

INHERITANCE INDICATORS IN FIRST-GENERATION F₁ HYBRIDS OF COTTON BASED ON QUALITATIVE AND QUANTITATIVE TRAITS

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Annotation. The manuscript provides data on the inheritance patterns of qualitative and quantitative traits in the first-generation F₁ cotton hybrids produced through direct and reciprocal crosses of *G. hirsutum* L. varieties. The findings reveal that in intraspecific cotton hybrids, raw cotton mass exhibits both positive and negative overdominance, fiber length demonstrates underdominance, the fiber yield displays partially dominance, and fiber length during the growing season exhibits heterosis in both hybrid combinations.

Keywords. Cotton, *Gossypium hirsutum* L., intraspecific variety, inheritance, fiber length, fiber yield, boll weight, duration of the growing season.

ПОКАЗАТЕЛИ НАСЛЕДСТВЕННОСТИ У ГИБРИДОВ ПЕРВОГО ПОКОЛЕНИЯ F₁ ХЛОПЧАТНИКА ПО КАЧЕСТВЕННЫМ И КОЛИЧЕСТВЕННЫМ ПРИЗНАКАМ

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Аннотация. В рукописи приведены данные о закономерностях наследования качественных и количественных признаков у гибридов хлопчатника первого F₁ поколения, полученных в результате прямого и реципрокного скрещивания сортов *G. hirsutum* L. Результаты показывают, что у внутривидовых гибридов хлопчатника массы хлопка сырца демонстрирует как положительное, так и отрицательное сверхдоминирование, длина волокна демонстрирует отрицательное сверхдоминирование, у выхода волокна наблюдалось частичное доминирование, а у признака

продолжительность вегетационного периода зафиксирован гетерозис в обеих гибридных комбинациях.

Ключевые слова. Хлопчатник, *Gossypium hirsutum* L., внутривидовая разновидность, наследственность, длина волокна, выхода волокна, масса коробочек, продолжительность вегетационного периода.

G'O'ZADA SIFAT VA MIQDORIY BELGILARNING F₁ AVLOD DURAGAYLARDA IRSIYLANISH KO'RSATKICHLARI

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Annotatsiya. Ushbu maqolada *Gossypium hirsutum* L. turichi xilma-xilliklarini o'zaro to'g'ri va resiprok chatishtirish natijasida olingan F₁ duragay avlodlarda sifat va miqdoriy belgilarning irsiylanish ko'rsatkichlari haqida ma'lumotlar keltirilgan. Tadqiqot natijalariga ko'ra, g'o'zaning turichi *G.hirsutum* L. F₁ duragay o'simliklarida bitta ko'sakdagi paxta vazni belgisida – ijobiy va salbiy o'ta dominantlik, tola uzunligida – salbiy o'ta dominantlik, tola chiqimida esa – qisman dominantlik holatlari aniqlangan bo'lsa, vegetasiya davri davomiyligi belgisi bo'yicha har ikkala duragay kombinasiyalarda geterozis holati qayd etilgan.

Kalit so'zlar. G'o'za, *Gossypium hirsutum* L., turichi xilma-xilliklar, irsiylanish, tola uzunligi, tola chiqimi, ko'sak vazni, vegetasiya davri davomiyligi.

Introduction

Scientific endeavors worldwide are dedicated to the advancement of cotton breeding, particularly focusing on the creation of novel varieties within the *Gossypium* L. family, including *G. hirsutum* L. and *G. barbadense* L. These studies are centered on identifying economically valuable traits in tetraploid cotton species, aiming to harness their genetic potential for practical breeding applications. By delving into hybridization, researchers seek to unravel the inheritance patterns and variability of key morpho-biological traits essential for

economic prosperity. The ultimate objective is to integrate these traits into cultivated varieties, thereby yielding genetically enriched forms.

Successful hybridization hinges upon a comprehensive understanding of trait patterns across generations [6]. Crucial economic attributes such as earliness, fiber quality, and yield, among others, play pivotal roles. Moreover, deciphering the genetic mechanisms governing these traits and their interactions accelerates the breeding process, facilitating the development of superior cotton varieties.

