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INHERITANCE OF HAIRINESS IN INTRASPECIFIC CROSSES IN COTTON (*GOSSYPIUM HIRSUTUM* L.)

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G. hirsutum L. crosses were analyzed to determine the inheritance pattern of hairiness of leaves. In all the crosses, the results indicated the involvement of two gene pairs for the genetic control of leaf hairiness. H_1^r gene confers hairs of sufficient length and density. It is completely dominant to h_1^r and in homozygous $H_1^r H_1^r$ or heterozygous $H_1^r h_1^r$ conditions produces medium hairy plants and it appeared to be carried by local varieties LSS, L 11, AC 134, AC 307 and Pak 51. H_2^a gene produces sparsely hairy plants. Additively to H_1^r it gives profusely hairy plants. It is completely dominant to h_2^a. The exotic type Acala 4-42 seems to carry H_2^a gene. Deltapine smooth leaf, an exotic variety appeared to possess $E_1^a E_1^a$ gene with an epistatic effect on H_2^a and no effect on H_1^r gene. There appeared certain intensifying or modifying genes also, which affect the density and length of hairs produced by major genes.

INTRODUCTION

Most of our existing commercial varieties are low yielding due to one reason or the other. With no further scope of increasing the area under the crop, ways and means have to be found to increase the yield per unit area. Before embarking upon an effective breeding programme information on the genetic mechanism of characters especially those affecting quality and quantity of the crop is of immense importance. Harland (1932) studied a cross between Barbadense (nearly glabrous) and Purpurascence (Hirsutum) and found F_1 nearly glabrous. In the F_2 both parental types reappeared, with a series of intermediates and also types much more hairy than the hairy parents. Knight (1952) has reported that the jassid resistance of Mu-8b, a hirsutum commercial type from India, was controlled by H_1 gene accompanied by hair length intensifiers. H_1 also provided the genetic basis for the resistance found in St. Ignatius, a variety of *G. hirsutum*. Knight and Sadd (1954) confirmed that the major

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hairiness genes in Kapas Purao, was allelic to H_1 and gave it the symbol H_1^k. They also showed that jassid resistance of Phillipines Ferguson (*G. hirsutum*) to be controlled by H_1^k and the results indicated that the resistance was largely dependent on minor genes (mainly intensifiers). Saunders (1961) concluded that the pubescence was a complex trait involving both major and minor genes. Only one major gene H_1 was found and its role as a key gene was confirmed. Ramey (1962) reported a gene Sm which appeared epistatic to H_2 and not to H_1 and it controlled the pubescence of plants. Muttuthumby *et al.* (1969) found that gene H_1^* and H_2^a played an important role in the genetic control of pubescence of leaves in intraspecific crosses of *G. hirsutum*. The major gene H_r^* induced hairs of sufficient length and density to confer resistance to the attack of *Empoasca* sp. in Pak 51, L 11 and AC 134, and was completely dominant to h_r^*. H_1^a allele additively to H_1^* gives profusely hairy plants. They further emphasised that presence of certain intensifying or modifying genes seemed to affect the density and length of hairs. The present studies were carried out to obtain preliminary information on the inheritance of hairiness in cotton so that effective breeding could be designed to achieve the desired targets of production.

MATERIALS AND METHODS

Six intraspecific crosses in the F_2 generation were available in the Department. Fresh crosses were also made to obtain F_1 seed of the very crosses in the green house in order to ascertain the character in F_1 generation. Half of the fresh crosses were grown in the green house and the remaining seed with F_3 generation in the field. Random selection was operated in F_2 generation and the following F_3 progenies were constituted.

S.No.	Cross	No. of Progenies
1.	LSS × Deltapine Smooth Leaf	88
2.	L 11 × Deltapine Smooth Leaf	120
3.	AC 134 × Deltapine Smooth Leaf	96
4.	AC 307 × Deltapine Smooth Leaf	110
5.	L 11 × Acala 4–42	28
6.	Pak 51 × Acala 4–42	42

Data pertaining to leaf hairiness were recorded by the following procedure. Leaves from main stem from six week aged plants were collected. The leaf position for the study was fixed at third node from apical leaf on main stem.

The counting of the hairs on the abaxial surface was done with the help of a dissecting microscope. The number of hairs on three main veins radiating from the axial spot of the leaf, visible in the field of view, was counted. Some of the hairs were found to be single while which emerged from a common origin and were in clusters, were also counted as single hairs. The average length of two or three hairs from a thin transverse section of a leaf was measured using compound microscope (× 100) and a micrometer. On the basis of measurement the lamina hairiness was grouped into four classes viz., profusely hairy, medium hairy, sparsely hairy and smooth. The data so collected were analysed and the genetic interpretation of inheritance data was confirmed by Chi-square test.

