FIBER QUALITY TRAITS VARIABILITY AND SELECTION ASSESSMENT IN F_3 HYBRID GENERATIONS OF COTTON (GOSSYPIUM HIRSUTUM L.)

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Abstract. The article investigates fiber quality traits in five F_3 hybrid combinations of cotton. The experiments were conducted in comparison with the standard variety C-6524. The results showed that all F_3 combinations surpassed the control variety in fiber length, with the highest indicators recorded in F_3 Andijan-36 × Omad (33.9 mm) and F_3 Andijan-35 × Omad (33.8 mm) combinations. In terms of fiber yield, the F_3 Andijan-36 × Omad combination demonstrated the best result (38.8%), exceeding the control variety C-6524 (36.1%) by 2.7%.

Keywords: cotton, F_3 generation, fiber length, fiber yield, micronaire, relative breaking strength, hybrid combination, selection.

Introduction. Cotton fiber is the most important raw material for the textile industry, and its quality parameters directly affect the quality of the final product. The modern textile industry is increasing demand for cotton varieties with high-quality, fine, long, and strong fiber (Smith & Coyle, 2019). Therefore, improving fiber quality traits is a crucial strategic objective in cotton breeding. Fiber quality comprises several components: fiber length (mm), fiber yield (%), micronaire (fiber fineness and maturity), fiber length (inches), and relative breaking strength (g/tex). All of these traits are polygenic in nature, and their expression is influenced not only by genotypic factors but also by environmental conditions, agrotechnical practices, and climatic factors (Paterson et al., 2020). Hence, studying fiber quality parameters in hybrid generations and assessing their variability and heritability is of significant scientific and practical importance for breeders.

In cotton breeding, the F_3 generation represents one of the most genetically complex stages. The segregation of genes initiated in F_2 continues into F_3; however, at this stage, the ratio of homozygous to heterozygous plants shifts, increasing the efficiency of selection (Khujayev et al., 2015). In the F_3 generation, each plant progeny (family) is evaluated phenotypically to identify valuable genotypes. Thus, a detailed analysis of fiber quality parameters in F_3 provides a foundation for subsequent breeding stages (F_4–F_6). In ongoing breeding programs in Uzbekistan, comprehensive studies of fiber quality traits in F_3 hybrids derived from local varieties (Andijan-35, Andijan-36, Namangan-77, Namangan-34, Omad, Andijan-40, UzPITI-101) have not yet been conducted at a

sufficient level. Particularly, analysis of F_3 hybrids involving local varieties for traits of modern industrial importance, such as micronaire and relative breaking strength, remains a relevant task.

Materials and methods. Five F_3 hybrid combinations served as the research objects: F_3 Andijan-35 × Omad, F_3 Andijan-36 × Omad, F_3 Namangan-77 × Andijan-35, F_3 Namangan-34 × Andijan-36, and F_3 Omad × Andijan-40. The local standard variety C-6524 was used as the control.

Variation statistics methods were applied to the obtained data. For each indicator, the arithmetic mean (M) and standard error (±m) were calculated. The reliability of differences between variants was assessed using the $LSD_{0.5}$ (least significant difference) criterion. Statistical processing of the experimental results was carried out based on analysis of variance according to the method of B.A. Dospekhov (1985).

Results. Five main fiber quality parameters were studied in the F_3 hybrid combinations. The obtained results are presented in Table 1.

Table 1

Fiber quality indicators of F_3 plants in the third-year biological nursery

№	Combinations	Fiber				
		Fiber length, mm	Fiber yield, %	Micronaire	Fiber length, inch	Relative breaking strength, g/tex
		M±m	M±m	M±m	M±m	M±m
1	F_3Andijon-35 x Omad	33,8±0,5	36,9±0,7	4,5±0,6	1,32±0,11	31,7±0,8
2	F_3Andijon-36 x Omad	33,9±0,4	38,8±0,3	4,3±0,4	1,34±0,06	29,5±0,6
3	F_3 Namangan-77 x Andijon-35	33,4±0,7	37,5±0,7	4,5±0,5	1,31±0,05	28,8±0,6
4	F_3Namangan-34 x Andijon-36	33,2±0,7	35,6±0,2	4,3±0,2	1,29±0,06	31,4±0,7
5	F_3Omad x Andijon-40	32,5±0,5	37,4±0,6	4,4±0,3	1,26±0,07	29,2±0,5

6	Andoza C-6524	31,5±0,4	36,1±0,5	4,5±0,2	1,26±0,06	31,4±0,4
$LSD_{0.5}$ values: fiber length – 0.9 mm; fiber yield – 1.4%; micronaire – 0.3; breaking strength – 1.6 g/tex.						

