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Research Note

Genetic variability, character association and path analysis studies in Guinea grass (*Panicum maximum* Jacq.)

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Abstract
The present study was conducted to assess the magnitude of genetic variability, correlation and path analysis in Guinea grass genotypes for fodder yield and its component traits and quality parameters. The traits, green fodder yield per plant and crude protein content showed moderate PCV and GCV while the trait, crude fibre content showed low PCV and GCV. High heritability coupled with high genetic advance as per cent of mean was observed for number of leaves per plant, leaf weight and crude protein content and these characters were controlled by additive gene effects, hence selection of genotypes based on these traits would be effective in the improvement of both fodder yield and quality. Correlation and path analysis showed that due importance should be given for leaf weight, leaf stem ratio, plant height, number of tillers per plant and number of leaves per plant. Hence these traits may be considered as selection indices for guinea grass improvement programme.

Key words
Guinea grass, Genetic variability, correlation and path analysis.

The Guinea grasses (*Panicum maximum* Jacq.) are well established throughout tropical countries of both hemispheres where that play an important roles in dairy production. The species is extremely variable (Ramaswamy and Raman, 1971) and is poorly understood taxonomically and phylogenetically (Jouhar and Joshi, 1966). A green crop value should be in a position to give large quantity of quality fodder in an unit space and time and as such importance is given to the fodder yield. Though Guinea grass is in cultivation throughout the world and a good variability is available, concerted efforts have not been made adequately to categorize this variability and study the association among characters. As a result, the genetic improvement in Guinea grass for fodder yield and quality has become impasse. Hence an attempt was made to study the variability within the Guinea grass germplasm accessions for different biometrical traits and association among traits which could be further utilized in breeding programme.

The experimental material consisted of 60 germplasm accessions of Guinea grass (*Panicum maximum* Jacq.) obtained from various countries and maintained at Department of Forage Crops, Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore. The accessions were planted using rooted slips on one side of ridge of 4 metres length, adopting a spacing of 60 x 50 cm in a Randomized Block Design with two replications. All the agronomic practices were followed to maintain the crop stand. The biometrical observations on fodder yield were recorded on single plant basis at the time of harvesting as per descriptors for *Panicum miliaceum* L. (UPOV, 2007) and characterization of perennial *Panicum* species (Wouw *et al.*, 2008). For recording single plant observations, three plants from each entry/replication were randomly selected. Average of these three plants in respect of plant height, number of tillers and leaves per plant, leaf weight, leaf stem ratio, green fodder yield per plant and dry matter content. Same plants were subjected for the estimation of quality parameters such as crude protein, crude fibre and crude fat content. Statistical methods suggested by Burton (1952) for variability, Lush (1940) for heritability, Johnson *et al.* (1955) for genetic advance as percent of mean were adopted to find out the respective estimates. Further categorization of estimates was made based on the suggestions of Sivasubramanian and Madhavamenon (1973) for variability, Johnson *et al.* (1955) for heritability and genetic advance as percent of mean. Genotypic and phenotypic correlations were partitioned into path coefficient analysis using the technique outlined by Dewey and Lu (1959).

Analysis of variance revealed highly significant differences among accessions for all the characters under investigation thereby indicating the presence of a considerable magnitude of genetic variability among the experimental material (Table 1). The general mean value for each trait and its range among the genotypes and estimates of genetic parameters like phenotypic and genotypic coefficient of variation, heritability and genetic advance are presented in Table 2.

Variability: In general, the estimates of phenotypic coefficient of variation (PCV) were higher than the estimates of genotypic coefficient of variation (GCV) for all the traits under study indicating the environmental influence over the traits. The high and moderate estimates of PCV and GCV were observed for number of tillers per plant (22.52, 12.92), number of leaves per plant (20.27, 17.05), leaf weight (20.84, 16.76) and leaf stem ratio (21.28, 16.42) respectively. It is in accordance with the findings of Vedansh *et al.* (2010), Jain *et al.* (2011), Govindaraj *et al.* (2011) and Nirmalakumari *et al.* (2013).

Moderate PCV and GCV were observed for green fodder yield per plant (12.87, 10.30) and crude protein content (13.35, 11.42) respectively. Similar results were reported by Vidyadhar *et al.* (2007). Selection will be effective based on the heritable nature of these traits.