RESULTS AND DISCUSSION

The data pertaining to the development of leaf hairiness in F_2 populations as well as of the parents and F_1 progenies of different crosses are presented in Table 1 (a, b). The F_2 progenies for hairiness were grouped into four classes, namely, profusely hairy, medium hairy, sparsely hairy and smooth, depending upon the density and length of hairs. Some of the classes had to be pooled and treated as one group because of overlapping of classes. Based upon the pooled data of different classes, two types of ratios have been obtained in crosses under study. Table 1(a) shows a ratio of 12:4 for pooled profusely, medium and sparsely hairy combined and smooth, in F_2 of the crosses LSS × DPSL, L 11×DPSL, AC 134×DPSL and AC 307×DPSL. The 'P' values also showed a satisfactory fit to the expected 12:4 ratio. Table 1(b) shows a ratio of 9:6:1 for profusely hairy, medium and sparsely hairy combined and smooth classes, in crosses of L 11 Acala 4–42 and Pak 51 Acala 4–42. The 'P' values also show a satisfactory fit to the expected ratio of 9:6:1. From the data presented in Table 1(a, b) it is evident that two separate major genes control the hairiness in local and exotic varieties. The results find support from the previous findings of Harland (1932), Knight and Sadd (1953, 1954), and Saunders (1961) who reported that a single major gene conditioned hairiness in various varieties studied by them. The results are also in accordance with the findings of Muttuthamby *et al.* (1969) and the varieties involved in these studies have the same genetic constitution as illustrated by them. Varieties like AC 134, L 11, LSS, AC 307 and Pak 51 seem to carry H_1^{*} gene which induces medium type of hairiness. Gene H_1^{*} seems to be carried by Acala 4–42 which produces sparsely hairy plants. The results confirm the findings of Knight (1952), who reported that jassid resistance to Mu-8b, a hirsutum commercial type of India was due to H_1 gene accompanied by hair length intensifiers. Knight (1952)

Table 1 (a) *Genetic Analysis of Hairiness of Leaves in F_2 Generation of Various Crosses.*

Cross	Generation	Frequency Distribution: Profusely 1	Medium 2	Sparsely 3	Smooth 4	Total	Aggregated F_2 Frequencies: 1	2+3	4	Expected F_2 Freq. on 12:4 ratio		X^2	P
LSS × DPSL	P_1	—	10	—	—	10	—	—	—	—	—	—	—
	P_2	—	—	—	10	10	—	—	—	—	—	—	—
	F_1	—	10	—	—	10	—	—	—	—	—	—	—
	F_2	—	52	38	26	116	—	90	26	87.0	29.0	0.446	0.50
L 11 × DPSL	P_1	—	10	—	—	10	—	—	—	—	—	—	—
	P_2	—	—	—	10	10	—	—	—	—	—	—	—
	F_1	—	6	—	—	6	—	—	—	—	—	—	—
	F_2	—	70	63	40	173	—	133	40	129.75	43.25	0.325	0.60
AC 134 × DPSL	P_1	—	10	—	—	10	—	—	—	—	—	—	—
	P_2	—	—	—	10	10	—	—	—	—	—	—	—
	F_1	—	6	—	—	6	—	—	—	—	—	—	—
	F_2	—	69	53	42	164	—	122	42	123.0	41.0	0.0325	0.90-0.8
AC 307 × DPSL	P_1	—	10	—	—	10	—	—	—	—	—	—	—
	P_2	—	—	—	10	10	—	—	—	—	—	—	—
	F_1	—	8	—	—	8	—	—	—	—	—	—	—
	F_2	—	56	41	38	135	—	97	38	101.25	33.75	0.721	0.40

Table 1 (b) *Genetic analysis of hairiness of leaves in F_2 generation of various crosses.*

		Frequency Distribution					Aggregated F_2 Frequencies			Expected F_2 Freq. on 9:6:1 ratio.			X^2	P
		Profusely	Medium	Sparsely	Smooth	Total	1	2&3	4					
		1	2	3	4									
Pak 51 ×	P_1	—	10	—	—	10	—	—	—	—	—	—	—	—
Acala 4—42	P_2	—	—	10	—	10	—	—	—	—	—	—	—	—
	F_1	6	—	—	—	6	—	—	—	—	—	—	—	—
	F_2	41	11	15	4	71	41	26	4	39.96	26.64	4.44	0.085	0.97
L11 ×	P_1	—	10	—	—	10	—	—	—	—	—	—	—	—
Acala4—42	P_2	—	—	10	—	10	—	—	—	—	—	—	—	—
	F_1	10	—	—	—	10	—	—	—	—	—	—	—	—
	F_2	158	50	64	20	292	158	114	20	164.25	109.50	18.25	0.621	0.80

however, concluded that gene H_1 was transferred from *G. arboreum* to Sakel and that H_1 was key factor in the control of hairiness in cultivated new world cottons. Deltapine Smooth Leaf seems to possess a minor gene $E_1^{\blacktriangle}$ which differentiates it from other American varieties. This gene has been observed to exert epistatic effect on $H_2^{\blacktriangle}$ but displays no effect on $H_1^{\blacktriangledown}$. Ramey (1962) also observed that Sm gene had some epistatic effect on H_2 gene for reduced pubescence but not on H_1. The present investigations, however, do not agree with Harland (1932), in that he worked with hairy genes transferred from one species to the other; the non-agreement between the results is thus genuine. It has been observed during the present course of study that same variety and even the like genotype varied in length and density of hairs. This is most probably due to the interaction of some modifying or intensifying genes. These observations are in close confirmity with those of Knight (1952) and Sadd (1954).

On the basis of present investigations and discussion made in the light of previous work reported on relevant topics the most probable genetic constitution of the varieties under study could be as follows:

LSS, L 11, AC 134, AC 307, Pak 51	$H_1^{\blacktriangledown}$ $H_1^{\blacktriangledown}$ $h_2^{\blacktriangle}$ $h_2^{\blacktriangle}$ $e_1^{\blacktriangle}$ $e_1^{\blacktriangle}$
Acala 4–42	$h_1^{\blacktriangledown}$ $h_1^{\blacktriangledown}$ $H_2^{\blacktriangle}$ $H_2^{\blacktriangle}$ $e_1^{\blacktriangle}$ $e_1^{\blacktriangle}$
Deltapine Smooth leaf	$h_1^{\blacktriangledown}$ $h_1^{\blacktriangledown}$ $h_2^{\blacktriangle}$ $h_2^{\blacktriangle}$ $E_1^{\blacktriangle}$ $E_1^{\blacktriangle}$

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