

Selection of Cotton for Early Natural Leaf Fall

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Abstract. In connection with environmental violations of the environment, there is a need to create cotton varieties with weak foliage or early natural deciduousness, high yields, resistance to diseases and environmental stress factors.

Key words: deciduousness, foliage, productivity, cotton

1 Introduction

In connection with environmental violations of the environment, there is a need to create cotton varieties with weak foliage or early natural deciduousness, high yields, resistance to diseases and environmental stress factors. One of the ways to solve this issue is the development and introduction into production of highly productive, wilt-resistant, early-ripening varieties of cotton with weak foliage or early natural deciduousness and resistance to agricultural diseases and pests, as well as having a good set of economically valuable traits [1].

The creation of varieties with weak foliage or with early natural deciduousness during the ripening period of the crop makes it possible to partially and completely exclude defoliation or desiccation of plants in order to remove leaves to accelerate ripening and use mechanized harvesting of raw cotton.

Therefore, the study of the physiological, biochemical, anatomical, morphological and genetic foundations of plant resistance to diseases and pests in varieties of domestic and foreign breeding, in distant intraspecific cotton hybrids with varying degrees of foliage will give a deeper understanding of the nature of plant resistance, which will significantly speed up the work of breeders in business. creation of deciduous, highly productive, early maturing varieties, lines and families of cotton, resistant to agricultural diseases and pests. With a high yield (38-40%) and quality IV-V fiber that meets international standards [2].

Similar studies are being carried out in the USA, India, China, Turkmenistan and other cotton-growing countries of the world. The significance of this problem is discussed in the works of N.I. Vavilov, A.A. Abdullaev, A. Alimukhamedov, Mirpulatova, Kamilova, V.N. Fursova, A. Egamberdiev, R.G. Kim and many other scientists who created varieties and lines with weak foliage with naturally early deciduous.

The economic efficiency from the introduction into production of wilt-resistant, early-ripening, highly productive, low-leaved, deciduous varieties of cotton with complex resistance to agricultural pests and diseases will be about (150-250 USD) 150.0-250.0 thousand soums per 1 ha.

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2 Materials and methods

The intensification of agricultural production, including cotton growing, put forward demands for comprehensive mechanization of the cultivation and harvesting of raw cotton. Many researchers Sadykov S.S., Rakhimbaev R.R., Lyubetskaya M.F. [3], Barkhatova T.A. [4], Fursov V.N., Mashadov A.M., Fursov I.V. and Orlov V.A. [5], T.A. Barkhatova [6], Kurbanniyazov B.B. [7], Ya.A. Babaev and A.B. Amanturdiyev [6], Ya.A. Babaev [8], Ya.A. Babaev, R.G. [9], conducted a study on the inheritance and variability of the trait of low leafiness and natural early leaf fall to create varieties with naturally early leaf fall with a complex of morphological and economic traits.

It should be noted that certain successes have been achieved in this direction, since many researchers have already obtained low-leaf lines and varieties of cotton with natural early deciduousness. However, despite the achievements made, the scientific breeders still do not have an integral theory and methodology for creating low-leaved and deciduous cotton varieties with a complex of morphological and economic traits. Therefore, in the creation of low-leaf and deciduous lines and varieties of cotton, it is necessary to comprehensively study the nature of the inheritance of this trait and its relationship with other morphological and economic traits, as well as resistance to agricultural diseases, by involving in hybridization contrasting lines and varieties of cotton with natural early deciduousness and having a complex economically valuable traits.

In this regard, the staff of the laboratory for breeding intensive cotton varieties carry out the following work to study the early natural deciduousness of cotton varieties, as well as genetic breeding work:

- to study new varieties with weak foliage and with naturally early leaf fall, in terms of productivity, early maturity, resistance to verticillium wilt, as well as the mass of raw cotton in one box, yield, length and quality of the fiber, the height of the main stem, and other morphological and economic features;
- study of the genetic nature of weak foliage, early natural deciduousness in varieties, forms and hybrids of cotton, as well as their degree of resistance to wilt;
- study of inheritance and heritability of early natural deciduousness in varieties, lines and F1-F2-F3 hybrids of cotton;
- to study the correlations of weak foliage and early deciduousness with yield, early maturity, weight of raw cotton per boll, fiber yield and length, resistance to verticillium wilt in F2 hybrids.

