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THE MANIFESTATION OF CERTAIN TRAIT CHARACTERISTICS IN THE PHENOTYPE OF G. HIRSUTUM L.

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Abstract
This article analyzes the data collected as a result of scientific research conducted at the Institute of Genetics and Plant Experimental Biology of the Academy of Sciences of the Republic of Uzbekistan, aimed at identifying the manifestation of important morpho-agronomic trait indicators characteristic of upland cotton genotypes. As research materials, the varieties Kelajak, UzFA-707, UzFA-710, Mehnat, Yulduz, and AN-Boyovut-2, as well as the lines T-19, T-41, T-826, T-840, T-1278, T-1326, T-1336, T-1391, T-1470, T-1477, T-1777, and T-8588, were sown and cultivated in 2020 under the prevailing soil and climatic conditions of Tashkent region. In the resulting populations, average values were determined for

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traits such as plant height, number of sympodial branches, total and opened bolls per plant at the end of the vegetation period, number of locules per boll, seed cotton weight per boll, fiber yield, and fiber length. The manifestation of correlation relationships among these traits was also identified. The obtained data were analyzed both in terms of inter-genotypic variation and by comparison with the standard varieties Namangan-77 and C-6524. It was found that, during the research period, the average values of the analyzed traits varied among the cotton genotypes and in comparison with the standard varieties. Although none of the research materials demonstrated consistent superiority across all traits in a balanced manner, certain varieties and lines exhibited advantages over others in specific traits under investigation. During the research period, the variety Kelajak was identified as one of the most productive genotypes. At the conclusion of the article, based on the superior performance of the analyzed cotton genotypes compared to the standard and other samples in the studied traits, important conclusions and recommendations were provided regarding the use of these genotypes not only in production but also in scientific research.

Keywords: G. hirsutum L., varieties, lines, populations, morpho-agronomic traits, indicators, variability, correlation, genotype, phenotype, differentiation, data, comparative analysis.

Object of the study: The materials of this research consist of upland cotton varieties Kelajak, UzFA-707, UzFA-710, Mehnat, Yulduz, and AN-Boyovut-2, as well as the lines T-19, T-41, T-826, T-840, T-1278, T-1326, T-1336, T-1391, T-1470, T-1477, T-1777, and T-8588. In order to compare the trait indicators of these cotton genotypes, the variety Namangan-77 was used as a standard for fiber yield, and C-6524 as a standard for fiber length.

Location and climatic conditions of the research: The experiments were conducted in the fields of the Durmon Scientific Experimental Station, affiliated with the Institute of Genetics and Plant Experimental Biology of the Academy of

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Sciences of the Republic of Uzbekistan, located in Kibray district of Tashkent region. The average annual temperature in the district is 13.9 °C, and the average annual precipitation is 449 mm. The highest rainfall typically occurs in March, while the lowest is observed in August.

The soil in the experimental area is irrigated meadow gray soil, with a humus content of 0.8–1.2% and an average available phosphorus content of 30–38 mg/kg.

Research methods: In conducting the research, methods such as population analysis in genetics, comparative morphology, and phenological observations were applied. The experimental variants were arranged using a randomized design with three replications. For each genotype under analysis, 100 plants from the corresponding population were measured for main stem height using a centimeter measuring rod. Other morphological traits were recorded manually, while indicators such as seed cotton weight per boll, fiber yield, and fiber length were determined under laboratory conditions. The seed cotton weight per boll was calculated by dividing the total weight of raw cotton by the total number of harvested bolls. Fiber quality was assessed using the "HVI" device in accordance with the Uz DSt 604-2001 standard [18; p. 10].

The fiber yield of the genotypes and the hybrid plants derived from them was determined using the following formula:

$$\text{Fiber yield} = \frac{(\text{Seed cotton weight} - \text{seed weight}) \times 100\ \%}{\text{Seed cotton weight}}$$

The degree of association (correlation) between traits was determined using the following formula according to B.A. Dospekhov [20; p. 416]:

$$r = \frac{\Sigma XY - (\Sigma X \Sigma Y) \div n}{\sqrt{(\Sigma x^2 - (\Sigma x)^2 \div n) * (\Sigma Y^2 - (\Sigma Y)^2 \div n)}}$$

Where: r – correlation coefficient; x – mean value of the studied trait x; y – mean value of the studied trait y; n – sample size, i.e., the number of paired observations.

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It is known that the correlation coefficient ranges from –1.0 to +1.0 ($-1 < r < +1$). A correlation is considered weak when $r < 0.33$, moderate when $r = 0.33–0.66$, and strong when $r > 0.66$. The data were statistically processed using the ANOVA program.

Literature Review:

In order to make broad use of the unique characteristics of the cotton plant, various studies have been conducted in several countries around the world. As a result, species that demonstrated positive effectiveness when cultivated and propagated in agriculture were identified, and through both intraspecific and interspecific hybridization, numerous new cotton varieties have been developed and introduced into agricultural production. In such genetic and breeding research conducted in cotton farming, particular attention is given to the heritability, variability, development across generations, stabilization, and fixation of morpho-agronomic trait indicators.

The effectiveness of complex hybridization in improving valuable economic traits in cotton has been studied by many researchers, including S.S. Sodiqov (1972), V.P. Senoyedov (1972), Sh.I. Ibragimov (1986), O.J. Jalilov (1993, 1997), A. Egamberdiev (1993, 1994), V.A. Avtonomov (2010, 2012), Sh.E. Namozov (2014, 2017), I.T. Qahhorov (1990, 1996, 2000, 2015, 2018), M. Dhillon (1991, 1993), B. Allashov et al. (2006, 2007), Z. Rahmonov and A. Siddiqov (2003), E. Tukhtayev et al. (2009), and P.Sh. Ibragimov et al. (2010, 2013). The variation of quantitative traits in cotton depending on environmental conditions has been studied by M.D. Dzhumaev et al. (1986) and B.K. Sunnatov (1993). The drought tolerance of upland cotton varieties has been researched by a number of scholars, including Kh.S. Samiev et al. (1979; 1982; 1984; 1987; 1991; 1996; 2005; 2010), E.A. Papova et al. (1984), K.G. Marfina, D.Kh. Khodjaev, and A.E. Kholliev (1991, 1999), M.W. Van Lersal and D.M. Oosterhuis (1996), S.M. Gaziyants and O.J. Jalilov (1996), R.M. Usmonov (1997), Y. Saranga et al. (1998, 1998, 2004), W.T. Pettigrew (2004), S.A. Liver et al. (2007), A.E. Kholliev et al. (2005, 2011, 2015), M.I. Akhmedov (2007), I.S. Karimova (2009), M. Tojiev et al. (2009),

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O.E. Kuchkarov et al. (2012), A.E. Kholliev and U.T. Norboeva (2012), and N.N. Sanaev and Sh. Yunuskhanov (2016a, 2016b).

