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A Study on the Inter-relationship of Lint Quantity Genes in *G. arboreum* L.

by
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Introduction: The genetic basis of lint production in Asiatic cotton is extremely wide and is governed by a number of genes. Occurrence of lintless types in Asiatic cottons has made it possible to identify some of the genes responsible for lint production. So far, eight lintless mutants have been noted and their genetics studied. Hutchinson and Gadkhari (1937) recognised two types of behaviour which resulted in lintlessness. In the most extreme case, the whole hairiness mechanism of the plant is disturbed including production of lint hairs, resulting in glabrous lintless types. This is governed by two recessive genes h_a and h_b which are, however, complementary to each other for development of hairiness. In the second case, plant body hairs develop normally but the production of lint hairs is controlled. A number of recessive genes like li_a, li_b, li_d, li_e and li_f have been identified to be responsible for the hairy lintless types. Ramiah and Kaiwar (1942) from further studies in the genetics of lintlessness in Asiatic cotton, recognised a third type of behaviour which brings about a general reduction in the growth rate from flowering time onwards and the arrest of lint development happens to be one of the effects of this gene. The gene responsible for this pleotropic effect was found to express dominance. This was located *G. arboreum* race *bengalense* and was called the Punjab Hairy Lintless (Afzal and Hutchinson, 1933). The genetical relationship of this dominant mutant gene with other lintless mutants has been studied by Gadkhari (1950) and Krishnamurthy and Ramachandran (1964).

During a survey of Coconada Tract, a number of mutants affecting lint quantity and quality were located in the *indicum* race (Balasubramanian, *et al* 1946). CST-1 (Coconada Survey Type 1) is a short linted type governed by a recessive gene li_{sh} (Balasubramanian and Santhanam, 1952). CST-4 is an immature linted type governed by a recessive gene l_m (Balasubramanian *et al* 1950). A sparse linted mutant, 1711, is governed by a recessive gene li_{sp} (Balasubramanian and Santhanam, 1950). A study on the genetical relationship of these three mutant types with the Punjab Hairy Lintless type was taken up and the results are presented in this paper.

Material and Methods: From the collection of economic types and mutant forms maintained at the Cotton Breeding Station, Coimbatore, the short linted CST-1, immature linted CST-4, sparse linted 1711 and Lintless

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Downy (homozygous form of Punjab Hairy Lintless) besides K 2, a normal linted type, formed the material for this study. A short description, indicating the important characters in which these types differ, is given in Table 1

TABLE 1. *Parents, their characters and their Gene symbols*

Parents		Fibre characters			Distinct character	Gene symbols
Types	Origin	Mean halo length (mm)	Ginning %	Lint Index (g)		
CST-1	*G arboreum* race *indicum*	less than 10	6-9	0.4-0.6	Short lint	li_{sh}*
CST-4	— do —	15	5-9	0.3-0.4	Immature fibre	l_m*
1711	— do —	10-15	3-4	less than 0.2	Sparse lint	li_{sp}*
K. 2	Inter racical derivative of *indicum*×*cernuum*	23-25	31-32	3.0-3.5	Normal lint	
Lintless Downy	*G.arboreum* race *indicum*	—	—	—	Lintless	li_e @

* Balasubramaniam *et al* (1952, 1950a and 1950b)
@Hutchinson and Gadkari (1937)

Observations were made on F_1s, F_2s and the test cross progeny of the following combinations:

i) CST-1×Lintless Downy, ii) CST-4×Lintless Downy, iii) 1711×Lintless Downy and iv) K.2×Lintless Downy. Reciprocal crosses were also made. The test crosses were effected with both the parents and studied. The segregants were classified into phenotypic groups by visual observations and from the study of their fibre characters like halo length, ginning per cent and lint indices as indicated by Kalyanaraman *et al* (1956).

Results: The different classes of segregants in each of the combinations and the X^2 values on the expected ratios are presented in Table 2. In F_1s all of them were fuzzy lintless.