Low estimates of PCV (7.57) and GCV (7.39) were observed for crude fibre content which is highly influenced by the environment and selection would be ineffective. This was in agreement with findings of Suthamathi and Dorairaj (1997).

<u>Heritability and genetic advance</u>**:** High heritability coupled with high genetic advance as per cent of mean was observed for number of leaves per plant (70.73, 29.54), leaf weight (64.66, 27.77) and crude protein content (73.33, 20.19) respectively which indicates the lesser influence of environment in expression of these characters and prevalence of additive gene action in their inheritance, hence selection of these traits in breeding program would facilitate the improvement of both fodder yield and quality. It is in accordance with the findings of Bibi *et al.* (2012) and Jain and Patel (2012).

Moderate heritability (30.00) coupled with high genetic advance as per cent of mean (27.27) was recorded for leaf stem ratio which revealed the additive gene effects coupled with high environmental impact. The present results are in agreement with the findings of Mohamed Subi and Idris (2013) and Krishna *et al.* (2013).

Moderate heritability coupled with moderate genetic advance as per cent of mean was recorded for number of tillers per plant (32.88, 15.27) and crude fat content (40.00, 13.10) respectively which indicate that these characters are influenced by environment and hence selection would be ineffective. Low heritability coupled with low genetic advance as per cent of mean was observed for plant height (22.68, 5.39) and dry matter content (25.00, 9.00) respectively thereby indicating that these characters were highly influenced by environment and selection would be ineffective. This was in agreement with the findings of Mohamed Subi and Idris (2013).

<u>Correlation and path analysis:</u> In the present investigation, the correlation coefficients were estimated among different characters are presented in Table 3. Green fodder yield per plant was highly significant and positively associated with number of tillers and leaves per plant, leaf weight and dry matter content. This was in close agreement with early findings of Iyanar *et al.* (2010). Interestingly, there were significant correlation exist among the above characters as well as green fodder yield per plant which, suggested that these characters may be considered for improvement of fodder yield. Hence, based on these relationships, presumed that for improving fodder yield in Guinea grass, a model plant type would be that increased number of tillers and leaves per plant, highest leaf weight and dry matter content.

Among the yield components, number of leaves per plant and leaf weight had positive and significant correlation with crude protein content, while both characters were showed negative and significant association with crude fibre content. This is also a desirable association because favourable fodder quantity and quality could be easily combined. Similar findings with regard to number of leaves with crude protein content were reported by Sukhchain and Siddhu (1992), Manickam and Vijendra Das (1994) and Basheeruddin *et al.* (1999).

Path analysis partitions the total correlation coefficient into direct and indirect effects and measures the relative importance of the causal factor (Dewey and Lu, 1959). In the present study, green fodder yield was considered as dependent character and other characters were taken as independent characters. The results of path analysis are presented in Table 4 and the same depicted in Figure 1. The component of residual effect of path analysis was 0.047. The lower residual effect indicated that the characters chosen for path analysis were adequate and appropriate. Leaf weight had very high positive direct effect on green fodder yield indicating that there is always scope for enhancement of fodder yield by selection of this trait. The present results are in agreement with findings of Raut *et al.* (1992), Patel *et al.* (2005), Bahadur and Lodhi (2009) and Jain and Patel (2012). The trait leaf stem ratio had a high negative direct effect on green fodder yield per plant.

Among the traits, leaf weight had high positive indirect effect via number of tillers per plant, number of leaves per plant and leaf stem ratio. However leaf weight had high negative indirect via plant height. Leaf stem ratio had high indirect effect via plant height and moderate negative indirect via number of tillers per plants and leaves per plant on green fodder yield. This was in accordance with the findings of Iyanar *et al.* (2010). Hence, selection for either one of the components will have an adverse effect on the other and lead to effect in yield.

In the present study, genetic analysis showed that high heritability coupled with high genetic advance as per cent of mean was recorded by number of leaves per plant, leaf weight and crude protein content while moderate heritability and high genetic advance as per cent of mean was observed for leaf stem ratio which implies that these characters were under the control of additive type of gene action. Therefore, selection of these traits would offer scope for improvement of both green fodder yield and quality in Guinea grass. Correlation and path analysis showed that due importance should be given for leaf weight, leaf stem ratio, plant height, number of tillers per plant and number of leaves per plant. Hence these traits may be considered as selection indices for guinea grass improvement programme.

