The Pharma Innovation Journal 2022; 11(12): 6143-6145

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(12): 6143-6145

www.thepharmajournal.com
Received: 09-10-2022
Accepted: 18-11-2022

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Selection criteria for grain yield in barnyard millet (*Echinochloa frumentacea*) in association with yield contributing traits

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Abstract
Eighteen barnyard millet genotypes were evaluated under rainfed condition at Regional Agricultural Research Station, Palem. Experiment was conducted in a replicated trial and biometric characters were recorded. The traits *i.e.*, plant height (cm) and grain yield (kg/ha) have shown high phenotypic coefficient of variation, genotypic coefficient of variation and heritability. Fodder yield (kg/ha) and Days to 50% flowering have positive association with grain yield. High direct effect on grain yield was recorded for number of productive tillers per plant. This study infers that number of productive tillers, days to maturity and days to 50% flowering can contribute for increasing grain yield in barnyard millet.

Keywords: Genetic parameters, correlation coefficient, path analysis, barnyard millet

Introduction

Millets are group of small grained cereal food crops which are gaining importance because of their nutritional value and adaptability to drought and varied soil conditions. Realizing the nutraceutical values of small millets, they are now considered as "nutria-cereals". Barnyard millet is one among the small millets which is the fastest growing of all millets. It is cultivated mainly for the nutritious grains and the straw has a good fodder value. It has fair source of protein, which is highly digestible and is an excellent source of dietary fibre. The carbohydrate content is low and slowly digestible, which makes the barnyard millet a nature's gift for the modern mankind who is engaged in sedentary activities. It is an excellent source of Fe content which ranged from 2.29 to 18.00 mg/100 g (Renganathan *et al.*, 2017) [9]. Studies on correlation provide cognition of association among different traits and yield which results in selecting genotypes possessing desired traits for genetic improvement of yield. The path coefficient analysis is nothing but a standardized partial regression of coefficient which splits the correlation coefficient into the measures of direct and indirect effects, in other words, it measures the direct and indirect contribution of various independent traits on a dependent character. The present research was undertaken to assess the nature of genetic parameters, correlation and path analysis in different diverged genotypes of barnyard millet to develop a criterion for selection that could be effectively used for selecting the favourable genotypes for high yield potential in future.

Material and Methods

Advanced barnyard millet breeding lines of 18 numbers were received from All India Coordinated Small Millets Improvement Project (AICSMIP), IIMR, Hyderabad. These genotypes were evaluated in a replicated trial along with two national checks and one local check. The field experiment was conducted at Regional Agricultural Research Station, Palem (16^0 30'18" N latitude and $78^0$19' E longitude and 458 m mean sea level) during *Kharif*, 2020 under rainfed condition. The rainfall received during the crop growing period was 475 mm. Observations on days to 50% flowering, plant height (cm), days to maturity, number of productive tillers per plant, grain yield (kg/ha) and fodder yield (kg/ha) were recorded. The data was analyzed for genetic parameters, correlation and path coefficient analysis using INDOSTAT.

Results and Discussion

The analysis of variance showed significant variability for all the traits studied. High phenotypic coefficient of variation (PCV) was recorded for the trait number productive tillers and high genotypic coefficient of variation (GCV) was exhibited by the trait plant height among the traits studied (Table 1). 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. Low GCV was recorded by all the traits (below 10%). Plant height (cm), number of productive tillers and grain yield (kg/ha) have exhibited high PCV values (values between 10% to 20%). Low PCV values (below 10%) has shown by days to 50% flowering, days to maturity and fodder yield (kg/ha). It indicates that selection may be effective based on these characters with high PCV and their phenotypic expression would be a good indication of genetic potential. Similar results also reported by Rao and Agrawal (2000) [8] in barnyard millet;

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. The traits recorded high broad sense heritability were days to maturity (75.61%), grain yield (56.59), days to 50% flowering (54.75) and plant height (54.01). High GAM was recorded for grain yield, fodder yield and plant height. Traits like grain yield and plant height 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. Similar results have also in agreement with the result of Selvarani and Chandirasekaran (2000) [10]; Rao and Agrawal (2000) [8] in barnyard millet

The genotypic and phenotypic correlations of grain yield with other characters are indicated in Table 2. 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.

