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Inheritance and Variability of Boll Weight in F_1-F_2 Plants of Fine-Fiber Cotton Varieties

Abstract: *This paper deals with the results of conducted research on the issues of the inheritance and variability of boll weight in F_1-F_2 plants of fine-fiber local cotton varieties. According to the experiments, we have made that generation hybrids in F_1, the trait of boll weight were inherited basically positive superdominance. Additionally, the determination of the general combining ability of fine-fiber cotton varieties of morpho-agronomic traits, and genetic-selection were further conducted the possibility of using Duru Gavkhar and Bukhara-7 varieties as a valuable primary source of cotton weight of boll. Furthermore, selection work in the population of the family O-449, depended on the basis of a combination of F_2 Surkhan-9 x Termez-32 hybrids. Moreover, a new cotton variety "Marvarid" was created.*

Key words: *fine-fiber cotton varieties, hybrids, heterosis, combining ability, inheritance, variability, boll weight.*
Language: *English*

Introduction

Currently, scientific research on fine-fiber cotton varieties around the world is aimed at studying the genetics of valuable economic traits in geographically remote hybrids of cotton varieties, lines and forms and exporting excess fiber while meeting domestic demand based on increasing yield and fiber quality. Fine-fiber cotton varieties are characterized by high fiber quality, resistant to verticillium wilt, other diseases and pests, as well as adverse environmental factors, which is the main disease of *G.hirsutum* L. fiber varieties. Therefore, the creation of competitive fine-fiber cotton varieties is one of the most important scientific and practical directions. Some scholars in the field of agriculture made some contributions, they were I.E.El-Beially and G.I.Mohamed (2008), S.H.Abd-El-Haleem, and others (2010) found that quantitative traits are inherited in F_1 hybrids with different levels of dominance or super dominance of the parent species. A.M.El-Zanaty et al (2012) identified phenotypic variability in quantitative characteristics in fine-fiber Egyptian cotton varieties,

M.M.Abd El-Maksoud (2003), A.M.Abdal El-Bary (2013) identified combining abilities some of foreign cotton varieties and lines.Also, recently, scientific and practical research on the genetics and selection of *G. barbadense* L. varieties in our country carried out by M.I.Iksanov (2011), K.O.Khudarganov, S.A.Usmanov (2015), Vik.A.Avtonomov and others. Vik.A.Avtonomov, R.R.Egamberdiev, M.H.Kimsanboev (2009) carried out geographical far hybridization and selection work on fine-fiber cotton varieties.

It is known that the weight of boll is one of the main components of plant productivity. Therefore, in genetic-selection research, special attention is paid to the study of the manifestation, inheritance and variability of this trait. According to S.A.Usmanov, S.S.Alikhodjaeva and others (2007), in some fine-fiber donors the weight of boll can reach 5.0-6.0 grams. R.R.Egamberdiev and others (2007) reported that it was advisable to start the selection work on weight of boll and yield per plant from F_2 generation in geographically far hybrids of G.barbadense *L.* type.

In F_1 combinations were further conducted a research by K.O.Khudargonov, S.A.Usmanov (2015), mean medium of both parent was observed on the indicator boll weight. The intergenerational rate of boll weight of Surkhan-16 and Surkhan-101 varieties was $h^2 = 0.50$ and higher.

Research methods

The aim of the research was to determine the inheritance and variability characteristics of boll weight in F_1-F_2 hybrids of local cotton varieties belonging to species of G.barbadense L. Local Surkhan-9, Termez-32, Duru Gavkhar, Bukhara-7, Surkhan-10 cotton varieties of G.barbadense L. species and their diallel F_1-F_2 generation plants were used as **the object of research.**

In our experiment, the primary source was the local fine-fiber cotton varieties Surkhan-9, Termez-32, Duru Gavkhar, Bukhara-7, Surkhan-10 and their interspecific plants F_1, F_2. In the study, combinations of each variety and F_1 hybrid were placed in three turns, 4 rows, and 25 in each row using the randomization method. Planting scheme 90x20x1. In the course of the experiment, the inheritance and variability of important morphobiological and valuable-economic traits in F_1 plants, the scale of variability of some valuable-economic traits in F_2 combinations were studied in comparison with parental forms. Varieties and 30 plants in each of their F_1 combinations and 150 plants in each of the F_2 combinations were studied.

