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COMBINING ABILITY FOR YIELD AND YIELD COMPONENTS IN SORGHUM

N.MOHAMED SHERIFF and M.N.PRASAD

School of Genetics Tamil Nadu Agricultural University, Coimbatore 641 003.

ABSTRACT

Combining ability for grain yield, panicle length, panicle weight and number of grains was estimated through a full diallel analysis involving 6 parents of sorghum *viz.*, Co.18, 148, Co.23, Co,22, CSV.3 and AS.3880 under four environments. The variances due to GCA and SCA were significant, the former being predominant. The operation of both additive and non-additive gene actions in the inheritance of the four characters studied was inferred. Among the parents P3 (Co.23) exhibited high positive and significant gca effects with high *per se* performance. The hybrid P4 X P5, P1 X P3 and P2 X P3 showed high positive significant sca effects for grain yield. The hybrids involving P3 as one of the parents were generally better in *per se* performance and sca effects for economic traits observed. Considering the gene actions (fixable and non-fixable) involved, a recurrent selection programme for the improvement of grain yield and its components is suggested.

A comprehensive understanding on the genetic architecture of the parents, knowledge on the combining ability of parents and hybrids, identification fo superior hybrid combinations for economic traits and recognising superior genotypes and hybrids favourably interacting with environments are the essential needs of a breeder for implementing a systematic crop improvement programme. The present investigation was oriented towards eliciting basic and applied information on the above aspects and to formulate a breeding strategy to be adopted in sorghum *(Sorghum bicolor* L. Moench) with special reference to the set of materials involved, through a diallel analysis.

MATERIALS AND METHODS

Six promising genotypes of sorghum *viz.* Co.18, 148, Co.23, Co.22, CSV.3 and AS.3880, chosen for diversity in panicle shape and compactness were crossed in all the possible combinations including reciprocals at the Sorghum unit, Tamil Nadu Agricultural University, Coimbatore, during monsoon 1980, by adopting hand emasculation and artificial pollination. The resultant 36 progenies (30 hybrids + 6 parents) were raised in a randomised block design replicated thrice in two seasons *viz* summer, 1981 (January - April) and monsoon, 1981 (July -October) under two levels of fertility conditions (High: 100 N + 80 P_2O_5 + 60 K_2Okg/ha and Low : No fertilizers).

The four environmental conditions provided for the study were

E1 : 1981 summer season : High fertility
E2 : 1981 summer season : Low fertility
E3 : 1981 monsoon season : High fertility
E4 : 1981 monsoon season : Low fertility

Each genotype was raised in three rows of 3 m length in each replication. A spacing of 45 cm between rows and 15 cm between plants in the row was adopted. Observations on panicle length, panicle weight, number of grains/panicle and grain yield/plant were recorded in ten plants selected at random. Combining ability analysis out lined by Griffing (1956) for individual environment and pooled analysis over environment following Daljit Singh (1979) for method I - Model I were adopted.

Table 1. Analysis of variance for combining ability in individual environment.

Character	Environment	Mean squares due to			GCA/SCA
		GCA	SCA	Reciprocal	
Panicle length	E_1	273.54	13.59	4.72	20.13
	E_2	246.58	11.77	1.98	20.95
	E_3	196.86	12.64	8.73	15.57
	E_4	193.24	11.07	7.30	17.46
Panicle weight	E_1	884.46	716.42	187.64	1.23
	E_2	957.51	472.91	105.36	2.02
	E_3	1188.93	684.15	236.28	1.74
	E_4	820.81	386.98	203.18	2.12
Number of grains / panicle	E_1	882293.29	507366.00	238915.76	1.74
	E_2	519499.01	329574.44	157481.68	1.58
	E_3	1433387.46	465492.82	298053.10	3.08
	E_4	643225.24	184950.15	189583.13	3.48
Grain yield per plant	E_1	408.02	270.64	67.45	1.51
	E_2	317.08	232.76	53.36	1.36
	E_3	559.24	256.11	69.55	2.18
	E_4	562.54	198.03	36.57	2.84

(All mean squares are significant at 1% level)

RESULTS AND DISCUSSION

The mean squares due to GCA and SCA for the four characters under individual environments and over environments were significant. The proportion between GCA and SCA variances was more than unity in all the cases (Table). This situation suggests the importance of both additive gene actions in the inheritance of the characters studied. However, the predominant role played by additive over non-additive gene action is brought out. The proportion GCA/SCA was wide in the case of panicle length and narrow for panicle weight. The importance of both additive and non-additive gene actions in determining panicle length, panicle weight, number of grains/panicle, grain yield/plant observed in the study are in agreement with the findings of Niehaus and Pickett (1966) Chiang and Smith (1967), Nishibe *et al.* (1974) and Indi and Goud (1981).

