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Sorghum, Spikelet—Awn Relationships and Inheritance

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The classification of sorghum is based primarily on the characters of the sessile spikelets, because they are less likely to have been modified in the evolution of the various cultivated species from their wild ancestors. The spikelets of sorghum may be awned or awnless. The awn is prominent in wild sorghum, in which it can be as long as 40 mm. In cultivated sorghum, however, the awn is much shorter, the longest being about 15 mm. Most of the wild sorghums possess awns; in the cultivated races both awned and awnless conditions prevail. The presence or absence of awn and the gradations in its length when present, are governed by genic factors. Given the full complement of factors determining maximum expression of length, it can be said in general terms, the bigger the spikelet the longer the awn tends to be. Among the wild sorghums that have so far been examined at the Millets Breeding Station, Coimbatore, this relationship was borne out.

Wild sorghums

Species.	Size of flowering spikelets in mm.	Awn length in mm.
Sorghum sudanense, Stapf	5·0 × 2·5	7 - 9
S. arundinaceum, Stapf	6·0 × 2·5	9 – 11
S. virgatum, Stapf	6·0 × 2·5	11 – 13
S. versicolor, J. N. Anderss	6·5 × 2·5	30 – 35
S. dimidiatum, Stapf	7·0 × 2·5	32 – 37
S. purpureo-sericeum, Aschers et Schw	8·0 × 3·0	35 – 40

Among the cultivated races of sorghum, owing to constant inter-crossing and continued selection, this relation between the spikelet size and awn length was disturbed with the result that in the highly developed grain sorghum groups, numerous blends of spikelet-awn length combinations are met with. This disturbance was least in *S. coriaceum*, Snowden, an African group with markedly coriaceous glumes and prominent awns, in which the relationship is maintained.

***Sorghum coriaceum*, Snowden.**

Selection No.	Name of variety.	Place.	Size of spikelets mm.	Length of awn	
				Average mm.	Range mm.
A. S. 4165	Nsonte	N. Rhodesia	8·0 × 4·5	14	13 – 15
„ 4203	Plot 69/1931 Masabuka Experiment Station	„	6·0 × 4·0	12	11 – 13
„ 4149	Munkokwe	„	6·0 × 4·0	11	10 – 12
„ 3445	Zibaiba	„	5·5 × 3·5	10	9 – 11
„ 4132	Luano	„	5·5 × 3·5	10	9 – 11
„ 4135	Masaka Luwemba	„	5·5 × 3·5	10	9 – 11
„ 4160	Shamba	„	5·0 × 3·0	8	7 – 9
„ 4161	Chibolwe	„	5·0 × 3·0	8	7 – 9

Describing the *S. coriaceum* group Snowden says, "Little is known as to its origin; but the strongly coriaceous glumes and the frequent occurrence of long strong awns suggest that it may have arisen through the inter-crossing of indigenous wild species with a cultivated race such as *S. caffrorum*, Beauv." (Snowden, J. D., 1936. The Cultivated Races of Sorghum", Pp. 126 – 27) Hence it is probable that *S. coriaceum* by virtue of its closer affinity to wild sorghums, is showing this ancient *spikelet-awn* trend graphically.

The size of the well developed flowering spikelets within a pure breeding line and within a panicle is constant, there being practically no variation. The length of the awn is fairly constant within a pure breeding line. Within a panicle there is a small variation in the length, those towards the top of the panicle tending to be a little longer than those below. This varies from 0·5 mm. to 2·55 mm. in cultivated sorghum and up to 5·0 mm. in the wild ones, depending upon the length of the awn, the longer awns showing greater variation. The awns at about the middle of the panicle may be taken to represent roughly the average length.

A. S. 4163 is a selection of *S. caffrorum*, Beauv. from North Rhodesia, Africa. This has ovate spikelets measuring 4·0 × 3·0 mm. with awns 4 mm. in length. In this family a natural cross with spikelets ovate in shape measuring 4·5 × 3·2 mm. with awns 6 mm. long was noted. The characters of this F_1. and the behaviour of the progeny in the F_2. and subsequent generations indicated that the pollen parent must have belonged to the group *S. coriaceum*, Snowden. This selection segregated in the F_2. generation for spikelet shape and size and awn length. The following are the character pairs that segregated.

