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COMBINING ABILITY AND INHERITANCE STUDIES IN DIALLEL CROSSES OF THE PIMA COTTON (*GOSSYPIUM BARBADENSE* L.)

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SUMMARY

The following study comprised the combining ability in parental genotypes and the inheritance of yield-related traits in F_1 hybrids of the Pima cotton (*Gossypium barbadense* L.). The cotton cultivars, Surkhon-9 and Termiz-32, were notably the high-level donor parental genotypes in seed cotton yield and play a vital role in the development of high-yielding cotton cultivars. In all cultivars (σ2si>σ2gi), the dominant role of non-additive variances was evident in managing the seed cotton yield. Study results showed the cultivar Termez-32 can become a donor parent in developing new cultivars with numerous bolls per plant. By comparing the GCA and SCA variances of cotton cultivars, the bolls per plant reflected the control of non-additive genes (σ2si>σ2gi) in cultivars Surkhon-9, Duru Gavhar, and Surkhon-10. In cultivars Termiz-32 and Bukhoro-7, the bolls per plant had the additive genes (σ2si<σ2gi) managing them. Thus, the inheritance of the seed cotton yield per plant and the number of bolls traits occurred mainly with the positive superdominance in the F_1 cross combinations. An outcome of the presented study revealed the development of the new Pima cotton cultivar 'Guzor.'

Keywords: Pima cotton (*G. barbadense* L.), cultivars, diallel crosses, combining ability, inheritance, dominance, yield-related traits

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Key findings: Results revealed that Pima cotton (*G. barbadense* L.) cultivars, Termiz-32 and Bukhoro-7, can be desirable for improving the seed cotton yield, while Surkhon-9 and Termiz-32 can be useful for enhancing bolls per plant of cotton. The said breeding material can be beneficial in the development of high-yielding Pima cotton cultivars.

INTRODUCTION

The growing of cotton crops is mainly for fiber production, with around 69 countries engaged in cotton production. The cotton crop and its trade are one of the central areas of world agriculture and economy. In past years, the cotton crop area has increased by 30-35 million hectares, and fiber production amounted to 27 million tons. The introduction and development of stable, high-yielding cotton cultivars in the context of global climate change is the primary focus of cotton genetic and breeding research. In this case, research aimed at the development of Pima cotton (*Gossypium barbadense* L.) cultivars resistant to adverse environmental factors to produce a high-quality fibrous product compared with Upland cotton, also grown mainly in cotton fields (Amanov *et al*., 2020; Amanov and Abdiev, 2021; Shavkiev *et al*., 2022; 2025).

Cotton is one of the most valuable industrial crops that provide natural fiber for the textile industry, both in the past and the present (Akter *et al*., 2019). Today, Uzbekistan occupies one of the last places in the world for fiber production, although it ranks sixth in cotton cultivation (Shavkiev *et al*., 2023). A great need of *G. barbadense* L. cultivars arises in the textile and industrial sectors worldwide. In the world market, the fiber of fine-fiber cotton cultivars is twice as costlier than the fiber from medium-fiber cottons (*G. hirsutum* L.). By developing the fine-fiber cultivars of the species *G. barbadense* L., the methods of double hybridization and backcrossing are effective for use to obtain cultivars with the desirable, economically valuable traits and further improve them through genetic and breeding studies.

In this case, hybrid populations have a hereditary origin to boost the variability in economically valuable traits and recombination, with the local cultivars well adapted to the soil and climatic conditions of different genealogies used as the base material. The identification of morpho-biological indicators is highly essential, including the combining ability for economically worthwhile features, the identification of these traits' heredity peculiarities in hybrids, and their application in the breeding process. Therefore, developing and introducing fine-fiber cotton cultivars in regions with extremely hot climates and launching a suitable system of agriculture technologies are urgent.