The dominance coefficient (hp) in F_1 plants were determine by formula S.Wright given in the works of G.E. Beil and R.E. Atkins [1965].

$$ hp = \frac{F_1 - MP}{P - MP} \quad (2.1) $$

hp - coefficient of dominance; F_1 - the medium arithmetic mean of the hybrid F_1; MP- the arithmetic mean of both parents; P- the arithmetic mean of the best parent.

hp = 0 - no dominance;

$0 < hp < \pm 1.0$ - intermediate dominance;

hp = ± 1.0 - complete dominance;

hp> ± 1.0 - extreme dominance

The results of the applied research carried out by statistical processes in the method of B.A. Dospexov [1985]. In this case, the parameters obtained for each character were analyzed by variance, namely, the differences between varieties and hybrids were determined by the Fisher criterion (F), the total error of the experiment $\overline{S}x$, the error of the mean differences Sd and the smallest difference (EKF) 95%, and each of the data obtained on one character were statistically analyzed using a modern variance (ANOVA) program.

Litun P.P., Proskurin N.V. [1976] suggests that the Griffing 4 method (model 1) is widely used in determining combining ability in the field of practical selection. Therefore, in our study, the combining ability of varieties Griffing (B.I. Griffing) [1956] was determined using the following formula based on method 4.

The sum of the squares of the General combining ability: (2.2)

$$ Sg = \frac{1}{P-2}\sum_i x^2_{i.} - \frac{4}{P(P-2)}x_{..}^2 $$

The sum of squares of special combining ability: (2.3)

$$ Ss = \sum_i \sum_j x_{ij} - \frac{1}{P-2}\sum_i x^2_{i.} + \frac{2}{(P-1)(P-2)}X^2_{..} $$

GCA (General combining ability) of each variety: (2.4)

$$ g_i = \frac{1}{P(P-2)}(pxi. - 2x..) $$

GCA variance: (2.5)

$$ \sigma^2_{gi} = \frac{P-1}{P(P-2)}y^2 $$

The SCA (specific combining ability) constant of each hybrid combination: (2.6)

$$ S_{ij} = X_{ij.} - \frac{1}{P-2}(Xi. + Xj.) + \frac{2}{(P-1)(P-2)}X_{..} $$

SCA variance (2.7)

$$ \sigma^2_{si} = \frac{P-3}{P-1}y^2 $$

The ratio of genotypic variance to total phenotypic variance determined by the rate of transmission of the trait from generation to generation (h^2) by the formula R.W. Allard [1956]: (2.10)

$$ h^2 = \frac{\sigma^2 F_2 - \dfrac{\sigma^2 F_1 + \sigma^2 P_1 + \sigma^2 P_2}{3}}{\sigma^2 F_2} $$

h^2 – F_2 the transmission of the mark from generation to generation in hybrids;

$\sigma^2 F_1$ - a $\sigma^2 F_2$ -second generation dispersion;

$\sigma^2 P_1$ -first parental dispersion;

$\sigma^2 P_2$ - second parental dispersion;

Results of research: Bukhara-7 and Duru Gavkhar (2.97g and 2.89g, respectively) have the highest boll weight, while Termez-32 and Surkhan-9 have the lowest (2.52g and 2.62g, respectively).) was shown (Table 1).

The highest values of this trait in F_1 plants of varieties are Duru Gavkhar x Bukhara-7 (3.25g), Surkhan-9 x Bukhara-7 (3.10g), Termez-32 x Bukhara-7 (3.05g), Bukhara-7 x In the combinations of Surkhan-10 (3.00g), and relatively low performance Termez-32 x Surkhan-10 (2.62g), Surkhan-10 x Surkhan-9 (2.65g), Surkhan-9 x

Surkhan-10 (2, 73g), Duru Gavkhar x Surkhan-9 and
Bukhara-7 x Surkhan-9 (from 2.77g).

Table 1. Inheritance of boll weight in F_1 plants of fine-fiber local cotton varieties.

