The Degree of Population Variability of G.hirsutum L. Varieties in Different Climatic Conditions

Malokhat Khalikova[1], Guzal Kholmurodova[2], Umida Qarshiyeva [3], Khurshida Keldiyarova[3], Shukhrat Sharipov[1], Baxrom Madartov[1], Jaxongir Ergashev[1]

[1]Cotton Breading, Seed Production and Agrotechnologies Research Institute, Tashkent, 111218, Uzbekistan
[2]Tashkent State Agrarian University, Tashkent, 100140, Uzbekistan
[3]Samarkand State University named after Sharof Rashidov, 140104, Samarkand, Uzbekistan

khalikovamalokhat@gmail.com

Abstract. The morphological and economic characteristics of local cotton varieties (*Gossypium hirsutum L.*) were studied under different soil and climatic conditions. The dynamics of variability and heritability of traits, as well as correlations between them, were analyzed over several years. It was found that cultivars Omad, Akkurgan-2, S-01, Bukhara-6, Bukhara-102, and lines T-100 and L-001 differed in quantitative traits and in the proportion of atypical plants within populations. The results indicate that the variability observed is largely due to environmental adaptation, which affects the stability and quality level of the varieties. These findings emphasize the need for continuous selection work, proper zoning, and maintenance of population stability in breeding programs.

Keywords: cotton, population, variability, heritability, modification, population variability, typicality

1 Introduction

The creation of promising lines and varieties of cotton, the study of the homeostasis of their morphobiological traits, the formation of economically valuable characteristics determining productivity within populations, and the development of methods to increase their homogeneity through the identification of genetic patterns of variability and interrelations among major economically valuable traits within populations, are considered priority tasks, and research in this field is necessary [1-4]. In cotton genetics, numerous studies have been conducted on the processes of change occurring within varietal populations. [20-23]. In particular, well-known works include those of S.S.

A. M. Bozdoğan et al. (eds .), *Proceedings of the 5th International Conference on Research of Agricultural and Food Technologies (I-CRAFT 2025)*, Atlantis Highlights in Sustainable Development 8,
https://doi.org/10.2991/978-94-6239-666-1_31

Chetverikov on the saturation of natural populations with recessive mutations [5]; M. Kimura on the neutral theory of molecular evolution and the influence of random genetic drift on gene frequency changes within populations [6]; D.Ya. Bubeyker [7] on the role of the external environment in population changes; and L.L. Cavalli-Sforza [8] in the study of human population genetics. Research conducted by scientists in our country has also revealed several aspects of this problem. For instance, S.S. Sadykov and M.M. Kikteev [9] studied the increase in varietal efficiency through uniformity and earliness within populations; O.J. Jalilov, S. Odilov, A.P. Abukhovskaya [10]; S. Odilov, S.M. Nabiev, and T.D. Allambergenov [11] examined the formation of homeostasis within cotton variety populations; I.T. Kakhkhorov [12] investigated the genetic foundations for producing high-quality seeds of new cotton varieties; and Kh. Tuychiev [13] explored the balance of morphobiological and economic traits of biotypes within populations of cotton varieties and lines. It should be emphasized that scientific research aimed at determining the degree of variability in cotton variety populations arising under different climatic conditions and at studying the influence of this variability on changes in the phenotypic structure of populations has not yet been sufficiently carried out [14].

2 Materials and methods

The studies employed classical and population-based methods of cotton genetics and breeding, comparative morphology, phenological observations, and genetic-statistical analysis methods [15]. The objects of research were the cotton varieties Omad, Akkurgan-2, S-01, Bukhara-6, Bukhara-102, and the lines L-001 and T-100, all belonging to the species Gossypium hirsutum L. In the population analysis of the research samples, the methodologies of F. Ayala, Yu.P. Altukhov, M. Kimura, and S. Xu [16–18] were used. According to these methodologies, the populations of varieties and lines were divided into corresponding groups based on fiber yield, boll weight, and fiber length.