Currently, the research on identifying and utilizing various genetic and biometrical methods of the combining ability (general and specific) of parental cultivars and their hybrids through diallel crosses is crucial. The combining ability has two types: the general combining ability (GCA) of the parental cultivars and the specific combining ability (SCA) of their hybrids, with their management largely by the additive and non-additive gene actions, respectively (Youssef *et al*., 2021). By evaluating the combining ability of the parental genotypes, it is essential to determine the movement of genes regulating the heredity of traits of the promising parental cultivars (Mutimaamba *et al*., 2020; Moustafa *et al*., 2021).

The most important aspect determining the success of genetic patterns and breeding work is the accurate selection of parental genotypes. In doing this work, breeders must have a good understanding of characteristics being controlled by which genes during the inheritance pattern of the parental cultivars, their combining ability, the influence of the genes, and the genetic variations occurring in them (Fasahat *et al*., 2016; Abdelghany *et al*., 2022; Makhmudov *et al*., 2023; 2024; El-Sorady *et al*., 2022).

Along with determining the combining ability of parental genotypes, it is possible to combine the beneficial genes in hybrids by crossing. The specific combining ability enables to identify the genotypes with the highest productivity (Mir *et al*., 2016). Past studies stated that during the evaluation of the general and specific combining ability of several cultivars revealed the most effective donors for the genetic improvement in cotton (Ashokkumar and Ravikesavan, 2008; Chorshanbiev *et al*., 2023). One should note the biometrical analyses used to assess the combining ability also help probe the interaction of genes, their role in the inheritance of quantitative traits, and the heterotic effects. Crossing cotton cultivars with different hereditary origins is important for obtaining the organisms with the highest inheritance, increasing seed cotton yield with a desirable fiber quality (Khokhar *et al.*, 2018).

Several studies have reported their findings on the effectiveness of heterosis in F_1 hybrids of cotton (Khan *et al*., 2007; Chorshanbiev *et al*., 2021). In cotton, the seed cotton yield is a complex trait formed in connection with the number of bolls and the boll weight. Past studies detailed that obtaining the cotton cultivar 'Bo'ston' resulted in the hybrid combination of Bukhoro-7 x Surkhon-9 of Pima cotton, with the cotton cultivar Durdona-2 developed from the hybrid combination of 8763-I x Karshi-8 before cultivation (Shavkiev *et al*., 2022). It was a proposal to plant these cultivars in the southern and middle regions of the Republic. Despite extensive research in the field of genetics and cotton breeding, improvement is still essential in the manifestation and heredity of morphological and economic characteristics in hybrids of the Pima cotton. Therefore, the presented study aimed to investigate the combining ability in parental genotypes and the inheritance of yield-related traits in F_1 hybrids of the Pima cotton (*Gossypium barbadense* L.).

MATERIALS AND METHODS

Plant material and growing conditions

The latest research on the Pima cotton (*Gossypium barbadense* L.) transpired at the Zangiota Experimental Field of the Institute of Genetics and Plant Experimental Biology, Academy of Sciences, Uzbekistan. The soil of the experimental field is a typical gray loam, non-saline, with a deep groundwater table (more than 8.0 meters). Agrotechnical activities ensured the better growth and development of the cotton plants. Temperature increases in April during the cotton sowing season and decreases in late September before the harvesting period. The Pima cotton local cultivars, viz., Surkhon-9, Termiz-32, Duru Gavhar, Bukhoro-7, and Surkhon-14, and their F_1 hybrids were the specimens used (Table 1). This study used the randomization method, with three replications for each cultivar and F_1 hybrid. Each genotype incurred planting in two rows per replication, with a scheme of 90 × 20 × 1. In F_1 hybrids, the dominance coefficient determination engaged the Griffing (1956) formula (Beil and Atkins, 1965) below.

$$hp = \frac{F_1 - MP}{P - MP}$$

Where hp = dominance coefficient, F_1 = mean of the hybrid, MP = mean of both parents, P = mean of the best parent, and heterosis = a deviation from the best parent (positive or true heterosis) and as a deviation from the worst parent (negative heterosis) and expressed in percentage.

