GENETIC ANALYSIS OF GRAIN YIELD AND ITS ATTRIBUTES IN PEARL MILLET

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ABSTRACT
The nature of gene action was studied for grain yield and eleven component traits in pearl millet using 8 x 8 diallel fashions. The preponderance of non-additive gene action was observed in the inheritance of days to flowering, days to maturity and 1000-grain weight. Whereas, the importance of both additive and non-additive gene action were noticed for grain yield per plant, ear head length, ear head weight, plant height, number of grains per square cm, dry fodder yield per plant and harvest index. However, the magnitude of dominant gene action (H1) was greater than their corresponding additive gene effects (D) for all the traits. This suggested that the dominant genes played a significant role in the control of all the characters. The average degree of dominance (H1/D) 0.5 was found to be in the range of over dominance for all the characters except number of effective tillers per plant, ear head girth and number of grains per square cm (partial dominance). The distribution of genes with positive and negative effects was found asymmetrical for all the traits except nearly symmetrical distribution for days to flowering, days to maturity and ear head girth. The ratio of KD/KR revealed that the dominance genes were more frequent than recessive ones. A few genes gene governed characters. Narrow sense heritability estimates was high for ear head weight, number of grains per square cm, grain yield per plant, dry fodder yield per plant and harvest index, whereas they were moderate for ear head length. The rest of the characters showed low heritability.

Key words: Pearl millet, Full-diallel, Gene effects, Pennisetum glaucum

INTRODUCTION
Pearl millet [Pennisetum glaucum (L) R. Br.] is the most drought and heat tolerant crop, grown on about 10 million ha, and thus ranking third after wheat and rice in area in India (GOI 2008). The aim of a plant breeder is to identify parents that will combine well and produce productive progenies. The success depends on the choice of parents, the nature and magnitude of gene action for components of productivity and efficiency of selection during segregating generation. Besides high yield correlated morphological traits are also important for harnessing the yield potential fully. Estimates of additive and dominance genetic variance help to choose the most effective breeding procedure to be followed for a crop species. Selection within population would be advisable only if the gene action is mainly additive. On the other hand, existence of dominance or epistasis justifies the use of hybrid programme. These components of variance do explain the genetic architecture of the population at hand and help to draw up the breeding strategies on the basis of expected performance of progenies. Therefore, the present study was undertaken to elucidate the nature and magnitude of gene action involved in inheritance of grain yield and its components and to create variability for recovery of desirable recombination using F1s of 8 x 8 full diallel cross in pearl millet.

MATERIALS AND METHODS
Eight genetically diverse inbreds viz., J-2290, J-2340, J-2405, J-2454, J-2467, J-2480, J-2511 and H-77/833-2 were crossed in all possible combinations including reciprocals during summer 2009 to generate a diallel set. Eight
parents and their 56 F1s were evaluated for grain yield and 11 yield components in a Randomized Block Design with three replications at Main Millet Research Station, Junagadh Agricultural University, Jamnagar (Gujarat), during Kharif-2009. Each entry was sown in single row of 5.0 m length having 60 x 15 cm crop geometry. All the recommended cultural practices were adopted to raise good crop of pearl millet. Observations were recorded on five randomly selected competitive plants for each entry, in each replication for 12 characters (Table 1). The mean values were used for the analysis to determine genetic components of variation following Hayman (1954).

