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Variability of Agronomic Valuable Traits of Cotton Lines Depending on the Genotype and Vegetation Conditions in Different Ecological Zones

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Abstract: In addition, the characteristics of lines in different soil-climatic zones are given in accordance to the magnitude of variability and homeostaticity of the studied traits. The data of two-factor analysis of variance on the relative share of genotypic, environmental, and variability caused by the interaction of growing conditions × genotype in the general phenotypic variation of the trait are presented. According to the results of two-factor analysis of variance of cotton lines, it was revealed that the point of cultivation was the main factor that influenced the variability of the studied traits, the contribution of which, depending on the agronomic valuable trait, was 36.5-99.4%.

Keywords: Uzbekistan, cotton, lines, a raw cotton weight of one boll, fiber output, fiber length, adaptability, analysis of variance, growing conditions.

Introduction. Selection for resistance to adverse environmental factors requires the availability of an appropriate source material, the use of various artificially created backgrounds for studying the source and breeding material, its extensive environmental testing and a comprehensive assessment of the breeding material, starting from the early stages of selection. Dependent on the success in the increase in the resistance of varieties to adverse environmental factors, is the growth in the size and quality of the crops in adverse, and particularly, extreme conditions. The recommendation of varieties for cultivation in certain backgrounds should be based on the data of a two-way analysis of variance, and to assess the stability and adaptability of hybrids and varieties, variety tests should be carried out under various environmental conditions [3,5]. There are many studies where the need for a detailed analysis of individual elements of ear productivity is noted for a targeted influence on the formation of the crop structure in varying soil, agronomic and climatic conditions [1,8].

The genotype-environment interaction is the main reason that in different years or at different points, varieties differ in ranks in terms of yield levels, since different genotypes react differently to the same environment, and the same genotypes react differently to different environments [6, 7]. Increasing the stability of the crop and its structure is characteristic of varieties with a wide homeostaticity. Breeding for broad homeostaticity is of practical importance, as a high adaptability of a variety can ensure crop stability under varying environmental conditions. It is known that, different genotypes react differentially to the same environment. That which arises due to the discrepancy between genetic and non-genetic effects, will constitute the genotype-environmental interactions [12].

Cotton is known to be multi-genome and heterogeneous in its genetic structure. In this regard, in the populations of species, varieties and varieties, there is extensive polymorphism in morphological, agronomic valuable traits, properties, depending on the growing conditions, which was noted by many researchers. Previously, we have carried out studies on the influence of photoperiodic and thermoperiodic factors on the development of cotton plants. The results of the two-way analysis of variance indicate a significant effect of day length and temperature on the transition of the studied varieties of G. hirsutum to the generative phase. The purpose of the research is to study the variability of agronomic valuable traits of cotton lines depending on the genotype and growing conditions in different ecological zones.

Materials And Methods. The studies were carried out in 2018-2019 on the experimental field of Cotton breeding, seed production and agrotechnologies research institute in the Tashkent region and its branch in the Syrdarya region. Lines related to G.hirsutum L-33, L-34, L-35, L-36, L-37 served as experimental material. These lines were obtained with the participation of the wild variety yucatanense sample No. 397503. The studies were carried out in two versions: 1 - natural wilt background conditions, groundwater depth 8-10m, during 4 irrigations according to the 1-2-1 scheme in the Tashkent region; 2 - conditions of a natural saline background with a depth of groundwater of 1.5-2m, with one irrigation according to the 0-1-0 scheme in the Syrdarya region. In the Syrdarya region, when analyzing the soil in spring, the amount of chlorine ions was 0.025%, total 0.022%, sulfate ions 1.253%, dry residue 1.468%. In autumn, these indicators were exceeded in comparison with spring: the amount of chlorine ions by 0.019%, total 0.011%, sulfate ions 0.116%, dry residue 0.239%, which indicates an increase in salinity of the experimental plot. Statistical processing of the obtained digital material was carried out according to Dospekhov [4], using the Microsoft Excel software package. Homeostatic parameter, calculated according to the formula of V.V. Khangildin [13]. The studies were carried out within the framework of the KX-A-KX 2018-201 project.

RESULTS. The main criterion for any breeding work is the increase in the yield of new varieties. In cotton, the productivity of one plant is made up of factors, such as the number of bolls formed on one plant and the raw cotton weight of one boll. To assess the ecological plasticity and stability to environmental conditions according to the studied agronomic valuable traits, we compiled Table 1, which presents the characteristics of the agronomic valuable traits of the studied lines in the conditions of the Tashkent and Syrdarya regions. The limit of variability of the raw cotton weight of one boll in the studied cotton lines, grown in two geographical points, was in the range from 5.0 to 10.0 g, while most of the studied lines had an average raw cotton weight of one boll within 6.8 -7.2 g. The parameters of homeostasis in the conditions of the Tashkent region were 60-73, and in the conditions of the Syrdarya region 51-63, and significant differences in both genotype and growing conditions were not noted. Similar results were obtained with respect to fiber yield. Thus, in the conditions of the Tashkent region, the limit of variation of the indicators of this trait was 31.0-45.1%, with homeostatic parameters of 682-839, and in the conditions of the Syrdarya region, respectively, 32.6-46.6% and 539-796.