In scientific studies conducted on cotton genetics and breeding, the role of interspecific hybridization (G. barbadense L. × G. hirsutum L.) in increasing the resistance of this plant to adverse environmental conditions was thoroughly investigated by F. Wang et al. (2011).

Results and Discussion:

Research on cotton plants places particular emphasis on aspects such as the productivity of this crop species [15; pp. 162–174], the correlation between traits [56; pp. 900–910], the formation and stabilization of economic traits across several plant generations [42; pp. 10–14], the resistance of seed cotton to various pathogenic fungi during the germination process [40; pp. 179–185], the manifestation of tolerance levels in the leaf blades of emerging seedlings [41; pp. 54–61], as well as the analysis of various viral diseases in other crops [57; pp. 957–967].

In achieving high-quality and abundant cotton yields, alongside economically significant traits, certain morphological characteristics—particularly the degree to which plant height (main stem height) is genetically determined and phenotypically expressed—also play an important role. For this reason, scientific research in this area places special emphasis on examining the general average values of this trait and analyzing the structure of populations as comprehensively as possible [9; p. 128, 19; pp. 8–9, 24; pp. 63–68, 25; pp. 233–235, 27; pp. 242–244, 32; pp. 118–120, 35; pp. 245–246, 38; pp. 8–9, 39; pp. 3–4, 46; pp. 81–83, 49; pp. 203–205, 50; pp. 205–207, 54; pp. 262–271, 55; pp. 2527–2531].

The expression of main stem height in cotton hybrids, as shaped by their genotypes, does not have a significantly negative or positive impact on their yield characteristics. During the cultivation of any plant variety, if agrotechnical practices are carried out in a timely and high-quality manner in accordance with the requirements of the genotype, the morpho-agronomic indicators validated by researchers will manifest in the phenotype.

If, during the cultivation of cotton genotypes, environmental factors cause plants within the population to develop with reduced main stem height, this may

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accordingly lead to a decline in both yield and quality indicators. However, it would be incorrect to conclude that a variety or line with short-statured plants is inherently low-yielding. This is because, despite certain varieties having populations characterized by consistently shorter plant height, they may still exhibit high yield and quality performance.

Although the main stem height of plants may be low, their yield can still surpass that of standard varieties, as repeatedly confirmed during the study of the upland cotton variety Kelajak [47; pp. 83–85].

In the experimental field established in 2020, the sowing and evaluation of seed cotton from upland genotypes revealed the phenotypic expression of traits such as main stem height and the number of sympodial branches within the populations. These indicators were analyzed based on the data presented in Table 1 below:

Table-1 Manifestation of the main stem height and number of sympodial branches in cotton in 2020

№	Genotypes	Main stem height			Number of sympodial branches		
		X ± m	**σ**	**Cv**	**X ± m**	**σ**	**Cv**
1	Namangan-77 (standard)	115,76±0,63	4,20	3,63	12,21±0,22	1,44	11,77
2	C-6524 (standard)	117,34±0,71	4,68	3,99	12,51±0,21	1,41	11,28
3	Kelajak	84,71±0,62	4,12	4,86	12,81±0,20	1,32	10,33
4	UzFA-707	120,28±0,62	4,09	3,40	12,41±0,23	1,54	12,39
5	UzFA -710	118,07±0,68	4,50	3,81	12,11±0,22	1,48	12,19
6	Mehnat	119,21±0,68	4,54	3,81	12,08±0,20	1,30	10,76
7	Yulduz	118,91±0,88	5,86	4,93	11,80±0,22	1,46	12,34
8	AN-Boyovut-2	117,32±0,77	5,09	4,34	12,41±0,23	1,51	12,18
9	T-19	121,43±0,83	5,54	4,56	12,41±0,24	1,60	12,91
10	T-41	121,79±0,92	6,09	5,00	11,91±0,23	1,50	12,64
11	T-826	112,50±0,67	4,46	3,96	12,21±0,20	1,31	10,75
12	T-840	113,70±0,57	3,78	3,32	11,92±0,17	1,12	9,36
13	T-1278	119,71±0,62	4,12	3,44	12,20±0,22	1,49	12,22
14	T-1326	120,09±0,60	4,01	3,34	11,82±0,22	1,45	12,29
15	T-1336	117,91±0,81	5,35	4,53	11,90±0,23	1,51	12,67
16	T-1391	118,11±0,89	5,89	4,98	12,20±0,22	1,48	12,11
17	T-1470	121,36±0,68	4,49	3,70	12,42±0,23	1,55	12,44
18	T-1477	116,03±0,61	4,03	3,47	11,90±0,22	1,45	12,15
19	T-1777	117,63±0,83	5,53	4,70	11,61±0,23	1,50	12,95
20	T-8588	115,91±0,71	4,73	4,08	11,60±0,20	1,34	11,56

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By managing and restricting the growth of the lateral branches of plants typical of cotton hybrid populations cultivated in agricultural fields, it becomes possible to redirect the movement of water and dissolved nutrients, which would otherwise be consumed by the primary stem, toward the yield-forming elements. This, in turn, enables the production of high-quality and abundant yields from these populations.

Stabilizing selection serves as the guiding factor in the integration of traits within plant genotypes. This type of selection reduces genotypic variability within populations, meaning the number of genotypes becomes fewer than what would be expected from the independent assortment of non-allelic genes. In the absence of stabilizing selection, recombination-driven genotypic variability would increase from generation to generation (which is why primary and elite breeding programs are conducted). However, because recombinant genotypes are eliminated in the early stages of development during the selection process, variability within the reproductive segment of the population is regularly monitored.

