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Issue Article

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PRODUCTIVITY OF F1 HYBRIDS OF FINE-FIBER COTTON VARIETIES IN CONDITIONS OF UZBEKISTAN

Abstract: *The article carry out information about combining ability of the parent varieties of fine-fiber cotton varieties. Information about combining ability of parents and crossings is crucial in breeding efforts. Genetic variety is crucial to the effectiveness of yield improvement efforts because it helps to broaden gene pools in any given cotton. The presence of statistical differences in total productivity trait indicators in some reciprocal combinations of F_1 generation of fine-fiber cotton varieties suggests that cytoplasmic genes as well as nuclear genes are involved in the genetic control of these traits. In combinations F_1 Surkhan-9 x Termez-32, F_1 Surkhan-9 x Surkhan-10, F_1 Surkhan-10 x Termez-32 and F_1 Surkhan-10 x Duru Gavkhar, the positive heterosis effect on total productivity was 122.7-157.2%. These hybrid combinations can be use as a valuable resource for heterosis selections. It was noted that the nonadditive effect of genes on plant productivity in F_1 plants of varieties was strong.*

Key words: *G.barbadense, cotton, variety, hybrid, combining ability, plant productivity.*
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Introduction

Currently, the growing population is leading to an increase in demand for fiber and other products of cotton, which are the main agricultural crop in many countries, along with food sources. Cotton was and still is the most important and popular crop providing natural fiber for the textile industry (T.Akter *et.al*., 2019). The most important species of cotton are *G.hirsutum* L. and *G.barbadense* L. (A.Rehman *et.al*, 2020). Currently, the world's cotton area is around 35 million hectares, of which about 1.0 million are in Uzbekistan where the cotton is grown under different climatic conditions (Worldbank.org, 2020). In the international cotton market, the fiber of fine-fiber *G.barbadense* L. cotton varieties is more expensive than the fiber of *G.hirsutum* L. Several times more fabric is spun than a ton of this type of fiber, and the cost is also high. 8620 m^2 of fabric is made from medium fiber varieties of fiber type V, 15510 m^2 of fabric is produced from 1 ton of fiber of fine fiber types of type I (http://tadbirkor-fermer.uz/ingichka-tolali-uza-ustirish/).

In the analysis of the leading countries growing fine-fiber cotton, the United States (11%), Egypt (47%), Sudan (17%), Uzbekistan (25%), Spain (38%) accounted for 7% of the world's cotton area growth was observed. Declines were observed in India (-7%), China (-14%) and Israel (-33%) M.A.Avliyoqulov *et.al.*, (2021).

The Republic of Uzbekistan is one of the countries in the world that has mastered the cultivation of fine-fiber cotton. The main reason for this is the high temperature in the southern regions of the country, the high heat reserves in Sherabad compared to Cairo (Egypt), and in Termez to Alexandria (Egypt) and Bayram Ali (Turkmenistan), and also many years of effective works of advanced breeders and seed scientists (M.I.Iksanov, 2009).

Recently scientific and practical researches in speice of *G.barbadense* L. in our country conducted by scientists such as B.Kh.Amanov *et.al.* (2020), J.Shavkiev *et.al.*, 2021, N.E.Chorshanbiev *et.al.* (2021), M.A.Avliyakulov *et.al.* (2021).

The main goal of Egyptian cotton breeders is to find high-yielding genotypes. There is also a lot of research going on to study the unused genetic variability of Egyptian varieties and to create new varieties (A.Yehia *et.al.*, 2019).

In the selection process genes were achieved through combining ability to create high-yielding varieties (M.A.Abdel-Monaem *et al.*, 2020).

N.Avliyokulov *et.al.* (2018) also conducted research on fine-fiber cotton varieties and created L-858, L-914, L-1532 ridges, which yield 4-26% higher than standard varieties.

Gamal I.A. Mohamed *et.al.* (2009) identifies that all traits were under the control of additive and non-additive genes in F_1 combinations of fine-fiber cotton varieties. The plant productivity trait was found to inherit complete dominance in generation F_1 and incomplete dominance in generation F_2.

Combining ability analysis is particularly important in cross-pollinated crops since it aids in the identifi cation of probable inbred parents for hybridization. Such research also aids in determining the nature and amplitude of various types of gene action influencing the manifestation of quantitative economic features (Pal AK, Prodhan H.S.,1994).

At present, researches on the study of the combining ability of initial forms using various genetic and statistical methods in interbreeding was escalating. The most accurate informative method of assessing general and specific combination ability is diallel crossing.

There are two types of combining abilities examined in biometrical genetics: general combining ability (GCA) and specific combining ability (SCA). General combining ability is a measure of additive gene activity that relates to the average performance of a genotype in a series of hybrid combinations, whereas specific combining ability is the performance of a parent in a specific cross in combining ability (Ali Q., Ali A., 2014).