RESULTS AND DISCUSSION

The estimates of genetic parameters, their ratio and narrow sense heritability for grain yield and its components are presented in Table1. The results revealed that the non-significant values of ‘t2’ for all the characters except days to maturity and dry fodder yield per plant assured the fulfillment of assumptions underlyng diallel analysis. The estimates of additive genetic component (D) and non-additive genetic components (H1, H2) were significant for grain yield per plant, ear head length, ear head weight, plant height, number of grains per square cm, dry fodder yield per plant and harvest index, indicating the importance of both additive and dominance components in the inheritance of these traits. However, the magnitude of dominance gene effects (H1, H2) was higher than their respective additive gene effect (D) for all the characters, which revealed preponderance of non-additive gene action in their expression. The result was in confirmation with the findings of Kumar et al. (1977) and Phul and Singh (1970). Only dominance components (H1 and H2) of genetic variance were significant for days to flowering, days to maturity and 1000-grain weight. This manifested that these traits were primarily under control of non-additive gene action. Further, the estimates of F were positive for all the traits implying that dominant genes played a significant role in the control of these traits. The non-significant estimates of environment (E) for all the traits except days to maturity, ear head weight, plant height, dry fodder yield per plant suggested that there was no considerable environment influence modifying their expression.

The estimates of average degree of dominance [H1/D] 0.5 was found to be more than unity for all the traits except number of effective tillers per plant, ear head girth and number of grains per square cm (partial dominance) indicating over dominance which suggested that heterosis breeding might be advantageous to get higher yield in pearl millet. The equal distribution of positive and negative alleles in the parents helps the breeder in selecting a particular desirable trait without losing any other desirable trait. In the present study, asymmetrical distribution of positive and negative alleles in the parental lines was observed from the estimated; H2/4H1 was less than 0.25 for all the traits except nearly symmetrical distribution for days to flowering, days to maturity and ear head girth.

The proportion of KD/KR revealed the relative value of dominant and recessive alleles among the parents, determining the extent of genetic gain that can be made in a particular direction. If the alleles present in the population are predominantly of recessive nature, the extent of genetic gain/advance will be limited. On the other hand, it is desirable that there should be dominant genes, if any, worthwhile selection gain can be had. This ratio of dominance and recessive genes was more than unity for all the traits, showing that the dominance genes were more frequent than recessive ones. The estimates of two proportions of genetic components, namely, H2/4H1 and KD/KR thus gave contradictory results regarding symmetrical distribution of alleles with positive and negative effects and were not always followed by the equal distribution of dominant and recessive alleles, respectively. In other words, dominant alleles may or may not be associated with positive effect. Likewise, a recessive allele may or may not be correlated with a negative effect. More the dominant genes more is the gain expected. The results showed that the numerical values ranged between 1.24 for days to maturity to 3.20 for dry fodder yield per plant which indicated that the recessive and dominant genes were not in high disproportion and most of allelic pairs would be exist in heterozygous forms. Knowledge of number of gene groups which exhibit dominance and are responsible for particular traits is important for the genetic progress through selection. In the present investigation, the value of
h2/H2 was less than unity in all the cases except days to flowering and days to maturity indicating that a few genes generally controlled the inheritance of a particular character.

High estimates of heritability in narrow sense was observed for ear head weight, number of grains per square cm, grain yield per plant, dry fodder yield per plant and harvest index suggesting that selection based on these attributes would lead to rapid improvement. Hence, major part of phenotypic variability was due to addictiveness and possibility of fixing these traits by simple selection. The results was corroborate with the findings of Lakshmana et al. (2009), Dang et al. (1985) and Mukherji et al. (1980). Moderate heritability was also observed for ear head length, whereas days to flowering, days to maturity, number of effective tillers per plant, ear head girth, plant height and 1000-grain weight displayed low heritability, indicating major role of dominance gene action in the expression of these traits. As reported in the present investigation, low to moderate heritability was observed by Govindaraj et al. (2010), Kunjir and Patil (1986) and Mukherji et al. (1980).

The overall results of present investigation suggested that reciprocal recurrent selection procedure would mop up the additive gene effects and would also allow dissipation of non-additive gene effects. Bi-parental mating may also be used in the segregating generations to break the undesirable linkages and to exploit both additive and non-additive gene effects simultaneously for isolating superior transgressive segregants (inbred lines) in later segregating generations. However, due to preponderance of non-additive gene effects of grain yield and most of its component traits, heterosis breeding would also be practically feasible in pearl millet.

REFERENCES


