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Research Article

Heritability and Variability of the form of Leaf Shape in Cotton F_1, F_2 and F_1b_1 Hybrids

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Abstract

This article presents data on the inheritance and variability of leaf shape in intra- and interspecific hybrids F1 and F2 obtained from varieties of tetraploid cotton species (*G.hirsitum* L., *G.tricuspidatum* Lam.). The obtained results showed that intermediate inheritance is observed in the trait of the leaf shape in F1 hybrids. In F2, splitting was observed in a ratio of 1:2:1. The study of the inheritance of the trait in intra- and interspecific hybrids F1, F2 revealed semi-dominant, polygenic inheritance.

Keywords: Cotton; G.Hirsutum L., Genome; Hybrid; Leaf; Dominant

Introduction

Cotton (*Gossypium* sp.) is an important economic crop in the world, and cotton fiber is mainly used as a raw material for textile production. In the genus Gossypium, the leaf shape is a highly variable trait; cultivated cotton consists of broad leaves [14]. The study of the genetic conditioning of the structural and functional features of the leaf blade should be considered one of the most urgent problems of modern plant genetics, since this is of interest not only for breeding, but also for cotton phylogeny.

Cotton genotypes with deeper foliage showed better adaptation to the environment, less pile, better crown structure, ventilation and light transmission. The deep-leaf cotton phenotype is also associated with pest and disease resistance [15], drought tolerance [17,18,20], early maturity [19], fiber quality and yield [16,21-24].

According to the literature data [1,3,4,6], the tetraploid cotton plant *G.hirsutum* L., as a rule, has two forms of leaves- palmately lobed and palmately dissected. Varieties of this species, sown in the cotton zones of the world, have a palmate-lobed leaf shape. Varieties and specimens with a palmately dissected leaf blade are very rare.

Many researchers noted that the trait of a dissected leaf blade is dominant. And also, palmate-lobular and palmate-dissected forms are determined by the allelic state of one gene and are inherited according to the type of incomplete dominance [1,4,7,8].

M.F. Abzalov., *et al*. [2], based on genetic analysis in inbred lines of *G.hirsutum* L., determined the shape of the leaf blade by two non-allelic genes (In^1-in,O_L-o_L). The interaction of various allelic states of these genes ensures the phenotypic development of different forms of the leaf blade.

D.A. Musaev [5] argues that against the background of O_L polymeric genes function - $O_{L1}-o_{l\,1}$; $O_{L2}-o_{l\,2}$, contributing to the formation of additional lobes on the central lobe of palmately dissected leaves.

Varieties and lines of medium staple cotton are tetraploids (amphidiploids) and have identical AD genomes, which indicates the common structural and functional organization of nuclear genes that determine photosynthesis rates in this species.

According to S.G. Stephens [9], the leaf blade shape genes L^0 (okra), L^e (Sea-Island), L^s (super okra), L^u (sub-okra), and L (normal, digitilobular) are members of a series of multiple alleles, localized in the “L” locus of the 15th chromosome of the D genome. Later, additional genes were identified, at least five more alleles that determine the shape of the leaf blade, which are located in the “L” locus of the 1st chromosome of the A genome [10].

Many studies have confirmed that the okra leaf phenotype in mountain cotton is controlled by a pair of imperfectly dominant genes [25,26].

Analysis of mountain cotton QTL showed that the main gene was mapped to the short arm of chromosome 15 [27-29].

A.A. Nichiporovich and N.F. Konyaev [11-13] established that the development and activity of the leaf apparatus are determined by the growing conditions and plant genotype.

Despite the importance of leaf shape, the molecular and genetic control of leaf shape in cotton is not well understood.

We have studied the nature of splitting and inheritance of the form of leaf blades in intra- and interspecific hybrids of cotton.

Materials and Methods

The material of the research was the varieties of tetraploid cotton species *ssp.mexicanum var.nervosum* (Victoria), *ssp.mexicanum var.microcarpum palmerii* (*G.hirsitum L.*.), *ssp.purpurascens, ssp. purpurascens var.el-salvador* (*G.tricuspidatum* Lam.).

The research used classical methods of genetics and cotton breeding, intra- and interspecific hybridization and hybridological analysis.

Results and Discussion

The wild and ruderal forms of the species *G.hirsutum* L. taken for the study were contrasting in this trait. So, for ssp.*mexicanum* var.*nervosum* (Victoria), ssp.*purpurascens*, ssp.*purpurascens* var. *el-salvador* palmate-lobed leaves are characteristic, for ssp.*mexicanum* var.*microcarpum palmerii*, palmately dissected (Table 1, figure 1).

