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THE INHERITANCE OF BASAL FEATHERED STIGMAS (AND BASAL BARBED SUBULES) IN SORGHUM*

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In three previous papers [1-3] many evidences were adduced proving the homology between stigmas and awns in sorghum. In the third paper the occurrence of basal feathered stigmas was recorded and also the fact that along with such occurrence and the presence of awns, the barbs of the subular portion of the awn were also basal in occurrence.

The stigmas in sorghum are generally fully feathery (Fig. 1.). The length and disposition of the feathers may vary between varieties[4]. The experience in the suppression of the feathers in the top portion of the usually feathery area of the stigma was met with in 26 sorghum varieties from Central and East Africa, i.e., N. Rhodesia, Nyasaland, Tanganyika and Kenya territories. These sorghums belong chiefly to the groups *S. conspicuum* Snowden and *S. Roxburghii* Stapf, groups characterised by gaping glumes. In these varieties the stigmatic portion is feathery at the base only with a bare cylindrical projection at the top (Fig. 2). The length of the feathery area varies from one-third to two-thirds the length of the stigma and is constant within the variety. To the naked eye, the non-feathery portion of the stigma appears smooth. Under the microscope, there are seen incipient projections, connoting suppressed feathers (Fig 4.). Stray feathery outgrowths can occasionally be seen in this otherwise smooth looking area. This peculiar kind of stigma is constant in its occurrence in the varieties mentioned above and to our knowledge the first experience of its kind in the Gramineae. The setting of the seed is normal in spite of the restricted feathery area in the stigmas.

Of the 26 varieties in which basal feathered stigmas occur, 24 were awnless and two long awned (9—11 mm.). In these long awned varieties, parallel to the basal feathers of the stigma, the subule of the awn, was barbed at its base only (Fig. 6). In one of these long awned varieties, there occurred a natural cross with normal (fully feathered) stigmas. This cross had short awns 2—4 mm. in length. When sown next year, this selection (A. S. 4971) segregated and gave plants with 81 normal and 27 basal feathered stigmas in the second generation. The family segregated for awns

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also giving 81 short awns (0·5 - 5 mm.) and 27 long awns (9 - 13 mm.). Cross-collated, the figures were as follows: -

Family No. A. S. 4971.

	Short awn.		Long awn	
Stigma—	Fully feathered	Basal feathered	Fully feathered	Basal feathered
	60	21	21	6

In the short awn group, the length of the awn at the longer end though separable into column and subule, does not give enough subular area for a clear pursuit of the distribution of the barbs in that area. Even with this difficulty, when the awn is long enough, it is noticed that when the stigmas are basal feathered, the bases alone of the subules are barbed. In the long awn group, all the 21 plants with normal stigmas were barbed the entire length of the subule (Fig. 5.) and the six plants that had the basal feathered stigmas had barbs only at the base of the subules of their awns (Fig. 6.). In a second family A. S. 4961, raised from another natural cross from a nil-awn family, a similar di-hybrid ratio was obtained, the numbers being 43, 16, 15 and 3.

From the family A. S. 4971, four selections with long awns and fully feathered stigmas were carried forward and a third generation raised. Of these, one bred true and three segregated giving a total of 153 plants with normal stigmas and fully barbed subules and 52 with basal feathered stigmas and basal barbed subules.

Crosses between normal (fully feathered) and basal feathered stigma selections resulted in the F_1 with fully feathered stigmas. Two of the F_1 selections were carried forward to a second generation. These segregated and gave a total of 282 plants with fully feathered and 79 with basal feathered stigmas. The barbs of the subular portion of the awn were inherited in a parallel way to the feathers of the stigma. When the stigma was fully feathered, the subule was fully barbed and when the stigma was basal feathered, the subule was basal barbed.

In four other families which were awnless, simple monogenic segregations have been obtained for normal and basal feathered stigmas, the total figures being 253 normal and 87 basal feathered.

A gene designated St_{bf}, Central and Eastern African in origin, seems to be responsible for the suppression of feathers in about the top two-thirds of the stigmas. This peculiar characteristic has proved a simple recessive to the fully feathered condition of the stigma whose genetic constitution is St_{Bf}.