3 Results

The variability of morphobiological traits, including plant height and earliness, was studied in varieties and lines of cotton under two different soil and climatic conditions.In the first year, under the conditions of the Navoi region, statistical analysis showed that plant height ranged as follows: Omad – 84.0–97.0 cm, Akkurgan-2 – 91.0–111.0 cm, Bukhara-6 – 88.0–101.0 cm, Bukhara-102 – 93.0–112.0 cm, T-100 line – 92.0–112.0 cm, S-01 – 92.0–104.0 cm, and the short-stemmed L-001 line – 75.0–90.0 cm. The highest variability was observed in the varieties Omad (16.7%), Akkurgan-2 (19.4%), and in the lines T-100 (20.3%) and L-001 (18.1%). Over three years of studying the populations of each variety and line — by dividing them into internal groups — the following results were obtained: for the Omad variety, plant height in the first year was 84.0–97.0 cm (13.2% variation by group), in the second year 85.0–96.0 cm (11.2%), and in the third year 86.0–94.0 cm. For Akkurgan-2, the first-year range was

91.0–111.0 cm, the second year 95.0–110.0 cm, and the third year 97.0–111.0 cm. For Bukhara-6, the first-year range was 88.0–101.0 cm, the second year 87.0–98.0 cm, and the third year 87.0–96.0 cm. For Bukhara-102, plant height was 93.0–112.0 cm in the first year, 97.0–104.0 cm in the second, and 97.0–103.0 cm in the third. For **S-01**, the range was 92.0–104.0 cm in the first year, 94.0–104.0 cm in the second, and 98.0–105.0 cm in the third. For the T-100 and L-001 lines, the first-year values were 92.0–112.0 cm and 75.0–90.0 cm, respectively; in the second year -94.0-110.0 cm and 77.0–90.0 cm; and in the third year -98.0–111.0 cm and 78.0–89.0 cm, respectively. In the populations of the studied varieties and lines, plant height varied over the years. However, because of the selection and elimination of groups with low variability, the populations gradually approached a balanced state in subsequent years (Table 1).
Under the second comparative soil and climatic condition — in the environment of the Tashkent region — during three consecutive years, the following results on plant height were obtained for the studied cotton varieties. In the *Omad* groups, plant height in the first year ranged from 85.0–94.0 cm, in the second year from 85.0–96.0 cm, and in the third year from 87.0–92.0 cm. In the variety *Akkurgan-2*, the values in the first year were 97.0–108.0 cm, in the second year 97.0–106.0 cm, and in the third year 96.0–104.0 cm. In *Bukhara-6*, the respective values were 87.0–103.0 cm, 88.0–101.0 cm, and 87.0–98.0 cm; in *Bukhara-102* — 94.0–117.0 cm, 97.0–111.0 cm, and 96.0–107.0 cm; in *S-01* — 90.0–101.0 cm, 90.0–100.0 cm, and 92.0–99.0 cm. For the lines *T-100* and *L-001*, plant height in the first year was 94.0–110.0 cm and 75.0–88.0 cm, respectively; in the second year — 93.0–105.0 cm and 80.0–90.0 cm; and in the third year — 94.0–105.0 cm and 78.0–89.0 cm, respectively. In the populations of the studied varieties and lines, the degree of variability in plant height differed depending on genotype and growing conditions.

Table 1. Statistical analysis of plant height (cm) under different soil-climatic conditions

Variety / Line	**n**	**First year X±Sx**	**Lim**	**V %**	**Second year X±Sx**	**Lim**	**V %**	**Third year X±Sx**	**Lim**	**V %**
Navoi region										
Omad	100	92.1 ±1.3	84.0–97.0	16.7	92.0 ±1.5	85.0–96.0	13.2	91.0 ±1.1	86.0–94.0	11.2
Akkurgan-2	100	106.3 ±2.4	91.0–111.0	19.4	104.8 ±1.8	95.0–110.0	13.5	105.1 ±2.0	97.0–111.0	12.0
Bukhara-6	100	94.2 ±0.8	88.0–101.0	9.0	95.0 ±1.3	87.0–98.0	8.3	93.1 ±1.6	87.0–96.0	7.0
Bukhara-102	100	100.8 ±4.3	93.0–112.0	7.1	101.5 ±3.3	97.0–104.0	6.3	100.0 ±3.5	97.0–103.0	7.4
T-100	100	107.6 ±6.1	92.0–112.0	20.3	105.0 ±4.1	94.0–110.0	14.3	106.8 ±5.0	98.0–111.0	13.1

