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PER SE PERFORMANCE OF GENOTYPES AND ASSOCIATION STUDIES IN GUINEA GRASS (*PANICUM MAXIMUM* JACQ.)

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SUMMARY

Evaluation of 60 Guinea grass genotypes collected from various sources was carried out. Observations were recorded on plant height, number of tillers per plant, number of leaves per plant, leaf weight, leaf stem ratio, green fodder yield per plant and dry matter content along with quality traits such as crude protein content, crude fibre content, crude fat content of the grass and analyzed statistically. Among the genotypes, GGLC 12, GGLC 19, FD 679 and GGLC 1 were recorded the highest mean value of fodder yield and crude protein content. Correlation analysis revealed that green fodder yield per plant was positively and significantly correlated with number of tillers per plant, number of leaves per plant, leaf weight and dry matter content. However negative association was observed with crude fibre content, crude fat content. Hence selecting Guinea grass genotypes with more number of tillers per plant, number of leaves per plant, leaf weight and crude protein content will help to improve fodder yield and quality. On account of this *per se* performance and trait association it has been found that genotypes GGLC 12, GGLC 19, FD 679 and GGLC 1 were potential genotypes for yield and quality.

Key words : Guinea grass - *Per se* performance - association analysis, evaluation

Guinea grass (*Panicum maximum* Jacq.) belongs to the family poaceae, plays an important role as feed and forage in intensive livestock system in the tropics and subtropics. Among the irrigated fodder crops, Guinea grass occupies a unique place, because, apart from its high yield and nutritional content and wider adaptability to diverse ecological niches, the crop is also drought hardy and shade tolerant. In India, a wide range of variability in vegetative characters is available in Guinea grass, but very little attention has been paid for its genetic improvement. Selection of high yielding types with desired quality attributes is very essential to meet the fodder needs of the country. Hence, evaluation or screening of germplasm is the first step in any improvement programme to select high yielding types with all desirable attributes. The genetic correlation of yield components is an ideal tool for selecting suitable genotypes and such information is inadequate in this crop. This is very helpful for a plant breeder in developing a commercial variety with market preference by determining the component characters on which selection can be exercised based on the improvement in yield and quality. Hence, the present study was undertaken with the objective of selecting high yielding types of Guinea grass to determine the interrelationship of quantitative and qualitative characters contributing to fodder yield and quality characters of Guinea grass.

MATERIALS AND METHODS

The investigation was carried out at the Department of Forage Crops, Centre for Plant Breeding and Genetics, Tamil Nadu Agricultural University, Coimbatore during 2013-14 with 60 genotypes from diverse sources. The details and source of genotypes has been given in Table 1. These genotypes were planted using rooted slips on one side of ridge of 4 metres length, adapting a spacing of 60×50 cm in Randomized Block Design (RBD) with two replications. Recommended package of practices was followed to grow a successful crop. The biometrical observations on plant height (cm), number of tillers per plant, number of leaves per plant, leaf weight (g), leaf stem ration, green fodder yield per plant (g) and dry matter content (%) (Hazra, 1996) along with quality traits such as crude protein content, crude fibre content and crude fat content (AOAC, 1980). The data were subjected to statistical analysis to obtain information on the *per se* performance and to assess the association between yield and its components. Correlation analysis was done using

