https://doi.org/10.29321/MAJ.10.A02309

Madras Agric. J. 73(10) : 541-544 October, 1986

GENETIC ANALYSIS OF YIELD AND YIELD COMPONENTS IN SORGHUM*

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A comparative evaluation of 16 sorghum varieties has been attempted to identify suitable pairs of parents. Studies on combining ability indicated considerable variability for gene action in different sets of parents. A substantial portion of the total genetic variance was of the additive type for plant height, earhead length and grain yield. The magnitude of non-additive genetic variance in respect of the characters days to bloom and peduncle length was high. Parents with high combining ability have been identified.

Breeding for higher grain yield has been the main objective of crop improvement work. It is obvious that for exploitation of the large store of potential genetic variability for stepping up yield levels, the choice of parents should be based on line *per se* performance and the nature of combining ability. The nature of gene action involved in the biological material will greatly aid in formulating suitable breeding procedures. In this paper an attempt has been made to study the nature of gene action and the degree of combining ability for yield and some of its components in certain varieties of sorghum.

MATERIALS AND METHODS

The experimental material for this study consisted of six sorghum lines viz., 2077B, 3660B, 648B, VZM 2 B, M 35-1-B and G 1.B and ten derived varieties (testers). The lines (females) are of diverse origin, three of them being indigenous while the other three are derivatives of exotic x Indian parentage. Among the ten pollinators (testers), eight are extracts of exotic x Indian hybrids and the other two are drawn from homozygous derivatives of irradiated populations.

Sixty hybrid combinations were obtained by crossing each of the lines to the ten testers. These hybrids were raised in a randomised blocks design replicated four times. Observations on days to 50% flowering, plant heigth, peduncle lenght, earhead length and grain yield were recorded on five randomnly selected plants in each variant. The statistical analysis was based on the method developed by Kempthorne (1957).

RESULTS AND DISCUSSION

The analysis of variance (Table 1) revealed that the variance due to female parents was significant for all the characters. These variances were of a larger magnitude in comparison with those due to male parents indicating larger contribution of female parents to total *gca* effects. Male x female parents interactions were highly significant for all the characters. The hybrids were therefore involving considerable specific combining ability effects. However,

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relatively small variances due to male x female parent interaction indicate that both *gca* and *sca* effects contributed to the hybrids.

The data on the estimates of combining ability variances showed larger values of GCA than SCA for plant height, earhead length and grain y eld indicating that additive gene action was predominant for these characters. It is, therefore expected that selection procedures like pedigree breeding can result in superior varieties for these characters.

The *gca* effects of the 16 parents for all the five characters are presented in Table 2. Significant *gca* effects of most of the parents for plant height suggest appreciable quantity of additivity and possible improvement of this trait by pedigree breeding. A similar situation has been reported by Rao *et al* (1968) and Aberto Artola 1975. However, Rao (1970) showed the importance of both GCA and SCA variances for plant height. With the recognition of new plant type concept in sorghum, it is desirable to breed hybrids which are dwarf or medium tall in stature With this view 648B among the females and Uch. V2 among the males which have recorded the highest negative *gca* effects among their respective groups could be considered the best.

Early flowering is considered to be advantageous to stabilize sorghum yields and to avoid the earhead pests. This trait is largely under the influence of non-additive genetic effects, earliness being dominant over lateness. However, earlier reports on gene action underlying days to 50 per cent flowering stress the importance of additive gene action (Kirby and Atkins 1968). Since earliness is desired, parents with high negative *gca* effects could be considered best for exploiting this character. 648B and Uch. V2 were the best among the females and males, respectively that could be considered as good sources of earliness

A shorter peduncle is advantageous in sorghum since longer peduncles bend or sometimes break at the final stage due to earhead weight as it matures. In view of this parents showing negative *gca* effects could be selected for exploitation of this trait. G. 1B among the female parents and Uch V 3 among the males recorded the highest negative *gca* effects for peduncle length. Another pollinator parent, SB 803 also recorded high *gca* effects in the negative direction.

The length of earhead is positively and highly correlated with grain yield (Kamal and Abu El-Gasim, 1976) and an improvement of this trait is desirable. Predominance of additive gene action was conspicuous. This additivity combined with significant *gca* effects of parents 2077 B, 648 B, 232 and CSV 3 offers scope for selection of longer earheads by pedigree breeding.

