Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.7471

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **7 (3):** 257-262 (2019)

Research Article

International Journal of Pure & Applied Bioscience

OPEN ACCESS

Selection Criteria for Grain Yield in Pearlmillet (*Pennisetum glaucam* L.) in Association with Yield Contributing Traits

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Received: 16.04.2019 | Revised: 22.05.2019 | Accepted: 29.05.2019

ABSTRACT

Thirty-eight Pearl millet hybrids were evaluated in Randomized Block Design at Regional Agricultural Research Station, Palem. The objective of the study was to estimate the extent of genetic variability and association between yield and related traits. Analysis of variance revealed that there was highly significant ($p<0.01$) difference among the thirty-eight genotypes for the traits viz., days to 50% flowering, days to maturity, plant height, panicle diameter, test weight, dry fodder yield and grain yield and significant difference ($p<0.05$) for panicle length. Grain yield ranged from 0.222 kg/plot (IHT 230) to 1.090 kg/plot (IHT 210). Highly significant grain yield was recorded in IHT 210 (1.090 kg/plot) followed by IHT 207 (0.782 kg/plot), IHT 212 (0.750 kg/plot) and IHT 232 (0.668 kg/plot) compared to local check (0.563 kg/plot). Low Phenotypic Coefficients of Variation and Genotypic Coefficients of Variation values were recorded in Days to 50% flowering and Days to maturity, medium in Plant height(cm), Panicle length(cm), Panicle diameter (cm), Test weight (g), Plant stand and high in Number of productive tillers/plant, Dry fodder yield (kg/plot) and Grain yield (kg/plot). Overall, Grain yield had high PCV, GCV, heritability and genetic advance as a percent of mean reveals is very important for selection criteria for crop improvement. Grain yield showed highly significant positive correlation with plant height followed by panicle diameter and panicle length which indicates true relationship between these traits and grain yield. Therefore, emphasis should be given for these characters of pearl millet improvement program.

Key words: *Genetic variability, Heritability, Genetic advance, Correlation, Pearl millet.*

INTRODUCTION

For any crop improvement program, nature and magnitude of genetic variability is essential. Findings depending on the nature and magnitude of genetic variability have of vital value for planning efficient breeding program to improve the yield potential of genotypes.

Cite this article: Shobha Rani, T., Sameer Kumar, C.V., Maheswaramma, S., Parimal, M., Anil Kumar, G. and Sravanthi, K., Selection Criteria for Grain Yield in Pearlmillet (*Pennisetum glaucam* L.) in Association with Yield Contributing Traits, *Int. J. Pure App. Biosci.* **7(3):** 257-262 (2019). doi: http://dx.doi.org/10.18782/2320-7051.7471

Information on the association of plant characters with seed yield is of great important to breeder in selecting desirable genotypes.

Pearl millet (*Pennisetum glaucum* L.) originated in Africa from where it was imported into India in the early days[4] and is commonly grown in the arid and semi- arid regions of Africa and India as a staple food for millions of people. It is particularly adapted to nutrient- poor soil and low rainfall conditions, yet it is capable of rapid and vigorous growth under favorable conditions[7]. Among the cereals in India, pearl millet is fourth in acreage behind rice, wheat and sorghum and fifth in production behind rice, wheat, sorghum and maize[3]. The objective of the present study was to assess genetic variability for yield and related traits and to compare the correlations of the characters on grain yield.

MATERIAL AND METHODS

Experimental sites: The experiment was conducted at Regional Agricultural Research Station, Palem during 2018 cropping season. The location receives low annual rain fall of about 400-500 mm, moreover poor distribution of the rain fall coupled with high temperature. It is located at geographical coordinates at 16°30'18" N latitude and 78°19 'E longitude and 458 m mean see level.

Experimental materials: A total of thirty-eight different pearl millet hybrids, that include one local check are the testing materials of the study. The hybrids are of Initial Hybrid Trial evaluation material from AICRP centers of India.

Experimental design: The trial was laid out in Randomized Block Design with three replications.

Data collection: Data was collected either on plot basis or from randomly taken 10 plants on grain yield (kg/ha), dry fodder yield(kg/plot), days to 50% flowering, days to maturity, plant height(cm), number of productive tillers/plant, panicle length(cm), panicle diameter, test weight (g), plant stand.