Deciduous varieties of domestic selection L-5 deciduous Institute of Genetics and Experimental Biology (IGEBr, Academy of Sciences of Uzbekistan), early maturing varieties and lines S-8288, L-162, L-158, L -75, L-1703, L-1858, L-155, L-1708, L-175\245, L-303 and hybrids F1-F2-F3, as well as backcross hybrids F1B1 and F1B2 of the laboratory for breeding intensive varieties of cotton NIISAVKh.

In inheritances, some forms and hybrids with varying degrees of deciduousness were studied, which have different indicators of morphological and economic traits, the degree of resistance to agricultural pests, stress factors developed during the evolution of the host plant and parasite in wild, semi-wild forms and varieties of domestic and foreign selection.

Inheritance of the trait of natural early deciduousness in geographically distant parental forms and F1 hybrids was observed in different ways. Parental forms differed significantly on this basis. Lines L-175/245 and L-5 (deciduous) showed higher results in leaf fall, which amounted to 60.8% and 63.8%. The lowest indicator was observed in variety S-8288 38.6% (table-1).

Table 1. Inheritance of natural deciduousness in parental forms and hybrids of cotton F1

№	Variety, lines and hybrid combinations	Number of plants	leaf fall, in %	
			$M_1 \pm m$	hp
1	S-8288	60	38.6±8.3	-
2	L-175/245	90	66.3±7.4	-
3	L-5 (leaf)	90	64.0±3.7	-
4	L-155	60	49.3±0.8	-
5	L-303	60	35.8±8.8	-
6	L-1708	60	49.5±1.3	-
7	S-8288 x L-175/245	60	49.6±1.6	0.2
8	S-8288 x L-5 (leaf)	60	56.6±2.1	0.4
9	L-155 x L-175/245	60	71.3±6.1	1.5
10	L-155 x L-5 (sheet)	60	67.3±12.7	1.4
11	L-303 x L-175/245	60	67.3±13.2	1.1
12	L-303 x L-5 (leaf)	60	67.6±10.8	1.0
13	L-1708 x L-175/245	60	58.1±2.9	0.5
14	L-1708 x L-5	60	57.4±4.0	0.5
	NDS (05)			4.49

Inheritance of deciduousness in four hybrid combinations L-155 x L-175/245, L-155 x L-5 (deciduous), L-303 x L-175/245 and L-303 x L-5 (deciduous) is characterized by overdominance and dominance, and in the remaining four hybrid combinations, intermediate inheritance is observed. The percentage of leaf fall in these hybrid combinations ranged from 67.3% to 71.3%.

A hybridological analysis of the inheritance and variability of the trait deciduousness in F2 hybrids shows that in most cases hybrid plants tend to deviate towards parental forms with low leaf fall, and in some cases, for example, in the hybrid combination L-303 x L-5, the dominance of the trait is observed, and there is also a wide negative and positive transgression for this trait (Table-2).

From the data in Table 2, it can be seen that the deciduous trait in the second generation is inherited as a recessive one, with the emergence of plants with a low and high percentage of leaf fall. The range of trait variability varies from 11.0% to 100.0%, depending on the hybrid combination. The indicators of the heritability coefficient $h^2 F1/F2$, depending on the combination of crosses, were in the range of 0.76-0.95, which indicates a high heritability of this trait. A high coefficient of heritability ($h^2 F1/F2 - 0.95$) was noted in combinations L-155 x L-175/245, L-155 x L-5, where the L-155 line was used as the maternal form. In combinations S-8288 x L-175/245, L-155 x L-175/245, L-303 x L-175/245, L-1708 x L-175/245 with the participation of the L-175/245 line, coefficients heritability $h^2 F1/F2$ were in the range of 0.81-0.95.

Table 2. Heritability and variability of natural deciduousness in F2 cotton hybrids