The weight of 1000 seeds is a very important feature for cotton, since the weight of a raw cotton weight of one boll, fiber output and index depend on the value of this feature. The average values of this trait in the conditions of the Syrdarya region were slightly lower, but there were no significant differences in the values of the limit of variability depending on the growing conditions. A significant limit of variability in the weight of 1000 seeds should be attributed to some unevenness of the plots in terms of fertility and moisture supply.

Fiber length values largely depend on the plant genotype. During the process of breeding work on the studied lines, plants corresponding to the IV type of fiber were selected, which was reflected in the average values of the lines. The average fiber length of the studied lines, regardless of the growing conditions and the genotype of the lines, was 35.4-36.4 mm. The parameters of homeostasis in the conditions of the Tashkent region were 796-935, and in the conditions of the Syrdarya region, they were slightly higher 874-1024.

To assess the genotype-environmental interaction, the significance and the magnitude of the contribution of various factors to the formation of agronomic valuable traits of the studied cotton lines, we carried out a two-factor analysis of variance (Table 1).

Table 1

Characteristics of agronomic valuable traits in cotton lines in the conditions of Tashkent and Syrdarya regions (Average indicators for 2018-2019).

Agronomic valuable traits	**L-33**		**L-34**		**L-35**		**L-36**		**l-37**	
	Tashkent	**Syrdarya**	**Tashkent**	**Syrdarya**	**Tashkent**	**Syrdarya**	**Tashkent**	**Syrdarya**	**Tashkent**	**Syrdarya**
a raw cotton weight of one boll, r	7,2	6,9	6,9	6,8	7,2	7,0	7,0	6,8	7,1	6,9
limit of variability	5,0-9,2	5,2-10,0	5,0-9,5	5,0-9,4	5,0-9,8	5,2-9,9	5,0-9,3	5,1-10,0	5,0-9,9	5,2-9,8
homeostatic index	60	62	65	61	72	63	70	61	73	51
fiber output, %	38,2	38,5	38,4	38,4	39,1	38,3	39,1	39,4	39,6	38,9

Agronomic valuable traits	L-33		L-34		L-35		L-36		l-37	
	Tashkent	Syrdarya	Tashkent	Syrdarya	Tashkent	Syrdarya	Tashkent	Syrdarya	Tashkent	Syrdarya
limit of variability	32,4-43,8	32,6-45,3	32,3-45,1	32,7-44,5	31,0-44,7	32,6-44,3	36,3-44,7	33,0-44,7	35,6-44,2	32,8-46,6
homeostatic index	763	796	682	673	809	686	839	722	734	539
weight of 1000 seeds, г	136	127	128	124	129	122	130	120	131	120
limit of variability	100-165	94-159	90-168	95-160	91-168	88-158	107-170	99-150	100-173	92-172
homeostatic index	1694	1355	1440	1389	1590	1118	1622	1412	1356	1069
fiber length, мм	35,8	35,5	35,8	35,4	36,2	36,4	36,1	36,1	36,3	36,0
limit of variability	31,4-39,2	31,4-39,9	31,4-39,9	32,0-39,0	31,9-40,0	32,6-40,0	32,2-39,4	31,6-39,2	33,0-39,6	32,0-39,6
homeostatic index	796	972	874	890	927	922	935	1024	915	874

The results of the conducted analysis of variance revealed the very fact that the "genotype–environment" interaction is present. At the 5% significance level, the significance of the influence of the studied factors and their interaction on the variability of agronomic valuable traits of cotton lines depending on the genotype and vegetation conditions in various ecological zones was proved. According to the two-way analysis of variance, the factor of the soil-climatic zone (from 98.8% to 99.4%) makes the largest contribution to the variation in the number of bolls formed on one plant, regardless of the genotype (Table 2).