Grain yield showed highly significant positive correlation with number of productive tillers (r_g =0.447, r_p= 0.431), which reveals this trait is more important selection criteria than the other traits. Days to 50% flowering (r_g= 0.352) and days to maturity (r_g=0.257) shown positive association with grain yield genotypically indicating that late maturing types are high yielders. Arunachalam *et al.* (2008) reported that the early maturing types were poor yielders and *vice vers*a. Similar results were also reported by Gupta *et al.* (2009) [4], Upadhaya *et al*. (2014), Sood *et al.* (2015) [11], Joshi *et al.* (2015) [5] and Arya *et al.* (2017) [2] in barnyard millet. Similarly negative association was observed with plant height (r_g=-0.438). Fodder yield (r_p=0.414) and Days to 50% flowering (r_p=0.257) have positive association with grain yield phenotypically, which infers that these traits were played a role in yield improvement.

The effect of quantitative traits on grain yield was unconfounded through path coefficient analysis (Table 3). Path coefficient analysis as outlined by Dewey and Lu (1959) [3] was carried out to split the correlation coefficients in to measure the direct and indirect effects. The estimated coefficients were then categorized as negligible, low, moderate, high and very high based on the scales suggested by Lenka and Mishra (1973) [6]. Number of productive tillers recorded high direct effect (0.760) followed by days to maturity (0.720) and days to 50% flowering (0.636) on grain yield (Prakash and Vanniarajan, 2015) [7]. Traits contributed to grain yield through number of productive tillers were days to 50% flowering (0.031) and plant height (0.002).

Based on the character association and their effects revealed in this study the traits namely number of productive tillers, days to maturity and days to 50% flowering can be concentrated for increasing grain yield in barnyard millet breeding programmes.

Table 1: Mean performance and genetic parameters of Barnyard millet genotypes

S. No	Traits	Range	Mean	GCV (%)	PCV (%)	Heritability (%)	Genetic gain (%)
1	Days to 50% flowering	**45-59**	53.57	7.14	9.85	54.75	13.64
2	Plant height (cm)	105.3-148.3	123.00	7.72	10.51	54.01	14.99
3	Days to maturity	79 – 94	88.41	5.16	6.95	75.61	9.12
4	Number of productive tillers	3.8 – 5.5	4.63	2.16	17.94	19.12	11.69
5	Grain yield (kg/ ha)	1511- 1946	1680.47	9.47	11.24	56.59	19.82
6	Fodder yield (kg/ha)	2785 - 3279	3046.25	3.63	9.24	48.21	18.75

Table 2: Genotypic correlation (upper) and phenotypic correlation (lower) of yield attributes in Barnyard millet

Traits	Days to 50% flowering	Plant height (cm)	Days to maturity	Number of productive tillers	Fodder yield (kg/ha)	Grain yield (kg/ ha)
Days to 50% flowering	1.000	0.710	0.998	0.352	-0.141	0.352
Plant height (cm)	0.593***	1.000	0.737	0.138	-0.150	-0.438
Days to maturity	0.956***	0.619***	1.000	0.258	-0.0.47	0.257
Number of productive tillers	0.049	0.207	0.026	1.000	0.140	0.447***
Fodder yield (kg/ha)	0.041	-0.292*	-0.0.47	-0.085	1.000	-0.223
Grain yield (kg/ ha)	0.257	0.006	0.174	0.431***	0.414	1.000

Table 3: Direct and indirect effects of quantitative traits on grain yield in Barnyard millet

Traits	Days to 50% flowering	Plant height (cm)	Days to maturity	Number of productive tillers	Fodder yield (kg/ha)
Days to 50% flowering	0.636	0.377	0.608	0.031	0.027
Plant height (cm)	0.004	0.008	0.005	0.002	-0.002
Days to maturity	0.401	-0.260	0.720	-0.011	0.020
Number of productive tillers	0.003	-0.012	-0.002	0.760	0.005
Fodder yield (kg/ha)	0.015	-0.107	-0.018	-0.031	0.365

Residual effect= 0.866

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