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GENETIC ANALYSIS OF FIBER QUALITY TRAITS IN F1 HYBRIDS DERIVED FROM MEXICAN AND US COTTON ACCESSIONS AND LOCAL VARIETIES

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Abstract

One of the main tasks in the field of plant breeding in our country is to create new early-maturing varieties and initial forms of cotton that are adapted to the soil and climatic conditions of the Republic and have high fiber quality and yield. Therefore, selecting ecologically and geographically distant accessions—such as those from Mexico and the USA—based on valuable economic traits, and crossing them with local varieties to develop intensive, optimally structured, early-maturing, high-yielding forms with high fiber output and quality that meet international standards is a current and pressing issue. This article explores the fiber length, micronaire value, fiber strength, spinning coefficient (one of the indicators of fiber quality), and dominance (hp) degree in ecologically distant accessions, local varieties, and F1 hybrids, and evaluates whether the fiber quality meets international standards.

Keywords

cotton hybridization, hybrid combinations, fiber quality, micronaire, spinning coefficient, fiber strength, inch, dominance coefficient, heterosis, eco-geographic, international standards.

INTRODUCTION. Cotton breeders around the world and in our country are conducting research in various directions to increase cotton yields. Countries such

as the USA, Mexico, Brazil, China, and several African nations, which have well-developed cotton industries, have achieved significant results by applying modern breeding techniques to obtain high and quality yields from cotton. The introduction of advanced technologies and valuable traits from new cotton varieties of these foreign countries into the breeding process helps improve yield and earliness, which remains a relevant issue for enhancing cotton fiber quality and output in our Republic.

To overcome these challenges, it is essential to involve foreign samples from cotton collections in the breeding process and select promising forms. Therefore, selecting ecologically and geographically distant accessions, such as those from Mexico and the USA, based on valuable economic traits and crossing them with local varieties to create intensive, optimally structured, early-maturing, high-yielding forms with high fiber output and quality that fully meet international standards is one of today's main priorities.

According to many years of research conducted by O. Kuchkorov et al. [7], involving wild and semi-wild cotton forms in hybridization with varieties from the USA and taking fiber quality into account in the selection of initial forms has had a positive effect on the technological indicators of fiber in the developed lines.

According to the analysis by D.Kh. Akhmedov, J.S. Jabborov [4] and others, samples from the world collection with donor characteristics were identified by the following fiber quality indicators: JS-65, 85, 100, 101, and 103 showed optimal micronaire values; fiber length in all samples corresponded to type IV and V categories. In terms of maturity, samples like Acala 05838 (USA), SP-179, 94, 99, and 103 were notable. All varieties and samples showed "medium" to "high" levels in fiber quality indicators such as spinning coefficient, fiber strength, and uniformity index. Therefore, they were recommended as donor forms to breeders for crossing.

RESEARCH METHODS. The scientific research was conducted under field and laboratory conditions at the Karakalpakstan Scientific Research Institute of Agriculture [1; 2]. The institute is located 4 km northeast of Chimboy city, at 43°–44° N latitude, within the territory of Chimboy district, Karakalpakstan Republic. The mechanical composition of the experimental field soil is medium and light loam, and groundwater is found at a depth of 2.0–3.0 meters. Summer days are mostly cloudless, and annual precipitation is around 150–160 mm. In spring, the soil surface typically thaws in March. In autumn, the topsoil begins to freeze by the end of October or early November. Seeds were sown in the field at a depth of 3–5 cm in a 60 × 25 × 1 pattern, using a threefold replication with 50 hills per replication and 3–4 seeds per hill.

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After harvesting, studies were conducted in laboratory conditions to examine foreign and local varieties and first-generation hybrids of cotton. The main goal was to recommend new initial forms of medium-staple cotton that are intensive, optimally structured, early-maturing, and high-yielding—derived from hybridizing ecologically distant samples from Mexico and the USA with local varieties—for practical breeding work under the conditions of Karakalpakstan. **F1 hybrid generations planted based on the samples, parental forms, and the C-4727 variety as a control**. All field observations were carried out according to the methods for conducting field experiments. Specifically, the research involved phenological observations based on morphobiological traits in field experiments, and valuable economic traits were analyzed both in the field and laboratory. The results obtained from the experiments were statistically processed using the method of B.A. Dospekhov [5]. For each trait, the obtained indicators were analyzed mathematically, i.e., the significance of differences between varieties and hybrids was determined using the Fisher criterion (F), the general error of the experiment Sx, the standard error of the difference between means Sd, and the Least Significant Difference (LSD) at a 95% confidence level.

The degree of dominance was calculated using the formula of S. Wright, according to the method presented in the work of Abdul Jalil Hassan Muhammad Al Kharani [3], where:

- F1 – the arithmetic mean indicator of the hybrid;
- MP – the arithmetic mean of the parents;
- P – the arithmetic mean of the best parent;
- hp – the dominance coefficient.

