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Genetic component analysis in pearl millet for dual purpose

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ABSTRACT
In a study of 55 single cross hybrids derived from 11 × 11 diallel without reciprocals, both additive and dominance components were important with the predominance of dominance effects for almost all grain cum stover yield and their contributing traits. The positive and negative genes in the parents were distributed unequally for all the traits as was evident from the ratio $H_2/4H_1$. Since majority of the traits exhibited very low narrow sense heritability and preponderance of dominant effects, suitable hybridization programme may be adopted to bring desirable genetic improvement in all the traits.

Key words : Additive gene action, Non-additive gene action, Over dominance, Genetic components and Heritability.

INTRODUCTION
Pearl millet (*Pennisetum glaucum* (L.)R. Br.) is a stable diet for the vast majority of poor farmers and also forms an important fodder crop for livestock population in arid and semi-arid regions of the country. Increased emphasis on development of dual purpose (grain cum fodder) pearl millet, is therefore necessary to ensure high grain yield as well as higher dry fodder yield under rainfed cultivation (Dangaria and Atara, 2004).

Genetic component analysis serves as a useful tool in identifying the genetic architecture of any trait. However information available on genetic nature of dual purpose lines is limited. Hence, this study was undertaken to obtain genetic information in pearl millet for dual purpose.

MATERIALS AND METHODS
The study included a set of 11 diverse pearl millet genotypes (which were selected based on the diversity study for grain cum stover yield and its attributing traits) namely, IP 20381 (P_1), PT 5665(P_2), GP 15071(P_3), PT 5600(P_4), PT 5651(P_5), IP 20334(P_6), PT 5136(P_7), IP 19125(P_8), IP 20389(P_9), GP 16239(P_{10}) and IP 20350(P_{11}). These genotypes were crossed in a diallel mating system (excluding reciprocals) during Kharif 2003. The 55 F_1s and 11 parents were grown in a randomized block design with three replications in Rabi 2003. The experiment was conducted in the Department of Forage Crops, Center for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore. The entries were planted in two rows of 3 m length with 45 cm of row-to-row and 15 cm of plant-to-plant distances. All the recommended cultural practices were followed before and after sowing. Data were recorded on 5 randomly selected plants in each treatment and replication for grain and stover yield and their associating characters. The genetic components of variation were calculated as per the method proposed by Hayman (1954).

RESULTS AND DISCUSSION
The estimates of genetic components and ratios are presented in Table 1 and 2. For days to 50 per cent flowering, the estimate of degree of dominance ratio $(H_1/D)^{½}$ was more than unity suggested the predominant role of over dominance for this trait. The H_1 value was higher and highly significant than D. This also indicated the greater influence of over dominance. But Santhosh (2002) reported partial dominance for this trait. The positive covariance estimate of F and more than unit value of KD/KR indicated the greater frequency of dominant alleles in the parents for this character. The value of $H_2/4H_1$ indicated an asymmetrical distribution of positive and negative alleles in the parents. The narrow sense heritability was very low for this character.

In case of plant height, the degree of dominance ratio exceeded unity indicating over-dominance. The highly significant H_1 value over significant D value indicated the presence of more of non-additive gene action and the occurrence of non-additive gene action was also confirmed by Logasundari and Fazlullah Khan(1996). The value of $H_2/4H_1$ suggested an asymmetrical distribution of positive and negative alleles in the parents. The positive covariance estimates of 'F' and more than unit value of KD/KR indicated the presence of more dominant alleles in the parents. All the above results suggested a non-additive genetic control in the inheritance of this trait. The narrow sense heritability percentage was very low for this character.

For number of tillers, the ratio of $(H_1/D)^{1/2}$ was more than one also revealing the operation of overdominance. The highly significantly H_1 value over significant D value indicated the presence of more of non-additive gene action than the additive gene action. Mahudeswaran (1979) and Logasundari and Fazlullah Khan (1996) also reported the over dominance for number of tillers. The value of $H_2/4H_1$ indicated an asymmetrical distribution of positive and negative alleles in the parents. The ratio of KD/KR was more than one and 'F' value was positive indicated the presence of more dominant alleles in the parents.

In case of number of productive tillers, the genetic ratio $(H_1/D)^{½}$ reflecting the presence of over dominance. Santhosh (2002) also reported over dominance for this trait. Both additive and dominant components were significant, the additive component (D) was lesser in magnitude indicating the predominance of over dominance. The distribution of positive and negative genes was not symmetrical in the parents. The positive values of F showed the presence of dominant alleles with higher frequency. The estimate of heritability in narrow sense was lower in magnitude due to the influence of over dominance effects for this trait.