♀ \ ♂	Surkhon-9	Termiz-32	Duru Gavxar	Bukhara-7	Surkhan-10
Surkhon-9	2,62*	2,84 / 5,40	2,82 / 0,48	3,10 / 1,74	2,73 / 1,20
Termiz-32	2,84 / 5,40	2,52	2,99 / 1,54	3,05 / 1,36	2,62 / 0,10
Duru Gavxar	2,77 / 0,11	2,92 / 1,16	2,89	3,25 / 8,00	2,85 / 0,53
Bukhara-7	2,77 / − 0,14	2,92 / 0,78	2,82 / − 2,75	2,97	3,00 / 1,24
Surkhan-10	2,65 / − 0,40	2,94 / 3,20	2,97 / 1,94	2,82 / − 0,20	2,72

ЭКФ$_{05}$= 0,2г

Note: * - the average value of the character in F_1 plants

In the denominator - an indicator of the degree of superiority (l.s.)

The boll weight inherited in 11 of the 20 F_1 combinations with a positive super-predominance, 5 with an incomplete dominance of the high-yielding variety, 3 combinations with an incomplete dominance of the low-yielding variety, and 1 with a negative super-dominance.When Surkhan-9 and Termez-32 varieties, which are close to each other in terms of same size, were cross-bred, the trait was inherited in a positive extreme dominance (hp = 5.40) in reciprocal combinations. When mixing Bukhara-7 and Termez-32 varieties, which differ in character, F_1 Bukhara-7 x Termez-32 combination was incomplete (hp = 0.78), however in the combination F_1 Termez-32 x Bukhara-7 there were cases of positive overdose (hp = 1.36). Thus, the boll weight inherited in the F_1 plants of the studied varieties mainly in the case of positive super-predominance and incomplete predominance of high-yielding variety, negative super-predominance in one combination and incomplete dominance of low-yielding variety in 3 combinations.

When analyzing the boll weight according to EKF$_{05}$, the effect of heterosis observed only in 4 combinations – F_1 Duru Gavkhar x Bukhara-7 - 109.4%, F_1Surkhan-10 x Termez-32 - 108.1%, Surkhan-9 and Termez- It was found that 108 varieties accounted for 108.4% in reciprocal combinations.

The dispersion analysis showed that there was a statistical difference between the variants on boll weight ($F_f > F_{05}$). Reciprocal differences were noted in the reciprocal combinations of Surkhan-9 and Bukhara-7, Termez-32 and Surkhan-10, Duru Gavkhar and Bukhara-7 varieties. This suggests that cytoplasmic genes are also involved in the genetic control the weight boll.

When the combining ability of the primary varieties were studied according to the Fisher (F) criterion, it was found that the varieties differed in terms of GCA yield and SCA variance (P> 0.05). It was found that the relatively highest GCA yield in terms of boll weight was in the large boll Bukhara-7 variety ($\hat{g}_1$ = 0.23) (Table 2). In the remaining varieties, a negative GCA effect was noted. Our data show that the Bukhara-7 variety should be used as a primary source in the creation of a relatively large boll fine-fiber cotton varieties.

In the Bukhara-7 and Surkhan-10 varieties, the GCA variance is higher than the SCA variance($\sigma^2_{gi} > \sigma^2_{si}$), indicating that the trait is mainly controlled by additive genes. In other varieties, additive and non-additive genes are involved in the control of this trait.

Table 2. GCA yield ($\hat{g}_i$), SCA constant ($\hat{s}_{ij}$), GCA variance (σ^2_{gi}) and SCA variance (σ^2_{si}) of fine-fiber local cotton varieties by boll weight

♀ \ ♂	Surkhan-9	Termiz-32	Duru Gavhar	Buxoro-7	Surkhon-10	$\Sigma\hat{s}_{ij}^2$	σ^2_{si}	σ^2_{gi}	$\hat{g}_i$
Surkhan-9		0,15	-0,11	0,0033	0,04	0,0162	0,0049	0,005	-0,072
Termiz-32			0,06	-0,04	-0,08	0,0141	0,0042	0,004	-0,065
Duru Gavhar				0,02	0,02	0,0165	0,0050	0,005	0,071
Buxoro-7					0,01	0,0021	0,0002	0,053	0,231
Surkhon-10						0,0085	0,0023	0,027	-0,165

In the parent cotton varieties, the variability of the boll weight in one was 4 classes in all varieties except Bukhara-7, and 3 classes in Bukhara-7. In F2 hybrids of varieties the most classes are in correct combinations of Termez-32 variety with Bukhara-7 and Surkhan-10 varieties (9 classes), Surkhan-9 x Bukhara-7, Surkhan-10 x Bukhara-7 combinations and Bukhara-7 and recorded in reciprocal hybrids of Duru Gavhar varieties (8 classes) (Table 3).