As shown in Table 1, among the upland cotton genotypes cultivated in the experimental field in 2020, the T-41, T-19, and T-1470 lines exhibited greater plant main stem height compared to the standard varieties and other forms. The Kelajak variety, in particular, demonstrated the most pronounced differences with the highest values among all studied samples. Similar values close to those of the high-performing genotypes were observed in forms such as UzFA-707 and T-1326 with respect to the analyzed trait. In contrast, varieties and lines such as UzFA-710, Mehnat, Yulduz, T-1278, and T-1391 showed values similar to the standard variety C-6524. Meanwhile, genotypes like AN-Boyovut-2, T-1336, and T-1777 manifested nearly identical results, whereas the T-1477 line showed lower values, while still exceeding the standard reference variety Namangan-77. The T-8588 line displayed values very close to Namangan-77, while the T-826 and T-840 lines differed with comparatively lower indicators.

An analysis of the upper and lower fluctuation limits of the overall average values for the trait of main stem height in the populations revealed that the T-41 line

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exhibited the highest measurements compared to all other genotypes. Similarly, forms such as T-1391, Yulduz, T-1777, T-19, AN-Boyovut-2, and T-8588 demonstrated higher values relative to the standard and other varieties. In all remaining samples, the results were close to those of the standard varieties. Even when comparing the standard varieties to each other, their values were found to be relatively similar.

A wide range of variability in any trait of cotton genotypes is one of the key factors that enhances the possibility of obtaining diverse and desirable materials for genetic and breeding research.

In terms of the trait analyzed, the T-41 line showed the highest average values in terms of variability within the population. Meanwhile, in other genotypes such as T-1391, Yulduz, T-1777, T-19, T-1336, AN-Boyovut-2, and T-8588, the values observed were close to those of the standard varieties.

Practical studies on the cotton plant have shown that, like other plants that form fruiting structures through branching, the number of sympodial branches in cotton is one of the key factors that significantly affects its yield indicators. Therefore, researchers pay special attention to the expression of this trait in the phenotype of genotypes [4; pp. 50, 6; pp. 210–212, 16; pp. 339–345, 19; pp. 8–9, 21; pp. 188–190, 30; pp. 5–6, 32; pp. 118–120, 33; p. 11, 36; pp. 249–251, 44; pp. 19–20, 45; p. 13, 46; pp. 81–83, 48; pp. 89–91, 51; p. 10, 52; pp. 207–208].

When analyzing the manifestation of sympodial branches in the plants of the studied genotypes, the highest values were observed in forms such as Kelajak, 2nd standard C-6524, T-1470, UzFA-707, AN-Boyovut-2, T-19, 1st standard Namangan-77, T-1278, T-1391, UzFA-710, and Mehnat. Other materials showed comparatively lower values. When evaluating the increase in average values, it was found that all genotypes produced relatively similar results. The highest degree of fluctuation was noted in the T-19 line, while the lowest values were identified in the T-840 line.

An analysis of the variability range of the trait within the population revealed that genotypes such as T-1777, T-19, T-1336, T-41, T-1470, UzFA-707, Yulduz, T-1326, and T-1278 exhibited higher values compared to the standard varieties and

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other forms. In contrast, the lowest values were observed in samples such as T-840, Kelajak, Mehnat, and T-826.

Each year, several varieties of upland cotton with different characteristics are cultivated and managed across a significant portion of the country's main irrigated agricultural lands, resulting in the production of high-quality and abundant cotton yields. These hybrids used in production differ from one another in various aspects. While each variety may surpass others in certain features, other varieties also possess their own unique advantages. In particular, both production and scientific institutions place great importance on the formation of average values for the total number of bolls per genotype. A number of scientific sources analyzed on this subject also indicate that researchers have paid special attention to a thorough study of this trait [12; pp. 79–83, 28; pp. 218–219, 29; pp. 220–221, 43; pp. 5–6, 53; pp. 197–200].

As a result of genetic and breeding research conducted by scientists, it becomes possible to obtain higher yields from existing land areas by ensuring that the total number of bolls in cotton plant families selected during the research surpasses those of the initial sources and is genetically passed on and expressed in subsequent generations.

The statistical analysis of research conducted to determine the total number of bolls and the number of opened bolls per individual plant in cotton genotypes is presented in Table 2 below:

Table-2 Manifestation of the Total and Opened Number of Cotton Bolls in 2020

№	Genotypes	Total number of bolls per plant			Total number of opened bolls per plant		
		X ± m	**σ**	**Cv**	**X ± m**	**σ**	**Cv**
1	Namangan-77 (standard)	16,32±0,28	1,83	11,18	10,90±0,19	1,28	11,77
2	C-6524 (standard)	15,22±0,27	1,78	11,72	11,72±0,21	1,40	11,95
3	Kelajak	14,43±0,23	1,55	10,76	12,13±0,23	1,54	12,71
4	UzFA-707	16,40±0,26	1,73	10,54	12,73±0,21	1,39	10,93
5	UzFA -710	16,51±0,27	1,76	10,67	11,90±0,21	1,42	11,97
6	Mehnat	15,71±0,27	1,79	11,38	11,51±0,19	1,27	11,01
7	Yulduz	15,81±0,27	1,80	11,36	13,09±0,21	1,38	10,53

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8	AN-Boyovut-2	16,13±0,25	1,67	10,38	11,91±0,20	1,32	11,07
9	T-19	16,12±0,24	1,58	9,79	12,91±0,17	1,10	8,53
10	T-41	16,41±0,26	1,69	10,32	12,32±0,20	1,29	10,50
11	T-826	15,82±0,30	1,96	12,40	12,60±0,24	1,60	12,66
12	T-840	16,21±0,28	1,88	11,61	12,31±0,24	1,60	13,00
13	T-1278	15,40±0,25	1,66	10,80	12,51±0,21	1,40	11,22
14	T-1326	15,10±0,23	1,55	10,29	11,90±0,19	1,24	10,45
15	T-1336	16,32±0,26	1,70	10,41	12,81±0,19	1,28	10,03
16	T-1391	16,71±0,30	2,00	11,98	12,12±0,20	1,30	10,70
17	T-1470	16,21±0,27	1,80	11,10	11,20±0,19	1,28	11,42
18	T-1477	15,11±0,24	1,59	10,51	11,80±0,21	1,40	11,86
19	T-1777	15,31±0,26	1,73	11,28	11,91±0,20	1,34	11,26
20	T-8588	15,12±0,25	1,65	10,93	11,91±0,20	1,36	11,39

According to Table 2, when analyzing the total number of bolls in cotton genotypes, the highest values for this trait were observed in forms such as T-1391, UzFA-710, T-41, UzFA-707, and T-1336, exceeding both standard varieties. In samples like T-1470, T-840, AN-Boyovut-2, and T-19, the values were nearly identical to the first standard variety, Namangan-77, while they showed negative differences compared to the second standard variety, C-6524, and other forms. Based on the comparison of trait indicators across all genotypes, the greatest fluctuation was recorded in the T-1391 line, whereas the lowest boundaries were observed in the T-1326 and T-1477 lines.