Character.	Dominant.	Recessive.
Spikelet shape	Ovate	Elliptic
Spikelet size	Length 4·5 mm. Breadth 3·2 mm. { Range L. 4·0 to 5·0 mm. } { ,, B. 3·0 to 3·5 mm. }	Length 7·0 mm. Breadth 4·5 mm.
Awn length	6·0 mm. (Range L. 4·0 to 8·0 mm.)	11·0 mm.

The character group ovate, smaller spikelets and shorter awns went together. The bigger elliptic spikelets with longer awns also went together. The segregration was for these two groups, viz., 81 of the former and 31 of the latter. From this segregating family, 10 selections consisting of 7 with small ovate spikelets and short awns and 3 with large elliptic spikelets and long awns were carried forward and an F_3. generation raised. Of the 7 selections with short ovate glumes and short awns, 3 bred pure and 4 segregated again giving a total of 303 plants with small ovate spikelets with short awns and 99 plants with bigger elliptic spikelets with long awns. The 3 large elliptic spikelet selections with long awns bred pure. There was the inevitable accentuated fluctuation and the consequent wider range in the size of spikelets and length of awns in the dominant group, especially with a 2/3 heterozygous population.

Concurrent with the segregation for spikelet size, the stigma and anther sizes also varied. The smaller spikelets had smaller stigmas (4·0 mm.) and smaller anthers (2·5 mm.) and the bigger spikelets had bigger stigmas (6·0 mm) and bigger anthers (3·5 mm). Even the size of the lodicules responded likewise.

Summary. In sorghum it could be stated in general terms that awns, when present (in whatever strength of expression) increase in length and keep pace roughly to spikelet size. In Mendelian segregations small ovate glumes with short awns have proved a monogenic dominant to big elliptic spikelets with long awns. The stigma, anther and lodicules kept pace with spikelet size.

SELECTED ARTICLE

Nutrition and Agriculture

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If human beings are to be properly nourished they must have enough food to eat and the right kind of food to eat. In India we are faced with the problems of obtaining enough food for the people and the right kind of food. The former takes precedence over the latter. A considerable part of the population is underfed in the quantitative sense—as the nutrition workers say, food intake falls short of calorie requirements. What proportion lacks sufficient food we do not exactly know, but recent dietary investigations suggest that it is no small one. In some parts of the country the danger of famine is always imminent.

Enough Food. It follows that the *principal* aim of agriculture must be to increase production of *all kinds of food*. It is essential, as we shall see, that the quality of diets should be improved, but in attempting to achieve something in this direction we should never lose sight of the primary need for more food. At present this must be produced in the country itself, because India cannot afford to import food in large quantities. All activities which will increase food production are therefore of the utmost importance. The development of fisheries, the extension of irrigation, the use of efficient manuring methods, the introduction of improved or high-yielding strains of common food crops—all come under this head. The value of the last may be particularly emphasized. Improved strains may give a yield from 10 to 30 times in excess of those they replace. in the Madras presidency in 1937, 1·78 million acres were under improved varieties of rice, representing about 18 per cent of the total area under rice; while in the Punjab 4·26 million acres were sown with similar varieties of wheat, which amounts to nearly half the total acreage under wheat in that province. This represents an achievement on which agricultural research institutes and departments are to be congratulated.

One of the advantages of increasing the production per acre of staple food grains is that it releases land for the production of other kinds of food. India is a densely populated country, and at present most of the good land must be used to grow cereal crops. Otherwise there would not be enough food to go round. Land so cultivated gives a higher return of solid food than land used, let us say, for producing fruit, vegetables or milk.

The right kind of food. The chief defect of Indian diets, on the qualitative side, is that they contain too much grain and too little else. Diets of this kind