The lowest classes of character, namely the relatively narrow range of variability are in the reciprocal hybrids of Termez-32 and Surkhan-9 varieties, Termez-32 x Duru Gavkhar, Duru Gavkhar x Surkhan-10, Bukhara-7 x Termez-32 and Bukhara-7xSurkhan-10 combinations (6 classes).The highest percentage of plants in the varieties Surkhan-9, Surkhan-10 and Termez-32 belongs to the modal class with an index of 2.5-2.7g (40.0; 46.6; 50.0%, respectively), Duru Gavkhar and Bukhara-7 in varieties it corresponded to modal classes with an index of 2.8-3.0g (40.0 and 50.0%, respectively). The highest percentage of plants is in the right combinations of Surkhan-10 with Surkhan-9 and Termez-32 in the modal class of 1.9-2.1g, in F2 Duru Gavkhar x Surkhan-9 and Bukhara-7 x Surkhan-10. together with the class belonged to the modal classes with indicators of 2.2-2.4g and 2.5-2.7g. Also, the maximum percentage of plants is 2.2-2.4g in 11 combinations, 2.5-2.7g in 3 combinations, 2.8-3.0g in 1 combination, 2.5-2.7g in 5 combinations and in 2 combinations belonged to the modal classes with an index of 2.8-3.0g. In all the F2 combinations studied, a left-sided negative transgressive variability in one boll weight, namely, a shift from the lowest-performing edge classes of the parent varieties to grades 2-3, was noted. In 10 of the 20 hybrid combinations, a right-sided transgressive variability occurred, resulting in large-bolled plants relative to the parent varieties.The shift to the right to class 2 was observed in the correct combinations of F2Bukhara-7 x Duru Gavkhar, as well as Termez-32 mixed with Bukhara-7 and Surkhan-10 (Figure 1). In the remaining F2 combinations, a shift to class 1 to the right was noted.The presence of right-sided transgressive variability in boll weight is important from a selection point of view, indicating that larger cotyledonous genotypes can also be obtained from parent varieties. Isolated large-boll genotypes can be a valuable resource in the creation of new large-celled varieties.

As having analyzed the coefficient of variation on the bollweight, it was found that it had a small variability (V = 7.7–11.4%) in the parent varieties. The average variability in most F2 combinations (V = 13.9-20.5%), in only 2 combinations, the large variability (V = 27.7% and V = 29) in hybrids of Termez-32 mixed with Duru Gavkhar and Bukhara-7 varieties. , 5%) were observed.

In all the F2 combinations studied, the coefficient of intergenerational transmission of the bollweight averaged 0.30–0.63. Only in the Termez-32 x Duru Gavhar combination it found was that the transmission of the mark from generation to generation was very low (h^2=0,24).

CONCLUSION

1. In the first generation hybrids of local cotton varieties belonging to the genus *G. barbadense* L., the boll weight was mainly in a state of positive super-predominance.

2. The presence of statistical differences in morphological characteristics of some reciprocal combinations of fine-fiber cotton varieties of F1 indicates that genetic control of these traits involves not only nuclear genes, but also cytoplasmic genes.

3. Duru Gavkhar and Bukhara-7 varieties can be used as a valuable starting source for the bollweight in a in genetic-selection research on the basis of determining the general combining ability of fine-fiber cotton varieties on economic characteristics.

4. In the F2 generation of fine-fiber local cotton varieties, the coefficient of variation was average and high in terms of boll weight.

