbadense L, cotton, variety, hybrid, morphological traits, inheritance, dominance coefficient.

INTRODUCTION

In many countries, including the United States, China, Australia, India, Pakistan, Turkey, and Uzbekistan, leading cotton-growing countries, many varieties and hybrids are currently being developed that are early maturing, have high fiber yield and fiber quality, are suitable for machine harvesting, are resistant to diseases and pests, are productive, and are tolerant to various climatic conditions. However, in global cotton production, obtaining stable and high-quality fiber products, as well as improving yield and other morphological traits and characteristics in newly developed varieties, remains one of the most important tasks. Compared with other

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agricultural crops, cotton differs in that it simultaneously provides three types of valuable products: fiber as a raw material for the textile industry, oil for food products, and meal and husk for animal feed.

Currently, the main cotton-growing areas around the world cultivate cotton varieties G. hirsutum L. and G. barbadense L. In the international cotton market, the fiber of extra-long staple cotton varieties belonging to the G. barbadense L. is valued more highly than the fiber of medium fiber varieties. From one ton of this type of fiber, several times more fabric can be spun, and its price is also higher. While 8620 m^2 of fabric can be produced from one ton the fiber obtained from medium fiber cotton varieties belonging to fiber type V, 15510 m^2 of fabric is produced from one ton of extra-long staple cotton varieties of fiber type I (http://tadbirkor-fermer.uz/ingichka-tolali-uza-ustirish/).

Uzbekistan is considered one of the countries in the world that has successfully mastered the production of extra-long staple cotton. The main reason for this is the high temperature in the southern regions of our republic, the higher heat reserves in Sherabad compared to Cairo (Egypt), and in Termez compared to Alexandria (Egypt) and Bayram Ali (Turkmenistan), Another important factor is the many years of effective work carried out by leading breeders and seed scientists (Iksanov, 2009).

Extra-long staple cotton varieties of the G. barbadense L. species are very demanding on high temperatures due to their biological characteristics and are grown in small areas in the southern regions of our republic. Establishing the production of extra-long staple cotton and processing the harvested high-quality fiber into yarn and finished products brings significant economic benefits to the state economy. To achieve this goal, it is important to develop early-maturing, high-yielding varieties of the G. barbadense L. species with high-quality fiber and to expand their cultivation areas (Vik.Avtonomov et.al; 2017; S.M.Nabiyev et al.; 2020; B.X.Amanov et al.; 2021; J.F.Zhang, et al.; 2017).

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RESEARCH MATERIALS AND METHODS

Our research was conducted at the Zangiota experimental field of the Institute of Genetics and Plants Experimental Biology of the Academy of Sciences of the Republic of Uzbekistan. The soil of the experimental field was a typical gray soil, not saline, with deep groundwater (more than 8.0 meters), and naturally infected with wilt disease. Agrotechnical measures were carried out on time and with high quality. As research materials, local cotton varieties belonging to the G.barbadense L. - Termiz-32, Duru Gavhar, Bukhoro-7 and Surkhan-10 - were used.

RESULTS OF RESEARCH AND THEIR ANALYSIS

In our research, among the studied extra-long staple cotton varieties, the Bukhara-7 variety had the greatest plant height (114.8 cm), while relatively short plants were found in the Surkhan-10 variety (66.3 cm). Among the F_1 plants, the highest values for this trait were exhibited by the hybrid combinations Duru Gavhar × Bukhara-7 (117.3 cm) and Bukhara-7 × Termiz-32 (108.1 cm). Short-statured plants were mainly observed in all hybrid combinations developed with the participation of the Surkhan-10 cotton variety variety (Table 1).

In 12 F_1 combinations obtained by diallel crossing of parental varieties, the plant height trait was inherited as follows: incomplete dominance of the tall variety was observed in 2 combinations, incomplete dominance of the dwarf variety was observed in 6 combinations, positive overdominance was observed in 2 combinations, negative overdominance was observed in 1 combination, and intermediate dominance was observed in 1 combination, i.e., the low-growing variety showed no dominance. In the reciprocal hybrid combinations between the tallest variety, Bukhara-7 cotton variety, and the shortest variety, Surkhan-10 cotton variety, incomplete dominance of the trait of the Surkhan-10 cotton variety was expressed.

The plant height trait was inherited in F_1 hybrids by the type of positive overdominance in the combinations Duru Gavhar x Termiz-32 and Duru Gavhar x Bukhara-7, and by the type of negative overdominance in the combinations Surkhan-10 x Termiz-32. Thus, in extra-long staple cotton varieties, the plant

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height trait in F_1 combinations was inherited depending on the parental forms, showing incomplete dominance of either the taller or shorter parent, as well as cases of overdominance and intermediate expression. According to analysis of variance ($LSD_{0.05}$ = 5.1 cm), reciprocal differences in plant height were identified in both direct and reciprocal crosses between Duru Gavhar and Bukhara-7 varieties, as well as between the Bukhara-7, Termiz-32 and Duru Gavhar varieties. These results indicate that, in the genetic control of this trait, both nuclear genes and cytoplasmic genes are involved.