All the research and data compilation and its statistical analyses progressed by following the methodology of Dospekhov (1985). In this case, the values obtained for each character reached analysis by dispersion. The reliability of differences among the parental cultivars and their F_1 hybrids used Fisher's criterion (F), total error of the experiment $S\bar{X}$, error of the means S_d, with the mean differences determined by the least significant difference ($LSD_{0.05}$) test. The data obtained for each trait underwent statistical analysis using the analysis of variance (ANOVA). The Griffing Method-4 and Model-I, as widely used in the sphere of practical selection, determined the combining ability (Griffing, 1956; Litun and Proskurin, 1992).

The diallel types of estimates of variation due to F_1 hybrids have undergone further partitioning into sources due to GCA and SCA. Therefore, the differences among the diallel depended on whether including the

Table 1. Origin and pedigree of the six cotton genotypes under study.

No.	Genotypes	Pedigree	Origin	Authors
1	Surkhon-9	ML-100 x 07630	Uzbekistan	Vad. A. Avtonomov, A.A. Usmanov *et al*.
2	Termiz-32	Ash-25 x Termiz-31	Uzbekistan	V. Istomin, YE. Gavrilov
3	Duru Gavhar	S-6041x9647-Iolotan	Uzbekistan	O.J. Jalilov, Y.A. Siryanov
4	Bukhoro-7	L-2724 x L-2340	Uzbekistan	A. Batalov, M. Barakayev, N. Simongulyan.
5	Surkhon-10	S-6041 x Ash-25	Uzbekistan	M.I. Iksanov, M.E. Ashurov, X. Xusanov.
6	Guzor	Surkhon-9xTermiz-32	Uzbekistan	N.E. Chorshanbiev, S.M. Nabiev *et al*.

Table 2. Estimates of combining ability effects for diallel methods II and IV with reciprocal crosses.

Components	Method II			Method IV		
	d.f.	Genetic Effects Formula	S.E.	d.f.	Genetic Effects Formula	S.E.
GCA effects	p-1	gi=1/p+2[Σ (Yi.+Yii)-2/pY..	[(p-1)mse/p (p+2)]1/2	p-1	gi=1/p(p-2)[pYi.-2Y..]	[(p-1) mse/p(p-2]1/2
SCA effects	p(p-1)/2	Sij=Yjj-1/p+2(Yi.-Yii.+Y.j+Yjj+(2/(p+1) (p+2))Y..	[2(p-1) mse/(p+1)(p+2)]1/2	p(p-3)/2	(Sij=Yij-1/p-2 (Yi.+Y.j)+(2/(p-1)(p-2))Y..	[(p-3)mse /(p-1)]1/2

direct and reciprocal effects in the model. The reciprocal crosses estimate the variation due to material effects, which were expected for some traits. A relatively larger GCA/SCA variance ratio demonstrates the importance of additive gene effects, and a lower ratio indicates the predominance of dominance and epistatic gene effects. The GCA and SCA effects of the parental genotypes and their F_1 hybrids proceeded calculation after confirming the significant mean squares due to GCA and SCA (Tables 2).

RESULTS AND DISCUSSION

In successfully carrying out the genetics and selection of cotton, it is necessary to deeply and comprehensively study the laws of inheritance of morpho-economic characters in F_1 plants. In this case, an assessment of the degree of dominance and heredity of the parental variety of traits in F_1 plants of cotton varieties provides vital information (Simongulyan, 1991). The results of the experiments have confirmed past opinions that the super-dominance inheritance is the sign of plant productivity (Krishnamurthy and Henry, 1979; Avtonomov *et al*., 2017).

