Variability for Leaf Hairiness Pattern in *Gossypium* L. Species

SS Mehetre*, VL Gawande, AR Aher and VM Saitwal
All India Coordinated Cotton Improvement Project, MPKV, Rahuri-413722, Dist. Ahmednagar, Maharashtra

Different species in the genus *Gossypium* L. were found to have glabrous to densely hairy leaves with variation in type of hairs. These leaf hairs reported to correlated with jassid resistance in cotton. Variation in the morphology of leaf hair also contributes to the degree of resistance. In this context, sections from fully grown leaves were stained and observed under microscope. Variability of leaf hairiness pattern of wild species *viz.*, G. *anomalum, G. davidsonii, G. mustelinum, G. raimondii, G. thurberi and G, barbasonum* was compared with cultivated *G. arboreum* var,' Y-1', *G. herbaceum* var. GBHV-189 and *G. hirsutum* var. JLH-168. Leaves of *G. raimondii* had longest hair length on leaf lamina as well as on midrib also it had highest number of hairs per unit area and higher cross sectional midrib length and width. The findings indicated that *G. raimondii* is the most useful species in respect of all desirable hair attributes studied followed by *G. anomalum* and *G. barbasonum.*

Key Words: *Gossypium* spp., Hairiness, Variability

Apart from the degree of hairiness ranging from glabrous to a densely hairy plant body, there is variation in the type of hairs on the cotton plant. Youngman and Pande (1929) in their study of the epidermal outgrowths in the genera *Thespesia* and *Gossypium* describe two types of hairs, (i) the single hair – unicellular outgrowths and (ii) the stallet hair, which originates from tufts of several cells fused at their bases.

Apparent functions of trichomes are reviewed (Wagner *et al.*,2004) extensively leaf hairiness is associated with jassid resistance (Parnell *et al.*, 1949). Resistance to cotton leafhoppers in cotton has been found to be correlated with hairiness of the plant and particularly of the leaves. There has also been rather frequent evidence that not all hairy plants are resistant to jassids. This has been true in an early report from Africa (Parnell, 1925), in Queensland (Marriott, 1943), and particularly in India (Husain and Lal, 1940). Parnell *et al.* (1944) presented a diagram showing relationship between hair length, hair density per square millimeter and the number of nymphs per 10 leaves for 72 plants from the F_2 generation of crosses between U 4 (*G. hirsutum*) and *G. barbadense* (Sea Island and Egyptian) cotton was supported.

Jassids *Empoasca devastans* lays fewer eggs on resistant than susceptible cotton (Varma and Afzal, 1940). The fecundity of adult females is not affected by rearing the nymphs on resistant plants (Husain and Lal, 1940) but since the adult lays eggs over a period of several weeks the fecundity may be affected by their food while the eggs developing. Thus it is possible that antibiotic factors are involved in resistance of cotton to this insect. A screening of wild species against diseases and pests has indicated that there was differential response of wild species for sucking pests specially jassid resistance. Hence, it was thought necessary to study the pattern of leaf hairiness in cultivated as well as wild species of *Gossypium.*

Fully-grown leaves were selected in all the species for study. Leaf sections 10-15 μ were cut and stained with crystal violet and light green stain (Johanson, 1960) and observed under microscope. Ten observations were recorded from each leaf. Three leaves were studied and each leaf was treated as one replication. The data was subjected to statistical analysis (Panse and Sukhatme, 1965). Analysis of variance (Table 1) indicated that there were significant differences for all the parameters studied.

The hair length (μ/hair) in *G. raimondii* (Fig. 9 and 10) was longest 394.57 μ hair (Table 2) followed by *G. harbaceum* (297.26), *G. anomalum* (294.92) *G. davidsonii* (Fig. 7 and 8) (248.61), while *G. thurberi* (Fig. 12 and 13) and *G. hirsutum* (Fig. 11) were glabrous. Minimum distance (8.64) was found between two hairs in *G. raimondii* followed by *G. harbaceum* (111.97), *G. arboreum* (Fig. 1 and 2) (123.97), *G. mustelinum* (124.64) (Fig. 5 and 6). The hairs of *G. davidsonii* were distantly (534.53) located. Maximum number of branches/ spot were observed in *G. anomalum* (7.85) followed by *G. mustelinum* (5.45), *G. raimondii* (5.15), *G. barbasonum* (Fig. 3 and 4) (5.00), *G. raimondii* had highest number of hairs per unit area (53.50) followed by *G. barbasonum* (14.40), *G. arboreum* (8.20). Maximum cross sectional midrib length (955.09) was observed in *G. raimondii* followed by *G. harbaceum* (727.15) *G. hirsutum* (712.99),