In terms of the variability range for the analyzed trait, the highest values were found in forms such as T-826, T-1391, and C-6524, while the lowest were observed in genotypes like T-19, T-1326, T-41, and AN-Boyovut-2. The fact that both standard varieties showed high variability ranges in this trait indicates that the alignment of lines and varieties reflects a positive divergence from the standard varieties.

Alongside yield indicators, one of the key aspects that draws the attention of specialists is the percentage of the main cotton yield that opens before the onset of cold and rainy autumn weather conditions. Achieving a positive outcome in both of these characteristics within a single genotype is a particularly pressing issue for researchers engaged in genetic and breeding studies. Therefore, relevant

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literature in the field places special emphasis on studying processes such as the population structure based on the total number of opened bolls at a certain stage of plant vegetation, their heritability and formation across generations, and the expression of these traits in the phenotypes of successive generations over the years. These aspects are the focus of intense scientific research [7; pp. 168–170, 30; pp. 5–6, 31; pp. 233–235].

When analyzing the total number of opened bolls per plant in the studied upland cotton varieties and lines, it was determined that the highest values were recorded in genotypes such as Yulduz, T-19, T-1336, UzFA-707, T-826, and T-1278. Although the values in some samples were lower than those of the top-performing genotypes, positive variation was still observed in varieties and lines such as T-41, T-840, Kelajak, T-1391, AN-Boyovut-2, T-1777, T-8588, and UzFA-710 when compared to both standard varieties.

Although the overall average number of opened bolls per plant among the studied genotypes was between 10 and 12, it was found that groups of plants exceeding these average values were also present within the population structure of the varieties and lines. This situation suggests that if genetic and breeding studies are carried out with the aim of improving the number of early-maturing plants within these genotypes to even higher levels, it can be concluded that all forms involved in the research possess high population potential.

The variability range for this trait was higher in genotypes such as T-840, Kelajak, T-826, UzFA-710, C-6524, T-1477, Namangan-77, T-1470, T-8588, T-1777, T-1278, AN-Boyovut-2, and Mehnat compared to other forms in the study. Meanwhile, samples such as T-19, T-1336, T-1326, T-41, Yulduz, T-1391, and UzFA-707 demonstrated positive variation with favorable values.

To address certain challenges in cotton breeding, it is more effective to select plants not based solely on average values (modal selection), but rather by identifying those that differ from the average population indicators based on a complex of traits. This approach yields more positive results in the improvement of traits.

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During the breeding process, it is advisable to conduct selection based on a complex of morphological and economic characteristics, considering the adaptability of plants to environmental conditions at the population level.

One of the key factors determining the cotton yield of the plant is the number of locules in its bolls, along with the closely correlated trait of cotton weight per boll. The percentage at which these trait indicators are expressed within the populations belonging to specific genotypes holds significant importance for agricultural production.

The indicators of general cotton and fiber yield in any variety or line can vary depending on the number of locules in the bolls. In most cotton varieties with high lint output, the lighter boll weight is often due to lower seed weight. However, reduced seed weight negatively affects the overall boll weight as well. Still, if plants bearing five-loculed bolls are formed at higher proportions within the population compared to those with predominantly four-loculed bolls, the increased number of seeds will contribute to a rise in cotton weight per boll. This, in turn, serves as a factor contributing to increased cotton and fiber yield.

It is essential to analyze the variability range of studied traits—especially quantitative ones—in population-based research on cotton. These trait indicators are taken into account when selecting and propagating cotton genotype.

Scientific sources analyzed on this topic also confirm that researchers have paid special attention to studying the expression of these traits in hybrids [1; p. 23, 8; pp. 170–172, 11; pp. 214–217, 22; p. 127, 38; pp. 8–9]. Furthermore, knowing in advance how the population structure of varieties and lines specific to this plant is formed in terms of these traits serves as an important factor for researchers in the field when selecting productive plant families in the future.

Studying and analyzing varieties and lines annually based on average trait indicators allows for the identification of the ontogenetic variability of genotypes. Additionally, examining genotype populations each year by classifying them based on trait indicators can serve as a criterion for assessing their stability and for maintaining genetic control.

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A comparative analysis of the number of locules per boll and the cotton weight per boll in the studied cotton forms yielded the following results:

Table-3 Manifestation of Locule Number and Cotton Weight per Boll in Cotton in 2020

№	Genotypes	Locule number per boll			Cotton weight per boll		
		X ± m	**σ**	**Cv**	**X ± m**	**σ**	**Cv**
1	Namangan-77 (standard)	4,44±0,08	0,50	11,24	5,59±0,05	0,32	5,71
2	C-6524 (standard)	4,51±0,08	0,50	11,14	5,80±0,07	0,47	8,15
3	Kelajak	4,65±0,07	0,48	10,31	6,34±0,08	0,56	8,87
4	UzFA-707	4,39±0,07	0,49	11,17	6,10±0,08	0,55	9,05
5	UzFA-710	4,44±0,08	0,50	11,24	5,78±0,08	0,50	8,72
6	Mehnat	4,59±0,07	0,49	10,77	6,70±0,10	0,67	9,96
7	Yulduz	4,63±0,07	0,49	10,48	6,53±0,11	0,76	11,6
8	An-Boyovut-2	4,68±0,07	0,47	10,02	6,12±0,10	0,66	10,7
9	T-19	4,54±0,08	0,50	11,03	6,33±0,12	0,80	12,7
10	T-41	4,59±0,07	0,49	10,77	6,20±0,10	0,65	10,4
11	T-826	4,57±0,08	0,50	10,89	6,54±0,10	0,67	10,2
12	T-840	4,66±0,07	0,48	10,22	6,22±0,09	0,58	9,30
13	T-1278	4,45±0,08	0,50	11,24	6,80±0,10	0,68	10,0
14	T-1326	4,41±0,07	0,49	11,21	6,12±0,09	0,63	10,2
15	T-1336	4,35±0,07	0,48	11,02	6,04±0,09	0,63	10,4
16	T-1391	4,46±0,08	0,50	11,23	6,82±0,11	0,72	10,5
17	T-1470	4,43±0,08	0,50	11,23	5,51±0,09	0,57	10,4
18	T-1477	4,51±0,08	0,50	11,14	6,11±0,10	0,64	10,4
19	T-1777	4,46±0,08	0,50	11,23	6,14±0,11	0,73	11,9
20	T-8588	4,58±0,07	0,50	10,83	6,51±0,10	0,67	10,2