The presented research determined the genetics and selection indicators for the studied characters in the parental cultivars and F_1 hybrids of the Pima cotton (*G. barbadense* L.). Amanov *et al*. (2020) reported the quantitative economic traits with the inheritance of F_1 hybrids were notable with the partial, dominance, and overdominance types of gene action. Used for the development of new cotton genotypes, knowledge of genetic diversity and relationships among the genotypes and various traits is essential to plant breeders for improving the cotton crop. The generation mean analysis is a quantitative genetic method that also estimates the additive, dominance, and epistatic effects (Mather and Jinks, 1982). Genetic analysis using generation means has been operational in cotton breeding to estimate the type of gene action controlling the quantitative traits (Esmail, 2007; Dawwam, 2009). Heterosis breeding is an important genetic tool to facilitate yield enhancement and help enrich various descriptive quantitative and qualitative traits. Sarwar *et al*. (2012) found superiority of a non-additive gene action in the inheritance of seed cotton yield and the majority of its components.

The analysis of general combining ability effects showed positive effects of GCA on plant productivity, as observed in the parental genotypes Surkhon-9 and Termiz-32 (4.69). This indicates the prospects of using cultivars Surkhon-9 and Termiz-32 as high-level donor parents for seed cotton yield and the selection of high-yielding Pima cotton cultivars. The other three cultivars, i.e., Duru Gavhar, Bukhoro-7, and Surhon-10, possessed negative GCA effects (-2.55, -3.28, and -3.55, respectively), with an average yield of 35.7, 46.2, and 42.2 g of seed cotton per plant, respectively. Inadequacy between the highest values of $\bar{X}$ in the last two cultivars and their low values of GCA effects could be due to the different ratios of dominant and recessive genes in the Pima cotton cultivars (Table 3). In all these cultivars, the ratio ($\sigma^2_{si}>\sigma^2_{gi}$) expressed a predominant role of non-additive variance in the expression of plant productivity. The highest positive SCA in the cross combinations, Duru Gavhar x Bukhoro-7 ($\hat{s}_{ij}$=10.32), Surkhon-9 x Bukhoro-7 ($\hat{s}_{ij}$=9.09), and Termiz-32 x Surkhon-10 ($\hat{s}_{ij}$=8.35), revealed the inheritance of the said trait was through a positive overdominance (hp -= 3.23, 10.08, and 90.63, respectively). The highest negative SCA values appeared in the F_1 hybrids, Bukhoro-7 x Surkhon-10 and Surkhon-9 x Duru Gavhar ($\hat{s}_{ij}$, -11.98 and -11.05, respectively) (Table 3).

Factually, the economically valuable traits controlled by many genes showed considerable variations with the influence of environmental factors. The plant productivity trait is very crucial due to its genetic structure and depends mostly on other contributing traits. The entire harvest of the parental cultivars and their F_1 hybrids surfaced at three stages, i.e., at the end of September, October 10, and at the end of October, and together make up the total yield. Analysis of the data detailed the highest productivity per plant resulted in the cultivar Bukhoro-7 (46.2 g), followed by the cultivars Surkhon-9, Surkhon-10, Termiz-32, and Duru Gavhar (42.3, 42.2, 37.4, and 35.7 g, respectively) (Table 4).

According to readings of the dominance coefficient (hp) in 18 out of 20 F_1 hybrids, the said trait's inheritance had the type of superdominance, at 17 cross-combinations with positive and one with negative heterosis. In one cross-combination, the complete dominance of the best parent was visible, while an incomplete dominance existed in the other worst parents. The heterotic effects in the reciprocal hybrids of the cultivar Surkhon-9 with Surkhon-10 and Termiz-32 were quite significant and ranged from 117.8% to 157.2% of the best parent, making them valuable for selection based on heterotic effects.

Table 3. General (GCA) and specific combining ability (SCA) effects of the parental cultivars and their F_1 hybrids, respectively, for plant productivity and the number of bolls per plant in the Pima cotton.