For all the characters studied, the GCA x environment interactions were relatively higher in magnitude than the interactions of SCA variances. Similar observations have been made by Liang (1967), and Govil and Murthy (1973) for yield and yield componets in sorghum. Though the high interaction of GCA with environment indicates the sensitive nature of additive component for environmental changes, its high stability has already been demonstrated (Beil and Atkins, 1967).

An examination of *gca* effects of parents revealed a gradual increase from P_1 to P_6 in respect of panicle length while for the other three traits namely panicle weight, grain number and grain yield, the performance of the parents was alike with better experssion in parent Co.23. The *gca* effects of Co.23 for the three traits were positive and significant with highest *per se* performance among the parents. This observation shows that the parent Co.23 is a good general combiner for yield and its components like panicle weight and grain number.

Highly significant *sca* effects were observed in most of the crosses indicating the role of non-additive generation for the four characters studied. The hybrid Co.22 X CSV 3 showed maximum *sca* (pooled) effects for panicle length, number of grains and grain yield. For panicle weight the hybrid Co.18 X Co.23 recorded the highest sca effects. In respect of other traits also the sca effects of Co.18 X Co.23 were high, positive and significant. All the hybrids involving Co.23 as one of the parents recorded a relatively better sca effects besides high *per se* performance for the characters examined.

Thus the study has revealed that the parent Co.23 with high expression of characters and combining ability possesses considerable breeding value. It has also produced several heterotic hybrid combinations with other parents. The operation of both additive and non-additive types of gene actions in the inheritance of grain yield and yield components is inferred in the present investigation. Of the available breeding procedures, recurrent selection techniques would result in the improvement of yield components in the desired direction effectively harnessing the fixable (additive) and non-fixable (dominance) gene effects as observed in the present study.

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COMBINING ABILITY FOR DAYS TO FLOWERING AND GRAIN YIELD IN GRAIN SORGHUM *(Sorghum bicolor* (L.)Moench.)

P.VEERABADHIRAN, S.PALANISAMY and G.A.PALANISAMY.

Department of Pulses, School of Genetics, Tamil Nadu Agricultural University, Coimbatore 641 003

ABSTRACT

Knowledge on the prepotency in the parents of the hybrid is an essential requirement. To have the information on combining ability of the parents and crosses, a set of eighty one cross combinations of nine male sterile lines and nine restorer lines of sorghum were studied. Analysis of variances showed significant differences among the genotypes for days to 50 per cent flowering and grain yield per plant. The variance due to lines was significant and larger in magnitude. Days to 50 per cent flowering is largely under control of non-additive genetic effects. The components of variance for grain yield due to GCA and SCA pointed out the preponderance of non- additive gene action as reflected by high SCA variance. The male steriles 296A, 2077A and TNAU ms 1A among the lines and Co 25, TNS 34 and IL 101 among the testers with more of additive genetic effects could be utilized in exploitation of hybrid vigour.

Among the coarse grain cereals, sorghum ranks first in area and it contributes 43 per cent of the total millet production of the State of Tamil Nadu. Almost all the summer irrigated Sorghum area is covered by the hybrids besides a considerable area during rainfed season. Apart from their yielding ability, hybrids gave more reliable yields than varieties. In the utilization of heterosis, selection is for combining ability of two parents. Studies on combining ability are useful in understanding the nature of genetic variance present in the material and for selecting suitable parents for use in crossing programme for developing superior varieties/hybrids.

MATERIALS AND METHODS

Eighty one hybrid combinations were obtained by crossing nine male sterile lines viz., 296A, 2077A, 2219A, A_2A, TNAU ms 1A, 3002A, 3003A, 3006A, and 3050A with nine restorers namely Co 21, Co 25, Co 26, TNS 30, TNS 32, TNS 34, IL 101, IL 103 and IL 105. These eighty one hybrids along with eighteen parents were raised in three row plot, adopting randomised block design replicated twice. The row to row and plant to plant distance were 45 Cm and 15 Cm respectively. The biometrical observations on days to 50 per cent flowering was recorded by counting number of