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GENETIC VARIABILITY STUDIES IN INDIGENOUS ACCESSIONS OF GUINEA GRASS TO EXPLORE FOR ENHANCED GREEN FODDER YIELD

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SUMMARY

Guinea grass is one of the promising grass fodder crop originated from Africa and introduced into India. It plays a major role in livestock productivity due to its higher biomass and shorter duration. Though enough variability is present in Guinea grass, studies were limited in ascertaining its genetic variability. The present study was carried out in 75 accessions explored from different parts of India to estimate the magnitude of genetic variability, correlation and path analysis in Guinea grass for green fodder yield and its associated traits. The data recorded in the replicated experiment on different yield contributing traits revealed moderate PCV and GCV for the traits *viz*., number of tillers and leaf weight. High heritability coupled with moderate genetic advance was recorded in plant height and number of tillers while moderate heritability and genetic advance were observed in leaf weight. It implies that these traits are controlled by non additive gene action and direct selection may not be effective. Hence, further improvement in green fodder yield is feasible only through creation of variability followed by selection. Association studies revealed that plant height, leaf length, leaf breath and leaf weight were significantly and positively associated with green fodder yield. The trait leaf weight exhibited high direct effect on green fodder yield. Therefore, selection for these associated traits would be effective for enhancing the green fodder yield in Guinea grass.

Key words : Guinea grass, variability, association study, green fodder yield

Guinea grass (*Panicum maximum*) is a perennial forage grass and native to Africa (Pieterse *et al*., 1997). It is well adapted to medium fertile soil with rainfall of more than 600 mm (Fanindi *et al.,* 2019). It also mitigates the soil erosion due to its deep and fibrous root system (Humphers and Partridge, 1995 and Jank *et al.,* 2010). It possesses good forage value of clump forming nature. In general, the feeding value of forage crop is determined by its availability, accessibility, nutrient availability and the level of anti nutritional compounds (Dynes and Schlink, 2002). In Guinea grass, the usage of toxic chemical is zero due to its resistant nature against insect – pest and diseases and hence it is termed as eco-friendly fodder crop. Thus, it is well suited for pasture land and does not cause any detrimental effect to the grazing animals. Although diverse germplasm of Guinea grass is available in worldwide, sufficient study was not made in its genetic variability for green fodder yield and its associated traits. Hence, the present study was made to characterize the 75 accessions of Guinea grass through variability and association analysis for further utilization in the breeding programme towards the improvement of green fodder yield.

MATERIALS AND METHODS

The present study was comprised of 75 accessions explored from different parts of India and maintained at Department of Forage Crops, Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore. Explored accessions were planted during *rabi*, 2021 with a spacing of 50 cm × 50 cm in a randomized block design with two replications. All the recommended package of practices was followed. The seven phenotypic traits were recorded on three individual plants per replication *viz*., plant height, number of tillers, leaf length, leaf breath, leaf weight, leaf stem ratio and green fodder yield. Data were analyzed to identify the variability among the accessions and the association of different traits in the accessions.

Variability was studied in terms of phenotypic and genotypic variance which was arrived using standard methods. PCV and GCV were estimated by following the method of Sivasubramanian and Menon (1973): above 20% - high coefficient of variation, 10-20% - medium coefficient of variation and below 10% - low coefficient of variation. Heritability (h^2) in broad sense and genetic advance (GA) were worked out based on the category suggested by Allard (1960) and Johnson *et al.* (1995) respectively. The heritability per cent was categorized by Robinson *et al.* in 1949: less than 30% - low heritability, 31-60 – medium heritability and more than 60% - high heritability. Similarly, Johnson *et al.* (1955) classified genetic advance as per cent of mean (GAM) as different category: less than 10% – low GAM, 10-20 % – moderate GAM and more than 20% – high GAM.

In addition, obtained data were analyzed to assess the association between green fodder yield and its attributed traits. Correlation coefficient was computed by following the procedure given by Singh and Chaudhary. The relative influence of yield components on yield by themselves (direct effects) and through other traits (indirect effects) was evaluated by the method of path coefficient analysis as suggested by Dewey and Lu (1959). In path analysis, correlation coefficient was partitioned into its direct and indirect effects. The direct and indirect effect classifications were given by Lenka and Misra, 1973: More than 1.00 – very high, 0.30 to 0.99 – high, 0.20 to 0.29- Moderate, 0.10 to 0.19 – low and 0.0 to 0.09 – negligible.