In the F_2s, the CST-1×Lintless Downy gave a 13:3:48 ratio for normal, short and lintless. CST-4×Lintless Downy gave a similar ratio of 13:3:48 for normal, immature and lintless types. The 1711×Lintless Downy combinations segregated into linted, sparse and lintless types in the ratio of 15:1:48. The normal linted K. 2 was found to be a simple recessive to the Lintless Downy giving a 1:3 ratio for linted and lintless types. The reciprocals also behaved in a similar manner.

Backcross progenies with the recessive parents gave a 1 : 1 : 2 for linted, short and lintless, a 1 : 1 : 2 ratio for linted, immature lint and lintless, a 3 : 4 : 1 for linted, lintless and sparse and a 1 : 1 ratio for linted and lintless, respectively for the short. immature, sparse and linted combinations.

TABLE 2. *Class of Segregants*

Combinations	Class of segregants			Expected ratio	X^2 value	P between
I. Crosses with Short lint						
	Linted	Short	Lintless			
CST-1×LLD-12	11	1	38	13:3:48	0.805	0.70–0.50
CST-1×LLD-13	11	1	46	— do —	1.268	0.70–0.50
CST-1×LLD-14	29	8	96	— do —	0.816	0.70–0.50
CST-1×LLD-15	17	8	78	— do —	2.867	0.30–0.20
CST-1×LLD-18	33	5	119	— do —	1.171	0.70–0.50
Total for family	101	23	377	— do —	0.035	0.98–0.95
LLD×CST-1	9	1	24	— do —	0.952	0.70–0.50
LLD(CST-1×LLD)	—	—	56	—	—	—
CST-1 (CST-1×LLD)	23	17	46	1:1:2	1.256	0.70–0.50
II. Crosses with immature lint						
	Linted	Immature	Lintless			
CST-4×LLD-29	14	4	57	13:3:48	0.174	0.95–0.90
CST-4×LLD-30	39	3	103	— do —	5.482	0.10–0.05
Total for family	53	7	160	— do —	2.750	0.30–0.20
LLD (CST-4×LLD)	—	—	43	—	—	—
CST-4 (CST-4×LLD)	16	14	25	1:1:2	0.581	0.80–0.70
III. Crosses with sparse lint						
	Linted	Sparse	Lintless			
1711×LLD	28	2	72	15:1:48	0.829	0.70–0.50
LLD×1711	27	1	84	— do —	0.380	0.90–0.80
LLD (1711×LLD)	—	—	61	—	—	—
1711 (1711×LLD)	18	5	29	3:1:4	0.807	0.70–0.50
IV. Crosses with normal lint						
	Linted		Lintless			
LLD×K. 2	79		198	1:3	1.811	0.10–0.05
K. 2×LLD	12		36	— do —	—	—
LLD (K. 2×LLD)	—		42	—	—	—
K. 2 (K 2×LLD)	26		30	1:1	0.286	0.70–0.50

Note: i) The lintless class contained both downy and fuzzy lintless seeds.

ii) LLD—Lintless Downy.

All backcrosses to the Lintless Downy gave only lintless types. The observed frequencies gave a good fit on the basis of assumed ratios.