One of the key factors determining cotton yield is the number of locules in the plant's bolls. The extent to which this trait is expressed within the populations of genotypes is of significant importance for agricultural productivity. The overall productivity and lint yield indicators of any variety or line also vary depending on whether the number of locules per boll is high or low. In most cotton varieties

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with high lint output, the boll weight tends to be lighter due to the lower seed weight. However, if in such genotypes the number of five-loculed bolls exceeds that of four-loculed bolls within the population, the resulting increase in seed count contributes to a higher cotton weight per boll, thereby improving the overall yield.

In genetic and breeding research, it is advisable to carry out selection based on a complex of morphological and economic traits, taking into account the adaptability of cotton genotypes to environmental conditions at the population level.

Annually classifying and studying the populations of varieties and lines based on trait indicators can serve as a criterion for determining their stability.

According to Table 3, when examining the number of locules in the bolls of cotton forms cultivated in the experimental field during the study year, it was found that plants within all genotype populations bore both 4- and 5-loculed bolls. However, differences in the proportion of these locules varied among genotypes. For example, in some forms, 4-loculed bolls were observed at rates exceeding 50 or even 60%, whereas in other genotypes, 5-loculed bolls appeared at similarly high levels—50% or more. Among the genotypes cultivated in the experimental field, AN-Boyovut-2, T-840, Kelajak, Yulduz, Mehnat, T-41, T-8588, and T-826 showed a higher prevalence of 5-loculed bolls compared to the standards and other forms, with frequencies exceeding 50–60%.

The range of variability for this trait, progressing from negative to positive directions, was manifested in the following genotypes: T-840, Kelajak, Yulduz, T-41, Mehnat, T-8588, T-826, T-1336, AN-Boyovut-2, T-19, T-1477, C-6524, UzFA-707, T-1326, T-1777, T-1470, T-1391, T-1278, UzFA-710, and Namangan-77.

In research aimed at identifying key morphological and economic traits of cotton genotypes, it is observed that certain traits studied within a single plant may exhibit high levels of modification-based variability, while others show medium or low levels. It is worth noting that the coefficient of variation reflects the degree

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of sensitivity of a genotype's ontogenesis to the agro-technical, agrochemical, and other practices applied during plant cultivation.

One of the key economic traits of cotton genotypes is the cotton weight per boll. This is because the economic efficiency of cotton production is closely linked to the total weight of the harvested yield. The total yield weight, in turn, is determined by the cotton weight per boll within cotton populations.

Given that cotton weight per boll is considered one of the most important agronomic traits, particular attention is devoted to its in-depth study in scientific research conducted on this crop [1; p. 23, 3; pp. 5–6, 5; pp. 86–88, 11; pp. 214–217, 14; pp. 217–218, 16; pp. 339–345, 30; pp. 5–6, 37; p. 19, 38; pp. 8–9, 39; pp. 3–4, 45; p. 13, 46; pp. 81–83, 47; pp. 83–85, 48; pp. 89–91, 50; pp. 205–207, 51; p. 10, 52; pp. 207–208].

An analysis of the cotton weight per boll within the populations of the studied forms revealed that varieties and lines such as T-1391, T-1278, Mehnat, T-826, Yulduz, and T-8588 stood out with the highest values compared to the other samples. Following these, forms such as Kelajak, T-19, T-840, T-41, T-1777, AN-Boyovut-2, T-1326, UzFA-707, T-1477, and T-1336 also showed heavier boll weights than both standard varieties and genotypes like UzFA-710 and T-1470.

In terms of the variability range of this trait, a positive pattern was observed in varieties and lines such as the standard Namangan-77, C-6524, UzFA-710, Kelajak, UzFA-707, T-840, and Mehnat, when compared to other genotypes in the study. The highest values were recorded in forms like T-19, T-1777, and Yulduz.

The higher the quality of the fiber, the greater its market value on the global stage. In the Republic of Uzbekistan as well, the payment for the cotton yield harvested from cotton populations is based on the fiber type — that is, fiber of Type IV is priced higher than that of Type V. For this reason, leading farmers and agricultural enterprises often aim to cultivate varieties that produce Type IV industrial-grade cotton fiber in their fields. In this regard, one of the main requirements of the Cluster enterprises, whose operations have significantly expanded in recent years

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across the country, is to grow and propagate varieties that produce high-quality cotton fiber of Type IV.
The fiber length and lint yield indicators of the harvested cotton from the studied forms were analyzed based on the data in the following table:

