

Short Communication

Genetics of Waxy Bloom and Awning in Sorghum (*Sorghum bicolor* (L.) Moench)

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Waxy bloom (epicuticular wax) in sorghum (*Sorghum bicolor* (L.) Moench) helps leaves to retain water (Jordan *et al.*, 1984) by minimizing cuticular transpiration (Premchandra *et al.*, 1992). It has also been shown to impart tolerance to a number of other environmental stresses like heat, air pollution, pests, insects and pathogens (Jenks *et al.*, 1992). Awn is a filiform extension of varying length from the keel of the lemma and long glume, which tends to discourage birds from eating the grains when present in elongated form (Kullaiswamy and Goud, 1983). In this context, the study on the inheritance of these traits is important and the present investigation is an attempt towards it.

Two crosses were effected in rabi season of 2004-05 at the National Research Centre for Sorghum (NRCS), Hyderabad, between a bloomless restorer RS 647 and a waxy bloomed male fertile line 104B (RS 647 x 104B), and an advanced breeding line, RS 653 (RS 647 x RS 653) which were also contrasting for the presence and absence of awns (Table 1). The parents, and two F₁s (RS 647 x 104B, RS 647 x RS 653) were raised during kharif 2005 at NRCS, Hyderabad, and backcrosses (B1-Backcross to the first parent-(RS 647 x 104B) x RS 647; B2- Backcross to the second parent--(RS 647 x 104B) x 104B) were attempted. The parents, F₂ and backcross progeny were raised during the rabi 2005-06 at NRCS. Observations on presence and absence of waxy bloom were recorded during flowering while awning and panicle shape were recorded at physiological maturity. In the F₂ progeny of RS 647 x 104B, the panicle shape was also studied since its parents also differed for this trait (RS 647-Elliptic; 104B-Cylindrical). Segregation for all three traits could be studied only in the backcross of RS 647 x 104B since the parents of the other backcross (RS647 x RS653) were not differing for panicle shape. The goodness of fit between the observed and expected segregation pattern in these two cross combinations in F₂

generation and in backcross progeny {B₁= (RS 647 x 104B) x RS 647; B₂= (RS 647 x 104B) x 104B} was tested using chi-square test.

In both the crosses, the F₁s were 'bloomed' type indicating dominance of waxy bloom over bloomless condition (Table 2). Segregation pattern in F₂ for bloom character revealed that waxy bloom is under the control of a single dominant gene (Bm) in both the crosses as indicated by the good fit of 3:1 ratio. Out of a total of 908 individual plants over the families, 690 were bloomed and 218 were bloomless, thus fitting the overall segregation into a good fit of 3:1 ratio. Therefore, it is evident that presence of bloom in the parents studied is under monogenic control. This was further validated when segregation of bloomed and bloomless in backcross generations, where recurrent parent (RS 647) was bloomless, was in 1:1 ratio. Plants in backcross generation, where recurrent parent (104B) was bloomed, were all bloomed (Table 3). Earlier workers (Ayyangar and Ponnaiya 1941) found inheritance of waxy bloom to be monogenic in a cross between bloomless and heavy bloomed types and digenic control in a cross between bloomless and sparse bloomed types.

In both the crosses, the F₁'s were awnless indicating dominance of awnless over awned condition (Table 2). The F₂ population of the cross RS 647 x 104B gave a good fit for the monohybrid ratio of 3:1 while the cross RS 647x RS 653 segregated for 13:3 indicating digenic inhibitory gene action. Over the families, 212 were awned (An) and 702

Table 1. Pedigree and characters of the parental genotypes used in inheritance studies

Parent	Pedigree	Characters
RS 647	IS 15703 x RS 29	Bloomless, Awnless, Elliptic panicle
104B	296B x Swati	Bloomed, Awned, Cylindrical Panicle
RS 653	Selection from SPV492	Bloomed, Awned

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Table 2. *F₂ segregation of waxy bloom, awning and panicle shape in crosses of sorghum*

Character/Cross	F ₁	F ₂ population			X ² *	P
Waxy bloom		Bloomed	Bloomless	Total		
RS 647 x 104B	Bloomed	439	140	579	0.207 (3:1)	0.75-0.50
RS 647 x RS 653	Bloomed	251	78	329	0.292 (3:1)	0.75-0.50
Total		690	218	908	0.475 (3:1)	0.5-0.25
Awning		Awned	Awnless	Total		
RS 647 x 104B	Awnless	143	439	582	0.051 (3:1)	0.9-0.75
RS 647 x RS 653	Awnless	69	263	332	0.685 (13:3)	0.5-0.25
Total		212	702	914	1.589 (3:1)	0.25-0.1
Panicle shape		Elliptic	Cylindrical	Total		
RS 647 x 104B	Elliptic	299	225	524	0.239 (9:7)	0.75-0.5

* Value in parenthesis denotes the segregation ratio.

were awnless (A1) fitting the overall segregation into a good fit of 3:1 ratio. Plants in backcross generation where recurrent parent was awnless (RS 647) were all awnless while segregation of awnless and awned in backcross generations, where recurrent parent (104B) was awned, was in 1:1

This study revealed that presence of waxy bloom was monogenically controlled and elliptic shape of panicle was digenically controlled. A system of separate gene complexes operates in different genotypes for awning condition. The simply inherited traits can be easily combined into a good

Table 3. *Segregation pattern in backcross 1 (B₁) and backcross 2 (B₂) generations for three characters in the cross RS 647 x 104B*

Character	Generation	Observed		P
Waxy bloom		Bloomed	Bloomless	
	B ₁	44	40	0.75-0.25 (1:1)
	B ₂	73	0	
Awning		Awned	Awnless	
	B ₁	0	84	
	B ₂	32	41	0.5-0.25 (1:1)
Panicle shape		Elliptic	Cylindrical	
	B ₁	84	0	
	B ₂	17	56	0.75-0.25 (1:3)

B₁: (RS 647 x 104B) x RS 647; B₂: (RS 647 x 104B) x 104B.

ratio (Table 3). Contrasting reports are available for this character. Monogenic, digenic, trigenic and tetragenic control for this character have been reported earlier in sorghum (Kullaiswamy and Goud, 1980; Kullaiswamy and Goud, 1983).

The F₁ between elliptic RS 647 and cylindrical 104B was elliptic while in the F₂ population, 299 plants were elliptic and 225 were cylindrical fitting into 9:7 ratio indicating the digenic complementary gene control of elliptic shape over cylindrical shape. The gene symbols of E1 and E2 are proposed. Plants in backcross generation where recurrent parent (RS 647) was elliptic were all elliptic while segregation of elliptic and cylindrical panicle shapes in backcross generations, where recurrent parent (104B) was cylindrical was in 1:3 ratio (Table 3).

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