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GENETIC VARIABILITY STUDIES FOR FORAGE YIELD AND ASSOCIATED TRAITS IN MARVEL GRASS (*DICHANTHIUM* SPP.)

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SUMMARY

A total of 20 marvel grass genotypes were grown in randomized block design (RBD) with two replications at Grass Breeding Scheme, Mahatma Phule Krishi Vidyapeeth, Rahuri, District Ahmednagar, Maharashtra during **kharif** season of 2015-16. Objectives of investigation were to study genetic variability, correlation and path analysis for 13 characters viz., days to 50 per cent flowering, plant height (cm), number of tillers/tussock, stem thickness (mm), number of internodes/tiller, internode length (cm), number of leaves/tiller, leaf length (cm), leaf breadth (mm), green fodder yield (g/tussock), leaf : stem ratio, dry matter (%) and crude protein (%). Treatment differences were found to be significant for all the characters studied. Characters like number of tillers/tussock, stem thickness L : S ratio and green fodder yield showed high GCV and PCV. The estimates of genotypic as well as phenotypic coefficients of variances were the higher for leaf : stem ratio, stem thickness (mm), green forage yield and number of tillers per tussock. Maximum heritability (b.s.) was observed for leaf : stem ratio (97.10%) and minimum for dry matter (61.90%). High estimates of heritability accompanied by high estimates of genetic advance as percentage of mean were observed for characters like number of tillers/ tussock, stem thickness, L : S ratio, number of leaves/tiller, leaf length, leaf breadth, crude protein (%) and green forage yield indicating that these traits are predominately governed by additive gene action and selection for these characters will be effective. The characters like days to 50 per cent flowering, plant height, stem thickness, number of internodes/tiller, number of leaves/tiller, leaf length and leaf breadth, showed significant positive genotypic correlations with green forage yield. Plant height and leaf breadth exhibited high positive direct and indirect effect and significant positive genotypic correlation with green forage yield. The characters viz., number of internodes, stem thickness, leaf length and number of tillers/tussock also exhibited high indirect effects. Thus, emphasis should be given on these characters for green forage improvement in the present marvel grass.

Key words : *Dichanthium*, marvel grass, genetic variability, correlation, path coefficients, forage yield

Marvel grass is an excellent and widely used fodder grass much appreciated by all classes of ruminants. In mixed pastures, marvel grass is preferred to all other grasses (Cook *et al.*, 2005). Marvel grass can be used in pastures, in cut-and-carry system or for hay-making or silage making if it is cut before flowering (FAO, 2010). It is grown in area receiving rainfall from 300 to 1500 mm and all types of soil. It tolerates salinity but not acidity.

Around 20 species of the genus *Dichanthium* have been reported from tropical and sub-tropical regions, eight of which are found in India in various agro-ecological zones (Arora *et al.*, 1975). Two species viz., *Dichanthium annulatum* and *Dichanthium caricosum* are widely used for forage production. Being indigenous to India and Africa, the genus has shown remarkable genetic diversity in India and South Africa. The basic chromosome number in *Dichanthium* is 10; however, the *D. annulatum* complex shows different ploidy levels as well as distinct morphological characters.

To develop the pasture lands, there is always need of having superior species and accessions of grasses. To accomplish this, there is need to evaluate the available germplasm so that it can be used in the improvement of grasslands. The forage yield is a complex character and direct selection for yield is not so much easy. So, improvement in forage yield is made through improvement in the contributing characters. In order to have choice for forage yield enhancement, the knowledge of nature and magnitude of variability existing in available germplasm, the association of the component characters with yield and their exact contribution through direct and indirect effect are very important. Present study was, therefore, undertaken to estimate the genetic variability, correlation and path analysis in diverse marvel grass genotypes with a view to identify the genotypes with the best potentiality for enhancing yield and its component characters.