♂ ♀	Surkhon-9	Termiz-32	Duru Gavkhar	Bukhoro-7	Surkhon-10	$\Sigma\hat{s}_{ij}^2$	σ^2_{si}	σ^2_{gi}	$\hat{g}_i$
Plant productivity									
Surkhon-9	-	3.72	-11.05	9.09	-1.75	221.63	73.08	21.68	4.69
Termiz-32	-	-	-4.65	-7.41	8.35	160.09	52.57	21.68	4.69
Duru Gavhar	-	-	-	10.32	5.39	279.28	92.30	6.19	-2.55
Bukhoro-7	-	-	-	-	-11.98	387.56	128.39	10.44	-3.28
Surkhon-10	-	-	-	-	-	245.36	80.99	12.29	-3.55
Number of bolls per plant									
Surkhon-9	-	1.82	-2.88	1.82	-0.75	15.482	4.89	-0.06	0.22
Termiz-32	-	-	-1.92	-1.22	1.32	10.230	3.14	9.19	3.05
Duru Gavhar	-	-	-	2.38	2.42	23.502	7.56	2.95	-1.75
Bukhoro-7	-	-	-	-	-2.98	19.346	6.18	8.01	-2.85
Surkhon-10	-	-	-	-	-	17.042	5.41	1.63	1.32

Table 4. Inheritance of the plant productivity in F_1 hybrids of Pima cotton cultivars.

No.	Cultivars and their F_1 hybrids	$\bar{X}$	Hp	Heterosis (%)
1	Surkhon-9	42.3	-	-
2	Termiz-32	37.4	-	-
3	Duru Gavhar	35.7	-	-
4	Bukhoro-7	46.2	-	-
5	Surkhon-10	42.2	-	-
6	Surkhon-9 x Termiz-32	66.5	10.9	157.2
7	Surkhon-9 x Duru Gavhar	44.6	1.7	-
8	Surkhon-9 x Bukhoro-7	63.9	10.1	138.3
9	Surkhon-9 x Surkhon-10	52.8	211.0	124.8
10	Termiz-32 x Surkhon-9	53.7	5.7	127.0
11	Termiz-32 x Duru Gavhar	50.9	16.9	136.1
12	Termiz-32 x Bukhoro-7	47.4	1.3	-
13	Termiz-32 x Surkhon -10	62.9	9.6	149.1
14	Duru Gavhar x Surkhon-9	60.2	6.4	142.3
15	Duru Gavhar x Termiz-32	56.8	23.8	151.9
16	Duru Gavhar x Bukhoro-7	57.9	3.2	125.3
17	Duru Gavhar x Surkhon-10	52.7	4.2	124.9
18	Bukhoro-7 x Surkhon-9	60.7	8.4	131.4
19	Bukhoro-7 x Termiz-32	54.4	2.9	117.8
20	Bukhoro-7 x Duru Gavhar	46.0	1.0	-
21	Bukhoro-7 x Surkhon-10	34.6	-4.8	82.0
22	Surkhon-10 x Surkhon-9	51.9	193.0	122.7
23	Surkhon-10 x Termiz-32	66.1	11.0	156.6
24	Surkhon-10 x Duru Gavhar	62.8	7.3	148.8
25	Surkhon-10 x Bukhoro-7	42.8	-0.7	-

$LSD_{0.05}$=3.1

The latest results also confirmed the opinion explained in previous studies that the heritability of the total productivity has an overdominance type of gene action. Kimsanbaev (2011) reported that on the generation F_1 of species of *G. barbadense* L., the study concluded the inheritance of the plant productivity trait was by an intermediate type. In the present study's opinion, the reason for this is the author chose geographically distant varieties and lines that are dramatically different from each other as the initial resource (Abo-El-Zahab, 1973; Egamberdiev *et al*., 2007). The traits of the number of bolls and seed cotton yield of a cotton genotype determine its yield (Seoudy *et al*., 2014). In genetics processes, information about the inheritance mechanism in hybrids and the combining ability of parents is crucial.