Table-4 Manifestation of Fiber Length and Lint Yield in Cotton in 2020

№	Genotypes	Fiber length			Fiber yield		
		X ± m	**σ**	**Cv**	**X ± m**	**σ**	**Cv**
1	Namangan-77 (standard)	33,3±0,14	0,92	2,75	38,70±0,28	1,83	4,73
2	C-6524 (standard)	34,2±0,10	0,63	1,84	34,60±0,28	1,85	5,34
3	Kelajak	34,4±0,13	0,86	2,49	38,70±0,32	2,15	5,54
4	UzFA-707	34,4±0,14	0,90	2,61	38,60±0,26	1,73	4,48
5	UzFA-710	34,2±0,14	0,95	2,77	41,20±0,25	1,67	4,06
6	Mehnat	33,6±0,15	1,00	2,98	38,90±0,31	2,09	5,37
7	Yulduz	33,3±0,15	1,01	3,13	39,10±0,24	1,56	3,99
8	AN-Boyovut-2	33,7±0,14	0,91	2,72	35,10±0,30	2,00	5,70
9	T-19	33,9±0,14	0,91	2,67	39,10±0,34	2,29	5,85
10	T-41	34,1±0,12	0,80	2,34	38,10±0,32	2,15	5,64
11	T-826	34,2±0,11	0,73	2,15	37,50±0,34	2,28	6,07
12	T-840	34,1±0,13	0,84	2,46	37,94±0,34	2,28	6,02
13	T-1278	33,9±0,16	1,03	3,05	38,90±0,24	1,61	4,13
14	T-1326	34,1±0,15	1,00	2,93	39,01±0,30	2,01	5,16
15	T-1336	34,1±0,15	1,02	2,97	37,80±0,30	2,00	5,30
16	T-1391	33,9±0,16	1,08	3,19	38,40±0,30	1,99	5,18
17	T-1470	35,1±0,18	1,23	3,49	35,81±0,28	1,83	5,10
18	T-1477	33,8±0,16	1,06	3,13	38,10±0,34	2,28	5,99
19	T-1777	33,9±0,13	0,85	2,52	38,83±0,19	1,27	3,27
20	T-8588	33,8±0,15	1,01	3,00	38,10±0,33	2,20	5,79

Determining the population structure of fiber length—a key morphological and economic trait in the cotton plant—based on overall average values, along with understanding its heritability, variability in hybrid generations, and its development over the course of long-term genetic and breeding research, is

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essential for progressing from lines to fully developed varieties. Special attention is given to identifying how the unique traits of genotypes under varietal analysis are expressed phenotypically through the interaction between genotype and external environmental conditions, as well as to monitoring the stability of inherited traits over the years [1; p. 23, 2; pp. 41–45, 3; pp. 5–6, 10; pp. 6–7, 12; pp. 79–83, 13; pp. 326–328, 21; pp. 188–190, 23; pp. 208–209, 25; pp. 233–235, 28; pp. 218–219, 29; pp. 220–221, 30; pp. 5–6, 34; pp. 44–47, 37; p. 19, 38; pp. 8–9, 39; pp. 3–4, 43; pp. 306–307, 45; p. 13, 46; pp. 81–83, 47; pp. 83–85, 48; pp. 89–91, 49; pp. 203–205, 50; pp. 205–207, 51; p. 10]. In recent years, the growing demand for varieties and lines that maintain high fiber yield within their genotypes—recognized as one of the key agronomic traits of cotton populations—can be explained by the ongoing development of the textile industry in Uzbekistan, aimed at processing cotton fiber domestically. Numerous scientific sources have addressed the study and monitoring of this trait and its expression in hybrid generations [1; p. 23, 11; pp. 214–217, 25; pp. 233–235, 26; pp. 22–24, 29; pp. 220–221, 30; pp. 5–6, 35; pp. 245–246, 38; pp. 8–9, 39; pp. 3–4, 45; p. 13, 46; pp. 81–83, 47; pp. 83–85, 48; pp. 89–91, 49; pp. 203–205, 50; pp. 205–207, 51; p. 10].

Stabilizing selection serves as the guiding factor for the integration of traits. It reduces genotypic variability within populations, meaning the number of genotypes becomes lower than what would be expected from the independent assortment of non-allelic genes. In the absence of stabilizing selection, genotypic variability due to recombination increases from generation to generation (which is why primary and elite breeding work is conducted). However, since recombinant genotypes are eliminated in the early stages of development during selection, variability within the reproductive part of the population continues to be monitored.

According to Table 4, the fiber length of cotton yield samples collected from the populations of the research materials was studied, and it was found that the T-1470 line demonstrated a distinctly significant and positive difference compared to all other forms. In the subsequent rankings, genotypes such as Kelajak, UzFA-

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707, the second standard C-6524, T-826, UzFA-710, T-41, T-840, T-1326, and T-1336 showed fiber length values of 34 mm or more. Meanwhile, in lines such as T-19, T-1777, T-1278, T-1391, T-1477, and T-8588, fiber length indicators close to 34 mm were observed, exhibiting positive differences compared to Yulduz, the first standard Namangan-77, Mehnat, and AN-Boyovut-2 varieties.

With regard to the variability range for this trait, positive differentiation was noted in genotypes such as the standard C-6524, T-826, T-41, T-840, Kelajak, T-1777, UzFA-707, T-19, AN-Boyovut-2, the first standard Namangan-77, UzFA-710, T-1326, T-1336, and Mehnat compared to other studied forms.

An analysis of fiber yield indicators in the studied forms revealed that among the research genotypes, varieties and lines such as UzFA-710, Yulduz, T-19, T-1326, T-1278, and Mehnat demonstrated the highest values compared to all other forms. In contrast, the lowest—i.e., negatively deviating—values were recorded in forms such as C-6524, AN-Boyovut-2, and T-1470.

In terms of population-level variability for this trait, positive differentiation was observed in forms such as Yulduz, UzFA-710, T-1278, UzFA-707, and the first standard Namangan-77, compared to other samples. Additionally, the T-826 and T-840 lines showed higher values compared to the remaining forms.

A review of the relevant literature also confirms that in the cotton plant, fiber yield varies depending on the position of the bolls [12; pp. 170–172].

As with any plant, variation in trait expression in cotton genotypes is influenced by the phenomenon of inter-trait correlation. Moreover, the interaction between genotype and external environmental factors also has a significant impact on trait development. For this reason, considerable attention is devoted to this issue in relevant scientific studies [8; pp. 170–172, 14; pp. 217–218, 54; pp. 262–271].

As observed in most flora across the globe, the manifestation of key morphological and economic traits in the populations of cultivated crops, including cotton genotypes, is significantly influenced by the phenomenon of trait interdependence. Various ecological and soil-climatic conditions, as well as the climate factors encountered during cultivation and the implemented agro-technical practices, also have a considerable impact on population traits.

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Furthermore, the genetic composition formed within each hybrid plant's genotype plays a crucial role in expressing individual-specific traits and characteristics, exerting genetic control over them. Regardless of which specific factors play the primary role in the expression of morphological and economic indicators in plants, the phenomenon of inter-trait correlation remains a vital process. This is because the yield and quality of any plant are inevitably subject to external environmental influences, which in turn manifest through correlational relationships.