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

RESULTS AND DISCUSSION. According to the research of E. Rakhmatkhojaeva and others [6], the fiber quality indicators of systems developed as a result of eco-geographical distant hybridization in cotton—based on analyses of the fiber spinning coefficient (SCI), micronaire (Mic), fiber length (Lend in inches), specific relative breaking strength (Str in g/tex), and fiber uniformity index (UI%)—demonstrated that new lines belonging to Type IV fiber were selected from F3 hybrid plants obtained by crossing local varieties among themselves and with the African *G. stocksii Mast* specimen. These lines were later consolidated with other valuable economic traits and selected for the development of new starting material.

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It is of great importance in cotton growing that the fiber quality traits of newly created and currently cultivated cotton varieties in our country meet international standards. Fiber quality indicators were determined using the HVI modern measuring equipment at the "Quality" certification center. The fiber quality indicators such as Lend (inches), Mic, Str (g/tex), and SCI were analyzed in the samples of F1 simple hybrids from the parental forms and control C-4727 variety (Table 1).

Fiber length is a primary trait that defines the fiber type. Among the studied eco-geographically distant specimens, local varieties, and F1 hybrids, most met the criteria for Type IV fiber. Fiber length ranged from 1.08 inches in the USA sample 010559 Lancert 611 to 1.14 inches in the Mexican sample 010239 Holland 1806. Local varieties showed lengths from 1.10 to 1.13 inches. In F1 hybrids, it ranged from 1.09 inches in the F1 (Holland 1806 × KK-3535) combination to 1.17 inches in the F1 (HS-23 × KK-3535) combination. The control C-4727 variety had a fiber length of 1.12 inches.

When determining the degree of dominance (hp) for fiber length, it was observed that in 11 out of the 13 studied F1 hybrids, there was a positive heterosis effect. The dominance coefficient (hp) ranged from 1.0 in the F1 (DP1-SR-383 × Chimboy-5018) combination to 13.0 in the F1 (Brymer Brown × Chimboy-5018) combination, indicating positive inheritance. In 2 hybrids, negative heterosis was observed, with (hp) ranging from -0.33 to -2.33. This suggests that, in terms of this trait, F1 hybrids contain families with longer fiber compared to the parental forms and the control variety.

Regarding the micronaire trait, eco-geographically distant specimens showed values from 4.3 (Mexico 010309 Oclock 1518) to 5.1 (USA 011173 Dand p1 10-2). Local varieties ranged from 4.5 (Chimboy-5018) to 4.7 (KK-3535). In F1 hybrids, values ranged from 4.2 in the F1 (Holland 1806 × Chimboy-5018) combination to 5.0 in the F1 (Brymer Brown × Sultan) combination. The control variety showed a micronaire value of 4.6. There was no significant difference in micronaire values among eco-geographically distant specimens, local varieties, and their hybrids. Therefore, among the 13 studied F1 hybrids, 4 showed negative heterosis (hp = -0.5 to -7.0), 1 was intermediate (hp = 0), and 8 showed positive inheritance (hp = 0.6 to 7.0).

For the fiber strength trait (specific relative breaking strength), values in Mexican and US specimens ranged from 28.6 g/tex (Mexico 010309 Oclock 1518) to 34.5 g/tex (Mexico 010239 Holland 1806). In local varieties, it ranged from 28.6 g/tex in the Sultan variety to 30.6 g/tex in Chimboy-5018. Among the studied F1 hybrids, it ranged from 28.3 g/tex in the F1 (Dand p1 10-2 × Sultan) combination to

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33.8 g/tex in the F1 (Lancert 611 × KK-3535) combination. The control C-4727 variety had a strength of 28.6 g/tex.

For this trait, hybrids obtained with eco-geographically distant specimens and local varieties demonstrated somewhat higher values than the parental forms and the control variety. Consequently, out of 13 F1 hybrids, 8 combinations showed positive inheritance (hp = 0.06 to 23.0). The remaining 5 hybrids showed negative inheritance, with (hp) ranging from -0.5 to -12.3. In terms of fiber strength, F1 hybrids were 2–3 g/tex higher than the parental forms and the control variety, with F1 (Oclock 1518 × KK-3535) and F1 (Lancert 611 × KK-3535) combinations being particularly favorable compared to other hybrids.