TABLE 1
Details and source of genotypes

Sample code	Accessions	Source	Sample code	Accessions	Source	Sample code	Accessions	Source
1.	GGLC 1	Coimbatore	21.	GGLC 21	Coimbatore	41.	FD 699	Punjab
2.	GGLC 2	Coimbatore	22.	GGLC 22	Coimbatore	42.	FD 703	Punjab
3.	GGLC 3	Coimbatore	23.	GGLC 23	Coimbatore	43.	FD 744	Coimbatore
4.	GGLC 4	Rajasthan	24.	FD 135	Thailand	44.	FD 783	Coimbatore
5.	GGLC 5	Punjab	25.	FD 137	Thailand	45.	FD 786	Coimbatore
6.	GGLC 6	Coimbatore	26.	GG09 3	Coimbatore	46.	FD 791	Coimbatore
7.	GGLC 7	Coimbatore	27.	FD 606	Chengalpet	47.	FD 1659	Japan
8.	GGLC 8	Coimbatore	28.	FD 637	Madurai	48.	FD 2719	Coimbatore
9.	GGLC 9	Jhansi	29.	FD 653	Punjab	49.	FD 2184	Coimbatore
10.	GGLC 10	Hisar	30.	FD 657	Punjab	50.	FD 2186	Coimbatore
11.	GGLC 11	Andhra Pradesh	31.	FD 661	Punjab	51.	FD 2189	Coimbatore
12.	GGLC 12	Coimbatore	32.	FD 662	Punjab	52.	FD 2192	Coimbatore
13.	GGLC 13	Coimbatore	33.	FD 663	Punjab	53.	FD 2193	Coimbatore
14.	GGLC 14	Coimbatore	34.	FD 667	Punjab	54.	FD 2199	Coimbatore
15.	GGLC 15	Coimbatore	35.	GG09 5	Punjab	55.	FD 2206	Coimbatore
16.	GGLC 16	Coimbatore	36.	FD 675	Punjab	56.	FD 2209	Coimbatore
17.	GGLC 17	Coimbatore	37.	FD 678	Punjab	57.	FD 2214	Coimbatore
18.	GGLC 18	Coimbatore	38.	FD 682	Punjab	58.	FD 2219	Coimbatore
19.	GGLC 19	Coimbatore	39.	FD 679	Punjab	59.	GG 09 6	Coimbatore
20.	GGLC 20	Coimbatore	40.	FD 692	Punjab	60.	GG 09 7	Coimbatore

INDOSTAT package and genotypic correlation was worked out as per the methods suggested by Grafius (1956).

RESULTS AND DISCUSSION

Per se Performance

Development of high yielding genotypes of crops requires information about the nature and magnitude of variability present in the available genotypes and depends on judicious assessment of available data on phenotypic characters that are connected with yield. Hence, 60 Guinea grass genotypes were evaluated for growth and yield attributes (Table 2). Among the Guinea grass germplasm accessions, the highest mean value of green fodder yield per plant was recorded by the accession GGLC 12 (587.13 g) followed by GGLC 19 (534.20 g). Though the number of leaves per plant is an important trait, in recent days, preference is more for dark green and dense leaves. In the present study, the accessions, GGLC 5 (339.63 g) and GGLC 8 (320.00 g) registered comparatively lesser green fodder yield in favorable direction. This was in agreement with the findings of Babu and Bai (2001) in Guinea grass genotypes. The data on number of tillers per plant indicated that among the 60 genotypes, accession FD 667 (28.50) recorded the maximum tillers/plant followed by accession GGLC 6 (22). Similar to these results Sukhchain and Siddhu. (1992) also identified the highest mean performance for number of tillers per plant in Guinea grass genotype.

The number of leaves/plant is a preferable trait in Guinea grass genotype which could increase revenue during high foliage production. Number of leaves per plant was the highest in the accessions GGLC 19 (246.50) and GGLC 4 (241.00) among the genotypes. Similar findings were made by Srivas and Singh (2004) in forage maize. Guinea grass leaves are good source of crude protein. Animals consume Guinea grass leaves as raw one. In Guinea grass, genotype with more leaf weight is preferred. Observation on leaf weight per plant revealed that accession GGLC 12 (204.78 g per plant) and followed by the accession GGLC 19 (168.00 g per plant) recorded the highest *per se* value. Similar findings were made by Babu and Bai (2001) in Guinea grass.

The energy worth of the fodder crop is indicated by its crude protein content and its dry matter yield (Hazra, 1996). Estimation of leaf:stem ratio is essential for Guinea grass which indicates the palatability of the fodder. Evaluation of genotypes with mean performance revealed that the accession GGLC 8 (0.57), followed by GGLC 12 (0.54) and GGLC 5 (0.51) recorded desirable leaf stem ratio. Jain *et al.* (2011) reported similar results for leaf stem ratio in forage sorghum.