№	Variety, lines and hybrid combinations	Number of plants	class boundary, in %										X±Sx	S	h ² F1/F2	
			11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100					
1	S-8288	30		5	11	10	4							39.3±1.7	9.3	
2	L-175/245	90				10	25	30	10		15	10		63.8±1.2	11.5	
3	L-5	90				28	40	31	15	14				60.8±1.1	12.5	
4	L-155	30			7	11	8	4						48.0±1.8	9.8	
5	L-303	30		5	9	8	8							41.3±1.9	10.7	
6	L-1708	90			5	19	30	16	15	5				51.7±0.6	5.7	
7	S-8288 x L-175/245	120	3	25	28	30	15	13	3	3				42.6±1.3	15.0	0.81
8	S-8288 x L-5	120	3	34	35	31	6	6	3	2				38.5±1.2	14.1	0.76
9	L-155 x L-175/245	120		5	21	31	18	16	10	10			9	56.1±1.7	19.4	0.95
10	L-155 x L-5	120		5	15	25	24	21	6	11			13	59.0±1.8	19.7	0.95
11	L-303 x L-175/245	120		5	20	23	13	15	19	12			13	61.9±1.7	19.6	0.89
12	L-303 x L-5	120		4	6	26	30	10	16	16			12	62.3±1.7	19.0	0.90
13	L-1708 x L-175/245	120		3	8	32	35	19	15	6			2	56.5±1.3	14.5	0.92
14	L-1708 x L-5	120		2	11	30	36	19	20	2				55.5±1.2	13.2	0.84

Table 3. Heritability and variability of natural deciduousness in parental forms and hybrids of cotton F3

№	Variety, lines and hybrid combinations	Number of plants	class boundary, in %										X±Sx	S	h ² F ₂ /F ₃	
			11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100					
1	S-8288	12		2	2	6	2							41.6±2.8	9.8	
2	L-175/245	12					2	2	7	2	1			66.6±2.4	8.3	
3	L-5	12						6	3	3				62.5±2.5	8.9	
4	L-155	12			2	5	3	2						49.1±2.8	10.0	
5	L-303	12		2	3	7								39.6±2.1	7.8	
6	L-1708	12			1	3	5	3						53.3±2.7	9.3	
7	S-8288 x L-175/245	88	3	11	21	13	17	19	3	1				46.8±1.7	16.1	0.40
8	S-8288 x L-5	101	5	16	37	16	12	10	4	1				41.4±1.5	15.4	0.44
9	L-155 x L-175/245	78		1	7	20	17	19	6	7				59.7±2.0	18.1	0.41
10	L-155 x L-5	72		5	17	10	14	10	8	10				61.8±2.4	20.8	0.39
11	L-303 x L-175/245	106		2	15	25	27	10	8	8				58.1±1.8	19.0	0.40
12	L-303 x L-5	110		5	17	15	18	21	10	13				60.4±1.9	20.3	0.35
13	L-1708 x L-175/245	75		3	13	21	17	10	6	2				52.8±1.8	16.3	0.31
14	L-1708 x L-5	80	2	4	11	15	19	25	4					52.0±1.6	14.3	0.39

The selection of plants with a higher percentage of leaf fall in F2 allowed us to obtain F3 families with higher leaf fall (Table-3).

3 Results

The results of a family-by-family study of deciduousness in hybrids in F3 indicate a complex polygenic inheritance, the range of variability of the trait is similar to F2 hybrids.

Table 3 shows that the indicators of F3 hybrid families in terms of deciduousness varied from 11.0% to 100.0. Families with higher and lower rates of leaf fall were obtained than in the original forms, i.e. there was transgressive splitting both to the left and to the right side of the variation series, but the main number of families was located in intermediate classes between parents. This suggests that, regardless of the genetic complexity of the studied trait, it is possible to obtain families and lines with high leaf fall.

Table 3 shows the heritability coefficients of the trait deciduousness in F3 hybrids. The indicators of the heritability coefficient in F3 hybrids turned out to be significantly low compared to F2 hybrids, there were no significant differences in heritability depending on the combination of crosses, the indicators ranged from 0.31-0.44. This indicates that in F3 hybrids, the heritability of the deciduous trait was 56–69% dependent on environmental conditions. The lowest indicators of the coefficient of heritability on the basis of deciduousness in F3 hybrids were noted in combinations L-1708 x L-175/245, L-303 x L-5 ($h^2 F1 / F2$ - 0.31; 0.35), the highest indicator ($h^2 F1 / F3$ - 0.41; 0.44) in combinations L-155 x L-175/245 and S-8288 x L-5. In the F4 hybrid families, the deciduousness indicators differed from the F3 hybrid families, i.e. there is an increase in the percentage of leaf fall. Hybrid families L-155 x L-175/245, L-155 x L-5 and L-303 x L-5 were obtained, in which the percentage of leaf fall is from 59.7% to 61.8% (table-3).

In general, it can be noted that by selecting plants in F2 and F3 with higher rates of deciduousness and studying them in subsequent generations, it makes it possible to obtain families, lines and varieties of cotton with high rates.[10]

In the studies, the correlations of natural-early leaf fall with the height of the main stem of plants, early maturity, number of bolls, raw cotton weight of one bolus, productivity, yield and fiber length were studied (Table-4).