It is known that nowadays, one of the quality indicators of fiber is the spinning coefficient (SCI), and particular attention is paid to this by clusters, which increasingly demand a positive value of this trait. When studied by this trait, ecogeographically distant samples—i.e., from Mexico and the USA—had values ranging from 134 (Mexico 010309 Oclock 1518) to 161 (USA 010526 DP1-SR-383). Among local varieties, the values ranged from 148 in variety KK-3535 to 162 in Chimboy-5018. In F1 hybrids, the values ranged from 138 in the F1 (Brymer brown x Sulton) combination to 172 in the F1 (HS-23 x KK-3535) combination, while the standard variety C-4727 had a value of 146. Among the 13 F1 hybrids obtained from ecogeographically distant samples and local varieties, 9 showed positive inheritance of this trait with heterosis (hp) values ranging from 0.41 to 10.6. In 4 of the F1 hybrids, negative inheritance was observed with (hp) values ranging from -1.0 to -11.0. The highest inheritance was observed in the combinations F1 (HS-23 x KK-3535) at 10.6 and F1 (Lancert 611 x KK-3535) at 6.33, which were found to be higher compared to other hybrids.

CONCLUSION. As a result of the above research, the following conclusions can be drawn:

1. Based on the analysis of fiber quality indicators of the 13 F1 hybrids derived from the studied samples of Mexico and the USA, local varieties, and their combinations, it was found that 7 hybrids met international standards for fiber quality.
2. Among the studied samples, the combinations with relatively poor indicators in terms of fiber quality traits such as Length (inches), Micronaire (Mic), Strength (g/tex), and SCI were discarded, and those with positive fiber quality were retained.
3. Based on the analysis of traits such as early maturity, high number of bolls, large boll size, productivity, and fiber yield, promising samples were selected for further research in the coming years.

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Table 1

Inheritance of fiber quality traits in hybrids obtained from local varieties crossed with medium-fiber ecogeographical distant accessions (Mexico, USA).

№	Parental forms and F_1 hybrids	Lend (inch)	hp	Mic	hp	Str (g/tex)	hp	SCI	hp
1	(Mexico) 010203. Nazar 87	1.09		4.8		32.4		138	
2	(Mexico) 010236. HS-23	1.12		4.8		29.2		143	
3	(Mexico) 010239. Holland 1806	1.14		4.6		34.5		156	
4	(Mexico) 010309. Oclock 1518	1.13		4.3		28.6		134	
5	(USA) 010520. PSR-20	1.13		4.9		30.3		158	
6	(USA) 010526. DP1-SR-383	1.12		4.6		31.5		161	
7	(USA) 010559. Lancert 611	1.08		4.5		29.8		142	
8	(USA) 011170. Brymer brown	1.09		4.8		32.2		146	
9	(USA) 011173. Dand p1 10-2	1.12		5.1		28.7		135	
10	Sulton	1.13		4.6		28.6		152	
11	KK-3535	1.11		4.7		29.3		148	
12	Chimboy-5018	1.10		4.5		30.6		162	
13	F_1 [(Mexico) 010203. (Nazar 87×KK-3535)]	1.12	2.0	4.7	1.0	29.3	-1.0	153	2.0
14	F_1 [(Mexico) 010236. (HS-23×Sulton)]	1.14	3.0	4.3	4.0	32.8	13.0	166	4.11
15	F_1 [(Mexico) 010236. (HS-23×KK-3535)]	1.17	11.0	4.4	7.0	30.4	23.0	172	10.6
16	F_1 [(Mexico) 010239. (Holland 1806×KK-3535)]	1.09	-2.33	4.9	-5.0	30.5	-0.53	148	-1.0
17	F_1 [(Mexico) 010239. (Holland 1806×Chimboy-5018)]	1.15	1.5	4.2	7.0	32.7	0.07	163	1.33
18	F_1 [(Mexico) 010309. (Oclock 1518×KK-3535)]	1.13	1.0	4.3	1.0	33.2	12.1	167	3.71
19	F_1 [(USA) 010520. (PSR-20×Chimboy-5018)]	1.11	-0.33	4.8	-0.5	28.6	-12.3	154	-3.0
20	F_1 [(USA) 010526. (DP1-SR-383×Sulton)]	1.16	7.0	4.5	0	32.9	1.96	159	0.55
21	F_1 [(USA) 010526. (DP1-SR-383×Chimboy-5018)]	1.12	1.0	4.9	-7.0	31.4	0.77	156	-11.0
22	F_1 [(USA) 010559. (Lancert 611×KK-3535)]	1.15	3.66	4.3	3.0	33.8	17.0	164	6.33
23	F_1 [(USA) 011170. (Brymer brown×Sulton)]	1.13	1.0	5.0	-3.0	29.5	-0.5	138	-3.66
24	F_1 [(USA) 011170. (Brymer brown×Chimboy-5018)]	1.16	13.0	4.4	1.66	32.7	16.2	170	2.0
25	F_1 [(USA) 011173. (Dand p1 10-2×Sulton)]	1.14	3.0	4.7	0.6	28.3	-7.0	147	0.41
	Standard C-4727	1.12		4.6		28.6		146	