TABLE 2
Per se performance of Guinea grass genotypes for yield and quality traits

S. No.	Genotypes	PH (cm)	NT	NL	LW (g)	LS ratio	DMC (%)	CP (%)	C Fib (%)	C Fat (%)	GFY (g)
1.	GGLC-1	181.00	18.50	198.00	103.87	0.39	20.60	11.55	25.00	1.43	368.00
2.	GGLC-2	188.67	18.33	203.00	88.23	0.30	21.56	10.50	25.25	1.54	387.63
3.	GGLC-3	145.00	19.50	221.50	118.77	0.34	17.25	10.68	**23.00**	1.40	477.00
4.	GGLC-4	143.75	21.00	241.00	124.82	0.35	22.21	9.38	25.75	1.54	485.09
5.	GGLC-5	156.00	19.33	201.17	114.00	0.51	19.13	8.96	24.75	1.34	339.63
6.	GGLC-6	178.17	22.00	236.50	116.46	0.36	19.97	9.19	25.25	1.80	444.11
7.	GGLC-7	174.50	15.00	157.00	103.85	0.35	17.15	7.25	25.75	1.68	396.22
8.	GGLC-8	162.50	19.83	190.00	115.00	**0.57**	17.48	10.34	25.75	1.75	432.16
9.	GGLC-9	183.17	16.90	162.50	101.20	0.30	**14.48**	9.84	25.00	1.44	439.32
10.	GGLC-10	183.50	13.50	154.50	90.63	0.27	18.65	10.15	24.75	1.34	426.13
11.	GGLC-11	182.00	17.67	196.33	105.00	0.29	20.78	7.88	30.75	1.21	468.20
12.	GGLC-12	184.75	21.00	234.17	**204.78**	0.54	19.29	9.82	25.75	1.43	**587.13**
13.	GGLC-13	179.33	16.50	147.83	84.35	0.28	21.58	8.61	27.25	1.52	383.30
14.	GGLC-14	180.67	20.33	205.83	85.22	0.30	20.60	7.09	26.75	1.51	367.62
15.	GGLC-15	186.33	18.20	194.70	**75.60**	0.26	20.72	9.91	26.75	1.34	365.52
16.	GGLC-16	186.17	18.33	198.33	85.23	0.25	23.48	9.31	25.25	1.54	427.31
17.	GGLC-17	**120.33**	17.48	228.67	117.52	0.40	22.81	9.98	25.25	1.47	414.35
18.	GGLC-18	164.00	19.67	150.40	80.00	0.33	17.14	9.70	25.00	1.47	320.22
19.	GGLC-19	146.17	21.00	**246.50**	168.00	0.46	22.93	11.20	25.75	1.54	534.20
20.	GGLC-20	140.00	20.83	218.70	123.99	0.38	25.25	10.89	25.25	1.64	451.49
21.	GGLC-21	153.83	20.68	225.83	118.60	0.40	23.23	9.63	25.75	1.63	417.22
22.	GGLC-22	153.58	21.00	192.00	119.43	0.35	26.61	9.75	26.75	1.64	466.21
23.	GGLC-23	189.50	**12.00**	121.00	89.10	0.31	21.09	**7.09**	31.25	1.45	379.43
24.	FD 135	200.17	20.00	208.60	106.85	0.31	25.24	10.76	28.25	1.28	454.95
25.	FD 137	197.83	17.17	163.53	106.99	0.31	24.91	8.80	28.25	1.80	448.87
26.	GG09-3	193.67	14.50	151.60	81.75	0.25	22.41	9.50	28.25	1.25	406.95
27.	FD 606	186.17	20.83	204.80	113.20	0.30	25.46	8.42	29.25	1.60	489.78
28.	FD 637	179.67	19.00	198.67	109.88	0.31	26.53	11.38	27.75	1.25	465.01
29.	FD 653	174.67	21.00	197.50	104.87	0.36	22.01	8.12	**33.50**	1.60	398.27
30.	FD 657	188.83	14.17	163.00	82.59	**0.24**	23.98	8.94	26.50	1.53	**320.00**