The presented outcomes also confirmed the reports by Jatoi *et al*. (2010) and Monicashree *et al*. (2017) for the boll number per plant had a non-additive type of gene action. Meanwhile, Natera *et al*.'s (2012) findings showed how additive genetic effects were more important. Plant productivity has the non-additive genetic effects governing it. The obtained results on plant productivity testify to the selective value of the studied local Pima cotton cultivars with intraspecific heterozygous hybrids. This and a set of economically valuable traits require further refinement to a more perfect cultivar than the parental genotypes. Reciprocal effects also resulted in the direct and reverse hybrids of cultivars, i.e., Surhon-9 by crossing with Termiz-32, Duru Gavhar, and Bukhoro-7; cultivar Termiz-32 by crossing with Duru Gavhar, Bukhoro-7, and Surkhon-10; and genotype Duru Gavhar by crossing with Bukhoro-7 and Surkhon-10, and Bukhoro-7 with Surkhon-10. The reciprocal effects in most F_1 cross-combinations justify the essential role of cytoplasmic genes in the regulation of yield-related traits.

Bolls per plant is one of the principal yield components in cotton. The analysis showed significant ($p \leq 0.01$) differences among the genotypes for the number of bolls per plant. Dispersion analysis of the combining ability has shown varietal differences ($p \leq 0.05$) occurred in GCA and SCA variances in the number of bolls per plant. For the number of bolls per plant, the highest positive GCA effects ($\hat{g}i = 3.05$) were notable in the cultivar Termiz-32, while the relatively low GCA effect ($\hat{g}i = 0.22$) appeared in the cultivar Surkhon-9. The presented results further revealed the cultivar Termiz-32 can benefit as a donor parent in the selection and development of new cotton cultivars with numerous bolls per plant. The negative GCA effects for the number of bolls per plant were evident in the cultivars Bukhoro-7 ($\hat{g}i = -2.85$) and Duru Gavhar ($\hat{g}i = -1.75$).

By comparing the GCA and SCA variances of cotton cultivars, in cultivars Surkhon-9, Duru Gavkhar, and Surkhon-10, the bolls per plant bore influences and control by non-additive genes ($\sigma^2si>\sigma^2gi$), while in the parental genotypes Termiz-32 and Bukhoro-7 were by additive genes ($\sigma^2si<\sigma^2gi$). The results demonstrated that the hybrids obtained, with the participation of the parental cultivars Termiz-32 and Bukhoro-7, have the highest chances of developing promising recombinants in the Pima cotton (Table 3). The topmost positive SCA effects were distinct in the hybrids of cultivar Duru Gavhar with Bukhoro-7 and Surkhon-10 ($\hat{s}_{ij}$ 2.38 and 2.42, respectively). However, the maximum negative SCA effects emerged in the cross-combinations Bukhoro-7 x Surkhon-10 ($\hat{s}_{ij} = -2.98$) and Surkhon-9 x Duru Gavhar ($\hat{s}_{ij} = -2.88$).

According to the presented findings, on average, the cultivars Surkhon-9 and Termiz-32 differed and relatively showed more bolls per plant (25.8), while in contrast, the cultivar Duru Gavhar owned the least number of bolls per plant (20.8) (Table 5). In cross-combinations, the highest number of bolls per plant was visible in the F_1 hybrids Surkhon-10 x Surkhon-9, Surkhon-10 x Termiz-32, and

Table 5. Inheritance of the number of bolls per plant in F_1 hybrids of Pima cotton cultivars.

