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Quantitative Inheritance in Sorghum—Days to Flowering

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ABSTRACT

A study was conducted with the five generation set of the cross Shallu × GM 2–3–1. The study revealed that the two parents differed on three genes with reference to the inheritance of flowering date. Components of variation estimated indicated the significance of d^1 (add. + add. × dom), and i (add. × add.) indicating the highly additive genetic control of this character. Heritability in broad sense was high and potence ratio estimate suggested the operation of partial dominance in this cross.

INTRODUCTION

Rao *et al.* (1968) suggested that the answer to a major genetic improvement in yield performance of future sorghum hybrids lies in developing the highly heterotic combinations into males and females and correcting the draw-back of excessive tall habit and late maturity of the Indian parents, With this objective several Indian x exotic crosses were attempted and one among them was Shallu x GM 2–3–1. The results presented trace the nature of inheritance of the character and days to 50 per cent flowering,.

MATERIALS AND METHODS

The five generation set of the cross Shallu x GM 2–3–1, conforming the Hayman's (1958) model was set up. The details of the experiment was presented in an earlier paper (Goud *et al.* 1974). The character days to 50 per cent flowering, was measured as the days taken by the plants from sowing to a date when flowering was half on its way down the panicle.

RESULTS AND DISCUSSION

The two parents *viz.*, Shallu and GM 2–3–1 have wide difference (35 days) in their flowering duration (Table 1). The F_1 was intermediate between the two parents but was more towards the earlier parent, Shallu indicating the dominance for earliness in F_1 (Table 2). This dominance broke down in F_2; F_2 and F_3 approached GM 2–3–1. It is quite likely that plants with delayed maturity have been preferentially selected since the early flowering segregants being susceptible to shoot fly and stem borer attack have been possibly eliminated in F_2 resulting in an advance in the mean of F_3. Variances of the non-segregating generations were almost equal on both the scales, F_2 had the maximum variance followed by F_3.

Shallu and GM 2–3–1 appear to have a 3 gene difference (Table 3) in respect of days to flowering. There was not much distortion in the estimates of minimum number of genes even after transformation of the data on to

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TABLE 1. Observed and expected frequency distribution of P_1, P_2, F_1, F_2 and F_3 of a cross Shallu x GM 2-3-1 in respect of days to 50 per cent flowering

Populations		Mid class values											X^2	P at which the fit is good
		58	63	68	73	78	83	88	93	98	103	Total		
P_1 (Shallu)	Obs.	51	8									59	7.994	
	Exp.	41	18									59		*
P_2 (GM-2-3-1)	Obs.							3	53	10		66	2.716	
	Exp.							3	47	16		66		*
F_1	Obs.		4	16	1							21	1.732	
	Exp.		3	15	3							21		*
F_2	Obs.		45	168	298	593	422	330	131	30	17	2034	117.39	
	Exp.		92	102	318	481	490	336	155	48	12	2034		0.005
F_3	Obs.		24	20	369	875	487	42	1			1818	545.42	
	Exp.		1	18	311	921	515	51	1			1818		0.005

*Since the degrees of freedom for chi-square is zero, it is not possible to know the P value

TABLE 2. Means and variances of P_1, P_2, F_1, F_2 and F_3 of a cross Shallu × GM 2-3-1, in respect of date of flowering on original and transformed scale

Generations	Mean		Variance	
	Original	Transformed	Original	Transformed
P_1 (Shallu)	58.67	1.7682	2.93	0.00015106
P_2 (GM 2-3-1)	93.53	1.9708	4.64	0.00006230
F_1	67.28	1.8276	5.44	0.00022857
F_2	80.25	1.9024	60.36	0.00205019
F_3	83.25	1.9198	12.63	0.00051111

TABLE 3. Number of genes differentiating the two parents (Shallu and GM 2-3-1), potence ratio estimates, heritability estimates in broad sense and Mather's 'C' values with their associated variances in respect of days to flowering on original and transformed scales

Parameters	Original scale	Log scale
Number of genes		
(a) Sinnot's formula	2.7650	2.8166
(b) Burton's formula	2.8260	3.0577
Potence ratio estimates	-0.5002	-0.4136
Heritability in broad sense	92.82	92.87
Mather's 'C' value and its associated variance	+34.24 (NS) (995.0)	+0.2154 (NS) (0.03393)

logarithmic scale which suggests that the data conforms to an additive genetic model. Potence ratio estimates suggest a partial dominance of genes controlling earliness in this cross. Heritability of this character was very high (92 per cent). Again transformation had no effect on this estimate.

F_1 deviation (Table 4) further indicated the presence of partial dominance for earliness, inbreeding depression and F_2 deviation were highly significant indicating the presence of dominant and interacting alleles in this cross for flowering date.

Among the five genetic components of variation obtained on Hayman's (1958) model (Table 5) it was observed that, the estimates of 'd' and i were highly significant. The non-significant dominance and dominance x dominance interaction effects were in negative direction. These facts clearly suggested the additive control of the character.

TABLE 4. F_1 deviations, inbreeding depressions, F_2 deviations in respect of days to flowering on original and transformed scales expressed as deviations and also percentages

	Original Scale		Log Scale	
	Deviation	Percentage	Deviation	Percentage
F_1 deviation from:				
(a) Mid parent value	— 8.82**	— 13.10	— 0.0419**	— 2.24
(b) Better parent value	— 26.25**	— 28.06	— 0.1432**	— 7.26
Inbreeding depression	— 12.97**	— 19.27	— 0.0748**	— 4.09
F_2 deviation	+ 8.56**	+ 11.94	+0.0539	+ 3.45

TABLE 5. Estimates of the five genetic components in a cross Shallu × GM 2-3-1 in respect of date of flowering on original and transformed scales

Genetic component		Original scale	Log scale
m	(F^2 mean)	80.25	1.9024
d—j=d^1	(add. effects + add. × dom.)	17.43**	0.1013**
h	(dom.)	— 16.64	— 0.0962
i	(add. × add.)	436.17**	10.1845**
l	(dom. × dom.)	— 18.58	— 0.1060

Flowering duration in sorghum is reported to be controlled by four maturity genes (Quinby, 1966, 1967). In the present study however, there seem to be three gene difference between Shallu and GM 2–3–1. Based on the assumption that there are four genes governing height in sorghum (Quinby, 1966, 1967), it can be tentatively suggested that the genotypes of GM 2–3–1 and Shallu could be Ma_1, Ma_2, Ma_3, Ma_4 and ma_1, ma_2, ma_3 and Ma_4, respectively. However, further genetic analysis is necessary to suggest the exact genotypes of the two parents in respect of days to flowering.

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