From the data given in Table 4, it can be seen that in the studied hybrid combinations, the degree of correlation between leaf fall and the height of the main stem of the plant is weak positive and weak negative, except for the hybrid combination L-303 x L-175/245 where an average negative relationship was noted $r = -0.37$. So, in hybrid combinations S-8288 x L-175/245 ($r=0.12$), S-8288 x L-5 ($r=0.19$) and L-155 x L-5 ($r=0.11$) weak positive correlations were established, and in hybrid combinations L-155 x L-175/245 and L-303 x L-5 weak negative correlations were noted. Correlation coefficients between leaf fall and precocity in F2 hybrids showed weak insignificant positive correlations (0.08-0.20;), only in the hybrid combination L-155 x L-175/245 a weak negative correlation was noted. The data obtained show that the absence of correlations between these traits makes it possible, by selection from each combination, to isolate valuable recombinants that combine deciduousness and precocity.

An analysis of the correlation coefficients between deciduousness and the number of bolls per plant showed that in most of the studied hybrid combinations they had weak negative insignificant correlations (from $r=-0.02$ to $r=-0.18$), also in 3 combinations weak positive correlations were established. correlations (from 0.04 to 0.09).

Table 4. Relationship of deciduousness with the main morphological and economic features in F2 hybrids

№	hybrid combinations	Plant stem height		precoocity		Number of boxes		Weight of raw cotton per box	
		r±Sr	tr	r±Sr	tr	r±Sr	tr	r±Sr	tr
1	S-8288 x L-175/245	0.12±0.1	1.5	0.08±0.1	0.9	-0.02±0.1	-0.2	0.06±0.1	0.6
2	S-8288 x L-5	0.19±0.1	2.3	0.20±0.1	2.2	0.04±0.1	0.4	0.16±0.1	1.8
3	L-155 x L-175/245	-0.04±0.1	-0.4	-0.10±0.1	-1.1	-0.10±0.1	1.1	-0.14±0.1	-1.6
4	L-155 x L-5	0.11±0.1	1.2	0.10±0.1	1.1	-0.07±0.1	-0.8	-0.07±0.1	-0.8
5	L-303 x L-175/245	-0.37±0.1	-4.3	0.12±0.1	1.3	-0.18±0.1	-2.0	-0.16±0.1	-1.7
6	L-303 x L-5	-0.06±0.1	-0.7	0.09±0.1	0.9	-0.18±0.1	-2.0	-0.13±0.1	-1.4
7	L-1708 x L-175/245	0.15±0.1	2.1	0.12±0.1	-1.4	0.09±0.1	0.9	0.18±0.1	-1.6
8	L-1708 x L-5	0.14±0.1	1.8	0.14±0.1	1.6	0.08±0.1	0.7	0.15±0.1	-1.7

Table 5. Relationship of deciduousness with the main morphological and economic features in F2 hybrids

№	hybrid combinations	Productivity		Fiber output		Fiber length	
		r±Sr	tr	r±Sr	tr	r±Sr	tr
1	S-8288 x L-175/245	0.09±0.1	1.1	0.10±0.1	1.0	-0.10±0.1	-1.1
2	S-8288 x L-5	-0.09±0.1	-1.1	0.10±0.1	1.0	0.05±0.1	0.6
3	L-155 x L-175/245	0.06±0.1	0.6	-0.01±0.1	-0.1	0.06±0.1	0.6
4	L-155 x L-5	-0.12±0.1	-1.3	-0.04±0.1	-0.5	-0.11±0.1	-1.2
5	L-303 x L-175/245	-0.07±0.1	0.8	-0.02±0.1	-0.2	-0.11±0.1	-1.3
6	L-303 x L-5	-0.12±0.1	-1.5	-0.15±0.1	-1.6	-0.14±0.1	-1.6
7	L-1708 x L-175/245	0.06±0.1	0.6	0.18±0.1	-1.7	-0.13±0.1	-1.5
8	L-1708 x L-5	0.14±0.1	-1.8	-0.06±0.1	-0.5	0.05±0.1	0.6

It should be noted that there was no direct regular relationship between deciduousness and the number of bolls.

It was revealed that the leaf fall and the size of the capsule also do not have a significant regular relationship, where weak negative and positive relationships are noted.

Correlation relationships between the signs of deciduousness and productivity, fiber yield and fiber length also do not have clear patterns. (Table 4).