No.	Parental cultivars and their F_1 hybrids	$\bar{X}$	Hp	Heterosis (%)
1	Surkhon-9	25.8	-	-
2	Termiz-32	25.8	-	-
3	Duru Gavhar	20.8	-	-
4	Bukhoro-7	22.4	-	-
5	Surkhon-10	21.8	-	-
6	Surkhon-9 x Termiz-32	32.6	6.8	126.4
7	Surkhon-9 x Duru Gavhar	22.5	-0.32	-
8	Surkhon-9 x Bukhoro-7	26.1	1.18	101.2
9	Surkhon-9 x Surkhon-10	27.7	1.95	107.4
10	Termiz-32 x Surkhon-9	26.4	0.60	102.3
11	Termiz-32 x Duru Gavhar	26.3	1.20	101.9
12	Termiz-32 x Bukhoro-7	25.9	1.06	-
13	Termiz-32 x Surkhon -10	32.6	4.40	126.4
14	Duru Gavhar x Surkhon-9	31.7	3.36	122.9
15	Duru Gavhar x Termiz-32	29.6	2.52	114.7
16	Duru Gavhar x Bukhoro-7	24.7	3.88	110.3
17	Duru Gavhar x Surkhon-10	28.9	15.20	132.6
18	Bukhoro-7 x Surkhon-9	29.1	2.94	129.9
19	Bukhoro-7 x Termiz-32	24.5	0.24	-
20	Bukhoro-7 x Duru Gavhar	20.8	-1.00	-
21	Bukhoro-7 x Surkhon-10	22.4	1.00	-
22	Surkhon-10 x Surkhon-9	38.8	7.50	150.4
23	Surkhon-10 x Termiz-32	33.2	4.70	128.7
24	Surkhon-10 x Duru Gavhar	31.1	19.60	142.7
25	Surkhon-10 x Bukhoro-7	25.3	10.67	112.9

$LSD_{0.05} = 1.6$

Surkhon-10 x Duru Gavhar (38.8, 33.2, and 31.1, respectively). Additionally, these promising F_1 hybrids had other hybrids closely following them, i.e., Termiz-32 x Surkhon-10 (32.6), Surkhon-9 x Termiz-32 (32.0), Duru Gavhar x Surkhon-9 (31.7), Duru Gavhar x Termiz-32 (29.6), Bukhoro-7 x Surkhon-9 (29.1), and Duru Gavhar x Surkhon-10 (28.9). Conversely, the F_1 cross-combinations, such as Bukhoro-7 x Duru Gavhar, Bukhoro-7 x Surkhon-10, and Surkhon-9 x Duru Gavhar, showed a relatively small number of bolls per plant (20.8, 22.4, and 22.5, respectively).

In 15 out of 20 cross-combinations, the bolls per plant's inheritance was due to a positive overdominance—in two combinations with complete dominance of low and high-yielding cultivars and in three cross-combinations with incomplete dominance of high and low-yielding cultivars. Thus, inheriting the trait of bolls per plant mainly occurred by the positive overdominance in F_1 cross-combinations. By crossing the cultivars Surkhon-9 and Termez-32 that were close to each other for the number of bolls per plant, the trait's inheritance transpired with an incomplete dominance (hp = 6.2) with positive heterosis (124.0%). However, in the reciprocal cross-combination Termiz-32 x Surkhon-9, inheriting the said trait was with incomplete superiority of the high-performance cultivar (hp = 0.6).

By crossing the Pima cotton cultivars Surkhon-9 and Duru Gavhar that differed from each other, in the F_1 hybrid Surkhon-9 x Duru Gavhar, the bolls per plant's inheritance was with an incomplete dominance of the cultivar Duru Gavhar (hp = -0.3). However, in its reciprocal cross Duru Gavhar x Surkhon-9, inheriting the said trait happened by the positive overdominance (122.9%). By crossing the cultivars Termez-32 and Duru Gavhar, which sharply differed for the bolls per plant, a positive overdominance caused the inheritance of the said trait in the reciprocal hybrid. In the crossing of the cultivars Duru Gavhar and Bukhoro-7 that were close to each other for the bolls per plant, the said trait's inheritance by a positive heterosis overdominance (110.3%) had the direct combination. Meanwhile, in the reciprocal cross, the complete dominance of the low-yielding cultivar was evident.