31.	FD 661	190.50	20.83	214.50	114.23	0.31	22.95	9.94	26.25	1.40	484.16
32.	FD 662	181.00	15.17	153.37	106.75	0.36	22.59	9.00	30.50	1.60	405.63
33.	FD 663	186.67	14.83	148.20	109.63	0.32	25.35	10.15	28.00	1.24	454.43
34.	FD 667	176.00	**28.50**	187.50	107.00	0.32	24.21	8.68	28.75	1.20	437.40
35.	GG09-5	175.67	14.00	157.90	95.20	0.30	22.90	8.96	28.50	1.40	414.53
36.	FD 675	182.83	19.60	179.67	96.39	0.29	24.32	8.38	29.25	**1.17**	436.39
37.	FD 678	190.50	17.83	182.67	113.89	0.32	27.01	9.26	26.00	1.40	475.39
38.	FD 682	181.33	18.00	158.70	107.60	0.31	25.39	9.26	28.50	1.24	452.65
39.	FD 679	190.33	15.33	164.17	108.60	0.34	23.62	**13.53**	25.75	1.24	424.37
40.	FD 692	187.33	17.50	181.17	108.43	0.30	21.92	10.83	28.75	1.40	467.36
41.	FD 699	187.17	13.00	145.00	93.40	0.28	23.71	10.96	27.00	1.35	426.33
42.	FD 703	182.83	14.00	152.50	81.97	0.28	20.91	10.66	28.50	1.59	374.37
43.	FD 744	195.17	12.80	135.00	107.48	0.34	23.68	10.62	31.00	1.34	427.28
44.	FD 783	191.33	16.17	175.50	105.43	0.32	24.73	11.08	27.50	1.74	437.90
45.	FD 786	197.67	17.00	171.00	109.75	0.31	**30.97**	10.69	28.25	1.28	462.13
46.	FD 791	183.17	17.30	147.00	110.86	0.35	23.63	9.61	29.75	1.28	425.16
47.	FD 1659	**201.00**	17.17	162.83	112.35	0.31	22.85	9.94	27.50	1.27	471.57
48.	FD 2719	191.83	18.00	143.33	111.97	0.33	25.69	8.96	28.75	1.70	453.79
49.	FD 2184	179.33	20.17	154.83	96.57	0.31	22.47	7.84	31.25	1.23	406.29
50.	FD 2186	196.50	21.00	184.67	116.98	0.31	21.05	9.75	28.00	1.70	496.96
51.	FD 2189	183.17	13.33	138.00	105.70	0.29	28.09	8.47	27.00	1.23	464.47
52.	FD 2192	183.67	16.00	147.44	104.63	0.33	23.41	9.70	28.75	1.34	420.73
53.	FD 2193	181.67	15.17	144.07	99.87	0.30	24.29	9.78	29.00	1.34	437.60
54.	FD 2199	171.50	13.33	136.60	86.67	0.32	19.96	8.21	27.75	1.26	357.80
55.	FD 2206	195.17	12.50	140.83	100.10	0.29	20.00	8.19	30.25	1.69	445.80
56.	FD 2209	193.00	17.00	167.83	105.93	0.29	27.75	10.48	30.00	1.22	477.63
57.	FD 2214	188.00	15.67	148.33	102.80	0.30	24.98	9.10	29.25	1.34	449.20
58.	FD 2219	186.50	14.33	126.54	92.70	0.31	22.07	11.32	29.75	1.58	392.84
59.	GG09-6	191.50	12.17	**116.50**	81.60	0.29	19.96	9.51	28.00	**2.00**	357.13
60.	GG09-7	182.17	12.33	131.50	82.00	0.31	15.95	9.47	27.75	1.55	343.33
	SE(D)	18.22	3.21	19.21	13.04	0.05	3.41	0.66	0.45	0.16	33.13
	C. D. (P=05)	36.47	6.43	38.43	26.10	0.08	6.84	1.33	0.91	0.33	66.30

