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Genetic Analysis of Biometrical and Physiological Traits in Pearl Millet *(Pennisetum glaucum* (L) R. Br)

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Abstract : An experiment was conducted with eleven improved genotypes of pearlmillet of diverse origin were crossed in a diallel mating design that included reciprocals. Observations were recorded on six biometrical traits *viz.*, days to 50 % flowering, plant height (cm), number of productive tillers, panicle length (cm), 100 grain weight (g) and grain yield (g) and five physiological traits *viz.*, leaf area index (LAI), leaf area duration (LAD), specific leaf weight (SLW), net assimilation rate (NAR) and harvest index (HI). The F_1 hybrids of 110 cross combinations and 11 parents were evaluated for genetic components of variation. The genetic components D, H_1 and H_2 were significant for all the biometrical and physiological traits except panicle length and grain yield which showed non significance to D components. The h^2/H_2 indicated that number of blocks of genes involved in the inheritance of both the traits were less than one for all the traits except plant height, number of productive tillers, panicle length and grain yield per plant. The graphical analysis of test of homogenity (t^2) was non significant for all the traits and thus indicated that the data fulfilled the basic assumptions for diallel analysis. The regression coefficient (b) was significantly deviant from unity for the traits plant height, number of productive tillers, panicle length, leaf area duration and specific leaf weight. This revealed the presence of epistatic interaction for these traits.

Key words: Pearl millet, diallel, genetic analysis and graphical analysis

Introduction

Pearl millet *(Pennisetum glaucum* (L) R. Br) is the stable food crop for millions of people in several African countries and Indian sub continent. In India pearl millet occupies fourth position among cereal crops next to rice, wheat and sorghum. As a cereal for human food, it is considered to be highly palatable and is among the most nutritious of grain crops. It is also a source of fodder for livestock. The productivity of a crop community is dependent on its inherent capacity for photosynthesis, photosynthetic area developed and availability of photosynthetically active radiation with in the canopy. Thus the genotypic variation in productivity of a crop may be related to such parameters as net assimilation rate, crop growth, leaf area index, photosynthetically active radiation, interception by the canopy and partitioning of total photosynthate into economic and non economic sinks.

Table 1. Estimates of Genetic Parameters and Genetic Ratios of biometrical traits in Pearl Millet

Parameter/ Ratio	Days to 50 per cent flowering	Plant height	Number of productive tillers	Panicle length	100 grain weight	Grain yield
D	8.06** ± 1.57	1643.15** ±91.41	0.298** ±0.07	16.29± 8.26	0.126**± 189.44	285.59± 170.86
F	11.79**+ 3.59	2080.45** ±209.14	0.26±0.17	16.87± 18.88	0.235** ±432.94	223.80± 390.48
H_1	16.94** ± 3.243	1814.33** ±188.55	0.92**±0.15	60.87** ±17.02	0.359** ±390.31	1237.90** ±352.03
H_2	11.98**±2.73	1061.73** ± 158.50	0.83**±0.13	53.37** ± 14.31	0.237** ±328.11	1139.41** ±295.93
h^2	0.53 ±1.82	1376.72** ± 106.03	1.36±0.9	72.59** ±9.57	0.005.16±219.49	1530.51 ** ± 197.96
E	0.30 ± 0.45	2.15 ± 26.42	0.009 ±0.02	0.36±2.38	0.0005 ±54.69	4.71 ±49.32
$(H_1/D)^{½}$	1.45	1.05	1.75	1.93	1.685	2.082
$H_2/4H_1$	0.177	0.15	0.226	0.219	0.165	0.230
kD/kR	3.034	4.03	1.666	1.732	3.471	1.464
Heritability (%) narrow sense	15.87	37.07	22.07	29.50	9.41	21.68
h^2/H_2	0.044	1.29	1.64	1.36	0.021	1.34

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

Table 2. Estimates of Genetic Parameters and Genetic Ratios of physiological traits in Pearl Millet

Parameter/ Ratio	SLW	LAI	NAR	HI	LAD
D	1.53*±0.57	6737.07*±2275.17	0.104**± 136.27	0.027* ± 58.37	49.968** ± 14.00
F	1.91 ± 1.30	10964.24* ±5199.71	0.131.09** ± 311.44	0.0437** ±133.40	82.275*131.98
H_1	4.40*+1.17	16894.89* ±4687.72	0.151**±280.77	0.062** ±120.26	116.321** ± 28.84
H_2	3.59* ±0.99	11952.03* ±3940.71	0.103** ±236.03	0.0422**± 101.10	78.995** ±24.24
H^2	1.41*±0.66	5065.87 ±2636.09	0.026± 157.89	0.008 ±67.63	22.963 ±16.22
E	0.04 ±0.16	6.52± 656.78	0.002± 39.34	0.0002± 16.85	0.022 ±4.04
$(H_1/D)^{½}$	1.697	1.584	1.20	1.517	1.526
$H_2/4H_1$	0.204	0.177	0.17	0.169	0.170
kD/kR	2.169	3.114	3.178	3.267	3.344
Heritability (%) narrow sense	18.20	10.67	28.74	14.94	11.26
h^2/H_2	0.39	0.42	0.26	0.20	0.29