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Table 1. ANOVA showing values of mean squares for different characters in Guinea grass

Source of variation	Plant height (cm)	Number of tillers per plant	Number of leaves per plant	Leaf weight (g)	Leaf stem ratio	Green fodder yield per plant (g)	Dry matter content (%)	Crude protein (%)	Crude fibre (%)	Crude fat (%)
Treatment	527.18*	20.45**	2152.79**	792.64**	0.0078**	5001.93**	19.44*	2.85**	8.52**	0.07**
Error	332.26	10.32	369.01	170.12	0.0020	1097.98	11.68	0.44	0.21	0.03

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

Table 2. Estimates of variability parameters for different biometrical traits in Guinea grass

Characters	General Mean	Range	PCV (%)	GCV (%)	Heritability (h^2)	GA as per cent of mean
Plant height (cm)	179.81	120.33 - 201.00	11.53	5.49	22.68	5.39
Number of tillers per plant	17.42	12.00 - 28.50	22.52	12.92	32.88	15.27
Number of leaves per plant	175.17	116.50 - 246.50	20.27	17.05	70.73	29.54
Leaf weight (g)	105.27	75.60 - 204.78	20.84	16.76	64.66	27.77
Leaf stem ratio	0.33	0.24 - 0.57	21.28	16.42	30.00	27.27
Green fodder yield per plant (g)	429.03	320.00 - 587.13	12.87	10.30	64.00	16.97
Dry matter content (%)	22.51	14.48 - 30.97	17.52	8.75	25.00	9.00
Crude protein content (%)	9.62	7.09 - 13.53	13.35	11.42	73.33	20.19
Crude fibre content (%)	27.58	23.00 - 33.50	7.57	7.39	95.41	14.86
Crude fat content (%)	1.45	1.17 - 2.00	15.15	9.91	40.00	13.10

Table 3. Correlation coefficients of green fodder yield and yield components

Characters	Number of tillers per plant	Number of leaves per plant	Leaf weight (g)	Leaf stem ratio	Dry matter content (%)	Crude protein (%)	Crude fibre (%)	Crude fat (%)	Green fodder yield per plant (g)
Plant height (cm)	-0.387**	-0.941**	-0.582**	-0.763**	0.257*	-0.140	0.696**	-0.154	-0.063
Number of tillers per plant		0.971**	0.629**	0.533**	0.163	0.119	-0.322**	-0.261*	0.412**
Number of leaves per plant			0.623**	0.514**	-0.040	0.248*	-0.540**	0.041	0.406**
Leaf weight (g)				0.679**	0.077	0.257*	-0.235*	0.031	0.741**
Leaf stem ratio					-0.334**	0.175	-0.351**	0.273*	0.024
Dry matter content (%)						0.243*	0.484**	-0.713**	0.458**
Crude protein (%)							-0.377**	-0.092	0.204
Crude fibre (%)								-0.202	-0.009
Crude fat (%)									-0.206
Green fodder yield per plant (g)									

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

Table 4. Path coefficient analysis of different characters with green fodder yield per plant

Characters	Plant height (cm)	Number of tillers per plant	Number of leaves per plant	Leaf weight (g)	Leaf stem ratio	Dry matter content (%)	Crude protein (%)	Crude fibre (%)	Crude fat (%)	Green fodder yield per plant
Plant height (cm)	**0.068**	-0.026	-0.064	-0.040	-0.052	0.018	-0.010	0.047	-0.011	-0.063
Number of tillers/plant	-0.065	**0.167**	0.162	0.105	0.089	0.027	0.020	-0.054	-0.044	0.412**
Number of leaves/plant	0.148	-0.153	**-0.157**	-0.098	-0.081	0.006	-0.039	0.085	-0.007	0.406**
Leaf weight (g)	-0.727	0.786	0.778	**1.249**	0.847	0.096	0.321	-0.294	0.039	0.741**
Leaf stem ratio	0.602	-0.420	-0.406	-0.535	**-0.789**	0.263	-0.138	0.277	-0.216	0.024
Dry matter content (%)	0.085	0.054	-0.013	0.025	-0.111	**0.332**	0.081	0.160	-0.236	0.458**
Crude protein (%)	0.013	-0.011	-0.024	-0.025	-0.017	-0.023	**-0.095**	0.036	0.009	0.204
Crude fibre (%)	0.155	0.072	0.121	0.053	0.078	-0.108	0.084	**-0.223**	0.045	-0.009
Crude fat (%)	-0.033	-0.056	0.003	0.007	0.058	-0.152	-0.196	-0.043	**0.124**	-0.206