In the year the research was conducted, weak positive correlations were observed in the first standard variety Namangan-77 between main stem height and sympodial branches, as well as between cotton weight per boll and fiber length (with correlation coefficients r = 0.207* and r = 0.189*, respectively). Additionally, weak correlations were recorded between sympodial branches and total number of bolls, total number of bolls and 1000-seed weight, number of opened bolls and fiber length, and number of locules per boll and cotton weight per boll. A moderate negative correlation was found between total number of bolls and number of locules per boll (with correlation coefficients r = -0.272**, r = -0.204*, r = -0.275**, r = -0.189*, and r = -0.333***, respectively).

In the correlation analysis of morphological and economic traits in the C-6524 variety, weak negative correlations were observed between main stem height and lint yield, as well as between total number of bolls and cotton weight per boll (with correlation coefficients r = -0.251* and r = -0.177*, respectively). Weak correlations were found between monopodial branches and total number of bolls, and between total number of bolls and lint yield. A moderate correlation was recorded between the number of sympodial branches and 1000-seed weight, while a strong positive correlation was identified between the total and opened number of bolls (with correlation coefficients r = 0.214*, r = 0.172*, r = 0.361***, and r = 0.752***, respectively).

In the correlation analysis of morphological and economic traits in the Kelajak variety, a weak correlation was noted between main stem height and number of sympodial branches, and a strong positive correlation between total and opened

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number of bolls (r = 0.166* and r = 0.736***, respectively). Weak negative correlations were observed between main stem height and number of opened bolls, as well as between sympodial branches and both number of opened bolls and number of locules per boll, along with 1000-seed weight (r = -0.196*, r = -0.171*, r = -0.217*, and r = -0.175*, respectively).

In the UzFA-707 variety, a moderate negative correlation was observed between main stem height and the number of monopodial branches, and a weak negative correlation with lint yield. A weak negative correlation was also noted between the number of monopodial and sympodial branches (r = -0.302**, r = -0.184*, and r = -0.220*, respectively). Additionally, a weak positive correlation was recorded between the number of monopodial branches and opened bolls, while a moderate positive correlation was found between total and opened bolls (r = 0.224* and r = 0.524***, respectively).

In the UzFA-710 variety, weak correlations were identified between the number of monopodial branches and number of opened bolls, between opened bolls and 1000-seed weight, and between 1000-seed weight and fiber length (r = 0.187*, r = 0.174*, and r = 0.206*, respectively). A moderate correlation was found between the number of sympodial branches and cotton weight per boll, and a strong positive correlation between total and opened bolls (r = 0.347*** and r = 0.676***, respectively). A weak negative correlation was observed between the number of opened bolls and lint yield (r = -0.187*).

In the correlation analysis of morphological and economic traits characteristic of the Mehnat variety population, weak positive correlations were found between main stem height and the number of sympodial branches; between the number of monopodial branches and both total and opened boll count, as well as fiber length; and between total boll count and both fiber length and lint yield. A weak correlation was also observed between opened boll count and fiber length, while a strong positive correlation was recorded between total and opened boll counts (with correlation coefficients r = 0.218*, r = 0.233*, r = 0.175*, r = 0.171*, r = 0.167*, r = 0.189*, r = 0.209*, and r = 0.734***, respectively). On the other hand, weak negative correlations were identified between main stem height and fiber

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length; number of sympodial branches and 1000-seed weight; total boll count and 1000-seed weight; cotton weight per boll and lint yield; and 1000-seed weight and fiber length. A moderate negative correlation was found between the number of opened bolls and 1000-seed weight (with correlation coefficients r = -0.222*, r = -0.197*, r = -0.253*, r = -0.176*, r = -0.188*, and r = -0.305**, respectively)

In the correlation analysis of morphological and economic traits characteristic of the Yulduz variety population, weak positive correlations were observed between main stem height and the number of sympodial branches, total and opened boll count, the number of monopodial branches and number of locules per boll, and between the number of locules per boll and 1000-seed weight. A moderate positive correlation was identified between total and opened boll count (with correlation coefficients r = 0.224*, r = 0.195*, r = 0.247*, r = 0.291*, r = 0.190*, and r = 0.627***, respectively). During the study year, weak negative correlations were recorded between main stem height and cotton weight per boll, 1000-seed weight, and lint yield; between the number of monopodial branches and fiber length; between the number of sympodial branches and 1000-seed weight; and between the number of opened bolls and cotton weight per boll.

In the correlation analysis of morphological and economic traits characteristic of the AN-Boyovut-2 variety population, weak negative correlations were identified between main stem height and total number of bolls, cotton weight per boll and 1000-seed weight, number of sympodial branches and both cotton weight per boll and 1000-seed weight, number of opened bolls and 1000-seed weight, and between number of locules per boll and lint yield (with correlation coefficients r = -0.257*, r = -0.260**, r = -0.282**, r = -0.291**, r = -0.235*, and r = -0.182*, respectively). Moderate positive correlations were observed between main stem height and number of sympodial branches, total and opened number of bolls, while a weak positive correlation was recorded between fiber length and lint yield.

In the T-19 line, moderate negative correlations were identified between main stem height and number of opened bolls, as well as cotton weight per boll. Weak negative correlations were also observed between main stem height and fiber

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length, and between 1000-seed weight and fiber length (with correlation coefficients r = -0.354***, r = -0.357***, r = -0.196*, and r = -0.220*, respectively). Additionally, weak positive correlations were found between main stem height and 1000-seed weight, total number of bolls and cotton weight per boll, and number of opened bolls and cotton weight per boll. A moderate positive correlation was recorded between total and opened number of bolls (r = 0.227*, r = 0.226*, r = 0.267**, and r = 0.471***, respectively).

In the T-41 line, weak correlations were identified between main stem height and the number of monopodial branches, and between the number of sympodial branches and cotton weight per boll. A strong positive correlation was observed between total and opened number of bolls (with correlation coefficients r = 0.211*, r = 0.216*, and r = 0.699***, respectively). A moderate negative correlation was found between main stem height and fiber length, and a weak negative correlation between fiber length and lint yield (r = -0.307** and r = -0.256*, respectively).

In the T-826 line, a weak negative correlation was recorded between branching type and 1000-seed weight (r = -0.208*). Additionally, weak positive correlations were observed between total number of bolls and both opened bolls and cotton weight per boll, while a moderate positive correlation was found between total bolls and 1000-seed weight (r = 0.260**, r = 0.234*, and r = 0.323*, respectively).