Variety / Line	n	First year X±Sx	Lim	V %	Second year X±Sx	Lim	V %	Third year X±Sx	Lim	V %
S-01	100	102.1 ±3.4	92.0–104.0	10.4	103.0 ±3.8	94.0–104.0	9.1	103.1 ±2.3	98.0–105.0	8.0
L-001	100	84.6 ±2.4	75.0–90.0	18.1	86.0 ±2.7	77.0–90.0	14.1	86.8 ±1.7	78.0–89.0	12.0
Tashkent region										
Omad	100	90.2 ±1.6	85.0–94.0	7.7	91.0 ±1.1	84.0–93.0	8.0	90.0 ±1.0	87.0–92.0	5.6
Akkurgan-2	100	104.7 ±1.8	97.0–108.0	9.4	104.0 ±1.3	97.0–106.0	8.1	102.1 ±1.7	96.0–104.0	8.0
Bukhara-6	100	95.0 ±1.4	87.0–103.0	16.0	94.0 ±1.6	88.0–101.0	14.6	93.4 ±1.9	87.0–98.0	11.6
Bukhara-102	100	108.3 ±3.5	94.0–117.0	21.8	104.0 ±2.3	97.0–111.0	16.3	102.1 ±3.2	96.0–107.0	10.4
T-100	100	102.1 ±4.0	94.0–110.0	14.3	100.8 ±2.8	93.0–105.0	11.3	100.4 ±3.5	94.0–105.0	9.3
S-01	100	96.4 ±2.2	90.0–101.0	10.1	95.8 ±2.7	90.0–100.0	9.7	95.7 ±3.5	92.0–99.0	7.7
L-001	100	82.1 ±1.5	75.0–88.0	13.7	84.0 ±2.3	80.0–90.0				

Biological earliness. Biological earliness of the studied varieties and lines, i.e., the period from seedling emergence to the opening of the first bolls under the soil and climatic conditions of the Navoi region, was as follows: Omad — 113.2 days, Akkurgan-2 — 120.3 days, Bukhara-6 — 119.3 days, Bukhara-102 — 118.1 days, T-100 — 110.7 days, S-01 — 110.1 days, and L-001 — 96.4 days. During 2009–2011, when each variety and line population was studied with subdivision into groups, the following results were obtained: In Omad populations, biological earliness in the first year ranged from 105.0–118.0 days, in the second year 107.0–119.0 days, and in the third year 106.0–113.0 days. For Akkurgan-2, the values were 109.0–125.0 days, 110.0–124.0 days, and 110.0–120.0 days, respectively; for Bukhara-6 — 111.0–120.0 days, 113.0–121.0 days, and 111.0–120.0 days; for Bukhara-102 — 114.0–122.0 days, 113.0–120.0 days, and 111.0–120.0 days; for S-01 — 104.0–116.0 days, 105.0–112.0 days, and 108.0–114.0 days; and for the lines T-100 and L-001, respectively, 103.0–119.0 days and 90.0–102.0 days in the first year, 103.0–116.0 days and 90.0–98.8 days in the second year, and 105.0–115.0 days and 90.0–96.8 days in the third year. The obtained results indicate that diversity in the time of first boll opening was observed across populations of the studied varieties and lines. It is evident that such diversity showed higher values in the varieties developed under the climatic conditions of Tashkent.