Table 3. Variability scale and intergenerational transmission of boll weight in F₂ generation of varieties

T/p	Varieties and F₂ combinations	The percentage of the plants									$\overline{x}\pm S\overline{x}$	G	V%	h²
		1,3 1,5	1,6 1,8	1,9 2,1	2,2 2,4	2,5 2,7	2,8 3,0	3,1 3,3	3,4 3,6	3,7 4,0				
1	Surkhan-9				20,0	40,0	30,0	10,0			2,62±0,04	0,24	9,2	-
2	Termiz-32				36,6	50,0	10,0	3,3			2,52±0,04	0,22	8,7	-
3	Duru Gavxar				10,0	20,0	40,0	30,0			2,89±0,06	0,33	11,4	-
4	Bukhara-7					20,0	50,0	30,0			2,97±0,04	0,23	7,7	-
5	Surkhan-10				13,3	46,6	26,6	13,3			2,72±0,04	0,25	9,2	-
6	Surkhan-9x Termiz-32	1,3	13,0	20,8	39,0	16,8	9,1				2,35±0,03	0,41	15,2	0,46
7	Surkhan-9xDuru Gavxar	8,3	8,3	13,9	25,0	25,0	13,9	5,6			2,33±0,06	0,76	20,5	0,50
8	Surkhan-9xBukhara-7	1,3	2,6	29,0	34,2	19,7	6,6	5,3	1,3		2,35±0,03	0,38	16,6	0,39
9	Surkhan-9xSurkhan-10		6,2	12,3	29,2	27,7	16,9	4,6	3,1		2,49±0,03	0,41	15,7	0,44
10	Termiz-32xSurkhan-9		10,4	28,1	38,5	11,5	8,3	3,1			2,34±0,03	0,36	14,1	0,44
11	Termiz-32x Duru Gavxar		5,9	25,0	40,5	16,7	10,7	1,2			2,31±0,03	0,33	27,7	0,24
12	Termiz - 32xBukhara-7	7,6	13,6	19,7	16,7	21,2	10,6	6,1	3,0	1,5	2,86±0,05	0,56	29,5	0,63
13	Termiz-32xSurkhan-10	1,3	6,5	20,8	14,3	23,4	22,0	6,5	3,9	1,3	2,66±0,06	0,48	19,1	0,59
14	Duru Gavxar x Surkhan-9		12,2	31,7	26,8	9,9	14,6	2,4	2,4		2,29±0,03	0,42	15,2	0,50
15	Duru Gavxar xТермиз-32		2,4	12,9	24,7	18,8	28,2	11,8	1,2		3,21±0,03	0,41	20,2	0,34
16	Duru Gavxar xBukhara-7	2,1	5,2	21,9	31,2	12,5	12,5	9,4	5,2		2,77±0,04	0,47	15,1	0,49
17	Duru GavxarxSurkhan-10		3,0	10,6	22,7	24,2	25,8	13,7			3,2±0,03	0,40	14,5	0,39
18	Bukhara-7x Surkhan-9		1,4	6,9	23,6	32,0	23,6	9,7	2,8		2,63±0,06	0,67	14,9	0,58
19	Bukhara-7x Termiz -32		2,0	28,1	17,5	34,9	13,6	3,9			2,80±0,03	0,33	20,0	0,39
20	Bukhara-7 x Duru Gavxar		12,8	20,5	26,9	15,4	14,1	7,7	1,3	1,3	2,40±0,04	0,48	17,8	0,58
21	Bukhara-7xSurkhan-10		7,1	28,6	10,7	28,6	17,9	7,1			2,48±0,03	0,39	17,8	0,56
22	Surkhan-10x Surkhan-9	4,2	11,6	32,6	25,3	17,9	5,3	3,1			2,21±0,03	0,39	17,9	0,56
23	Surkhan-10x Termiz -32	2,4	7,0	29,4	21,2	20,0	17,6	2,4			2,34±0,03	0,42	17,9	0,55
24	Surkhan-10x Duru Gavxar	1,2	1,2	25,3	38,6	22,9	8,4	2,4			2,34±0,03	0,36	13,9	0,30
25	Surkhan-10xBukhara-7	3,1	9,4	11,0	23,4	23,4	17,2	9,4	3,1		3,09±0,04	0,49	18,4	0,50

Note: the number of selections in varieties - 30, in combinations F₂ - 150 plants

5. The emergence of valuable F₂recombinants with high performance traits has been at different levels depending on the mixing components, namely, the parent varieties and their combining ability.

6. As a result of selection work in the population of the family O-449, obtained on the basis of a hybrid combination F₂ Surkhan-9 x Termez-32, a variety of cotton "Marvarid" was created. This variety successfully passed the Ground Control of the State

Variety Test in 2017 and in 2018 was accepted to the varietal testing outlets of the DNS.

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