* *For correspondence E-mail: subhashmehetre@rediffmail.com*

Table 1. Analysis of variance for seven different hair characters

Source of variation	Hair length (μ)		Distance between hair spots (μ)		Branches/spot		Hairs/unit area		Midrib length (μ)		Midrib width (μ)		Midrib hair length (μ)	
	d.f.	M.S.	d.f.	M.S.	d.f.	M.S.	d.f.	M.S.	d.f.	M.S.	d.f.	M.S.	d.f	M.S.
Replication	3	466.96	3	943.76	3	0.165	3	0.021	3	559.79	3	1169.77	3	859.26
Treatment	8	25858.78**	8	99423.88**	6	15.105**	5	1489.52**	10	64721.8**	10	51060.8**	4	171219.5**
Error	24	940.38	24	2800.20	18	0.251	15	1.787	30	901.26	30	1859.10	12	702.62

** Significant at 1 % level of significance

Table 2. *Per se* performance of different *Gossypium* species for seven hair characters

S.No.	Species	Hair length (μ)	Distance between hair (μ)	Branches/ spot	Hairs/ unit area	Midrib length (μ)	Midbrib width (μ)	Midrib hair length (μ)
1.	*G. anomalum*	294.92	365.24	7.85	3.72	601.85	537.86	452.56
2.	*G. davidsonii*	248.61	534.53	2.90	2.90	617.85	553.86	259.27
3.	*G. mustelinum*	223.95	124.64	5.45	—	591.85	588.53	—
4.	*G. raimondii*	394.57	108.64	5.15	53.50	955.09	873.78	698.51
5.	*G. thurberii*	—	—	—	—	560.70	604.35	—
6.	*G. barbasonum*	225.94	422.56	5.00	14.40	517.87	469.22	169.95
7.	*G. arboreum* Var. Y-1	233.28	123.97	—	8.20	486.55	439.89	—
8.	*G. hirsutum* Var JLH-168	—	-	—	—	712.99	660.17	303.422
9.	*G. herbaceum* GBHV-189	297.26	111.97	—	7.30	727.15	593.19	—
10.	*G. arboreum* Kudakutti	198.62	322.59	2.40	—	642.51	581.86	—
11.	*G. arboreum* Punaspatti	99.98	289.26	2.80	—	615.85	561.21	—