Earliness under the Tashkent Region Conditions. The earliness of the studied varieties and lines, i.e., the duration (in days) from sowing to the opening of the first bolls under the soil and climatic conditions of the Tashkent region, was as follows: Omad — 113.2 days, Akkurgan-2 — 120.3 days, Bukhara-6 — 119.3 days, Bukhara-102 — 118.1 days, T-100 — 110.7 days, S-01 — 110.1 days, and L-001 — 96.4 days. During 2009–2011, when cotton varieties and lines were studied in the conditions of the Tashkent region, the following results were obtained for each variety and line: In the Omad groups, the vegetation period in the first year ranged from 106.0–115.0 days (V%=9.8), in the second year 106.0–117.0 days (V%=10.8), and in the third year 104.0–113.0 days (V%=9.5). For Akkurgan-2, the values were 114.0–126.0 days (V%=13.5), 116.0–125.0 days (V%=11.3), and 116.0–125.0 days (V%=12.0), respectively. For Bukhara-6, the values were 112.0–128.0 days (V%=18.3), 112.0–1(V%=15.5), 26.0 days and 114.0–126.0 days (V%=14.4). For Bukhara-102, the range was 113.0–127.0 days, 112.0–128.0 days, and 111.0–123.0 days; for S-01 — 106.0–114.0 days, 107.0–114.0 days, and 105.0–114.0 days. For the lines T-100 and L-001, the indicators were as follows: in the first year — 101.0–112.0 days and 90.0–98.0 days, respectively; in the second year — 102.0–112.0 days and 91.0–101.3 days; and in the third year — 103.0–110.0 days and 91.0–97.0 days.

Statistical analysis of the period from seedling emergence to the opening of the first bolls in the populations of varieties and lines revealed differences in the variability of this trait among populations developed under different soil and climatic conditions, as well as differences in results between groups. In addition to the genetic determination of plant productivity, its high or low values also depend on environmental factors. As is known, the productivity of a single plant is a complex trait derived from the weight of raw cotton per boll and the number of mature bolls per plant. In our studies, variability of the elements of this trait was observed.

Among the genotypes studied under different soil and climatic conditions, both the range limits of the trait and the scale of variability within populations differed. In particular, the productivity and variability of the variety Omad, developed in the Tashkent region, were 56.7–81.2 g and 19.7% in the conditions of the Navoi region, and 65.5–82.0 g and 12.4% in the conditions of the Tashkent region. In the Navoi region, the highest variability was observed in the variety Akkurgan-2, with a productivity range of 30.3–62.8 g and a coefficient of variation of 28.0%. For the variety S-01, developed in the Tashkent region but tested in Navoi, these values were 61.3–84.4 g and 18.0%, respectively, indicating a certain stabilization of the trait under these conditions. When the above-mentioned varieties and lines were studied under the conditions of the Tashkent region, the overall pattern of variability among the varieties and lines differed and was relatively low. In particular, the varieties Bukhara-6 and Bukhara-102, developed in relatively warm zones, showed high levels of variability in plant productivity—26.3% and 23.7%, respectively. This can be explained by segregation within the populations of these varieties (a wide amplitude of trait expression) when grown under more moderate soil and climatic conditions compared to their native zones. For example, in Bukhara-6, plants with productivity ranging from 56.4 g to 80.2 g were observed, whereas in the Navoi region this range was 61.5–86.4 g. After the elimination of groups with low productivity, by 2011 a reduction in the variability of this trait was observed, along with an increase in the proportion of plants showing positive productivity values. Differences in gene expression among genotypes and environmental influences led to variations in trait manifestation. By 2012, variability further decreased as the frequency of plants with favorable traits increased, indicating the adaptation of plants to different soil and climatic conditions and the stabilization of productivity traits within populations. It was noted that by the third year, in the population of the Omad variety grown under the conditions of the Navoi region, the lower limit of productivity was 60.6 g, and the upper limit was 86.0 g. Some stabilization of the trait was observed in subsequent generations (coefficient of variation = 13.1%). A similar trend of decreased variability was observed in other varieties, except for the T-100 line, which maintained a comparatively high level of variability. This may be attributed to segregation within this line's population and the occurrence of transgressive plants.