Table 1 Inheritance of trait the plant height in F_1 plants of extra-long staple cotton varieties, sm

№	Varieties and F_1 combinations	n	$\bar{x} \pm S_{\bar{x}}$	σ	V	hp
1	Termiz-32	30	87,0±1,2	2,0	2,4	-
2	Duru Gavxar	30	98,5±3,7	4,5	6,6	-
3	Bukhara-7	30	114,8±1,2	2,1	1,9	-
4	Surkhan-10	30	66,3±1,3	2,6	1,0	-
5	Termiz-32xDuru Gavxar	30	96,5±3,3	6,4	7,5	0,65
6	Duru GavxarxTermiz-32	30	99,0±6,3	9,3	11,4	1,10
7	Termiz-32x Bukhara-7	30	100,7±7,7	11,3	12,3	-0,01
8	Bukhara-7xTermiz-32	30	108,1±1,9	3,3	3,1	0,52
9	Termiz-32x Surkhan-10	30	67,6±2,0	3,5	5,3	-0,87
10	Surkhan-10xTermiz-32	30	63,7±2,3	5,2	6,5	-1,25
11	DuruGavxarxBukhara-7	30	117,3±2,8	4,8	4,1	1,30
12	Bukhara-7xDuru Gavxar	30	104,6±5,2	8,4	9,4	-0,25
13	Duru Gavxarx Surkhan-10	30	67,5±5,9	8,7	2,5	-0,93
14	Surkhan-10xDuru Gavxar	30	69,6±3,8	6,6	9,5	-0,80
15	Bukhara-7x Surkhan-10	30	68,0±6,0	10,5	15,4	-0,93
16	Surkhan-10x Bukhara-7	30	71,7±4,2	7,2	10,1	-0,78
	LSD_{05}		5,1			

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According to our data on plant productivity, the highest indicator in the group of extra-long staple cotton varieties studied was the Bukhara-7 variety (45.2 g/plant). The total productivity per plant was 41.2 g, 36.4 g and 34.7 g for the Surkhan-10, Termiz-32 and Duru Gawhar varieties, respectively.

According to the level of dominance, among the 12 F_1 combinations, 9 showed positive heterotic overdominance, 1 showed negative heterotic overdominance, 1 exhibited complete dominance of the high-performing variety, and 1 showed incomplete dominance of the low-performing variety. In all direct and reciprocal combinations of the Termiz-32 and Duru Gavhar varieties, the trait was inherited in a state of positive overdominance. In the reciprocal combinations obtained from crossing the Bukhara-7 and Surkhan-10 varieties, which do not differ significantly in trait expression, negative heterotic overdominance and incomplete dominance of the low-performing variety were recorded for this trait.

Thus, the trait of plant productivity in F_1 combinations was inherited primarily through overdominance with positive heterosis. In reciprocal hybrids obtained by crossing the Termez-32 variety with the Bukhara-7 variety, a high heterosis effect (from 136.1% to 151.9%) was identified. These hybrid combinations can be effectively utilized in heterosis breeding.

Our obtained results confirmed the conclusions of Viktor A. Avtonomov et al. (2015) that the inheritance of the plant productivity trait has an overdominant nature. In contrast, O.Kh. Kimsanboev (2011) concluded that the plant productivity trait is inherited in an intermediate state in F_1 hybrids of the species G. barbadense L. In our opinion, the reason for this is that the author chose geographically distant varieties and lines that differ sharply from each other as the initial source. According to Viktor A. Avtonomov (2008), positive heterosis for this trait can reach 30–40% compared to the high-yielding parent, depending on the specific crossing combinations used.

A high positive indicator of GCA (General Combining Ability) effect for plant productivity was recorded in the Termiz-32 variety ($\hat{g}_i$ was equal to 3.7, respectively) (Table 2). This indicates that the Termiz-32 variety can be used as a starting material in the selection of high-yielding cotton varieties. In terms of

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overall productivity, the Duru Gavhar, Bukhara-7 and Surkhan-10 varieties had a negative index of the effect of the GCA ($\hat{g}_i$ - 2.6; -3.3; and -3.6, respectively). Despite the high characteristic indices, the Bukhara-7 and Surkhan-10 varieties showed low indicators of the GCA effect. This indicates that the yield in these varieties is mainly controlled by recessive genes.

Table 2 General Combining Ability (GCA) effect ($\hat{g}_i$), Specific Combining Ability (SCA) constant ($\hat{s}_{ij}$), GCA variance (σ^2_{gi}) and SCA variance (σ^2_{si}) for the trait of plant productivity in varieties

♀ \ ♂	Termiz-32	Duru Gavhar	Bukhara	Surkhan-10	$\Sigma\hat{s}_{ij}^2$	σ^2_{si}	σ^2_{gi}	$\hat{g}_i$
Termiz-32		-4,7	-7,4	8,4	159,1	42,6	20,7	3,7
Duru Gavhar			9,3	5,4	280,0	82,3	6,2	-2,6
Bukhara				-10,8	377,6	118,4	9,4	-3,3
Surkhan-10					235,4	71,0	11,3	-3,6

In all varieties, the condition $\sigma^2_{si}>\sigma^2_{gi}$ is observed, which indicates the high effect of non-additive genes on plant productivity. A high positive Specific Combining Ability (SCA) constant was observed in the combinations Duru Gavhar x Bukhara-7 ($\hat{s}_{ij}$-=9.3) and Termiz-32 x Surkhan-10 ($\hat{s}_{ij}$=8.4), i.e., in combinations inherited in a state of superdominance with positive heterosis, while a high negative Specific Combining Ability (SCA) constant was observed in the combination Bukhara-7 x Surkhan-10 ($\hat{s}_{ij}$ respectively -10.8).

CONCLUSION

In F_1 combinations of extra-long staple cotton varieties, morphological traits were inherited primarily through positive superdominant. It was found that cytoplasmic genes, along with nuclear genes, also participate in the genetic control of these traits. As a result of studying the general combining ability of varieties, it was found that it would be effective to involve Termiz-32 in selection work to create high-yielding varieties.

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