Many scientists (S.Abro *et.al.*, 2009; S.Karademir *et.al.*, 2009; S.Singh *et.al.*, 2010) have conducted research to assess the general and specific combinig ability of several varieties and found the best performing donors for genetic improvement of cotton.

Conditions and methods for experiments

Our research was conducted at the experimental field of the Institute of Genetics and Plants Experimental Biology, District Zangi-Ota, Tashkent Region, Uzbekistan. The soil conditions of the experimental field are typical gray soil, unsalted, groundwater is deep (more than 8.0 m), damaged by natural vilt. Agrotechnical measures were the same for the entire experimental base. Local Surkhan-9, Termez-32, Duru Gavkhar, Bukhara-7, Surkhan-10 cotton varieties belonging to *G. barbadense* L. species, as well as their inter-varietal F_1-F_2 plants were used as research sources.

In our experiment were used as a initial forms with their genetically different origins local Surkhan-9, Termez-32, Duru Gavkhar, Bukhara-7, Surkhan-10 cotton varieties and their inter-varietal F_1, F_2 plants. In the research, combinations of each varieties and their F_1 hybrids were grown in three replication, each replication for 4 rows, and 25 nests in each rows using the randomized complete block design method. Planting scheme 90x20x1.

In the during of the experiment, the inheritance and variability of important morphobiological and economic valuable traits in F_1 plants, and the extent of variability of some economic traits in F_2 combinations were studied by comparing them with parental forms. We were studied 30 plants of each of the varieties, their F_1 combinations and 150 plants of each of the F_2 combinations.

The degree of dominance in F_1 plants was determined according to S.Wright's formula given in G.E.Beil and R.E.Atkins (1965):

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

hp – dominance coefficient;

F_1 – the avalute arithmetic mean of the hybrid;

MP – the avalute arithmetic mean of the both parents;

P – the avalute arithmetic mean of the best parents.

Results of research was carried out method statistical processing of B.A. Dospekhov (1985).

In this case, the indicators obtained for each character were analyzed by dispersion, that is, the reliability of differences between varieties and hybrids using Fisher's criterion (F), total mistake of experiment S $\bar{x}$, error of the mean S_d and the smallest difference ($LSD_{0,05}$) was determined by the level of reliability for 95%, also the data obtained for each traits were statistically analyzed using the modern analysis of variance with ANOVA program. P.P.Litun, N.V.Proskurin (1992) say that B.I.Griffing's 4 method (model 1) is widely used in the sphere of practical selection to determine combining ability.

RESULTS AND DISCUSSION

According to our data on plant productivity, the Bukhara-7 variety (46.2 g/plant) had the highest productivity in the group of studied fine-fiber cotton varieties. Sign of plant productivity was respectively 42.3 g/plant, 42.2 g/plant, 37.4 g/plant and 35.7 g/plant in Surkhan-9, Surkhan-10, Termiz-32 and Duru Gavhar varieties (Table 1).

According to the readings of the dominance coefficient (hp), out of 20 hybrid combinations of F_1, in 18 combinations the trait was inherited by the type of overdominance, in 17 combinations with positive, and one with negative heterosis.

Table 1. Inheritance of a trait "plant productivity" of F_1 plant of fine-fiber cotton varieties

№	Varieties and hybrids	$\bar{x}$	hp	heterosis; %
1	Surkhan-9 P1	42,3	-	-
2	Termez-32 P2	37,4	-	-
3	Duru-Gavkhar P3	35,7	-	-
4	Bukhara-7 P4	46,2	-	-
5	Surkhan-10 P5	42,2	-	-
6	P1 x P2	66,5	10,9	157,2
7	P1 x P3	44,6	1,7	-
8	P1 x P4	63,9	10,1	138,3
9	P1 x P5	52,8	211,0	124,8
10	P2 x P1	53,7	5,7	127,0
11	P2 x P3	50,9	16,9	136,1
12	P2 x P4	47,4	1,3	-
13	P2 x P5	62,9	9,6	149,1
14	P3 x P1	60,2	6,4	142,3
15	P3 x P2	56,8	23,8	151,9
16	P3 x P4	57,9	3,2	125,3
17	P3 x P5	52,7	4,2	124,9
18	P4 x P1	60,7	8,4	131,4
19	P4 x P2	54,4	2,9	117,8
20	P4 x P3	46,0	1,0	-
21	P4 x P5	34,6	-4,8	82,0
22	P5 x P1	51,9	193,0	122,7
23	P5 x P2	66,1	11,0	156,6
24	P5 x P3	62,8	7,3	148,8
25	P5 x P4	42,8	-0,7	-
	$LSD_{0,05}$	3,1		

A positive heterosis state observed in the reciprocal combinations of Surkhan-9 and Surkhan-10 varieties, which do not differ from each other. Thus, the plant productivity trait was inherited in a superdominant state with positive heterosis in F_1 combinations.