Fiber yield is a genetically complex polygenic trait that changes under the influence of various factors. Its variation across different forms (lines, varieties) ranges from 0.0% to 40.0%, and in some cases, even higher. Genetic stabilization of this trait occurs in association with fiber index and length. However, there are studies reporting its independent formation from other traits. Researchers have also noted the appearance of valuable transgressive forms in subsequent generations, located in the middle of the variation range. In our experiments, an independent statistical analysis of fiber yield (unrelated to other traits) showed that environmental influence on the population homeostasis of fiber yield was relatively small. Only minor differences were observed in variability scales (Table 2).

Table 2. Statistical analysis of fiber yield (%) in populations of cotton varieties and lines

Varieties and Lines	**n**	**First Year**		**Second Year**		**Third Year**	
		X±Sx	V %	X±Sx	V %	X±Sx	V %
Navoi Region							
Omad	100	35.6±0.8	6.6	34.6±0.6	7.0	35.6±0.8	6.6
Akkurgan-2	100	33.5±1.0	7.5	31.7±1.4	7.8	33.5±1.0	7.5
Bukhara-6	100	36.1±0.8	4.5	36.0±0.5	5.5	36.3±0.8	4.5
Bukhara-102	100	36.6±0.6	5.7	36.4±1.0	6.0	36.6±0.6	5.7
T-100	100	36.0±1.5	7.8	36.0±1.1	8.8	36.8±1.5	7.8
S-01	100	35.0±0.7	5.3	34.0±0.3	5.0	35.0±0.7	5.3
L-001	100	31.3±1.2	5.8	31.0±1.0	6.8	31.3±1.2	5.8
Tashkent Region							
Omad	100	35.4±0.5	3.7	36.2±0.7	4.5	36.4±0.5	3.7
Akkurgan-2	100	33.7±1.1	4.1	32.4±1.0	5.5	33.7±1.1	4.1
Bukhara-6	100	36.4±0.5	5.7	35.0±0.5	6.7	35.6±0.5	5.7
Bukhara-102	100	36.0±0.7	6.5	35.0±1.5	7.6	35.4±0.7	6.5
T-100	100	36.2±1.3	4.4	36.5±1.0	5.6	36.7±1.3	5.1

Varieties and Lines	n	First Year		Second Year		Third Year	
S-01	100	35.0±0.7	4.1	35.0±0.3	5.4	35.7±0.7	4.4
L-001	100	31.3±1.2	5.1	31.6±1.0	5.8	32.1±1.2	5.1

The data for the third year across regions showed slight differences. The results obtained indicate that the range limits of fiber yield traits are comparatively wide, complicating selection work; however, to some extent, this trait can be stabilized using the method of population analysis.

The results obtained for fiber length in the first year showed the presence of variation of the trait within populations**.** According to the literature, the formation of fiber length in generations depends on the genes controlling the trait and on the selection, strategy applied in accordance with them. That is, if long fiber is controlled by dominant genes, it is advisable to begin selection from the early generations; conversely, if recessive genes participate in the expression of the trait, selection should be carried out in the later generations**.** Fiber length is one of the traits suitable for assessing homeostasis within a varietal population. The varieties and lines studied in the first year of our research differed sharply in this trait across different zones. In most cases, the main trend—namely, the distinction according to the zone of origin—was preserved. Under the conditions of the Navoi region, comparatively high variability was observed in the varieties Omad (6.9%), Akkurgan-2 (7.8%) and in the lines T-100 (7.7%) and L-001 (8.4%). Under the conditions of the Tashkent region**,** comparatively high variability was noted in the varieties Bukhara-6 and Bukhara-102, at 6.5% and 6.1%**,** respectively (Table 3). Based on the results of our research, it should be emphasized that through the selection of plants with higher fiber length indicators over the years**,** we were able to raise the lower limits of this trait within populations, and the selection process proved to be effective **i**n improving fiber length stability within the population.