Data analysis: INDOSTAT statistical package was used for analysis. The heritability estimate of a trait was computed as the ratio between estimate of genetic variance and phenotypic variance. Coefficient of variability (CV), Heritability (Broad Sense) and Genetic Advance estimates as well as Genotypic correlation coefficients to determine association of yield traits with grain yield.

RESULTS AND DISCUSSION

In the present study, highly significant difference among all pearl millet hybrids ($p<0.01$) was observed for the traits Days to 50% flowering, Days to maturity, Plant height, Panicle diameter, Test weight, Dry fodder yield and Grain yield and significant differences ($p<0.05$) Panicle length. However, it was non-significant for Number of productive tillers/plant and Plant stand (Table 1). These findings indicate the presence of large variation among the tested hybrids. Similarly, Mamatha Nehra *et al*.[8] and Radhika Ramya *et al*.[9] reported significant differences for Days to 50% flowering, Leaf blade length, Spike length, Number of productive tillers /plant, Plant height, Test weight, Dry fodder yield and Grain yield.

Variance components and Coefficients of variation: Mean, Range, Estimates of Phenotypic (Vp), Genotypic (Vg) Variances and Phenotypic Coefficients of Variation (PCV), Genotypic Coefficients of Variation (GCV), Heritability and Genetic Advance as % Mean are given in Table 2. Mean values observed highest for Plant height (132.60 cm) while it was least for grain yield (0.476 kg/plot).

Grain yield ranged from 0.222 kg/plot (IHT 230) to 1.090 kg/plot (IHT 210). However highly significant grain yield was recorded in IHT 210 (1.090 kg/plot) followed by IHT 207 (0.782 kg/plot), IHT 212 (0.750 kg/plot) and IHT 232 (0.668 kg/plot) compared to local check (0.563 kg/plot). Similarly, Dry fodder yield was highest in IHT 232 (3.21 kg/plot) and it was least in IHT 233 (1.11 kg/plot). Kumar *et al*. (2014) observed high range for Days to 50 per cent flowering, Plant height, Panicle length, Panicle diameter, Number of nodes/main tiller, Inter node length and Grain yield.

Entry IHT 208 (44 days) was early to flower and IHT 232 was last to flower. Based on flowering the hybrids are categorized as one entry found to be early duration, 30 entries medium duration and 6 entries in late duration group. Similarly, IHT 201, 204, 213, 229 and 235 matured first and IHT 206 and check were late in maturity. IHT 219 was shorter in height (107 cm) and IHT 206 and 214 are the tallest. Number of productive tillers/plant ranged from 2.11 (IHT 228) to 4.00 (IHT 219).

Shortest panicle was observed in IHT 230 (14.89 cm) and it was longest in IHT 206 (23.11). Similarly, Panicle diameter was ranged from 2.19cm in IHT 237 to 3.31cm in IHT 214. Test weight was the highest in IHT 208, 214, 226 and 237 (18.33 g) and least in IHT 211(12.67 g). Plant stand was ranged from 16.67 (IHT 233) to 24.00 (IHT 216).

The genotypic coefficients of variation and phenotypic coefficients of variation were ranged from 4.19 & 4.45 (respectively for Days to maturity) to 33.64 & 34.68 (respectively for Grain yield). In this study the GCV values were lower than that of PCV indicating that the environment had an important role in the expression of these characters. Generally quantitative characters are highly influenced by the environment.

