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NEW GENES FOR AWNING IN SORGHUM (*Sorghum bicolor* (L.) MOENCH)*

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The inheritance of awning in *Sorghum bicolor* (L.) Moench) was studied in six cross combinations viz., 148 x M35-1, BJ105 x IS3691, SB1066 x IS873, SB1066 x IS1202, IS8744 x IS887 and IS8744 x IS1134. Monogenic to trigenic F_2 ratios were realised. The gene action involved is discussed.

Awn is a filiform extension of varying length from the keel of the lemma. Some sorghum varieties have extremely long awns, others are awnless and some other types show varying degrees of awn expression. Awns are not desirable, as they cause discomfort in harvesting. This is the case, where machine harvesting is done, while in countries like India, awns are not undesirable. Many species of birds feed on developing grains of sorghum. Each continent has its own bird problem against which various means have been devised. Long glumes and large awns tend to discoorage birds from eating the grains. In this context the study of the inheritance of this characters is important and the present investigation is an attempt towards it.

MATERIAL AND METHODS

Ten parents originating from India, U.S.A. and South Africa were made use of in hybridization. The crosses were effected in the Kharif season of 1978. The material was carried forward until the F_3 generation. The F_2 ratio was postulated based on the segregation pattern. However, the approprite ratio was fitted in after studying the F_3 populations. The number of F_3 progenies grown in various crosses varied from 70-90 (Table 3). The plants were classed as two phenotypic classes-awned (An)or awn less (Al).

RESULTS AND DISCUSSION

Table II depicts the phenotypes of the parents, F_1s and F_2 segregation. In the crosses, 148xM35-1, BJ105 x IS 3691 and IS 8744 x IS 1134, one pair of genes governed the inheritance of awning. For the crosses, SB 1066 x IS 873 and IS8744 x IS887, digenic F_2 ratios were fitted in. The F_2 population of the cross, SB1066 x IS1202, gave a good fit for the trihybrid ratio of 45:19.

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Contrasting reports are available regarding the inheritance of this character, especially so on the nature of dominance. Vinall and Cron (1921) reported that awnless condition was dominant to awned condition. In crosses between awnless and long awned parents, the awnless condition was completely dominant and in crosses between awnles x tip awned genotypes the F_1 was awnless (Sieglinger *et al.*, 1934). Jayaramaiah and Goud (1982) also found that awnlessness was dominant over the awned condition. The existence of the awned condition was found to be dominant by Ramanathan (1924), Laubscher (1945), Webster (1965) and Ghawghawe *et al.* (1966). Appadurai (1967) obtained F_2 ratios of both 3 (awned): 1 (awnless) and 3 (awnless) : 1 (awned) in the material studied by him. Kullaiswamy and Goud (1980) obtained a tetragenic ratio of 111 (awned): 145 (awnless). According to them awned coodition is controlled by a dominant gene A and in the presence of three inhibitory complimentary factors, awnlessness results. Gene symbols earlier adopted are A (Vinall and Cron, 1921) at (Seiglinger *et al*, (1934) and A; 1-A_1; 1-A_2 and 1-A_3 (Kullaiswamy and Goud, 1980)

The results obtained in the present study (crosses 148 x M 35-1 and BJ 105 x IS 3691) are in agreement with those of previous investigators indicating thereby the similarity of these genotypes as regards the transmission of awned trait with those handled by earlier workers.

The segregation ratios obtained in crosses 3 to 6 (Table 2) can be explained as follows. Awned condition is due to the presence of one basic complimentary gene designated as *An*, which compliment with one of the other two inhibitory comlimentary genes (An_1, An_2). In the presence of two inhibitory complimentary genes (I-An_a, I-An_b), the effect of the basic complimentary gene and its modifying complex is nullified, the result being the absence of awns. Although five pairs of genes are involved in the inheritance of awning (Table-4), only monogenic (1:3), digenic (9:7 and 7:9) and trigenic (45:19) F_2 ratios were realised because of the existence of these factors in different combinations of the parental genotypes.

In the light of the results obtained in the present study it may be concluded that the genes responsible for the dominant awned and dominant awnlessness appear to be separate and distinct. The complete gene situations determining the presence or absence of awn (An, An_1, An_2, I-An_a I-An_b) in some of the genotypes handled in the present investigation are brought to light. Such a system of separate gene complexes and different dominance mechanisms may be endowed in the genetic diversity of Eu sorghums (Appadurai, 1967 and Harland. 1934).