Table 3. Statistical analysis of fiber length (mm) in populations of cotton varieties and lines

№	Varieties and lines	Number of plants, pcs	Mean±S	Lim (range)	V%
Navoi region					
	Omad	100	34.6±0.5	32.0 – 36.0	6.9
	Akkurgan-2	100	32.8±0.5	28.0 – 33.7	7.8
	Bukhara-6	100	34.0±0.7	31.0 – 35.8	4.5
	Bukhara-102	100	34.4±0.6	31.7 – 35.8	5.5
	T-100	100	36.6±0.5	31.0 – 37.7	7.7
	S-01	100	34.6±0.7	32.0 – 35.4	6.3
	L-001	100	30.0±1.2	26.0 – 31.2	8.4
Tashkent region					
	Omad	100	34.4±0.7	33.0 – 35.5	4.3

№	Varieties and lines	Number of plants, pcs	Mean±S	Lim (range)	V%
	Akkurgan-2	100	32.0±0.8	29.2 – 33.3	5.4
	Bukhara-6	100	33.6±0.5	30.0 – 34.8	6.5
	Bukhara-102	100	34.4±0.6	30.2 – 36.0	6.1
	T-100	100	36.6±0.5	31.0 – 36.1	5.7
	S-01	100	34.6±0.7	32.5 – 36.3	4.3
	L-001	100	30.0±1.2	26.0 – 30.1	5.2

Heritability and variability of quantitative traits in cotton populations. N.G. Simongulyan et al. [19], based on the genetic analysis of quantitative traits, proposed dividing them into two groups. The first group of traits (productivity and number of bolls) are controlled by numerous polygenes exhibiting strong epistatic interactions and the effect of dominant alleles. In this case, paratypic variance is high, while heritability is low. The second group of traits (boll size, fiber length, fiber yield, etc.) are governed by a smaller number of polygenes with weaker effects. Here, paratypic variance is relatively low, and heritability tends to be somewhat higher. Among the studied traits, the heritability coefficient of plant height in the first year under the conditions of the Navoi region was 0.46, indicating that 46.0% of the trait's expression depended on genotype and 54.0% on environmental factors. In the second year, these indicators were 0.50; 50.0% and 50.0%, respectively, and in the third year (2011) — 0.62; 62.0% and 38.**0%**. In the Tashkent region, the expression of this trait showed some balance within the area of origin, but with observable differences, indicating a stronger influence of the genotype. This tendency was also characteristic of other varieties and lin**es.**

For the earliness trait, the heritability coefficient in the first year under Navoi conditions was 0.64, meaning 64.0% of the variation was due to genetic factors. In the second year, the value reached 0.66, and in the following year — 0.71**.** Under the conditions of the Tashkent region, the heritability coefficient of earliness was 0.73 in 2009, 0.76 in 2010, and 0.74 in 2011. The heritability coefficient of plant productivity in Navoi was 0.43 in 2009, 0.54 in 2010, and 0.52 in 2011. When this indicator was studied at the Scientific Research Institute of Cotton Breeding, Seed Production and Agrotechnology (SRICBSPA) fields, the respective values were 0.58; 0.57; and 0.67**.** These data show that under different soil and climatic conditions, the degree of trait stability varies, reflecting changes in the influence of genetic factors. Under the influence of adaptation to environmental conditions, a rightward shift of values was observed.

The fiber yield trait**,** among the complex polygenic traits, demonstrated relatively high heritability. Our studies in the Navoi region showed heritability coefficients of 0.71 in 2009**,** 0.73 in 2010**,** and 0.80 in 2011**.** The heritability coefficient of fiber length in Navoi was 0.34 in 2009**,** 0.37 in 2010**,** and 0.58 in 2011**.** At the SRICBSPA experimental fields, the corresponding values were 0.56 in 2009**,** 0.61 in 2010**,** and 0.65 in 2011**.**