According to Deshmukh *et al*.[2], PCV and GCV values greater than 20% are regarded as high, whereas values less than 10% are considered to be low and values between 10 and 20% to be medium. Based on this argument, Days to 50% flowering, Days to maturity, Plant height(cm), Number of productive tillers/plant, Panicle length(cm), Panicle diameter (cm), Test weight (g), Plant stand showed low genotypic coefficient of variation while it was high in Dry fodder yield (kg/plot) and Grain yield (kg/plot). Low PCV values were recorded in Days to 50% flowering & Days to maturity; medium in Plant height(cm), Panicle length(cm), Panicle Diameter (cm), Test weight (g), Plant stand; high in Number of productive tillers/plant, Dry fodder yield (kg/plot) and Grain yield (kg/plot). It indicates that selection may be effective based on these characters with high and medium Phenotypic Coefficients of Variation (PCV) and Genotypic Coefficients of Variation (GCV) values and their phenotypic expression would be a good indication of genetic potential. Bhasker *et al.*[1] reported, plant height, productive tillers per plant and fodder yield per plot, exhibited high magnitude of GCV and PCV indicating the presence of wide genetic variability for these traits and moderate values of GCV and PCV were observed for 1000 grain weight, panicle diameter, panicle length and grain yield per plant.

Heritability and genetic advance: A heritability estimate for characters under study is given in Table 2. Heritability values are helpful in predicting the expected progress to be achieved through the process of selection. Genetic coefficient of variation along with heritability estimate provides a reliable estimate of the amount of genetic advance to be expected through phenotypic selection[13].

Heritability ranged from 13.72% for Plant stand to 94.09% for Grain yield. According to Singh[12], heritability values greater than 80% are very high, values from 60-79% are moderately high, values from 40-59% are medium and values less than 40% are low. Accordingly, heritability estimate was very high (80%) for Grain yield followed by Days to maturity. Days to 50% flowering and Test weight has shown moderately high heritability and Dry fodder yield was medium. Plant height, Number of productive tillers/plant, Panicle length, Panicle Diameter (cm) and Plant stand recorded low heritability values. Heritability of Test weight and Grain yield was highest, whereas the Number of productive tillers had low heritability[14]. Very high heritability indicates selection will be effective.

Johnson *et al*.[5] classified genetic advance as percentage of mean (GAM); values from 0-10% are low, 10-20% are moderate and 20% and above are high. Based on this delineation, the range for GAM was from 5.91% (panicle length) to 67.22% (grain yield). High GAM was recorded for Dry fodder yield and Grain yield and medium for

Test weight. The lowest genetic advance as percentage of mean were for Days to 50% flowering, Days to maturity, Plant height, Number of productive tillers/plant, Panicle length, Panicle diameter and Plant stand. Sharma *et al.*[10] reported high heritability values coupled with high genetic advance as percent of mean for number of effective tillers per plant, grain yield and seed size.

Traits like Dry fodder yield and Grain yield had high Phenotypic Coefficients of Variation, Genotypic Coefficients of Variation, high heritability and high genetic advance as a percent of mean which are very important for selection than heritability estimates alone. Phenotypic selection for these characters will be effective.

Association among characters: The genotypic correlations of grain yield with other characters are indicated in Table 3. Grain yield is the result of many characters which are interdependent. Breeders always look for genetic variation among traits to select desirable types. Some of these characters are highly associated among themselves and with Grain yield. The analysis of the relationship among these characters and their association with Grain yield is essential to establish selection criteria[11].

Seed yield showed highly significant positive correlation with plant height (r=0.422). This indicates short stature is correlated with higher yield in pearl millet and highly influencing trait for Grain yield. Similarly, among panicle traits, Panicle diameter (r=0.1865) followed by Panicle length (r=0.1851) had significant positive correlation, which reveals panicle diameter is more important selection criteria than the Panicle length. However, non-significant positive correlation was observed with Test weight (r=0.0529) followed by Number of productive tillers/plant (r=0.0393) and Days to maturity (r=0.0117). The traits, number of effective tillers per plant, ear length, ear girth and seed density showed positive association with grain yield[10].

Dry fodder yield exhibited highly positive significant association with days to 50% flowering (r=0.3117) followed by Days to maturity (r=0.2416) which indicates duration had much related with Dry fodder yield than any other traits. Similarly, highly significant negative correlation was observed with Number of productive tillers/plant(r=-0.4526) followed by Panicle length (r=-0.3487). These two traits are negative selection criteria for increasing Dry fodder yield.

Panicle diameter(r=0.2192) and Plant height (r=0.1929) showed significant positive correlation with Test weight. However, Number of productive tillers/plant had highly significant negative correlation(r=-0.4470). Panicle diameter showed highly significant positive association with panicle length (r=0.2797) followed by plant height (r=0.2270). Similarly, Panicle length had significant positive association with Plant height (r=0.2811) followed by Number of productive tillers/plant (r=0.2071). However, Days to maturity(r=-0.2073) had high significant negative correlation.