By crossing the cultivar Surkhon-9 with Termez-32, Duru Gavhar, Bukhoro-7, and Surkhon-10, crossing the cultivar Termiz-32 with Duru Gavhar cultivar, and cultivar Duru Gavhar with the Bukhoro-7 and Surkhon-10, the nuclear and cytoplasmic genes contributed in the said trait's inheritance. The analysis showed a true heterosis appeared in 11 cross-combinations and the rate of heterosis was 150.4% in the F_1 hybrid Surkhon-10 x Surkhon-9, and 110.3% in the F_1 hybrid Gavhar x Bukhoro-7. The highest level of heterosis resulted in the F_1 hybrids Surkhon-10 x Duru Gavhar (142.7%), Duru Gavhar x Surkhon-10 (132.6%), Surkhon-10 x Termiz-32 (128.7%), and Termiz-32 x Surkhon-10 (126.4%).

Moreover, in the presented research, the morpho-economic traits underwent studies obtained from interspecific hybridization. As a continuation, the developed scientific work depended on the cross-breeding and selection of hybrids of local cultivars of fine-fiber cotton with different genetic bases. These were Surkhon-9, Surkhon-10, Termiz-32, Bukhoro-7, and Duru Gavhar, which also have different genealogical origins. The planted cotton lines, i.e., L-449, L-450, L-451, L-452, L-453, L-479, L-480, L-481, L-536, L-537, L-563, L-564, L-596, L-631, L-632, L-634, L-663, L-669, L-735, and L-736, in the experimental field, used the randomization method, with three replicates. In the said experiment, the necessary agrotechnical measures proceeded in time and in a good way. Appropriate phenological observations and calculations ensued during the vegetation period. A number of economic and plant productivity traits, determined in these cotton lines, included seed cotton weight per boll, fiber yield, 1000-seed weight, the bolls per plant, and plant productivity. The highest values of plant productivity of Pima cotton lines manifested in the lines L-563, L-596, L-452, L-736, L-450, and L-453 (55.3, 55.0, 54.8, 54.3, 52.1, and 51.4 g, respectively). In the cotton lines L-481, L-537, L-632, L-449, and L-564, the said values were 49.2, 48.8, 48.5, 48.4, and 48.2 g, respectively. The results enunciated the

Figure 1. Pima cotton cultivar Guzor.

lines L-563, L-596, and L-452 can serve as the base genetic material for the development of productive cultivars of the Pima cotton.

By studying the morpho-economic traits and conducting a targeted selection in the species *G. barbadense* L., the new Pima cotton 'line L-450' reached the pinnacle of development with the new cultivar name 'Guzor.' Likewise, its adoption for further evaluation by the State Cultivar Testing (SVT) materialized in 2021. The Pima cultivar Guzor received a patent for 'Selection Achievement' from the Intellectual Property Agency (Patent NAP No. 00462 dated 26.04.2024) (Figure 1). As a result, it was possible to plant this new Pima cotton cultivar in the fields of Surkhondarya and Kashkadarya regions, Uzbekistan. In 2024, the new cultivar Guzor proceeded with its planting on one hectare on a farmer's field (Jovliev Abduraup) in the District Nishan, Kashkadarya Region, and cultivation on 100 ha in the X\K cluster field of LLC - Indorama Agro, District Nishon, Uzbekistan.

The crossing of Pima cotton cultivars Surkhon-9 and Duru Gavhar developed the perennial selection through a new cultivar Guzor. Its various agronomic traits comprised branching type (0), growing period (125–127 days), plant height (110–120 cm), the number of branches on the main stem (25), space between the branches (4.0 cm), seed cotton weight per boll (3.7 to 4.0 g), productivity per plant (60.0 g), 1000-seed weight (133–136 g), fiber output (35%), fiber length (39 mm), fiber strength (48.8), fiber index (6.6 g), and micronaire (3.9).

CONCLUSIONS

Results revealed the Pima cotton (*Gossypium barbadense* L.) cultivars Surkhon-9 and Termiz-32 can serve as the base genetic material in the selection and development of productive Pima cotton cultivars.

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