RESULTS AND DISCUSSION

Analysis of variance exhibited significant differences among the genotypes for all traits except leaf stem ratio (Table 1) and graphical representation of green fodder yield in studied accessions is depicted in Fig. 1. The mean and variability parameters are depicted as values in Table 2 and graphically represented in Fig. 2. The results revealed that the presence of high PCV with moderate GCV for the trait green fodder yield (21.83, 10.81 respectively) and moderate PCV and GCV observed for the traits *viz*., number of tillers (14.1, 11.69 respectively) and leaf width (15.52, 11.51 respectively). Moderate with low PCV and GCV was recorded for plant height (10.27, 5.76 respectively), leaf length (10.37, 5.76 respectively) and leaf breath (16.25, 8.76 respectively) and low PCV and GCV was registered by leaf stem ratio (7.38, 1.29 respectively). Similar results were obtained by Subbhulakshmi *et al.,* 2018 and Vidyadhar *et al.,* 2006.

High heritability coupled with moderate genetic advance as per cent of mean was noticed for the traits *viz*., plant height (0.74, 15.73) and number of tillers (0.68, 19.86) respectively. Moderate heritability and genetic advance as per cent of mean was recorded in leaf weight (0.55, 15.73 respectively). Moderate heritability with low genetic advance as per cent of mean was observed for leaf length (0.31, 6.58 respectively). Low heritability with moderate genetic advance as per cent of mean was registered by green fodder yield (0.25 and 11.05, respectively). Low heritability and genetic advance as per cent of mean recorded in leaf breath (0.29, 9.74 respectively) and leaf stem ratio (0.03 and 0.47, respectively). Similar results were observed by Subbhulakshmi *et al.,* 2018.

The results of correlation study were depicted

TABLE 1

ANNOVA of mean sum of squares for green fodder yield and its associated traits in genotypes of Guinea grass

Sources of variation	Degrees of freedom	Plant height (cm)	Number of tillers	Leaf length (cm)	Leaf bradth (cm)	Leaf weight (g)	Leaf stem ratio	Green fodder yield (g)
Treatment	74	441.80**	7.98**	40.38**	0.08**	448.79**	0.0014	8086.03**
Error	74	64.93	1.52	21.35	0.04	130.33	0.0013	4897.52

**Significant at 1% level.

TABLE 2

Estimates of variance (PCV & GCV), heritability (h^2) and genetic advance as per mean (GAM) for green fodder yield and its associated traits in guinea grass

Traits	Mean	GCV	PCV	Heritability	GAM
Plant height (cm)	155.06	8.85	10.27	0.74	15.73
Number of tillers	15.38	11.69	14.17	0.68	19.86
Leaf length (cm)	53.60	5.76	10.37	0.31	6.58
Leaf breath (cm)	1.53	8.76	16.25	0.29	9.74
Leaf weight (g)	109.64	11.51	15.52	0.55	17.58
Leaf stem ratio	0.50	1.29	7.38	0.03	0.47
Green fodder yield (g)	368.96	10.82	21.84	0.25	11.05

in Table 3 and it is also represented in heat map (Fig. 3). In heat map, the value -1 indicates a perfectly negative linear correlation between two variables, 0 indicates no linear correlation between two variables and 1 indicates a perfectly positive linear correlation between two variables. It revealed that the direct correlation of the traits *viz*., plant height, leaf length, leaf breath and leaf weight exhibited positive and significant association with the complex trait of green fodder yield. Similar results were reported by Ramakrishnan *et al.* (2019), Jain and Patel (2012), Jain *et al*. (2011) and Iyanar *et al*. (2010). The inter correlation of plant height registered positive and significant association with the traits *viz*., number of tillers and leaf breath. Number of tillers also recorded positive and significant association with leaf breath. Leaf weight recorded positive and significant association with leaf stem ratio. Similar observations were reported by Jain and Patel (2012), Jain *et al*. (2011) and Basheeruddin *et al.* (1999). Among the traits, plant height, leaf length and leaf breath had significant moderate direct effect on green fodder yield and the trait leaf weight had high direct effect on green fodder yield (Table 4). It was found similar with the results recorded by Ramakrishnan *et al.* (2019), Jain and Patel (2012) and Basheeruddin *et al.* (1999).

CONCLUSION

Current study revealed that the moderate PCV and GCV recorded for the traits *viz*., number of tillers and leaf weight. High heritability coupled with moderate genetic advance was recorded in plant height and number of tillers while moderate heritability and genetic advance as per cent of mean were observed in leaf weight. It indicates that the selection may not be effective in these populations due to the presence of non additive gene action. Since a sufficient variation does not exist among these populations, creation of variability followed by selection would be the right choice for further enhancement of biomass in this crop. However, plant height, leaf length, leaf breath and leaf weight was significantly and positively associated with green fodder yield. The trait leaf weight exhibited high direct effect on green fodder yield. Hence, the green fodder yield in Guinea grass could easily be enhanced through the selection for these associated traits.