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

Genetic studies on physiological characters related to yield were very limited in pearl millet. The diallel analysis has been used to study the quantitatively inherited characteristics of crop plants in which the genetic analysis provides information on the genetic parameters and genetic ratios which provide information on the type of gene action associated with a particular trait. Keeping the above points in view, the present investigation was undertaken to understand the genetics of grain yield and physiological attributes and to assess the prepotency of parents by graphical analysis.

Material and methods

Eleven improved genotypes of pearlmillet of diverse origin *viz.,* CO 7, ICMB 93111, ICMB 93222, ICMV 221, ICTP 8203, PT 1890, PT 4450, PT5591, Pusa 383, UCC 17 and UCC 23 were crossed in a diallel mating design that included reciprocals. The F_1 hybrids of 110 cross combinations and eleven parents were sown in a randomized block design (RBD) with two replications during *rabi* 2003 (Dec-January) at Department of Millets, TNAU, Coimbatore. Each plot had three rows of 3m length with 30 x 15 cm spacing. Five competitive plants were randomly selected and used to record observations on six biometrical traits *viz.,* days to 50 % flowering, plant height (cm), number of productive tillers, panicle length (cm), 100 grain weight (g) and grain yield (g) and five physiological traits *viz.,* leaf area index (LAI), leaf area duration (LAD), specific leaf weight (SLW), net assimilation rate (NAR) and harvest index (HI). The mean data were analyzed and the genetic components of variation were worked out following the methods of Hayman (1954 a, b).

Results and discussion

Genetic analysis

The estimates of genetic parameters and their ratios for biometrical and physiological traits are presented in Table 1 and 2. The genetic components D, H_1 and H_2 were significant for all the biometrical and physiological traits except panicle length and grain yield which showed non significance to D components. The non significant estimates of environmental component suggested the low magnitude of influence by the environment. The ratio (H_1/D) provided overall measures of the mean degree of dominance over all the loci. The estimated value of more than the unity for all the traits suggested over dominance for all the traits. The distribution of genes with positive and negative effect was asymmetrical as shown by the ratio $H_2/4H_1$ of less than 0.25. The positive F together with the ratio KD/KR which was more than unity for all the traits revealed that the dominant genes were in excess of recessive genes (Vindhiyavarman, 2001).

The h^2/H_2 indicated that number of blocks of genes involved in the inheritance of both the traits were less than one for all the traits except plant height, number of productive tillers, panicle length and grain yield per plant. The ratio showed that these four quantitative traits were controlled by one to two group of genes. However, the ratio usually under estimates the number of genes and provides no interpretation about gene groups exhibiting dominance (Singh *et al.,* 1979). Further complementary interaction may also depress this value (Mather and Jinks, 1971). The heritability estimates in narrow sense were low for both the biometrical and physiological traits, establishing the importance of over dominance for these traits.

Table 3. Estimates of t^2, regression coefficient (b) and its deviation from Zero and unity in diallel crosses of Pearl millet.

Characters	t^2	b (WrVr)	SEb	b-0 / SEb	1-b/SEb
Days to 50% percent flowering	0.231	1.145	0.152	7.533**	-0.954
Plant height (cm)	2.91	0.194	0.210	0.924	3.838**
No. of productive tillers	0.424	0.020	0.162	0.123	6.049**
Leaf area index	0.645	-0.121	0.453	-5.331	1.94
Leaf area duration	0.886	-0.709	0.737	-0.962	2.319*
Specific leaf weight	0.001	-0.417	0.306	-1.363	4.631**
Panicle length (cm)	5.599	0.387	0.243	1.593	2.523**
Net assimilation rate	0.726	0.533	0.392	1.360	1.191
Harvest index	1.916	0.565	0.469	1.205	0.928
100 grain weight (g)	1.257	0.439	0.200	2.195	2.805*
Grain yield (g)	0.715	-0.090	0.149	-0.604	6.772

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

Graphical analysis

Graphical analysis of a diallel cross gives information on the proportion of dominant and recessive genes in individual parents. The analysis of test of homogenity (t^2) was non significant for all the traits (Table 3) and thus indicated that the data fulfilled the basic assumptions for diallel analysis (Natarajan, 1994). The regression coefficient (b) was significantly deviant from unity for the traits plant height, number of productive tillers, panicle length, leaf area duration and specific leaf weight. This revealed the presence of epistatic interaction for these traits.

The results from the above study indicated predominant role of non additive gene action in the inheritance of both the biometrical and physiological traits, which could be exploited through heterosis breeding.

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