Residual effect = 0.047 *, ** Significant at 5 and 1 percent level respectively Diagonal values (bold) are direct effects

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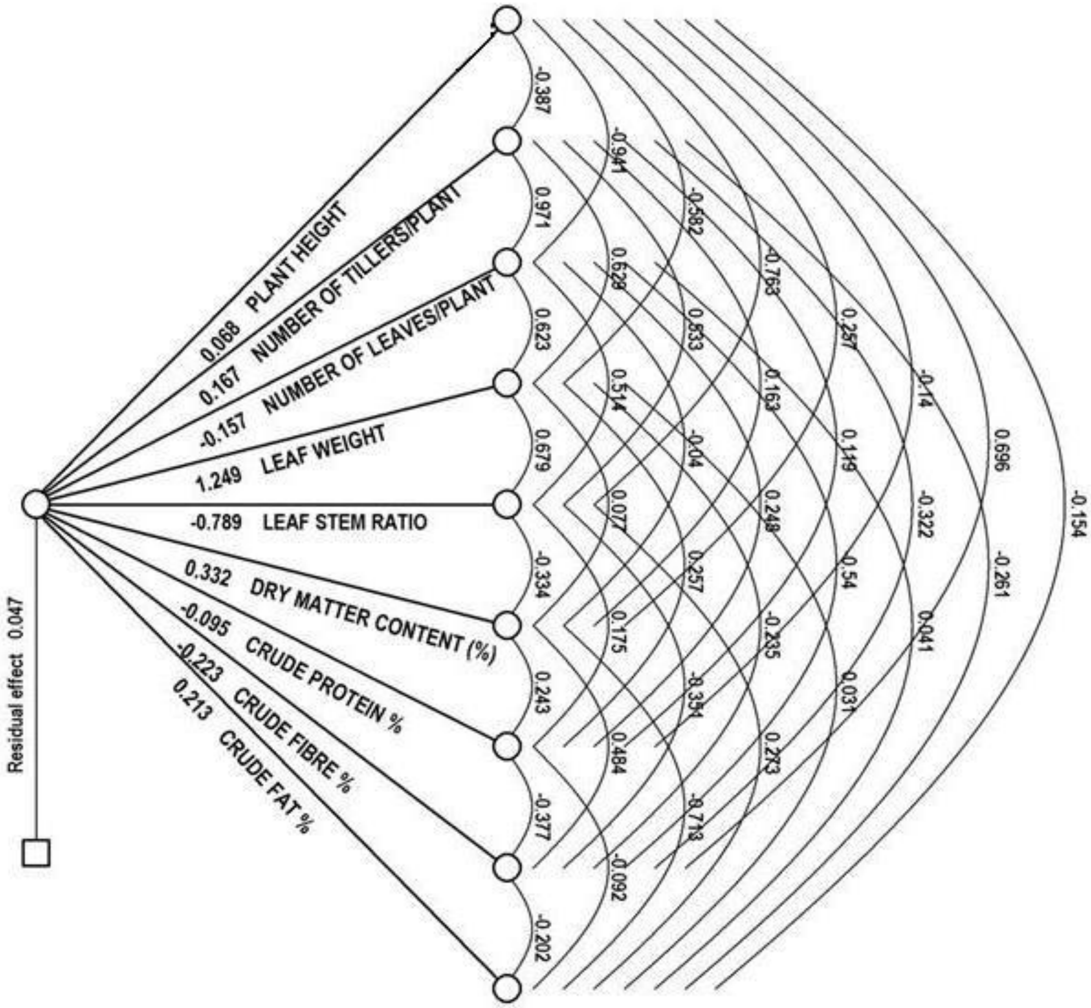

Fig. 1. Genotypical path diagram for green fodder yield per plant