TABLE 3

Correlation coefficients of green fodder yield and its attributing traits in Guinea grass

S. No.	Traits	Plant height (cm)	Number of tillers	Leaf length (cm)	Leaf breadth (cm)	Leaf weight (g)	Leaf stem ratio	Green fodder yield (g)
1.	Plant height (cm)	1.000	0.362**	0.159	0.408**	-0.052	-0.114	0.287*
2.	Number of tillers		1.000	0.103	0.323**	0.009	0.002	0.122
3.	Leaf length (cm)			1.000	0.178	0.092	-0.121	0.246*
4.	Leaf breath (cm)				1.000	0.176	-0.049	0.274*
5.	Leaf weight (g)					1.000	0.364**	0.567**
6.	Leaf stem ratio						1.000	0.024
7.	Green fodder yield (g)							1.000

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

TABLE 4

Direct (diagonal) and indirect effects of yield attributing traits on green fodder yield in Guinea grass

S. No.	Traits	Plant height (cm)	Number of tillers	Leaf length (cm)	Leaf breadth (cm)	Leaf weight (g)	Leaf stem ratio	Green fodder yield (g)
1.	Plant height (cm)	0.393	-0.010	0.094	0.066	-0.054	-0.071	0.287*
2.	Number of tillers	0.136	-0.028	0.046	0.058	0.022	-0.015	0.122
3.	Leaf length (cm)	0.108	-0.004	0.343	0.045	0.100	-0.093	0.246*
4.	Leaf breath (cm)	0.207	-0.013	0.124	0.125	0.194	-0.053	0.274*
5.	Leaf weight (g)	-0.033	-0.001	0.054	0.039	0.635	0.146	0.567**
6.	Leaf stem ratio	-0.268	0.004	-0.308	-0.064	0.897	0.104	0.024

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

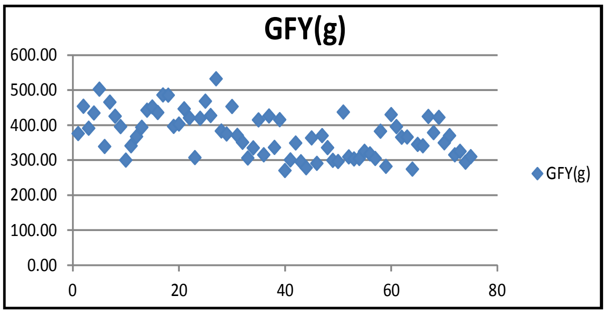

Fig. 1. Scatter plot for green fodder yield in Guinea grass germplasm.

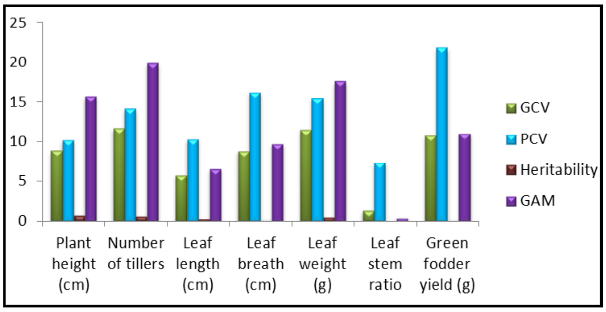

Fig. 2. Graphical representation of variability parameters in Guinea grass.

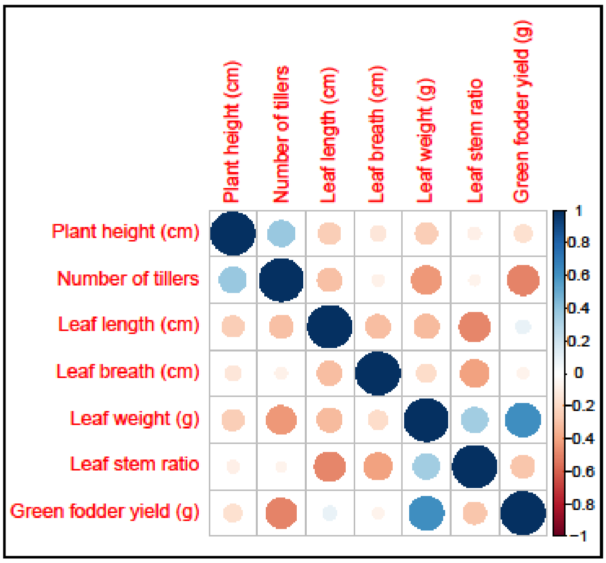

Fig. 3. Heat map for correlation coefficients of green fodder yield and its attributing traits in Guinea grass germplasm.

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