According to Y.A. Boboev and others (2009) [3], research findings underscore nuanced relationships among traits, with insights indicating minimal correlation between yield and fiber length vis-à-vis boll size. Notably, traits like precocity and boll characteristics exhibit independent transmission, underscoring the complexity of genetic inheritance in cotton.

Guidelines advocate commencing breeding efforts from the F_3 generation to leverage the expression of desirable traits controlled by recessive genes (Yusupova *et al.*, (1990). Furthermore, observations elucidate the intermediate inheritance pattern of fiber yield in hybrid generations, contingent upon genetic relatedness among parent varieties. Sh. Akmuradov (1996) [2], conducting topcross hybridization of fine-fibered varieties, noted that economically valuable traits are inherited in an intermediate state and deviate predominantly from the parental varieties. The genetic regularity determined by quantitative trait indicators may vary among hybrids of one group of varieties and hybrids of another group of varieties. This depends on important parameters of genetic selection such as the level of dominance, epistasis, combinatorial ability, transmission level from generation to generation, etc [1].

The main goal of our research is to assess the degree of dominance and heritability from the paternal or maternal form in the inheritance of morphological and economically-valuable traits in F_1 hybrids obtained from direct and reciprocal crosses of cotton varieties *G. hirsutum* L.

Materials and methods

Research work was carried out at the Laboratory of Experimental Polyploidy and Phylogeny of Cotton at the Institute of Genetics and Experimental Biology of Plants of the Academy of Sciences of the Republic of Uzbekistan. In the course of the research, samples of cotton from the collection of *Gossypium hirsutum* L. species were used, which are preserved in the collection of the unique object "Cotton Gene Pool". Cultural forms of *Gossypium hirsutum* L., subspecies ssp. *euhiirsutum* Omad cultivar and var. *religiosum*, as well as F₁ generation plants obtained from them were used in the study. The var. *religiosum* form was grown in a wagner pot as the parental representative, while the other forms were planted in the field experiment. Hybridization was carried out using a standard methodology. The F₁ hybrid offspring was morphologically characterized compared to the parental plants (Lemeshov N.) [5]. Statistical analysis was conducted using B.A. Dospekhov's methodology (1985) [4] for the main economically-valuable traits in F₁ hybrid generations.

The dominance coefficient (*hp*) for traits in first-generation hybrids was calculated using Wright's formula (G.M.Beil, R.E.Atkins, 1965) [8];

$$hp = (F_1 - MP) / (P - MP);$$

In this: <i>hp</i> -	degree of dominance;
F ₁ C –	the average value of the studied trait of the hybrid form;
P -	arithmetic mean of the best parental trait;
MP -	the arithmetic mean of both parents;
Dominance assessment in F ₁ hybrids was conducted using the following methodology:	
<i>hp</i> = 0,	No domination
0 < <i>hp</i> < 1,	Partial dominance
<i>hp</i> = 1,	Complete domination
<i>hp</i> > 1	Extreme domination

Results

The results of studies comparing morphological characteristics of hybrid combinations F₁, derived from the hybridization of the subsp. *euhiirsutum* (cultivar Omad) and var. *religiosum* parental species, were analyzed. The analysis focused on heredity parameters of key economically significant traits in the F₁ hybrid

generations, including cotton weight per boll, fiber length, yield, and growing season duration. Statistical analysis was conducted on these traits as outlined in Table 1.

G. hirsutum* L. var. *religiosum forms are vertically growing, leaves are of medium density. The height of the main stem is 95-100,0 cm, with a strong anthocyanin redness, medium hairiness. The total number of joints is 9-10, sympodial branches (*s*) 11, monopodial branches (*m*) are absent, belonging to the 1 type. Branching is sympodial, the 1st sympodial fruiting branch (*hs*) is located on the 3-5th joints (Fig. 1). The leaf is medium size (5.5x6.5 cm), claw-shaped with 3-5 lobes, dark green, medium hairy, with anthocyanin spots on the upper part, 1 nectary. Leaf band 6 cm, dark green, sparsely hairy. The flower is average in size (5.0 cm). Calyx petals are 3, medium in size, dark green in color, the base is broadly heart-shaped, 10-13 teeth (6.0x3.0 cm), covered with gossypol glands. Petals - 5 (5.0x4.5 cm), yellow color. The anthers are white, medium sized, the dust is orange in color. The stigma beak is 0.3 cm longer than the anther. The stigma is covered with gossypol glands. The cup is small, egg-shaped, green in color, with 4-5 pieces.