For number of leaves, the dominance component H_1 was significant and higher than the additive component. The degree of dominance ratio was more than unity. All these factors indicated the predominance of non-additive gene action with over dominance for this trait. Sidhu *et al.* (1980) and Logasundari and Fazlullah Khan (1996) also reported that non-additive genetic control for leaf number. The value of $H_2/4H_1$ indicated a slight asymmetrical distribution of positive and negative alleles in the parents. The ratio of KD/KR was more than unity and F value was positive. It indicated the presence of more of dominant alleles in the parents.

In case of leaf length, the degree of dominance ratio was more than unity and H_1 value was higher and highly significant than D. It indicated the greater influence of non-additive genes. Hooda *et al.* (1978) and Logasundari and Fazlullah Khan (1996) was obtained the similar result for this trait. The F value was positive and high and the KD/KR value was more than unity. It indicated the preponderance of dominant alleles in the parents. However the value of $H_2/4H_1$ suggested almost an asymmetrical distribution of positive and negative alleles in the parents.

For leaf breath, the dominance component H_1 was significant and higher than the additive component. The degree of dominance ratio was more than unity. All these factors indicated the predominance of non additive gene action with partial dominance for this trait. Logasundari and Fazlullah Khan (1996) also reported the importance

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Table 1 : Estimates of genetic parameters for grain cum stover yield and its contributing characters

Sl. No.	Characters	D	F	H_1	H_2	h^2	E
1.	Days to 50 per cent flowering	13.85 ± 8.92	14.74 ± 20.38	68.28** ± 18.37	56.45** ± 15.44	3.99 ± 10.33	0.23 ± 2.57
2.	Plant height (cm)	818.86** ± 124.21	164.01 ± 283.87	1666.15** ± 255.92	1414.58** ± 215.13	1540.99** ± 143.91	17.27 ± 35.86
3.	No. of tillers plant	4.92* ± 1.59	2.04 ± 3.64	19.16** ± 3.29	18.33** ± 2.76	0.90 ± 1.85	0.02 ± 0.46
4.	No. of productive tillers	3.77** ± 1.15	1.65 ± 2.64	12.93** ± 2.38	11.88** ± 2.00	0.48 ± 1.34	0.02 ± 0.33
5.	No. of leaves	62.48* ± 21.96	29.42 ± 50.19	201.82** ± 45.24	174.61** ± 38.03	80.38* ± 25.44	0.16 ± 6.34
6.	Leaf length (cm)	67.40** ± 16.19	73.13 ± 37.00	189.18** ± 33.36	138.92** ± 28.04	13.95 ± 18.76	0.07 ± 4.69
7.	Leaf breadth (cm)	0.31* ± 0.12	0.41 ± 0.27	1.73** ± 0.24	1.51** ± 0.20	0.04 ± 0.13	0.002 ± 0.03
8.	Panicle length (cm)	23.45** ± 5.10	39.81** ± 11.67	76.40** ± 10.52	52.17** ± 8.84	10.06 ± 5.91	0.03 ± 1.47
9.	Panicle width (cm)	0.19** ± 0.05	0.11 ± 0.11	0.55** ± 0.10	0.50** ± 0.08	0.001 ± 0.05	0.01 ± 0.01
10.	Stem diameter (cm)	0.03 ± 0.02	0.04 ± 0.04	0.17** ± 0.04	0.14** ± 0.03	0.10** ± 0.02	0.01 ± 0.01
11.	1000 grain weight (gm)	3.39** ± 0.94	2.79 ± 2.15	8.88** ± 1.94	7.78** ± 1.63	0.58 ± 1.09	0.02 ± 0.27
12.	Grain yield (gm)	7.73* ± 2.74	-3.99 ± 6.27	36.86** ± 5.65	34.55** ± 0.66	13.21** ± 3.18	0.05 ± 0.79
13.	Stover yield (gm)	8740.20* ± 3072.37	10685.07 ± 7021.65	36829.47** ± 6330.26	29431.93** ± 5321.50	7889.03 ± 3559.76	0.98 ± 886.92

* Significant at 5% level; ** Significant at 1% level

of non-additive gene action for this character. The value of H_2 / $4H_1$ indicated an asymmetrical distribution of positive and negative alleles in the parents. The ratio of KD/KR was more than unity and F value was positive, which indicated the presence of more of dominant alleles in the parents.

additive and non-additive gene action in influencing this character, but non-additive genes had a greater role. The F value was positive and significant and the KD/KR ratio was more than unity indicated the presence of greater number of dominant alleles in the parents. The H_2/ $4H_1$ value indicated an asymmetrical distribution of positive and negative