All F_3 hybrid combinations surpassed the control variety C-6524 (31.5 mm) in fiber length. The highest indicator was recorded in the F_3 Andijan-36 × Omad combination (33.9 mm), which was 2.4 mm (7.6%) higher than the control. The F_3 Andijan-35 × Omad combination ranked second with 33.8 mm. The lowest indicator was observed in F_3 Omad × Andijan-40 (32.5 mm), which still exceeded the control by 1.0 mm. In terms of fiber yield, the F_3 Andijan-36 × Omad combination demonstrated the highest result – 38.8%. This was 2.7% (7.5%) higher than the control variety C-6524 (36.1%). The F_3 Namangan-77 × Andijan-35 (37.5%) and F_3 Omad × Andijan-40 (37.4%) combinations also outperformed the control. The F_3 Andijan-35 × Omad (36.9%) indicator was close to the control, while F_3 Namangan-34 × Andijan-36 (35.6%) produced a result below the control. The micronaire value reflects fiber fineness and maturity. The industrially favorable range is 4.0–4.9. All F_3 combinations and the control variety fell within this range (4.3–4.5). The lowest values were recorded in F_3 Andijan-36 × Omad (4.3) and F_3 Namangan-34 × Andijan-36 (4.3), indicating fine and mature fiber. The control variety and other combinations ranged between 4.4–4.5. In terms of fiber length expressed in inches, F_3 Andijan-36 × Omad (1.34 inches) and F_3 Andijan-35 × Omad (1.32 inches) also demonstrated superiority. The control variety measured 1.26 inches. The lowest indicator was recorded in F_3 Omad × Andijan-40 (1.26 inches), which was equal to the control. Relative breaking strength determines fiber strength and its value for the yarn spinning industry. The highest indicator was recorded in the F_3 Andijan-35 × Omad combination (31.7 g/tex). F_3 Namangan-34 × Andijan-36 (31.4 g/tex) and the control variety (31.4 g/tex) followed. F_3 Andijan-36 × Omad showed 29.5 g/tex, F_3 Omad × Andijan-40 – 29.2 g/tex, and F_3 Namangan-77 × Andijan-35 – 28.8 g/tex.

Discussion. The studied F_3 hybrid combinations showed varying results for fiber quality parameters. All F_3 combinations surpassed the control variety in fiber length. This indicates that hybridization-based breeding for increasing fiber length is effective. The best result was observed in the Andijan-36 × Omad combination (33.9 mm). This indicator is consistent with findings of other researchers. For example, Rajabov et al. (2018) reported that fiber length in F_3 ranged from 32.5–34.0 mm. The significant superiority of F_3 Andijan-36 × Omad

(38.8%) over the control (36.1%) in fiber yield increases the selection value of this combination. A positive correlation was observed between fiber yield and fiber length – F_3 Andijan-36 × Omad led in both parameters. However, in F_3 Namangan-34 × Andijan-36, a discrepancy was observed between fiber yield (35.6%) and fiber length (33.2 mm) – long fiber with low yield – indicating the complexity of genetic relationships between these two traits (Abzalov et al., 2012).

For micronaire, all variants fell within the industrially favorable range of 4.0–4.9. Particularly, F_3 Andijan-36 × Omad (4.3) and F_3 Namangan-34 × Andijan-36 (4.3) were distinguished by producing fine and mature fiber. Micronaire values above 5.0 indicate coarse fiber, while values below 3.9 indicate immature fiber (Smith & Coyle, 2019). Therefore, the micronaire indicators of these hybrids are favorable for high-quality yarn spinning. For relative breaking strength, F_3 Andijan-35 × Omad (31.7 g/tex) and F_3 Namangan-34 × Andijan-36 (31.4 g/tex) showed results equal to or higher than the control variety. This parameter is important for the textile industry, as fiber with high breaking strength enables the production of high-quality and durable fabrics (Paterson et al., 2020). Although F_3 Andijan-36 × Omad had relatively lower breaking strength (29.5 g/tex), its overall evaluation remains high due to its leading position in fiber length and yield.

The research results demonstrate that in the F_3 generation, hybrid populations exhibit a wide variation spectrum for most of the studied traits. This is explained by the fact that genetic segregation initiated in F_2 continues into F_3, although the degree of homozygosity increases at this stage (Khujayev et al., 2015). Therefore, individual selection results in F_3 manifest more prominently in F_4–F_5, and the effectiveness of selection made at this stage is relatively high. From a breeding perspective, F_3 Andijan-36 × Omad and F_3 Andijan-35 × Omad combinations produced relatively stable and high results across all parameters. F_3 Namangan-77 × Andijan-35 and F_3 Omad × Andijan-40 also showed good results for some parameters (fiber yield, micronaire), but were insufficient for fiber length and breaking strength. F_3 Namangan-34 × Andijan-36 performed well for breaking strength but fell below the control for fiber yield.

Conclusion. All F_3 hybrid combinations surpassed the control variety C-6524 (31.5 mm) in fiber length. The highest indicators were recorded in F_3 Andijan-36 × Omad (33.9 mm) and F_3 Andijan-35 × Omad (33.8 mm). In terms of fiber yield, F_3 Andijan-36 × Omad (38.8%) exceeded the control variety (36.1%) by 2.7% ($P<0.05$). F_3 Namangan-77 × Andijan-35 (37.5%) and F_3 Omad × Andijan-

40 (37.4%) also outperformed the control, but the differences were not significant. For micronaire, all hybrid combinations fell within the industrially favorable range (4.3–4.5), with F_3 Andijan-36 × Omad and F_3 Namangan-34 × Andijan-36 (4.3) distinguished by fine and mature fiber. For relative breaking strength, F_3 Andijan-35 × Omad (31.7 g/tex) and F_3 Namangan-34 × Andijan-36 (31.4 g/tex) achieved results equal to or higher than the control variety (31.4 g/tex). Based on integral assessment, F_3 Andijan-36 × Omad and F_3 Andijan-35 × Omad were identified as promising combinations across all fiber quality parameters (length, yield, micronaire, strength).

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