This genic pair St_{Bf} St_{bf} seems to be independent of the sheath colour factors **P** and **Q**, as the following two tables will show (Tables I and II).

TABLE I. Segregating for St_{Bf} and Q.

Selection No.	Stigma Sheath	Fully feathered St_{Bf} Reddish Purple Q	Fully feathered St_{Bf} Blackish Purple q	Basal feathered St_{bf} Reddish Purple Q	Basal feathered St_{bf} Blackish Purple q
A. S. 4961		42	16	16	3
,, 4968		41	14	15	6
,, 4969		32	10	10	4
,, 4971		61	20	22	5
	Total	176	60	63	18
Expected ratio 9:3:3:1		178·30	59·45	59·45	19·80
		$X^2 = 417$	$P > 93$		

TABLE II. Segregating for St_{Bf}, P and Q.

Selection No.	Stigma Sheath	Fully feathered St_{Bf} Purple P Reddish. Q	Fully feathered St_{Bf} Blackish. q	Fully feathered St_{Bf} Brown p	Basal feathered St_{bf} Purple P Reddish. Q	Basal feathered St_{bf} Blackish. q	Basal feathered St_{bf} Brown p
A. S. 4972		51	21	25	21	6	7
Expected ratio 27:9:12:9:3:4		54·40	18·15	24·20	18·15	6·05	8·05
		$X^2 = 1·277$	$P > 93$.				

In the experiences so far met with, it has been noticed that this St_{Bf} gene is also independent of the grain colour factors B_1, B_2 and **W** as the following tables III, IV and V will show.

TABLE III. Segregating for St_{Bf} and one of the B factors

Selection No.	Stigma Grain	Fully feathered St_{Bf} Brown	Fully feathered St_{Bf} White	Basal feathered St_{bf} Brown	Basal feathered St_{bf} White
A. S. 4972	73	24		25	9
Expected ratio 9:3:3:1	73·70	24·55		24·55	8·2
	$X^2 = 105$	$P > 99$			

TABLE IV. Segregating for St_{Bf}, B_1 and B_2.

Selection No.	Stigma Grain	Fully feathered St_{Bf} Brown	Fully feathered St_{Bf} White	Basal feathered St_{bf} Brown	Basal feathered St_{bf} White
A. S. 4971		43	38	15	12
Expected ratio 27:21:9:7		45·60	35·40	15·20	11·80
		$X^2 = 346$	$P > 95$		

TABLE V. Segregating for St_{Bf} and W.

Selection No.	Stigma / Grain	Fully feathered St_{Bf} Pink W	Fully feathered St_{Bf} White w	Basal feathered St_{bf} Pink W	Basal feathered St_{bf} White w
A. S. 4961		42	16	14	5
Expected ratio 9:3:3:1		43·30	14·45	14·45	4·80
		$X^2 = 238$	P > ·96		

Summary. A gene St_{Bf}, Central and Eastern African in origin is responsible for the stigmas being fully feathered in sorghum. St_{bf} results in stigmas whose bases alone are feathered, leaving the top one-third to two-thirds of the feathery area devoid of feathers and simply columnar. This restricted feathering has not affected seed setting and has been noted to occur in varieties with gaping glumes. St_{Bf} is a simple dominant to St_{bf}. In awned varieties this differentiation in the feathery area shows a parallel effect in the homologous organ, i. e., the subule of the awn. When the stigma is fully feathered, the subule is fully barbed and when the stigma is basal feathered, the subule is basal barbed. The St_{Bf} - St_{bf} factor pair behaves in inheritance independent of the sheath colour factors **P** and **Q** and of the grain colour factors B_1, B_2 and **W**.

This is the first record of a restricted feathered occurrence of stigma in Gramineae. This kind of stigma is a varietal characteristic and is Mendelian in inheritance.