Table 2 : Estimates of genetic ratios for grain cum stover yield and its contributing characters

Sl No.	Characters	Genetic ratios				
		$(H_1/D)^{½}$	$H_2/4H_1$	KD/KR	h^2/H_2	Heritability (%) (Narrow sense)
1.	Days to 50 per cent flowering	2.22	0.21	1.63	0.07	0.28
2.	Plant height (cm)	1.43	0.21	1.15	1.09	0.55
3.	No. of tillers	1.97	0.24	1.24	0.05	0.29
4.	No. of productive tillers	1.85	0.23	1.27	0.04	0.35
5.	No. of leaves	1.80	0.22	1.30	0.46	0.41
6.	Leaf length (cm)	1.68	0.18	1.96	0.10	0.39
7.	Leaf breadth (cm)	2.35	0.22	1.77	0.02	0.14
8.	Panicle length (cm)	1.81	0.17	2.78	0.19	0.23
9.	Panicle width (cm)	1.68	0.23	1.41	0.002	0.36
10.	Stem diameter (cm)	2.19	0.21	1.72	0.69	0.24
11.	1000 grain weight (gm)	1.62	0.22	1.68	0.08	0.30
12.	Grain yield (gm)	2.18	0.23	0.79	0.38	0.45
13.	Stover yield (gm)	2.05	0.20	1.85	0.27	0.27

* Significant at 5% level ** Significant at 1% level

In case of panicle length, the degree of dominance ratio indicated the significance of over dominance. Mukherji *et al*. (1981) also reported over dominance for panicle length. The significant D value and highly significant H_1 component though indicated the importance of both alleles in the parents.

For panicle width, the degree of dominance ratio indicated over dominance, which was confirmed early by Aher and Ugale (1998). The significant D value and highly significant H_1 component also indicated the importance of both additive and non additive gene action in influencing this character, but non-additive genes had a greater role. The F value was positive and the KD/KR ratio was more than unity indicated the presence of greater number of dominant alleles in the parents. The $H_2/4H_1$ value indicated an asymmetrical distribution of positive and negative alleles in the parents.

In case of stem diameter, the degree of dominance ratio was more than unity and the high and highly significant H_1 estimates than D indicated the importance of non-additive gene action in controlling stem diameter. Hooda *et al*. (1978) and Logasundari and Fazlullah Khan (1996) also reported non-additive genetic control for this character. The value of $H_2/4H$, indicated an asymmetrical distribution of positive and negative alleles in the parents. The ratio of KD/KR was more than unity and the F value was positive denoted the higher frequency of dominant alleles in the parents.

For 1000 grain weight, the degree of dominance ratio exceeded unity indicating over dominance. The highly significant H_1 value over significant D value indicated the presence of more of non-additive gene action than the additive gene action. The value of $H_2/4H_1$ suggested asymmetrical distribution of positive and negative alleles in the parents. The positive covariance estimates of F and more than unity value of KD/KR indicated the presence of more dominant alleles in the parents for this character. All the above results suggested a non-additive genetic control in the inheritance of this trait. Santhosh (2002) reported partial dominance for 100 grain weight.

In case of seed yield per plant, the genetic parameters D, H_1, H_2 and h^2 were significant while the environment component of variation was non-significant, which indicated that the environmental influence was meager in the inheritance of this trait. The value of additive component (D) was much lower than the dominance components indicating the preponderance of over dominance effects. Aher amd Ugale (1998) also indicated the importance of over dominance for grain yield. The negative F value inferred the presence of recessive alleles in higher frequencies when compared to the dominant ones. The genetic ratio $(H_1/D)^{1/2}$ was more than unity which confirmed the earlier statement that the over dominance effects for this trait. The value of $H_2/4H_1$ was less than 0.25 and hence indicated an asymmetrical distribution of positive and negative genes.

For stover yield, the degree of dominance ratio was more than unity and the very high and highly significant H_1 estimate than D indicated the importance of non-additive gene action in controlling stover yield. The value of $H_2/4H_1$ indicated an asymmetrical distribution of positive and negative alleles in the parents. This trait possessed low narrow sense heritability. The ratio of KD/KR was more than unity and also the F value being positive and very high indicated the greater frequency of dominant alleles among the parents.

From the present study, it is concluded that any selection method to bring desirable genetic improvement is not much effective as all the traits exhibited very low heritability. However, since majority of the traits exhibited very low heritability (narrow sense) values and preponderance of dominant effects, suitable hybridization programme may be adopted to bring desirable genetic improvement in all the traits.

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