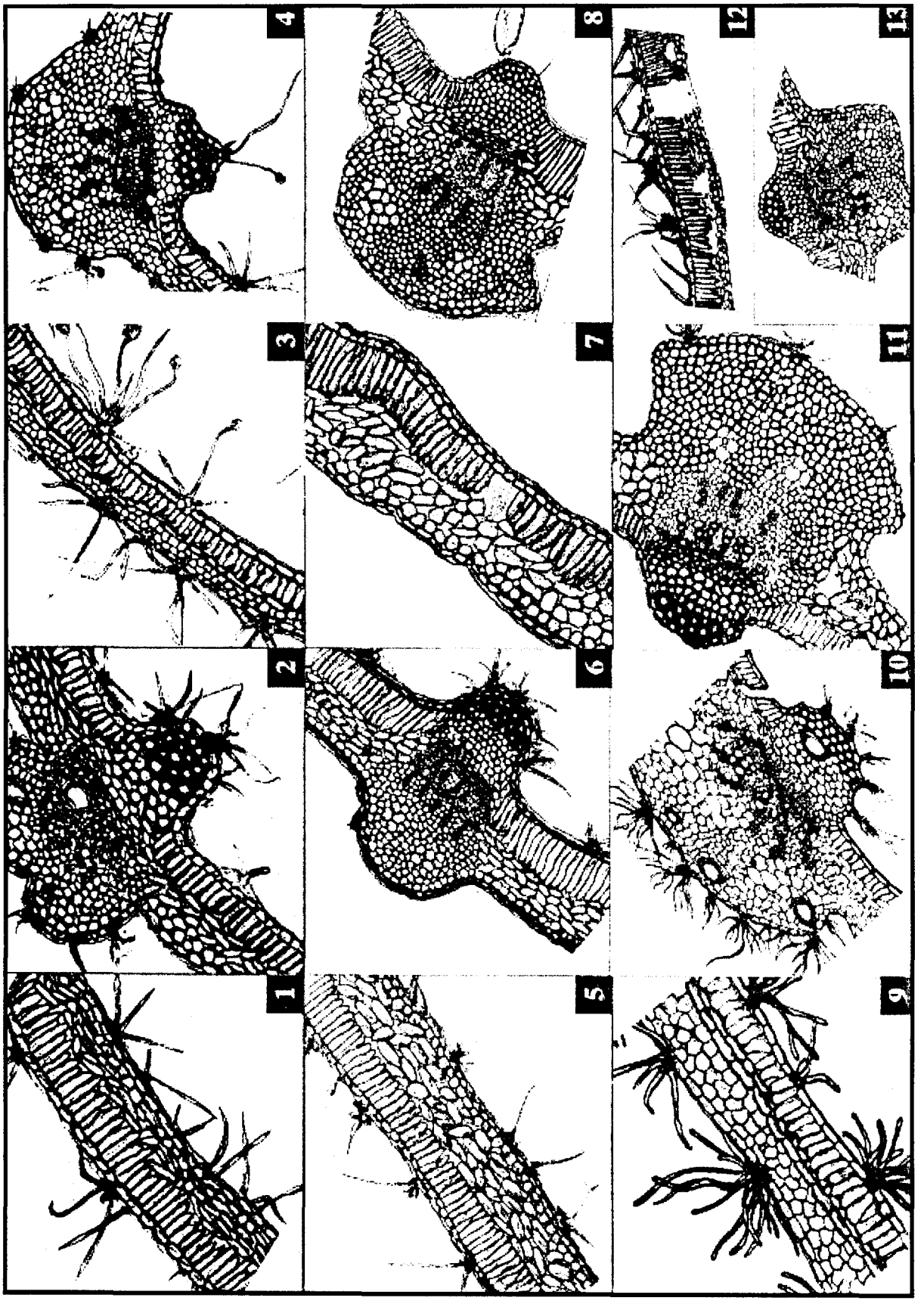
G. davidsonii (617.85), *G. anomalum* (601.85). Highest midrib width was noticed in *G. raimondii* (873.78) followed by *G. hirsutum* (660.17), *G. thurberi* (604.35), *G. harbaceum* (593.19), *G. mustelinum* (588.53). Of the eleven species studied, only five produced hair on the midrib with highest midrib hair length 698.51 in case of *G. raimondii* followed by *G. anomalum* (452.56), *G. hirsutum* (303.42), *G. davidsonii* (259.27) and *G. barbasonum* (169.95). The hairs on midrib (Stellate hairs) had more number of rays or branches per spot than observed on leaf blade in most of species, which had hairs on midrib. This confirms the earlier finding (Ramiah and Paranjape, 1944). Further, in case of *G. barbasonum,* certain hair terminals had swelling which was not observed in rest of the species studied.