A high heterosis effect (from 117.8% to 157.2%) was found in the reciprocal hybrids obtained by crossing the Surkhan-9 variety with the Surkhan-10 and Termiz-32 varieties. These hybrid combinations can be used in heterosis selection.

In our opinion, the reason for this is that the author chose geographically distant varieties and lines that are very different from each other as the starting source. Vik.A. Avtonomov *et.al.* (2007) stated that the positive heterosis for this character was 30-40% compared to the high index variety, depending on the hybrid combinations.

Variance analysis showed that there was a statistically significant difference between the variants of plant productivity (F_f>F_{05}). Reciprocal effects were detected in direct and reverse hybrids of varieties: Surkhan-9 with Termez-32, Duru-Gavkhar and Bukhara-7; Termez-32 with Duru-Gavkhar, Bukhara-7 and Surkhan-10; Duru-Gavkhar with Bukhara-7 and Surkhan-10; Bukhara-7 with Surkhan-10. Presence of reciprocal effects in advantageously most F_1 combinations points to the essential role of cytoplasmic genes in the regulation of this trait.

Obtained results on productivity of raw-cotton testify on selective value of the studied local fine-fiber cotton varieties at obtaining of intraspecific heterozygous hybrids with a set of economically valuable traits for further refinement of them to the level of a more perfect variety than existing ones.

Analysis of GCA (general combining ability) effects showed that on "plant productivity" positive effects of GCA are Surkhan-9 and Termez-32 ($\hat{g}_i$ respectively, on 4,69).

Table 2. GCA effect ($\hat{g}_i$), SCA constant ($\hat{s}_{ij}$), GCA variance (σ^2_{gi}) and SCA variance (σ^2_{si}) according to plant productivity sign of varieties

♀ \ ♂	Surkhan-9	Termez-32	Duru-Gavkhar	Bukhara-7	Surkhan-10	$\Sigma\hat{s}_{ij}^2$	σ^2_{si}	σ^2_{gi}	$\hat{g}_i$
Surkhan-9		3,72	-11,05	9,09	-1,75	221,632	73,08	21,68	4,69
Termez-32			-4,65	-7,41	8,35	160,092	52,57	21,68	4,69
Duru-Gavkhar				10,32	5,39	279,280	92,30	6,19	-2,55
Bukhara-7					-11,98	387,559	128,39	10,44	-3,28
Surkhan-10						245,358	80,99	12,29	-3,55

This indicates to prospects of using varieties Surkhan-9 and Termez-32 as high-level donors yields at the selection of highly-productive cotton varieties. Other varieties, i.e. Duru-Gavkhar, Bukhara-7 and Surkhan-10, possessed negative effects of GCA ($\hat{g}_i$, respectively – 2,55, -3,28 and -3,55) with an average yield of 35,7 grams, 46,2 grams and 42,2 grams of raw cotton per bush. Inadequacy between the high values of $\bar{x}$ in last two varieties and their low values of GCA effects, in our opinion, was due to the different concentration of dominant and recessive genes in the genotype of these varieties (Table 2).

In all varieties the condition $\sigma^2_{si}>\sigma^2_{gi}$ is present, which indicates the high effect of non-additive genes on total yield.

High positive SCA constant in combinations of Duru Gavkhar x Bukhara-7 ($\hat{s}_{ij}$=10.32), Surkhan-9 x Bukhara-7 ($\hat{s}_{ij}$=9.09) and Termez-32 x Surkhan-10 ($\hat{s}_{ij}$=8.35), i.e. The sign is in the superdominant combinations with positive heterosis (hp 3.23, 10.08 and 90.63, respectively), and the high negative SCA constant in the Bukhara-7 x Surkhan-10 and Surkhan-9 x Duru Gavkhar combinations ($\hat{s}_{ij}$ respectively -11.98 and -11.05) were recorded.

CONCLUSION

The presence of statistical differences in morpho-economic traits in some reciprocal combinations of the F_1 generation of fine fiber cotton varieties indicates that nuclear genes as well as cytoplasmic genes are involved in the genetic control of these traits.

Organized that F1 as such as Surkhan-9 x Termez-32, F1 Surkhan-9 x Surkhan-10, F1 Surkhan-10 x Termez-32 and F1 Surkhan-10 x Duru Gavkhar combinations showed a positive heterosis effect of 122.7-157.2% on plant productivity. These hybrid combinations can be used as a valuable resource for heterosis selection.

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