Across all studied cotton varieties and lines, the correlation coefficient between earliness and productivity fluctuated yearly, both positively and negatively, without clear regular patterns, although minor differences were noted under different soil–climatic conditions. A similar pattern was observed in the correlation between earliness and boll seed-cotton weight. In most cases, a weak or moderate negative correlation was recorded between the studied traits of varieties and lines. It is known that biotypes within a variety population are characterized by variable heritability for major traits. All traits exhibit both hereditary and modification variability, and their manifestation during growth and development is a biological regularity. Such variability in living organisms enables their adaptation to environmental and ecological conditions.In our experiments, the ratio of modified forms among cotton varieties and lines under two different soil–climatic conditions varied slightly. In particular, under Navoi region conditions in 2011, the average number of modified forms was relatively high in Akkurgan-2, T-100, and L-001 (11.5%, 7.3%, and 7.3%, respectively). The number of modifications decreased over the years. The results obtained in the Tashkent region indicated frequent occurrence of modified forms in the Akkurgan-2 and Bukhara-6 varieties (7.1% and 6.1%, respectively).

4 Conclusion

When cultivating the cotton varieties Omad, Akkurgan-2, S-01, Bukhara-6, Bukhara-102, and the lines T-100 and L-001 of the species Gossypium hirsutum L. under different soil and climatic conditions, and when studying the dynamics of variability over several years, differences were revealed in the quantitative indicators of several morpho-economic traits, in their variability, and in the level of formation of atypical plants. As a result of comparing data obtained under different environmental conditions, variability was observed, arising from the adaptation of cotton varieties and lines to climatic factors and its influence on changes in varietal uniformity. This, in turn, indicates the need for regular elimination (roguing) of off-type plants, taking into account that testing should be carried out in specific ecological zones at the initial stages of variety development, with proper placement and monitoring of changes occurring within populations. In cotton varieties and lines where the heritability coefficients of morphological and economic traits were studied, the manifestation of these traits demonstrated varying influences of genetic and environmental factors across years and soil-climatic conditions. An improvement in the degree of heritability and a stabilization of the phenotype, which is under genotypic control, were observed as a result of regular selection and removal of modified plants (modificants) that could lead to genotypic shifts. Among the studied varieties and lines, different ratios of typical and modified biotypes were identified over the years as a response of forms to the external environment. This creates favorable conditions for maintaining and improving population homeostasis and for the rapid adaptation of varieties to diverse agro-ecological conditions.

Disclosure of Interests. The authors have no competing interests to declare that are relevant to the content of this article.