Looking to the above results it appeared that *G. raimondii* is superior in respect of all desirable attributes hairs studied followed by *G. anomalum, G. barbasonum,* while *G. thurberi* was found to be completely glabrous, hence hold promise in transfer of this character to cultivated species for developing bollworm tolerance. Interspecific hybridization between *G. arboreum* x *G. anomalum, G. arboreum* x *G. thurberi, G. hirsutum* x *G. anomalum, G. hirsutum* x *G. raimondii, G. davidsonii* x *G. anomalum, G. herbaceum* x *G. anomalum* has been obtained. Thus, the introgression of hairiness for developing jassid resistant varieties of *G. hirsutum* and *G. arboreum* cotton can be planned through interspecific hybridization. While planning such programme, resistance to white fly, earliness and prolific boll bearing should also be given due importance. A microscopic examination of hairiness in a large number of cotton types both *arboreum* and *herbaceum* has shown that both the types of hair, single and stellate, are present in all the types but while the single hair is distributed all over the plant-body the stellate hair is mostly confined to the foliar organs, leaves, bracteoles and petals. The number of rays in the stellate hair varies from 2 to 12, the most common number being 8 for *arboreums* and 6 for the *herbaceums.* The length of the hair is generally found to be longer in the *herbaceum* than in the *arboreum* (Ramiah and Paranjape, 1944). The findings of present study are in line with the earlier reports.

As indicated by Zang *et al.* (2000) the variability observed for the pattern and development in the linted as well as lintless wild *Gossypium* spp will provide clues to understanding the molecular basis of fiber development in linted/ lintless species.

Acknowledgements

Authors are thankful to ICAR, New Delhi for sanctioning Technology Mission on Cotton, Mini Mission-I-MMA-6 Project entitled "Overcoming Incompatibility Barriers in Interspecific Hybridization" at Mahatma Phule Krishi Vidyapeeth, Rahuri-413722, Dist. Ahmednagar (Maharashtra).



Drawings of cross section of leaf and midrib, respectively in Fig. 1 and 2: *G. arboreum*; Fig. 3 and 4: *G. barbasonum*; Fig. 5 and 6: *G. mustelinum*; Fig. 7 and 8: *G. davidsonii*; Fig. 9 and 10: *G. raimondii*; Fig. 11: *G. hirsutum*; Fig. 12 and 13: *G. thurberii*

References

Husain MA and KB Lal (1940) The bionomics of *Empoasca devastans,* Distant on same varieties of cotton in the Punjab. *Indian J. Ent.* **2:** 123-136.

Johanson DA (1960) *Plant Microtechnique*, McGraw Hill, New York.

Marriott S (1943) Breeding jassid-resistant cotton varieties. *Qd. Agric. J.* **57:** 204-206.

Panse VG and PV Sukhatme (1965) *Statistical Methods for Agricultural Workers,* ICAR, New Delhi, pp-381.

Parnell FR (1925) The breeding of jassid resistant cottons. *Emp. Cott Gr. Rev.* **2:** 330-336.

Parnell FR, D MacDonald, DF Ruston and HE King (1944) Introductory note. Genetics and breeding, plant hairiness, hairiness and jassid resistance. *Empire Cotton Growing Corp. Rpts. Expt. Stas.* **1942-43:** 17-36.

Parnell FR, D MacDonald, DF Ruston and HE King (1945) Breeding and genetics. Leaf hairiness and jassid resistance. *Empire Cotton Growing Corp. Rpts. Expt. Stas.* **1943-44:** 23-24, 26-30.

Parnell FR, HE King, and DF Ruston (1949) Jassid resistance and hairiness of the cotton plant. *Bull. Ent. Res.* 539-575.

Ramiah K and VN Paranjape (1944) The occurrence and inheritance of a new type of hairiness in Asiatic cottons. *Curr. Sci.* **13:** 158-160.

Varma PM and M Afzal (1940) Studies on the cotton jassid (*Empoasca davastans* Distant) in the Punjab. I. Varietal susceptibility and development of the pest on different varieties of cotton. *Indian J. Agric. Sci.* **10:** 911-926.

Wagner GJ, E Wang and RE Shepherd (2004) New approaches for studying and exploiting an old protuberance, the plant trichome. *Ann Bot.* **93:** 3-11.

Youngman W and SS Pande (1929) Epidermal out growths of the genera *Thespesia* and *Gossypium. Ann. Bot.* **43:** 711.

Zhang JF, G Coyle and J McD Stewart (2000) A hairy anther mutant isolated in interspecific hybrid between upland cotton and pima cotton. Proceedings of the Cotton Research Meeting 2000, AAES Special Report 198. pp. 226-230.