In varying the number of bolls formed on one plant, the role of the genotype was insignificant, and the contribution of the factor-genotype was only 0.4-0.5%. Similar results were obtained for the interaction of the studied factors. Many researchers on other cultures have obtained similar results [9, 11]. From the data presented in Table 2, it can be seen that the mass of a raw cotton weight of one boll affects both the point of cultivation and the conditions of the year. Thus, in the conditions of 2018, the point of cultivation (69.5%) and its interaction with the genotype factor (16.8%) made the greatest contribution to the formation of this trait, while the contribution of the genotype was insignificant. In 2019 year, the influence of the point factor on the formation of this trait was 36.5%, and the genotype factor and their interaction was 31.1-32.4%, although a significant influence of the studied factors on the formation of this trait in 2019 year has not been statistically proven. This trait is made up of a combination of several traits, such as the weight of 1000 seeds, fiber output and seed completion. In 2019 year was characterized by high air temperatures during the growing season and, perhaps, therefore, a clear influence of the studied factors was not observed in 2019. Similar results were obtained based on the weight of 1000 seeds. In 2018 year, the contribution of the genotype factor and the interaction of factors was significant at the 5% significance level. Whereas in 2019 year, a significant influence of the factors of growing point and genotype on the manifestation of this trait was noted, and the interaction of factors was not significant. The greatest contribution to the formation of this trait was noted for the point factor, which amounted to 97.6%. A number of authors noted similar results on the significant variability in the share of the contribution of genotypic and environmental variability to the overall phenotypic variation in yields and the main agronomic valuable traits depending on the conditions of years, points, agro backgrounds, and sowing dates [2, 10]. A significant influence on the point of cultivation and the genotype of lines was observed on the manifestation of the fiber output trait. The contribution of these factors to the formation of the fiber output trait was 81.9-94.4% and 12.5-4.7%, respectively, depending on the year of the research. The role of the interaction of factors on the manifestation of the fiber output feature is insignificant. A significant contribution to the formation of fiber length was observed in the point factor 55.1-86.7%, the contribution of the genotype factor was 10.1-34.0%. The contribution of the interaction of these factors to the formation of the fiber length was insignificant at the 5% significance level.

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Thus, it has been established that the homeostatic index is the most informative in determining the adaptive capacity of the breeding material. The value for the number of bolls formed on one plant depended largely on the point of cultivation (43.4%), the influence of the genotype factor, and the interaction of factors "point × genotype" was insignificant. According to the results of a two-factor analysis of variance of cotton lines, it was revealed that the main share of the variability of the studied traits depended on the point of cultivation, the contribution of which, depending on the agronomic valuable trait, was 36.5-99.4%.

Table 2

Results of a two-factor analysis of variance of the variability of agronomic valuable traits of cotton lines depending on the genotype and point of cultivation in different ecological zones (2018-2019 years).

Traits	**Dispersion**	**Sum of squares *SS***		**Medium square *MS***		**Contribution of factors, %**		**F_f**		**$F_{0,5}$**	
		2018	**2019**	**2018**	**2019**	**2018**	**2019**	**2018**	**2019**	**2018**	**2019**
number of bolls formed on one plant	point of cultivation	1062,96	1075,36	1062,96	1075,36	99,4	98,8	463,23	432,04	4,17	4,17
	genotype	18,55	24,56	4,63	6,14	0,4	0,5	2,02	2,46	2,68	2,68
	point and genotype	5,88	28,63	1,47	7,15	0,2	0,7	0,64	2,87	2,68	2,68
	remainder (mistakes)	68,84	74,67	2,29	2,48						
	general	1156,24	1203,23								
a raw cotton weight of one boll	point of cultivation	0,65	0,13	0,65	0,13	69,5	36,5	11,62	1,86	4,17	4,17
	genotype	0,51	0,46	0,12	0,11	13,7	32,4	2,29	1,65	2,68	2,68
	point and genotype	0,62	0,45	0,15	0,11	16,8	31,1	2,80	1,59	2,68	2,68
	remainder (mistakes)	1,67	2,12	0,05	0,07						
	general	3,46	3,17								
fiber output	point of cultivation	21,02	13,80	21,02	13,80	81,9	94,4	33,23	50,86	4,17	4,17
	genotype	12,68	2,73	3,17	0,68	12,5	4,7	5,01	2,51	2,68	2,68
	point and genotype	5,75	0,57	1,43	0,14	5,6	0,9	2,27	0,52	2,68	2,68
	remainder (mistakes)	18,98	8,14	0,63	0,27						
	general	58,44	25,25								
weight of 1000 seeds	point of cultivation	1,22	2924,1	1,22	2924,1	1,8	97,6	0,14	271,16	4,17	4,17
	genotype	119,15	178,25	29,78	44,56	46,2	1,5	3,61	4,13	2,68	2,68
	point and genotype	134,15	106,15	33,53	26,53	52,0	0,9	4,06	2,46	2,68	2,68
	remainder (mistakes)	247,25	323,5	8,24	10,78						
	general	501,77	3532								
fiber length	point of cultivation	2,55	6,24	2,55	6,24	55,1	86,7	9,07	21,37	4,17	4,17
	genotype	6,29	2,91	1,57	0,72	34,0	10,1	5,60	2,69	2,68	2,68

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Traits	Dispersion	Sum of squares *SS*		Medium square *MS*		Contribution of factors, %		F_f		$F_{0,5}$	
		2018	2019	2018	2019	2018	2019	2018	2019	2018	2019
	point and genotype	2,01	0,91	0,50	0,22	10,9	3,2	1,79	0,78	2,68	2,68
	remainder (mistakes)	8,43	8,76	0,28	0,29						
	general	19,29	18,83								

The studied lines are recommended for inclusion in breeding programs as a source of adaptability with high rates of agronomic valuable traits, and for the introduction as a variety into production.

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