References

1. Inge-Vechtomov, S.G. (2010). Genetics with the Fundamentals of Breeding (2nd ed., revised and enlarged). St. Petersburg: N-L Publishing. 720 p.
2. Kartavtsev, Yu.F. (2009). Molecular Evolution and Population Genetics (2nd ed., revised and enlarged). Vladivostok: Far Eastern State University Press. 280 p.
3. Zhuchenko, A.A., Guzhov, Yu.L., Pukhalsky, V.A., & Smiryaev, A.V. (2003). Genetics. Moscow: Kolos. 480 p.
4. Shadraimov, R.E. (2012). Genetic Structure of Cotton Varieties and Lines by Traits and Its Changes under Selection. PhD Dissertation Abstract. Tashkent, pp. 7–17.
5. Chetverikov, S.S. (1983). Problems of General Biology and Genetics (Memoirs, Articles, Lectures). Novosibirsk: Science. 273 p.
6. Kimura, M. (1999). General Models of Evolution: Methods of Theoretical Population Genetics. The Theory of Neutrality. Copyright © Vladimir Red'ko, Oct 25, 1999.
7. Bubeiker, D.L. (1966). Agricultural Genetics. Moscow: Kolos.
8. Cavalli-Sforza, L.L. (2001). Genes, Peoples, and Languages. California. DOI: 10.1073/pnas.94.15.7719
9. Sadykov, S.S., & Kiktev, M.M. (1972). On the Study of Population Structure of Cotton Varieties Depending on Day Length. In Genetics of Cotton (pp. 65–70). Tashkent.
10. Zhalilov, O.Zh., Odilov, S., & Abukhovskaya, A.P. (2000). Modification as an Improving Mechanism of Population Structure in Cotton Varieties. Bulletin of Uzbek Agricultural Science, (4[18]), 35–38.
11. Odilov, S., Nabiev, S.M., Kakhkhorov, I.T., & Allambergenov, T.D. (2012). Population Homeostasis as a Biogenetic and Biophenotypic Basis of Improvement. In Proceedings of the Republican Scientific-Practical Conference "Application of Genetic and Breeding Methods in Developing New Cotton and Alfalfa Varieties Resistant to Extreme Conditions" (pp. 349–352). Tashkent, November 15–16, 2012.
12. Kakhkhorov, I.T. (2006). Genetic Fundamentals of Seed Production in Breeding and Production of Pure Cotton Seeds. In Proceedings of the International Scientific-Practical Conference (p. 221). Tashkent.
13. Tuychiev, Kh. (2010). Morphobiological and Economic Trait Stability of Biotypes within Populations of Certain Cotton Varieties and Lines. PhD Dissertation Abstract. Tashkent. 23 p.
14. Shodieva, O., Khalikova, M., & Matyakubova, E. (2019). Genetic Variability in Populations of Agricultural Crops and Methods of Its Study. Uzbek Journal of Biology, (2), 53–56.
15. Dospekhov, B.A. (1985). Methodology of Field Experiments (with Fundamentals of Statistical Processing of Research Results). Moscow: Agropromizdat. 351 p.
16. Ayala, F. (1984). Introduction to Population and Evolutionary Genetics. Moscow: Mir. 232 p.
17. Altukhov, Yu.P. (1989). Genetic Processes in Populations (2nd ed.). Moscow: Nauka. 328 p.
18. Xu, S. (2002). Advanced Statistical Methods for Estimating Genetic Variances in Plants. Plant Breeding Reviews, Vol. 22, 113–161. https://doi.org/10.10029780470650202.ch3
19. Simongulyan, N.G., Mukhamedkhanov, S., & Shafrin, A. (1987). Genetics, Breeding, and Seed Production of Cotton. Tashkent: Mekhnat, pp. 35–87.
20. Juraev S., Djumashev M., Ashurov M., Jamolova L. Analysis of Valuable and Economic Features of Introgressive Hybrids of Cotton in Different Soil and Climatic Conditions of

Uzbekistan. Uzbekistan. Fundamental and Applied Scientific Research in the Development of Agriculture in the Far East (AFE-2024) Agricultural Cyber-Physical Systems, Volume 1. P. 627-638. https://doi.org/10.1007/978-3-031-37978-9

21. Jurayev S., Rakhmankulov M., Yakubjanova N. Study of the Value and Economic Characteristics of F3 Hybrids of Different Genetic Origin in the Conditions of Tashkent, Fergana and Kashkadarya Provinces. Uzbekistan. Fundamental and Applied Scientific Research in the Development of Agriculture in the Far East (AFE-2024) Agricultural Cyber-Physical Systems, Volume 1. P. 689-699. https://doi.org/10.1007/978-3-031-37978-9
22. Juraev S., Jumashev M., Khudarganov K., Nazarov Kh. Evaluation of qualitative parameters of fiber in cotton hybrids grown in various regions of Uzbekistan. IOP Conference Series: Earth and Environmental Science. ICECAE-2022. IOP Conf. Series: Earth and Environmental Science 1142 (2023) 012084 IOP Publishing doi:10.1088/1755-1315/1142/1/012084. https://iopscience.iop.org/issue/1755-1315/1142/1
23. Juraev S., Makhammatova M., Jumashev M., Ashurov M. Variability of main value-economic characteristics of F2-F4 hybrids of cotton in different soil-climateregions of Uzbekistan. IOP Conference Series: Earth and Environmental Science. ICECAE-2022. IOP Conf. Series: Earth and Environmental Science 1142 (2023) 012084 IOP Publishing doi:10.1088/1755-1315/1142/1/012092 https://iopscience.iop.org/issue/1755-1315/1142/1.