In the T-840 line, a weak positive correlation was identified between main stem height and fiber length (r = 0.246**), while a weak negative correlation was found between lint yield and 1000-seed weight (r = -0.251*).

In the T-1278 line, weak positive correlations were observed between main stem height and number of opened bolls, as well as between total number of bolls and lint yield (r = 0.200* and r = 0.204*, respectively). A strong positive correlation was found between total and opened number of bolls (r = 0.738***). Weak correlations were also noted between the number of monopodial branches and total bolls, the number of locules per boll and 1000-seed weight, boll cotton weight and fiber length. A moderate negative correlation was observed between boll cotton weight and 1000-seed weight.

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In the T-1326 line, weak negative correlations were found between main stem height and the number of sympodial branches, total number of bolls, 1000-seed weight (via monopodial branches), number of locules per boll (via total and opened boll counts), and cotton weight per boll (with correlation coefficients r = -0.193*, r = -0.266**, r = -0.220*, r = -0.201*, r = -0.220*, and r = -0.209*, respectively). A moderate negative correlation was identified between main stem height and the number of opened bolls (r = -0.355***). Additionally, weak positive correlations were observed between main stem height and the number of locules per boll, total bolls and lint yield, and between number of opened bolls and 1000-seed weight (r = 0.213*, r = 0.220*, r = 0.172*, respectively). A moderate correlation was found between main stem height and cotton weight per boll (r = 0.309**), while a strong positive correlation was noted between total and opened number of bolls (r = 0.653***).

In the T-1336 line, a moderate positive correlation was found between main stem height and 1000-seed weight (r = 0.516***), while strong positive correlations were observed between total and opened number of bolls (r = 0.664***) and a weak positive correlation with number of locules per boll (r = 0.196*). Weak negative correlations were identified between total number of bolls and fiber length, as well as between cotton weight per boll and lint yield (r = -0.170* and r = 0.221*, respectively).

In the T-1391 line, weak negative correlations were observed between main stem height and 1000-seed weight, between number of sympodial branches and both number of locules per boll and 1000-seed weight, and between total number of bolls and fiber length (r = -0.169*, r = -0.166*, r = -0.189*, and r = -0.171*, respectively). Weak positive correlations were found between main stem height and lint yield, opened boll count and 1000-seed weight, and between number of locules and cotton weight per boll (r = 0.173*, r = 0.269**, and r = 0.177*), while a moderate positive correlation was recorded between total and opened number of bolls (r = 0.441***).

In the T-1470 line, weak negative correlations were observed between the number of sympodial branches and fiber length, as well as between the number of opened

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bolls and cotton weight per boll (r = -0.209* and r = -0.279**, respectively). A moderate positive correlation was identified between the total and opened number of bolls (r = 0.477***).

In the T-1477 line, weak negative correlations were found between main stem height and the number of sympodial branches, number of locules per boll, fiber length, and between total number of bolls and cotton weight per boll (r = -0.289*, r = -0.252*, r = -0.173*, and r = -0.273***, respectively). Moderate correlations were observed between the number of sympodial branches and both the number of locules per boll and fiber length, while a weak correlation was found with lint yield (r = 0.307**, r = 0.329***, and r = 0.290**, respectively). Additionally, weak correlations were detected between total number of bolls and fiber length, number of locules per boll and lint yield, and between cotton weight per boll and 1000-seed weight (r = 0.201*, r = 0.221*, and r = 0.290**). A strong positive correlation was noted between total and opened number of bolls (r = 0.759***).

In the T-1777 line, a moderate negative correlation was found between main stem height and number of opened bolls (r = -0.316**). Weak negative correlations were observed between cotton weight per boll and 1000-seed weight, number of monopodial branches and lint yield, and between number of sympodial branches and both total and opened number of bolls (r = -0.266*, r = -0.292**, r = -0.210*, r = -0.233*, and r = -0.248*, respectively). A strong positive correlation was identified between total and opened boll numbers (r = 0.788***), and weak positive correlations were noted between cotton weight per boll, number of opened bolls and cotton weight per boll, number of locules per boll, and 1000-seed weight (r = 0.247*, r = 0.226*, and r = 0.211*, respectively).

In the T-8588 line, weak positive correlations were found between number of monopodial branches and number of locules per boll, 1000-seed weight, total number of bolls and fiber length, number of locules per boll and cotton weight, and between fiber length and lint yield (r = 0.169*, r = 0.211*, r = 0.168*, r = 0.196*, and r = 0.284*, respectively). A strong positive correlation was recorded between total and opened number of bolls (r = 0.766***). A weak negative

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correlation was observed between number of sympodial branches and 1000-seed weight (r = -0.220*).

CONCLUSIONS

Based on the analyses conducted in this research, the following conclusions were drawn:

1. Studying the natural populations of varieties and lines reveals the diversity among the constituent plants, indicating that individual plants may differ from each other in terms of specific trait indicators.
2. By the later stages of the vegetation period, the population composition of the studied cotton genotypes showed significant variation in the number of total and opened bolls, confirming that some forms possess higher potential for these traits compared to the standard and other samples.
3. Based on the number of locules per boll, it was determined that genotypes such as AN-Boyovut-2, T-840, Kelajak, Yulduz, Mehnat, T-41, T-8588, and T-826 had the highest occurrence of 5-loculed bolls compared to other forms.
4. Regarding the trait of cotton weight per boll, forms such as T-1391, T-1278, Mehnat, T-826, Yulduz, T-8588, Kelajak, T-19, T-840, T-41, T-1777, AN-Boyovut-2, T-1326, UzFA-707, T-1477, and T-1336 were found to have heavier boll weights than the standard and other genotypes.
5. In terms of fiber length, genotypes such as T-1470, Kelajak, UzFA-707, C-6524, T-826, UzFA-710, T-41, T-840, T-1326, and T-1336 demonstrated values of 34 mm or higher.
6. For the trait of lint yield, genotypes such as UzFA-710, Yulduz, T-19, T-1326, T-1278, and Mehnat differed from all other forms in the analysis with notably higher values.
7. A moderate positive correlation was observed between the total and opened number of bolls in cotton genotypes, while correlations among other traits were generally weak, either positive or negative.

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