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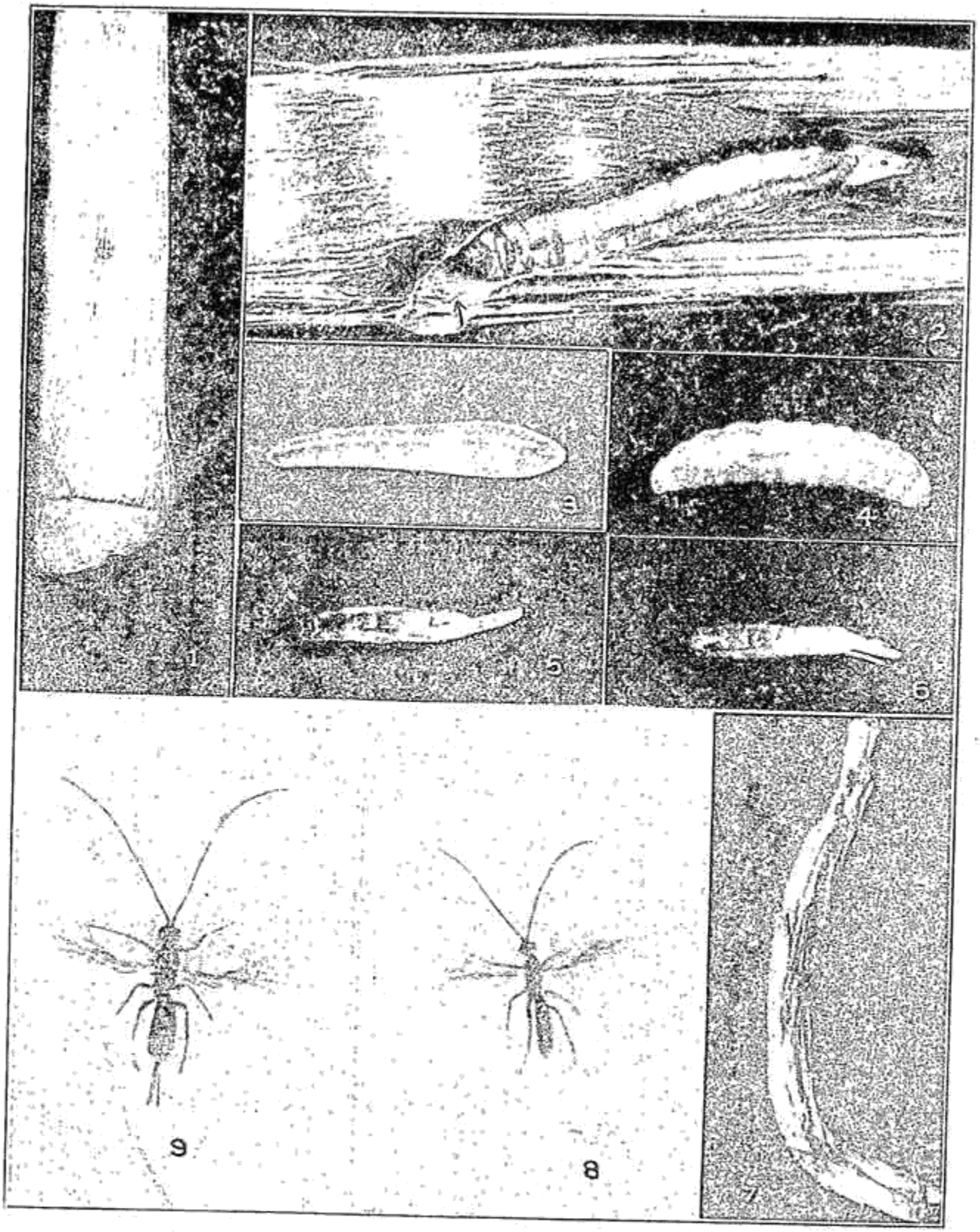

1. A stem attacked by *Scirpophaga* showing the plug.
2. A parasitised caterpillar with a cluster of eggs in *situ*.
3. Egg—magnified.
4. Grub - full grown.
5. Pupa—dorsal view.
6. Pupa—ventral view.
7. Cocoon spindle.
8. Adult—Male.
9. Adult—Female.