Table 1: Analysis of Variance for Grain yield and yield contributing characters in Pearl millet (*Pennisetum glaucum L.*) hybrids evaluated at RARS, Palem during *Kharif*, 2018

Source of Variation	Degrees of Freedom	Days to 50% flowering	Days to maturity	Plant height(cm)	No. of productive tillers/plant	Panicle length(cm)	Panicle Diameter (cm)	Test weight (g)	Plant stand	Dry fodder yield (kg/plot)	Grain Yield (kg/plot)
Replications	2	3.500	0.315	339.894	1.719	41.956	0.718	16.580	4.900	2.459	0.021
Treatments	37	18.920**	33.950**	372.628**	0.561	8.249*	0.142**	7.034**	8.388	0.679**	0.078**
Error	74	2.752	1.369	159.894	0.367	4.370	0.049	0.948	5.678	0.139	0.001

**Significant at 5 % level of significance.*

*** Significant at 1 % level of significance.*

Table 2: Genetic parameters for Yield and yield contributing characters in Pearl millet (*Pennisetum glaucum L.*) hybrids evaluated at RARS, Palem during *Kharif*, 2018

Traits	Mean	Range	Vg	Vp	GCV %	PCV %	h^2 (B.S)	Genetic advance as % mean
Days to 50% Flowering	48.11	44.33 - 54.00	5.38	8.14	4.82	5.93	66.20	8.08
Days to Maturity	78.55	74.00 - 85.33	10.86	12.23	4.19	4.45	88.80	8.14
Plant Height(cm)	132.60	107.00 - 151.33	70.91	230.80	6.35	11.45	30.72	7.25
Number of Productive tillers/plant	2.92	2.0 -4.0	0.06	0.43	8.66	22.44	14.91	6.89
Panicle Length(cm)	18.93	14.66 - 23.00	1.29	5.66	6.00	12.56	22.83	5.91
Panicle Diameter (cm)	2.62	2.20 - 3.30	0.03	0.08	6.70	10.83	38.30	8.54
Test Weight (g)	16.25	12.66 - 18.33	2.02	2.97	8.76	10.61	68.15	14.90
Plant Stand	20.20	16.66 - 24.00	0.90	6.58	4.70	12.69	13.72	3.59
Dry Fodder Yield (kg/plot)	2.05	1.11 - 3.20	0.18	0.32	20.61	27.44	56.41	31.88
Grain Yield (kg/plot)	0.476	0.22 - 1.09	0.025	0.027	33.64	34.68	94.09	67.22

Table 3: Genetic Correlation Coefficients of grain yield with yield contributing characters in Pearl millet (*Pennisetum glaucum L.*) hybrids evaluated at RARS, Palem during *Kharif*, 2018

Character(s)	Days to 50% Flowering	Days to maturity	Plant Height (cm)	Number of Productive Tillers/plant	Panicle Length (cm)	Panicle Diameter (cm)	Test Weight (g)	Dry fodder yield (kg/plot)	Grain Yield (kg/ha)
Days to 50% Flowering	1.0000	0.9031**	-0.2226**	0.0491	-0.0154	-0.0336	-0.0447	0.3117**	0.0322
Days to Maturity		1.0000	-0.2960**	-0.1524	-0.2073**	0.0445	-0.0180	0.2416**	0.0117
Plant Height (cm)			1.0000	-0.0548	0.2811	0.2270**	0.1929*	0.0875	0.4226**
Number of Productive Tillers/plant				1.0000	0.2071**	-0.0180	-0.4470**	-0.4526**	0.0393
Panicle Length (cm)					1.0000	0.2797**	0.1669	-0.3487**	0.1851*
Panicle Diameter (cm)						1.0000	0.2192*	0.0625	0.1865*
Test Weight (g)							1.0000	0.1222	0.0529
Dry Fodder Yield (kg/plot)								1.000	0.0830

*Significant at 0.05 probability, **Significant at 0.01 probability.

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