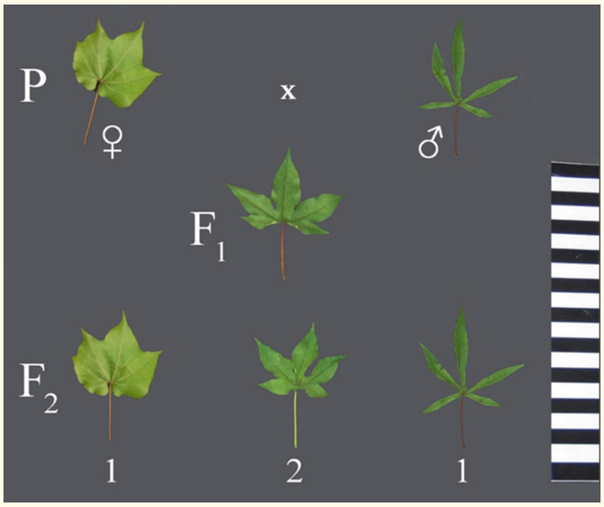

Figure 1: Inheritance of the shape of the leaf blade in an intraspecific hybrid F1, F2 *ssp.mexicanum var.nervosum* (Victoria) x *ssp.mexicanum var.microcarpum palmerii*.

№	Parent forms and hybrid combinations	Number of plants.	Palmate-lobular	Palmately divided	Palmately dissected	Ratio	X^2	P
Parents								
G.hirsutum L.								
1	ssp.*mexicanum* var.*nervosum* (Victoria)	10	100,0	0,0	0,0	-	-	-
2	ssp.*mexicanum* var.*microcarpum palmerii*	12	0,0	0,0	100,0	-	-	-
G.tricuspidatum Lam.								
3	ssp.*purpurascens*	12	100,0	0,0	0,0	-	-	-
4	ssp.*purpurascens* var.*el-salvador*	10	100,0	0,0	0,0	-	-	-
G.hirsutum L. x *G.hirsutum* L. F_1, F_2								
5	F_1 ssp.*mexicanum* var.*nervosum* (Victoria) x ssp.*mexicanum* var.*microcarpum palmerii*	10	0,0	100,0	0,0	-	-	-
6	F_2 ssp.*mexicanum* var.*nervosum* (Victoria) x ssp.*mexicanum* var.*microcarpum palmerii*	208	23,5	51,9	24,5	1:2:1	0,34	0,95-0,80
G.hirsutum L. x *G.tricuspidatum* Lam. F_1, F_2 и F_1B_1								
7	F_1 ssp.*mexicanum* var.*microcarpum palmerii* x ssp. *purpurascens*	10	0,0	100,0	0,0	-	-	-

8	F_2 ssp.*mexicanum* var.*microcarpum palmerii* x ssp. *purpurascens*	202	22,7	46,5	23,2	1:2:1	0,86	0,99-0,95
9	F_1 ssp.*purpurascens* x ssp.*mexicanum* var.*microcarpum palmerii*	10	0,0	100,0	0,0	-	-	-
10	F_2 ssp.*purpurascens* x ssp.*mexicanum* var.*microcarpum palmerii*	204	25	49,5	25,4	1:2:1	0,03	0,99-0,95
11	F_1 ssp.*mexicanum* var.*microcarpum palmerii* x ssp.*purpurascens* var.*el-salvador*	10	0,0	100,0	0,0	-	-	-
12	F_2 ssp.*mexicanum* var.*microcarpum palmerii* x ssp.*purpurascens* var.*el-salvador*	212	23,5	52,3	24,1	1:2:1	0,58	0,95-0,80

Table 1: Inheritance and variability of plate shape in intra- and inter-species hybrids F1, F2, F1B1.

In F_1, in all hybrid combinations, intermediate inheritance is observed for this trait, the studied hybrids were characterized by a palmately divided leaf shape.

In F2, inheritance according to the leaf shape also proceeded equally semi-dominantly, according to the monogenic type. The reason for this is that one of the parental forms had a palmately lobed, the other a palmately dissected leaf shape and, accordingly, in all the hybrid combinations studied, a splitting of phenotypic classes was revealed in a ratio of 1:2:1. 1 part of the plants had a palmate-lobular shape, 2 parts - palmately divided, 1 part - palmately dissected. F_1B_1 backcross progeny showed similar results (Figure 1, Table 1).

Thus, the results of studies of the inheritance of the form of leaf blades in the studied intra- and interspecific hybrids F_1, F_2 ssp.*mexicanum* var.*nervosum* (Victoria) x ssp.*mexicanum* var.*microcarpum palmerii*, ssp.*mexicanum* var.*microcarpum palmerii* x ssp.*purpurascens*, ssp.*purpurascens* x ssp.*mexicanum* var.*microcarpum palmerii*, ssp.*mexicanum* var.*microcarpum palmerii* x ssp.*purpurascens* var.*el-salvador* and F_1B_1 backcross (ssp.*mexicanum* var.*microcarpum palmerii* x ssp.*purpurascens* var.*el-salvador*) x ssp.*mexicanum* var.*microcarpum palmerii* showed an intermediate, semi-dominant inheritance of this trait. Our results are consistent with the literature data on the monogenic control of leaf shape inheritance [5].

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