The ultimate aim in any breeding programme is the grain yield and the breeding procedure is to be carefully formulated in increasing the potentiality of this complex character. The predominance of additive gene action for grain yield was evident from the greater value of GCA variance than SCA variance (GCA : SCA = 1.45:1). Such studies conducted by a number

Table 1 : Analysis of variance

Source	Plant height	Days to 50% flowering	Peduncle length	Earhead length	Grain yield per plant
Hybrids	6135**	26.35**	182.53**	72.22**	549.99**
Males	6680**	42.84**	188.64**	72.54**	1396.69**
Females	59936**	54.82**	893.63**	633.67**	2129.41**
Male x Female	48	19.89**	102.34**	9 77**	205.15**
σ^2 GCA	1039	0.90	13.70	10.73	48.26
σ^2 SCA	158	4.61	21.10	1.43	33.30
GCA/SCA	6.58:1	0.2:1	0.65:1	7.50:1	1.45:1

**Significant at one per cent level

Table 2 : *gca* effects of parents

Parents	Plant height	Days to 50% flowering	Peduncle length	Earhead length	Grain yield
Females					
2077 B	—16.92**	2.03**	6.11**	6.22**	3.33
3660 B	—39.15**	—0.47	5.40**	0.33	6.85**
648 B	—40.85**	—1.37	0.14	3.02**	3.93**
VZM 2B	19.90**	0.03	—3.82**	—3.64**	—1.22
M 35-1 B	20.62**	—0.67*	—3.88**	—2.52**	0.89
G.1 B	56.41**	0.43	—3.94**	—3.41**	—13.80**
Males :					
232	—19.04**	0.10	2.53	2.10**	—2.36
296	—10.69	1.60**	—1.03	0.35	—9.75**
Uch V 2	—23.54**	—2.57**	0.14	0.24	—4.72
Uch V 3	25.46**	—0.07	—4.92**	—0.90	16.36**
29/6	21.52**	—0.40	—0.31	0.39	—0 30
C 6. 3541—R9	5.43	1.60**	—1.51	0.70	5.36*
CSV 3	—6.97	—1.73**	3.26**	2.66**	—7.40**
SB 803	2.66	0.77*	—3.24**	—2.46**	5.85*
SB 411	—9.00	—0.07	3.69**	—1.13	0.85
Co 21	14.08	0.77	1.39	—2.46**	—3.87

**Significant at one percent

*Significant at five percent

of workers such as Beil and Atkins. (1967) and Rao *et al* (1968) are in general agreement indicating that *gca* effects are predominant for yield. However, estimates of genetic variance by Rao (1970) revealed that both *gca* and *sca* variance are of equal importance in influencing yields.

In case of both additive and non-additive gene action determining the grain yield in sorghum, the more appropriate breeding technique is exploitation of hybrid vigour and subsequent improvement through concentration of favourable genes by reciprocal recurrent selection as suggested by Doggett and Eberhart (1968). Since sorghum is predominantly self pollinated crop, the non-additive gene action cannot be maintained in advanced generations and would be eliminated in due course of selfing. Therefore, one can capitalize on additive gene action only. It is possible that with suitable choice of parents, pedigree method could improve the yield. The significant *gca* effects of 3660 B, 648B, Vch V. 3, SB 803 and CS 3541-R. 9 indicate that these parents possessed more of additive genes for yield.

The hybrid between the two highest general combiners 3660 B and Vch. V3 recorded the highest grain yield but their *sca* effects were low. Five of the six hybrids involving the high combining male parent Vch. V3 exhibited heterosis over the better parent. Further selection in segregating generation of these crosses may help to derive superior lines as observed by Balakotaiah *et al.*, (1974) while deriving lines from CSH 1 sorghum hybrid. Therefore, 3660B, 2077B and 648B among the females and Vch. V3, SB 803 and CS 3541 among the males with high *gca* effects provide a sound base material for breeding programme aimed to develop superior lines and these could be expected to throw high yielding segregants in later generations.

REFERENCES

ALBERTO ARTOLA. 1975. Combining ability in grain sorghum. *Sorghum Newsletter, 18*: 96-97.

BALAKOTTAIAH, K., D. P. TRIPATHI, B. S. RANA and N. G. P. RAO 1974. Progress from selection in a commercial sorghum hybrid. *Indian J. Agric. Sci.*, 44: 676-678.

BEIL, G. M. and R. E. ATKINS 1967. Estimates of general and specific combining ability effects in F1 hybrids for grain yield and its components in grain sorghum. *Crop Sci*, 7 : 225-228.

DOGGETT, H. and S. A. EBERHART 1968. Recurrent selection in sorghum. *Crop Sci.*, *8* : 119-121.

KAMBAL, A. E. K. and ABU-EL-GASIM 1975. Manifestation of hetetosis is grain sorghum. *Expl. Agric. 12* : 33-42.

KEMPTHORNE, O. 1957. *An Introduction to Genetic Statistics.* John Wiley and Sons., N. Y.

KIRBY, J. S. and R. E. ATKINS 1968. Heterotic response for vegetative and mature plant characters in grain sorghums. *Crop Sci.*, 8 : 335-339.

RAO, N. G. P., V. K. S. RANA and D. P. TRIPATHI 1968. Line x Tester analysis of combining ability in sorghum. *Indian J. Genet., 28 :* 231-238.

RAO, N. G. P., 1970. Genetic analysis of some exotic x Indian crosses in sorghum. *Indian J. Genet) 30* : 362-376.