Discussion: The Genetics of Punjab Hairy Lintless mutant was of considerable interest as it was found to be dominant mutant unlike other lintless mutants which were recessives (Afzal and Hutchinson, 1933). Gadkhari (1950) from his further studies on this lintless type reported that in F_2s of the various crosses which happened to be both inter-racial and inter-specific, there was significant excess of the hairy linted segregants over the ratio expected on the basis of the simple gene segregation. Crosses with other lintless types gave a 13:51 ratio for linted and lintless types instead of a 3:13 ratio. This alteration in the ratio was attributed by him to the play of a member of the gene complex responsible for lint quantity behaving as modifier of the other hairy lintless types involved in the crosses. Silow (1939a) had established the presence of such lint quantity genes in Asiatic cottons by establishing a linted $h_a h_a$ line (glabrous linted type). Krishnamurthy and Ramachandran (1964) using the Punjab Hairy Lintless (Lintless Downy) in their crosses with some other lintless types arrived at the segregation ratio of 13:51 ratio for linted and lintless types as indicated by Gadkhari (1950). In the present study the types used are distinguishable from lintless types and as such, the ratio that is expected on similar basis of supression due to the gene responsible for lintlessness in Lintless Downy will be 12:3:1 for lintless, linted and the respective mutant types. The results presented in Table 2 shows an excess of linted forms. This is possible if the assumption of the modifier action of the lint quantity genes as indicated by Gadkhari (1950) is extended to these cases also as with other lintless types. Here also, the homozygous form of the lint quantity genes appears to modify the expression of the genes li_{sh} and l_m. But in the case of li_{sp}, even heterozygous form of the lint quantity gene appears to act as modifier resulting in the 48:15:1 ratio for lintless, linted and sparse. This assumption is supported by the backcross ratio which is different with 1711. While it is 1:1:2 for linted, short or immature and lintless forms with CST-1 and CST-4 backcrosses, it is a modified ratio of 3:4:1 for linted lintless and sparse, the heterozygous forms of lint quantity genes acting as modifiers in backcrosses to 1711. Thus, the magnitude of modifier action of the lint quantity genes appear to vary in the presence of different genes. This confirms the "Theory of Gene Interaction" postulated by Silow (1939b). According to him, the degree of dominance of a gene is a direct function of the magnitude of its effect. This magnitude of effect of a given quantity gene is again dependent upon the portion of the range of variation in which it is working. The distinction in the degree of dominance is thus, a direct result of differences in potency of the genes. A gene of low magnitude of effect will not appreciably alter the range in which a second dose of the same gene will act. But, if the magnitude of effect of the gene is higher than the other gene, even the first dose (heterozygote) gives full saturation of character expression resulting in complete dominance.

The magnitude of effect of the lint quantity genes appear to be low in the presence of either li_{sh} or l_m and requires a second dose of the genes, that is homozygosity, to express dominance over them. Whereas, even the heterozygous forms are potent enough to express dominance over the gene li_{sp}. Apparently, the magnitude of effect of the genes li_{sh} and l_m is higher than li_{sp} in relation to the lint quantity genes. But the magnitude of effect of lint quantity genes in homozygous condition is higher than li_{sh} and l_m though in heterozygous condition its effect on these genes are lower. On the other hand, even in heterozygous condition its effect is felt in the case of 1711. In any case, it appears to alter or effect the expression of all the three genes and counteracts their adverse effect in the production of lint of normal length, normal maturity and normal density.

Summary: The genetic relationship between the mutants like short lint, immature lint and sparse lint with the Lintless Downy spotted in *G. arboreum* L has been studied and the results discussed. Supporting evidence is furnished for the suppression effect on lint production by a dominant allele in the Lintless Downy. The F_2 segregation in crosses of short linted mutant and the immature mutant with the Lintless Downy was 48 : 13 : 3 for lintless, linted and short. In the case of sparse linted 1711, the segregation is found to be 48 : 15 : 1 for lintless, linted and sparse. Differential modifier action of a gene complex for lint quantity is attributed to the differential ratios obtained. The differential effect of the lint quantity genes is explained as due to the magnitude of effect in relation to other genes involved. A possible function of the gene complex for lint quantity in counteracting the adverse effects of some of the major genes in the production of lint of normal length, normal maturity and normal density is also indicated.

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A Preliminary Account of Pests of Apple in Madras

by

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In recent years, apple cultivation is getting an impetus on the Nilgiris and Kodaikanal hills in Madras. A number of pests have been noted attacking the apple and an account of them is given in this paper.

Literature on pests of apple in Europe and America is too voluminous to be cited. Misra (1919) lists about three dozen insects on apple in North India, some of the important ones being *Lymantria obfuscata* Wlk., *Euproctis* spp., *Belippa laleana* Mo., *Laspeyresia pomonella* L. and *Myllocerus 11. pustulata* Fst., Fletcher (1919) mentions *Lithocolletis gonodes* Meyr. as occurring on apple at Parachinar. Pruthi and Batra (1938) mention SanJose scale, *Quadraspidiotus perniciosus* C., the woolly aphis, *Eriosoma lanigera* H ; the codling moth, *Cydia (Laspeyresia) pomonella* L. and a few other pests occurring on the

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