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TABLE-I Pedigree and orign of the parental genotypse

Parent	Pedigree
148	Cross derivative of IS 3687xAispuri
M 35-1	Local selection from Maldandi
BJ 105	Cross derivative of IS 84 x M 35-1
IS 3691	SA 7532-1-2-3-4-3
SB 1066	Selection from Purdue No. 954, originally introduced into U. S. A. from Africa
IS 873	SA 153 Cheyenne
IS 1202	AS 3783 Adkroo CR
IS8744	E 234 Framida
IS 887	Grain grass SA 7536-7-1-3
IS 1134	Coiapatcha

Table-II : Phenotypes of the parents, F_1 s and segregation ratios ratios from F_2 populations.

Parents		F_1	F_2 segregation	X^2	P with F_2 ratio
148 (Al)	M35-1 (An)	An	Obs 720 (An) 248 (Al)	0.20	0.7-0.5 (3An : 1 Al)
BJ 105 (An)	IS3691 (Al)	Al	Obs 579 (Al) 193 (An)	0	- - (3Al : 1 An)
SB1066 (Al)	IS 873 (An)	An	Obs 618 (An) 512 (Al)	1.12	0.3-0.2 (9An: 7 Al)
SB1066 (Al)	IS1207 (An)	An	Obs 854 (An) 344 (Al)	0.54	0.5-0.3 (45An: 19Al)
IS 8744 (Al)	IS 887 (An)	Al	Obs 392 (An) 454 (Al)	2.30	0.2-0.1 (7An : 9 Al)
IS 8744 (Al)	IS1134 (An)	Al	Obs 382 (An) 1056 (Al)	1.88	0.2-0.1 (1An : 3 Al)

An – Awned
Al - Awnless

Table : 3 F_3 breeding behaviour of awning for different crosses

Cross with expected F_2 segregation rations		Number of families								
	BTD	Segregation into						BTR		
		3:1	1:3	9:7	7:9	15:1	45:19			
148 x M35-1 (1:2:1)	O 20	48						24		
	E 23	46						23	0.52	0.80-0.70
BJ105 x IS3691 (1:2:1)	O 18	32						25		
	E 18.75	37.50						18.75	2.92	0.30-0.20
SB1066 x IS873 (1:4:4:7)	O 10	20		19				36		
	E 5.31	11.75		21.25				37.19	4.49	0.30-0.20
SB1066 x IS1202 (7:18:8:4:8:19)	O 12	23		12		[illegible]	[illegible]	30		
	E 9·84	25.30		11.26		5.63	11.26	26.71	2.52	0.80-0.20
IR8744 x IS887 (7:4:4:1)	O 29		20		17			4		
	E 30.63		17.50		17.50			4.37	0.49	0.95-0.90
IS8744 x IS1134 (1:2:1)	O 22		34					16		
	E 18		36					18	1.22	0.70-0.50

BTD : Breeds true for dominant character
BTR : ,, ,, recessive character
O : Observed
E : Expected

TABLE - IV Gene symbolisations to explanin the inheritance of awning

Parents/Hybrids		F_3 ratio
SB 1066 (A1)	IS 873 (An)	
an/an$_1$ an$_2$/i-An$_a$ i-An$_b$	An/An$_2$/i-An$_a$ i-An$_b$	
F_1 (An) Anan/An$_1$ an$_1$/an$_2$ an$_2$/i-An$_a$ i-An$_a$/i-An$_b$ i An$_b$		9(An) : 1(A1)
SB 1066 (A1)	IS 1202 (An)	
an/an$_1$ an$_2$/i-An$_a$ i-An$_b$	An/An$_1$ An$_2$/i-An$_a$ i-An$_b$	
F_1 (An) Anan/An$_1$ an$_1$/An$_2$ an$_2$/i-An$_a$ i-An$_a$/i-An$_b$ i-An$_b$		45(An) : 19(A1)
IS 8744 (A1)	IS 887 (An)	
An/An$_1$ An$_2$/I-An$_a$ I-An$_b$	An/An$_1$ An$_2$/i-An$_a$i- An$_b$	
F_1 (A1) AnAn/An$_1$An$_1$/An$_2$An$_2$/i-An$_a$ i-An$_a$/I-An$_b$ i-An$_b$		7(An : 9(A1)
IS 8744 (A1)	IS 1134 (An)	
An/An$_1$ An$_2$/I-An$_a$ I-An$_b$	An/An$_1$ An$_2$/i-An$_a$ I-An$_b$	
F_1 (A1) AnAn/An$_1$An$_1$/An$_2$An$_2$/I-An$_a$ i-Ana/I-An$_b$ I-An$_b$		1 [An] : 3(A1)