Highest mean values are indicated in bold and underlined, Lowest mean values are indicated in bold.
PH - Plant height (cm) , NT - Number of tillers per plant, NL - Number of leaves per plant , LW - Leaf weight (g), LS ratio - Leaf stem ratio , DMC - Dry matter content (%), CP- Crude protein content (%) , C Fib- Crude Fibre content (%) , C Fat- Crude Fat content (%), GFY- Green fodder yield per plant (g).

TABLE 3
Genotypic correlation between green fodder and its component traits in Guinea grass genotypes

Characters	PH (cm)	NT	NL	LW (g)	LS ratio	DMC (%)	CP (%)	C Fib (%)	C Fat (%)	GFY (g)
PH (cm)	1.000	-0.387**	-0.941**	-0.582**	-0.763**	0.257*	-0.140	0.696**	-0.154	0.063
NT		1.000	0.971**	0.629**	0.533**	0.163	0.119	-0.322**	-0.261*	0.412**
NL			1.000	0.623**	0.514**	-0.040	0.248*	-0.540**	0.041	0.406**
LW (g)				1.000	0.679**	0.077	0.257*	-0.235*	0.031	0.741**
LS ratio					1.000	-0.334**	0.175	-0.351**	0.273*	0.024
DMC (%)						1.000	0.243*	0.484**	-0.713**	0.458**
CP (%)							1.000	-0.377**	-0.092	0.204
C Fib (%)								1.000	-0.202	-0.009
C Fat (%)									1.000	-0.206
GFY (g)										1.000

*, **Significant at 5% and1% levels of significance, respectively.

Like legume fodder, the cereal fodder Guinea grass also possesses crude protein content. Estimation of crude protein content among the 60 Guinea grass genotypes showed that the accession FD 679 (13.53%) recorded the highest *per se* value for crude protein content followed by GGLC 1 (11.55 per cent). Hence these genotypes FD 679 and GGLC 1 could be utilized to develop variety with more crude protein content. These results were supported by the findings of Sukhchain and Siddhu (1992) in Guinea grass and Vedansh *et al*. (2010) in forage sorghum.

Analysis of crude fibre content in grass would be useful in the selection of fodder as a source of dietary fibre. Among the 60 genotypes of Guinea grass, the accessions FD 653 (33.50 per cent) recorded favorable high *per se* values of crude fibre content. Sukhchain and Siddhu (1992) in Guinea grass and Vedansh *et al*. (2010) in forage sorghum. Estimation of crude fat content among the 60 Guinea grass genotypes showed that the accession GG09 6 (2.00 per cent) recorded the highest *per se* value for crude fat content. Hence these genotypes GG09 6 could be utilized to develop variety with crude protein fat. Similar findings were made by Martuscello *et al.* (2012) in Guinea grass and Ghazy *et al.* (2012) in forage pearl millet.

Correlation Analysis

Yield being a complex character, is influenced by many yield components. Knowledge on the impact of various components on yield is essential before selection of desirable genotypes. In this context, correlation analysis will indicate possible association between the yield and yield attributes of Guinea grass genotypes. Estimation of correlation is a simple tool to select Guinea grass genotypes suitable for further crop improvement programme.

The genotypic correlation coefficients among the yield and yield attributes in Guinea grass are presented in Table 3. Doku (1970) suggested that inter correlation among the yield components need to be estimated because one component influences the other related components. The correlation analysis revealed that among the traits studied, number of tillers per plant, number of leaves per plant, leaf weight and dry matter content had positive and highly significant correlation with green fodder yield per plant. Similar result was also reported by Iyanar *et al.* (2010), Jain *et al.* (2011) and Jain and Patel (2013). The correlation between above correlated characters was also positive and significant which suggested that the selection of genotypes based on the performance of these characters will be of immense use by the breeder. 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.

Followed by direct correlation, inter correlations among the characters are also discussed. The inter correlation analysis among the yield components revealed that the number of leaves per plant and leaf weight exhibited 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).

CONCLUSION

Selection of genotypes with more yields is the primary objective in any hybrid/variety development programme. Based on the present study, among the 60 Guinea grass genotypes, accession GGLC 12 recorded the highest mean value of green fodder yield (587.13 g per plant) followed by GGLC 12 with the highest mean green fodder yield of 534.20 g per plant and FD 679 and GGLC 1 recorded the highest mean crude protein content of 13.53 and 11.56, respectively. Further genotypes GGLC 12, GGLC 19, FD 679 and GGLC 1 could be adjudged as the ideal genotype for yield as it proved its potential for number of leaves per plant, leaf weight and crude protein content. This study clearly indicated that these genotypes further used in breeding programme for development improved varieties.

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