Fig 1. *G. hirsutum* L.
var. *religiosum*



Fig 2. *G. hirsutum* L. ssp.
euhirsutum Omad cultivar

***G. hirsutum* L. subsp. *euhirsutum* Omad cultivar** vertical growth, the leaves are medium density. The main stem is 95-110,0 cm tall, has a medium anthocyanin blush, and is medium hairy. The total number of joints is 15-17, sympodial branches (*s*) 12-15, monopodial branches (*m*) 2-4, type 1. Branching is sympodial, the first sympodial fruit branch (*hs*) is located on the 6-7 joint (Fig. 2). The leaf is medium-sized (10.5x11.0 cm), claw-shaped with 3-5 lobes, dark green, weakly hairy,

there are gossypol glands on the back of the leaf, no anthocyanin blush, 1 nectary. Leaf band 12 cm, dark green, weakly hairy. The flower is average in size (5.0 cm). The petals are 3, medium in size, dark green in color, the base is broadly heart-shaped, 11-14 teeth (6.3×3.2 cm), covered with gossypol glands. Petals - 5 (5.1×4.4 cm), yellow in color. Anthers are medium, the anthers are white, the dust is orange in color. The stigma is 0.3 cm longer than the anther. The sigma is covered with gossypol glands. The cup is large, egg-shaped, green in color, with 4-5 pieces.

F₁ subsp. *euirsutum* Omad cultivar × var. *religiosum* (*G.hirsutum* L.) hybrid is vertically growing, leaves are in medium density. The height of the main stem is 60-110 cm, with a strong anthocyanin redness, medium hairiness. The total number of joints is 16-21, sympodial branches (s) 13-15, monopodial branches (m) 1-3, type 1. Branching is sympodial, the first sympodial fruit branch (*hs*) is located on the 3-7



Fig 3. *G. hirsutum* L.
var. *religiosum* × ssp. *euirsutum*
Omada cultivar

joint (Fig. 3). The leaf is medium-sized (10.5×11.5 cm), 3-5-lobed, dark green, without anthocyanin redness, weak hairiness. Nectary 1, ovoid. The leaf band is 12 cm long, dark green, weakly hairy. The flower is average in size (4.7 cm). The number of petals is 3, petals are medium in size, dark green in color, the base is wide heart-shaped, 8-11 teeth, covered with gossypol glands. Petals - 5 (4.7×3.7 cm), pale yellow, without anthocyanin redness. Anthers are medium in size, white, the dust is orange in color. The stigma is 0.4 cm longer than the anther. The stigma contains gossypol glands. The boll is medium in size, egg-shaped, green in color, 4-5 pieces.

F₁ subsp. *euirsutum* Omad cultivar × var. *religiosum* (*G.hirsutum* L.) (reciprocal combination) hybrid plants are vertically growing, leaves are of medium size. The height of the main stem is 80-110 cm, with moderate anthocyanin redness, strongly hairy. The total number of joints is 15-20, sympodial

branches (s) 11-16, monopodial branches (m) 1-2, type 1. Branching is sympodial, the first sympodial fruiting branch (hs) is located at the 5th joint (Fig. 4).

The leaf is medium in size (10.5×11.5cm), dark green, 3-5 lobed, without anthocyanin redness, covered with gossypol glands, weakly hairy. Nectary 1, ovoid. The leaf is blade 13 cm long, dark green, weakly hairy, with gossypol glands and anthocyanin spot. The flower is average in size. 3 petals, medium in size, light green in color, the base is wide heart-shaped, 7-8 teeth (2.7×2.0 cm), covered with gossypol glands. Petals - 5 (4.3×3.4 cm), pale yellow, without anthocyanin redness. Anthers are medium in size, white, the dust is orange in color. The stigma is 0.4 cm longer than the anther. The seed is covered with gossypol glands. The boll is medium in size, egg-shaped, green in color, 4-5 pieces.