MATERIALS AND METHODS

The experiment was conducted at Grass Breeding Scheme, Mahatma Phule Krishi Vidyapeeth, Rahuri, District Ahmednagar, Maharashtra during **kharif** 2015-16 to study the variability among 20 genotypes of marvel grass. A total of 20 marvel grass genotypes were grown in randomized block design (RBD) with two replications with spacing of 45 x 30 cm. Observations were recorded for 20 genotypes for 13 characters i. e. days to 50 per cent flowering, plant height (cm), number of tillers/tussock, stem thickness (mm), number of internodes/tiller, internode length (cm), number of leaves/tiller, leaf length (cm), leaf breadth (mm), green fodder yield (g/tussock), leaf : stem ratio, dry matter (%) and crude protein (%). Statistical analysis was performed by methods proposed by Panse and Sukhatme (1985). Variability parameters were estimated as suggested by Burton (1952), Johnson *et al.* (1955) and Allard (1960). Correlation coefficients were estimated as method suggested by Singh and Choudhari (1997), while path coefficient analysis was performed by methods of Dewey and Lu (1959).

RESULTS AND DISCUSSION

Estimates of Variability

The analysis of variance revealed significant genotypic differences for all the characters studied indicating wide range of variability for the characters. The estimates of GCV and PCV for all the characters studied showed little difference, PCV being slightly greater than the GCV, thus indicating that the variability existing in these characters was mainly due to genetic factors. High estimates of GCV and PCV were observed for L : S ratio (GCV=28.34, PCV=28.75) followed by stem thickness (GCV=25.08, PCV=25.64), green forage yield (GCV=25.04, PCV=26.55) and number of tillers/tussock (GCV=24.80, PCV=25.35). Moderate estimates for GCV and PCV were observed for number of leaves/tiller (GCV=14.58, PCV=16.28), leaf breath (GCV=13.14, PCV=14.37), leaf length (GCV=13.00, PCV=13.68), crude protein per cent (GCV=10.81, PCV=11.50) and plant height (GCV 10.11, PCV=10.97) (Table 1). Low estimates for GCV and PCV observed in case of days to 50 per cent flowering, number of internodes/tiller, internode length and dry matter per cent. Gupta and Gupta (1993) also reported wide variability for plant height, leaf length (cm), stem thickness (mm) and GFY, whearas Mohammad *et al.* (2007) noticed high variation for plant height, GFY and low variation range for 50 per cent flowering and number of internodes per tiller.

High heritability (>60%) was observed for all the characters studied. The highest estimate of heritability (b. s.) was observed for L : S ratio (97.10%) and lowest for internode length (67.80%). High estimates of genetic advance as percentage of mean were observed for all characters except days to 50 per cent flowering (4.46), dry matter per cent (10.99), number of internodes/tiller (11.49), internode length (14.11) and plant height (19.20). Further, high heritability accompanied by high genetic advance as per cent of mean was observed for L : S ratio, number of tillers/tussock, stem thickness, green forage yield, number of leaves/tiller, leaf length, leaf width and crude protein per cent indicating that these traits could be prominently governed by additive gene

TABLE 1
Estimates of variability parameters for green forage yield and yield contributing characters in marvel grass

S. No.	Characters	Range	GCV (%)	PCV (%)	ECV (%)	Heritability (b. s.) (%)	GA	G. A. as % of mean
1.	Days to 50% flowering	56.5 - 61.25	2.26	2.36	0.68	91.80	2.65	4.46
2.	Plant height (cm)	57.95 - 94.75	10.11	10.97	4.26	84.90	15.46	19.20
3.	No. of tillers/tussock	53.45 - 148.6	24.80	25.35	5.22	95.80	39.86	50.00
4.	Stem thickness (mm)	2.03 - 8.00	25.08	25.64	5.29	95.70	3.20	50.60
5.	No. of internodes /tiller	4.00 - 5.55	6.68	7.99	4.40	69.80	0.56	11.49
6.	Internode length (cm)	10.62 - 15.03	8.32	10.10	5.73	67.80	1.81	14.11
7.	No. of leaves/tiller	4.85 - 8.40	14.58	16.28	7.24	80.20	1.75	26.91
8.	Leaf length (cm)	13.81 - 22.2	13.00	13.68	4.28	90.20	4.77	25.43
9.	Leaf breadth (mm)	4.55 - 7.35	13.14	14.37	5.82	83.60	1.41	24.74
10.	Green fodder yield (g /tuss.)	104.48 - 638.5	25.04	26.55	8.82	89.00	213.08	48.66
11.	Leaf : stem ratio	0.28 - 0.79	28.34	28.75	4.86	97.10	0.26	57.53
12.	Dry matter (%)	29.17 - 40.66	6.78	8.62	5.32	61.90	3.78	10.99
13.	Crude protein (%)	5.36 - 8.09	10.81	11.50	3.92	88.40	1.34	20.93