Between deciduousness and productivity, insignificant weak negative and positive relationships are observed, the coefficients of which are from $r=-0.07$ to $r=-0.12$ and from $r=0.06$ to $r=0.14$.

Insignificant weak negative ($r=-0.01-0.15$) and positive ($r=0.10-0.18$) correlations were also revealed between leaf fall and fiber yield.

The same pattern was established between deciduousness and fiber length, where very weak insignificant negative ($r=0.10-0.14$), as well as positive ($r=0.05-0.06$) correlations were also noted, which make it possible to select deciduous, highly productive, high-yielding and long-staple cotton plants.

4 Conclusion

1. Parental forms differ in natural early deciduousness. The lines L-175/245 and L-5 deciduous have relatively high deciduousness, where natural leaf fall is 60.8 and 63.8%.

2. Inheritance of early natural deciduousness in F1 hybrids is characterized by overdominance, dominance and intermediate inheritance.

a) In F2, there is a wide range of variability in early natural deciduousness from 0 to 90-95 percent of leaf fall, which indicates the emergence of transgressive forms both to the left and to the right side of the variation series.

b) The selection of plants in F2 and F3 with high leaf fall, as well as their study in subsequent generations, made it possible to obtain families with high rates of early natural leaf fall, and with a good complex of economically valuable traits.

3. The results obtained show that deciduousness does not have regular correlations with the height of the main stem of plants, early maturity, the number of boxes and the mass of raw cotton in one box, productivity, fiber yield, fiber length, which is very important for creating deciduous, early ripening, highly productive varieties cotton with high rates of economically valuable traits.

4. In the process of breeding work, we created on the basis of hybrid material new early-maturing, low-leafed, deciduous varieties and lines S-8295, L-1435, L-115, L-45, L-1993 and L-932/1018 which have (with vegetation periods of 105-115 days) are highly productive, with a high yield and quality of type IV-V fiber that meets world standards, and they are also highly resistant to wilt and other agricultural diseases.

References

1. S. Suwarni, E.M. Akhmetshin, H.I. Okagbue, E.L. Lydia, K. Shankar. Digital economic challenges and economic growth in environmental revolution 4.0. Journal of Environmental Treatment Techniques, **8(1)**, 546-550(2020).
2. E.M. Akhmetshin, D.I. Stepanova, I.Y. Andryushchenko, H.A. Hajiyev, O.M. Lizina. Technological stratification of the large business enterprises' development. Journal of Advanced Research in Law and Economics, **10(4)**, 1084-1100 (2019). doi:10.14505/jarle.v10.4(42).10
3. S.S. Sadykov, R.R. Rakhimbaev, M.F. Lyubetskaya, Genetic basis for the creation of cotton varieties that naturally shed their leaves early. Theoretical foundations of part of

- the genetics and selection of cotton: Proceedings. report Rep. scientific conf. Tashkent, 33-39 (1983).
4. T.A. Barkhatova. Correlative relationship between deciduousness and quantitative traits in cotton species *G.hirsutum* L in various genotypic environments. Collection of scientific works of INEBR. Tashkent. 10-17 (1989).
 5. V.N. Fursov, A.M. Mashadov, I.V. Fursov, V.A. Orlov. New deciduous varieties. Cotton. Tashkent, **6**, 78 (1990).
 6. T.A. Barkhatova. Inheritance of early deciduousness in cotton in various genotypic environments.: Abstract of the thesis. dis. ...candidate of biological sciences, (Tashkent, 1990) 20.
 7. B.B. Kurbanniyazov. Creation of cotton deciduous donors on a new genetic basis, (St. Petersburg, 1992) 14.
 8. Babaev Ya.A., Amanturdiyev A.B. *Gossypium hirsutum* L. duragailarida tabiy barg tukish xususiyatining irsiylanishi. Botany fanning ustivor masalalari: Res. ilmy conf. maruzalar theses. September 12-14. (Tashkent, 1995) 171-172.
 9. Babaev Ya.A. The study of the trait of naturally early deciduousness in cotton breeding and the creation of families with a complex of economically valuable traits.: Abstract of the thesis. ...candidate of agricultural sciences. (Tashkent, 1998) 19.
 10. Ya.A. Babaev R.G. Kim, M.R. Kim. Creation of early ripening, highly productive varieties of cotton with early natural deciduousness. Tez. report int. conf. September 8-10, Almaty, 158 (2004).