Fig 4. *ssp. euhirsutum* Omad cultivar
× *G. hirsutum* L. var. *religiosum*

Table 1.

Inheritance indices weight of cotton in one boll, fiber length and yield, and the duration of the growing season F₁ hybrids and parental forms

Hybrid combinations and their parental forms	Mean±SE	Min-Max	SD	CV%	hp
Weight of cotton in one boll, g					
<i>ssp.euhirsutum</i> Omad cultivar	5,1 ± 0,34	4,1-7,2	1,0	21,1	
var. <i>religiosum</i>	4,5±0,22	3,8-5,2	0,5	11,1	
F ₁ <i>G. hirsutum</i> L. var. <i>religiosum</i> × <i>ssp. euhirsutum</i> Omad cultivar	5,49±0,34	3,95-7,2	1,0	19,5	2,3
F ₁ <i>ssp. euhirsutum</i> Omad cultivar × <i>G. hirsutum</i> L. var. <i>religiosum</i>	4,41±0,36	4,3-6,25	1,1	26,4	-1,3
Fiber length (mm)					
<i>G. hirsutum</i> L. <i>ssp. euhirsutum</i> Omad cultivar	34,4±0,73	30,4-36,7	2,3	6,7	
<i>G. hirsutum</i> L. var. <i>religiosum</i>	22,20±0,74	20,7-24,3	1,6	7,5	
F ₁ <i>G. hirsutum</i> L. var. <i>religiosum</i> × <i>ssp. euhirsutum</i> Omad cultivar	21,86±0,34	20,3-23,7	1,0	4,96	-1,0
F ₁ <i>G. hirsutum</i> L. <i>ssp. euhirsutum</i> Omad cultivar × <i>G. hirsutum</i> L. var. <i>religiosum</i>	20,86±0,72	16-23,33	2,2	10,9	-1,2
Fiber yield (%)					

<i>G. hirsutum</i> L. ssp. <i>euhi</i> rsutum Omad cultivar	40,76±1,56	34,14-51,02	4,9	12,1	
<i>G. hirsutum</i> L. var. <i>religiosum</i>	33,35±1,65	30,43-39,13	3,6	11,0	
F ₁ <i>G. hirsutum</i> L. var. <i>religiosum</i> × <i>G. hirsutum</i> L. ssp. <i>euhi</i> rsutum Omad cultivar	37,55±2,90	30,5-56,79	8,3	22,2	0,13
F ₁ <i>G. hirsutum</i> L. ssp. <i>euhi</i> rsutum Omad cultivar × <i>G. hirsutum</i> L. var. <i>religiosum</i>	37,43±0,67	33,33-40,42	2,1	5,73	0,10
Duration of the growing season (day)					
ssp. <i>euhi</i> rsutum Omad cultivar	111,3±1,14	104-117	3,6	3,25	
<i>G. hirsutum</i> L. var. <i>religiosum</i>	127,8±0,86	125-130	1,9	1,50	
F ₁ <i>G. hirsutum</i> L. var. <i>religiosum</i> × ssp. <i>euhi</i> rsutum Omad cultivar	104,4±0,58	104-107	1,8	1,76	1,84
F ₁ ssp. <i>euhi</i> rsutum Omad cultivar × <i>G. hirsutum</i> L. var. <i>religiosum</i>	104,1±0,54	102-107	1,7	1,66	1,87

Conclusions. Therefore, the F₁ hybrid generations resulting from the hybridization of *G. hirsutum* L. cotton varieties exhibit characteristics such as positive and negative super dominance in cotton weight per boll, negative super dominance in fiber length, and partial dominance in fiber yield. Moreover, heterosis was observed in the length of the growing season in both hybrid combinations. The hybridological analysis conducted on the inheritance and variability of morpho-biological and economically valuable traits in the hybrid combinations obtained through the hybridization of *G. hirsutum* L. cotton varieties underscores the significance of determining the genetic and selection potential of these hybrids based on the interpretation of the genetic laws inferred from the data. Selecting these hybrids as initial sources for practical breeding purposes emerges as a crucial consideration.

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