TABLE 2

Genotypic (above diagonal) and phenotypic (below diagonal) correlation coefficients of green forage yield and its attributes in marvel grass

S. No.	Characters	Days to 50% flowering	Plant height (cm)	Number of tillers/ tussock	Stem thickness (mm)	Number of internodes/ tiller	Internode length (cm)	Number of leaves/ tiller	Leaf length (cm)	Leaf breadth (mm)	Leaf : stem ratio	Dry matter (%)	Crude protein (%)	Green fodder yield (g/tuss)
1.	Days to 50% Flowering	1.000	0.460**	-0.386*	0.775**	0.734**	-0.090	0.475**	0.398*	0.567**	-0.218	-0.050	0.030	0.501**
2.	Plant height (cm)	0.407**	1.000	-0.055	0.701**	0.655**	0.452**	0.622**	0.463**	0.273	-0.098	0.312*	-0.059	0.714**
3.	No. of tillers/tussock	-0.345*	-0.067	1.000	-0.530**	-0.255	-0.138	-0.461**	0.010	-0.185	0.679**	-0.071	0.279	0.210
4.	Stem thickness(mm)	0.710**	0.632**	-0.529**	1.000	0.799**	-0.014	0.816**	0.656**	0.668**	-0.262	-0.054	0.182	0.574**
5.	No. of internode /tiller	0.631**	0.647**	-0.226	0.627**	1.000	-0.048	0.656**	0.395*	0.611**	-0.212	0.254	0.013	0.646**
6.	Internode length (cm)	-0.066	0.414**	-0.071	-0.046	0.014	1.000	0.065	-0.451**	-0.336*	-0.164	0.456**	-0.414**	-0.034
7.	No. of leaves/tiller	0.443**	0.542**	-0.416**	0.741**	0.519**	0.049	1.000	0.496**	0.558**	-0.342*	-0.088	0.014	0.514**
8.	Leaf length (cm)	0.342*	0.451**	-0.006	0.613**	0.373*	-0.307	0.419**	1.000	0.533**	0.156	-0.256	0.248	0.578**
9.	Leaf breadth (mm)	0.454**	0.293	-0.224	0.628**	0.542**	-0.333*	0.423**	0.502**	1.000	0.160	-0.598**	0.359*	0.538**
10.	Leaf stem ratio	-0.207	-0.077	0.657**	-0.259	-0.166	-0.126	-0.315*	0.146	0.162	1.000	-0.373*	0.431**	0.181
11.	Dry matter (%)	-0.046	0.235	-0.053	-0.006	0.201	0.239	-0.011	-0.203	-0.407**	-0.326*	1.000	-0.027	0.053
12.	Crude protien (%)	0.046	-0.073	0.296	0.164	-0.013	-0.309	0.030	0.200	0.270	0.398*	-0.041	1.000	0.217
13.	Green fodder yield	0.467**	0.584**	0.253	0.516**	0.440**	-0.020	0.415**	0.478**	0.393*	0.178	0.035	0.266	1.000

*,**Significant at P=0.05 and P=0.01 levels, respectively.

TABLE 3

Genotypic direct and indirect effects of yield components on green forage yield in marvel grass

S. No.	Characters	Days to 50% flowering	Plant height (cm)	Number of tillers/ tussock	Stem thickness (mm)	Number of internodes/ tiller	Internode length (cm)	Number of leaves/ tiller	Leaf length (cm)	Leaf breadth (mm)	Leaf : stem ratio	Dry matter (%)	Crude protein (%)	Genotypic correlation with GFY
1.	Days to 50% Flowering	**0.854**	0.966	0.326	-2.208	-0.337	0.071	0.278	0.071	0.556	-0.059	-0.025	0.007	0.501**
2.	Plant height (cm)	0.392	**2.103**	0.047	-1.999	-0.300	-0.359	0.365	0.082	0.271	-0.027	0.155	-0.014	0.714**
3.	No. of tillers/tussock	-0.329	-0.116	**-0.845**	1.509	0.117	0.110	-0.270	0.002	-0.182	0.185	-0.036	0.067	0.210
4.	Stem thickness (mm)	0.661	1.475	0.448	**-2.850**	-0.367	0.011	0.478	0.116	0.656	-0.071	-0.027	0.044	0.574**
5.	No. of internodes/tiller	0.623	1.377	0.216	-2.278	**-0.459**	0.038	0.384	0.070	0.599	-0.058	0.126	0.003	0.646**
6.	Internode length (cm)	-0.077	0.949	0.117	0.039	0.022	**-0.796**	0.038	-0.080	-0.330	-0.045	0.227	-0.099	-0.034
7.	No. of leaves/tiller	0.405	1.307	0.390	-2.325	-0.301	-0.051	**0.586**	0.088	0.547	-0.093	-0.044	0.003	0.514**
8.	Leaf length (cm)	0.340	0.973	-0.008	-1.869	-0.181	0.359	0.291	**0.177**	0.523	0.043	-0.127	0.059	0.578**
9.	Leaf breadth (mm)	0.484	0.580	0.157	-1.904	-0.280	0.267	0.327	0.094	**0.981**	0.043	-0.298	0.086	0.538**
10.	Leaf : stem ratio	-0.186	-0.206	-0.574	0.746	0.097	0.131	-0.200	0.028	0.157	**0.272**	-0.186	0.103	0.181
11.	Dry matter (%)	-0.043	0.655	0.060	0.153	-0.116	-0.363	-0.052	-0.045	-0.586	-0.101	**0.498**	-0.006	0.053
12.	Crude protien (%)	0.025	-0.123	-0.236	-0.520	-0.006	0.326	0.008	0.044	0.352	0.117	-0.013	**0.238**	0.217

Residual effect=0.306.

action and selection of these traits could be more effective for desired genetic improvement. Similar findings were reported by Yadav *et al*. (1974) in *Cencherus ciliaris*.

Correlation Coefficient

Correlated characters are of interest for three chief reasons, firstly, in connection with the genetic cause of correlation through the linkage pleiotropic action of genes, secondly, in connection with the change brought about by selections. It is important to know how the improvement of one character will cause simultaneous changes in other characters and thirdly in connection with natural selection. The value of correlation coefficient cannot be constant everywhere. Genotypic and phenotypic correlation coefficients between the traits are given in Table 2. It was revealed from the present study that, the genotypic correlation coefficients between most of the characters were higher in magnitude than the phenotypic correlation coefficients indicating strong inherent association between various characters studied and that the genotypic expression of the correlation was comparatively less influenced by the environmental conditions. It was revealed that green forage yield had highly significant positive genotypic and phenotypic correlations with plant height (0.714, 0.584) followed by number of internodes/tiller (0.646, 0.440), leaf length (0.578, 0.478), stem thickness (0.574, 0.516), leaf breadth (0.538, 0.393), number of leaves/tiller (0.514, 0.415) and days to 50 per cent flowering (0.501, 0.467). Similar findlings were also reported by Yadav *et al.* (1980) in buffel grass.

Path Coefficient

Direct effect of any component character on yield gives an idea about the reliability of indirect selections to be made through those characters to bring about improvement in yield. If the correlation coefficient between a causal factor and the effect is equal to its direct effect, then correlation explains the true relationship and a selection for that trait will be effective. If the final correlation coefficient is positive, but the direct effect is negative or negligible, in such relations the indirect causal factors are to be considered simultaneously for selection. The residual effect determines how best the causal factors account for the variability of the dependent factor, the green forage yield per plant in this case. From the path analysis, it was found that plant height (2.103) had the highest direct effect with significant positive genotypic correlation with GFY. Further, direct positive effect on the GFY in the decreasing order was as follows : leaf breadth (0.981), days to 50 per cent flowering (0.854), number of leaves/tiller (0.586), dry matter (%) (0.498), leaf : stem ratio (0.272) and crude protein (0.238). The characters viz., stem thickness (-2.850), number of tillers/tussock (-0.845), Internode length (-0.796), number of internodes/tiller (-0.459) had negative direct effect on green forage yield (Table 3).

Indirect effects for majority of traits via days to 50 per cent flowering, plant height, number of tillers/ tussock, internode numbers and internode length were higher and positive which resulted in significant correlation with green forage yield. This investigation, therefore, suggests that plant height, leaf breadth, 50 per cent flowering, number of tillers/tussock, number of internodes and internode length should be given more consideration as selection indices for the green forage yield improvement in marvel grass.

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