Indian Res. J. Genet. & Biotech. 10(3): 74-83 Nov (2018)

Character Association Studies In Cowpea [*Vigna unguiculata* (l.) walp.] For Green Fodder Yield And Related Traits

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(Received : September, 2017 : Revised : September , 2018; Accepted : September, 2018)

Abstract

The present investigation was carried out to assess correlation and path analysis for fodder production in cowpea during kharif season 2014 at Agriculture Research Station, SKRAU, Bikaner. The experimental material consisting of 29 genotypes of cowpea was laid out in randomized block design with three replications. The correlation studies revealed that the correlation of green fodder yield was positive and significant at phenotypic and genotypic levels with characters viz. plant height, number of primary branches per plant, number of leaves per plant, internode length, leaf: stem ratio, dry matter per cent and dry matter yield. The highest direct positive effect on green fodder yield was observed for dry matter yield, plant height and ash content.

Key words: Cowpea, character association, green fodder

Introduction

Cowpea (*Vigna unguiculata* (L.) Walp.) is an annual autogamous leguminous plant, which belongs to the family Leguminosae and sub family Papilioniodeae. Cowpea is locally known as *chaula*. It is grown as multipurpose crop throughout the tropics and subtropics. Cowpea is grown in arid and semi arid regions of India in both summer and rainy seasons. Cowpea is a drought tolerant and warm weather crop. It is cultivated for seed, fodder and vegetable. The drought hardy nature of cowpea crop enables it to maintain some growth under moisture stress condition. This trait is also extended by deep rooting habits of some varieties and accounts for the crop's ability to grow and yield under semi desert conditions. Cowpea forms

Corresponding author's e-mail:
Published by Indian Society of Genetics, Biotechnology Research and Development,

5, E Biotech Bhawan, Nikhil Estate, Mugalia Road, Shastripuram, Sikandra, Agra282007
Online management by www.isgbrd.co.in

excellent forage. It provides highly palatable, succulent and nutritious fodder. Feeding value of its fodder is high and quite comparable to lucerne. It can be fed in green, dry hay or preserved as silage in combination with cereal fodders. It also improves soil fertility by symbiotic nitrogen fixation with the help of bacteria *Rhizobium* sp. Cowpea is also utilized as fodder hay pasture. The crop besides meeting a high proportion of its own nitrogen requirement leaves fixed -N deposit in the soil up to 60-70 kg/ha for the succeeding crops.

Development of a plant breeding strategy depends mainly on the support provided by genetic information on the inheritance and behavior of major quantitative characters associated with the yield or any other economic trait of concern to the plant breeder. The potential productivity of any crop is basically valued in terms of the yield per unit area. Its improvement by direct selection is generally difficult because yield is a complex polygenic character largely influenced by its various component characters as well as by the environment. Hence, it becomes essential to estimate association of the yield with component characters and among themselves.

Materials And Methods

The experimental material for the present investigation comprised of 29 genotypes of cowpea obtained from AICRP on Forage crops and Utilization, Agriculture Research Station, Bikaner. The experimental material was laid out in a Randomized Block Design with three replications during Kharif - 2014. Each plot consisted of two rows each of 4.0 meter length. The spacing between row to row was 30 cm. Normal and uniform cultural operations were followed during the crop season to raise a good crop. The experiment was sown on August 1, 2014 under irrigated conditions with the basal application of 20 kg N + 40 kg P_2O_5 ha^{-1}. The observations were recorded on individual plant basis on five competitive randomly selected plants from each replication for the characters, viz. plant height, number of primary branches per plant, leaf length, leaf width, stem thickness, internode length and number of leaves per plant. While data for green fodder yield and dry matter yield were recorded on plot basis. The data were subjected to analysis of variance adopting standard statistical methods (Panse and Sukhatme, 1985; Singh and Choudhary, 1979).

Results And Discussion

The efficiency of selection can be increased, if it is simultaneously practiced for characters which are correlated with yield. In the quantitative traits, the genotype is influenced by the environment, thereby, affecting the phenotypic expression as well as association and consequently direction of association between the characters. The knowledge of magnitude and direction of correlation is used for judging how improvement in one character will bring simultaneous change in the other characters. High magnitude of positive correlation coefficient at genotypic level between component characters and yield is important for indirect selection for yield. Since, suitable test for significance of genotypic correlation coefficients is not available, therefore, major emphasis has been put on phenotypic correlation coefficients.

In general, the genotypic correlation coefficients were higher than the respective phenotypic correlation coefficients which might be from the modifying effect of environment on the association of characters at phenotypic level. Selection of yield as such may not be effective since there may be number of genes for yield *per se* and yield may be resultant of interaction among various components. Knowledge of relation between yield and its components is essential and selection for one component may bring about a simultaneous change in the other. Therefore, a rational approach to improve yield is to collect information on character association. Hence, under the present investigation, the phenotypic and genotypic correlation coefficients were worked out for green fodder yield and yield related characters

The correlations of green fodder yield were positive and significant at phenotypic and genotypic levels with characters, viz. plant height, number of primary branches per plant, number of leaves per plant, internode length, leaf: stem ratio, dry matter per cent and dry matter yield. It was significant and negative correlation with leaf length, leaf width and stem thickness both at phenotypic and genotypic levels. These characters need due consideration during any selection programme. Similar findings of correlation had been reported by Dangia and Paroda (1974), Tyagi *et al.* (1978), Kumar *et al.* (2002) and Singh *et al.* (2010).

The correlation of plant height was positively and significantly correlated with number of primary branches per plant, number of leaves per plant, internode length, leaf: stem ratio, dry matter per cent, dry matter yield and green fodder yield. Number of primary branches per plant was positively and significantly correlated with plant height, number of leaves per plant, internode length, leaf: stem ratio, dry matter per cent, dry matter yield and green fodder yield. Number of leaves per plant was positively and significantly correlated with plant height, number of primary branches per plant, internode length, leaf stem ratio, dry matter per cent, dry matter yield and green fodder yield. Leaf length was positively and significantly correlated with leaf width and stem thickness. Leaf width was positively and significantly correlated with leaf length and stem thickness. Internode length was positively and significantly correlated with plant height, number of primary branches per plant, number of leaves per plant, leaf: stem ratio, dry matter per cent, dry matter yield and green fodder yield. Stem thickness was positively and significantly correlated with leaf length and leaf width. Leaf: stem ratio was positively and significantly correlated plant height, number of primary branches per plant, number of leaves per plant, internode length, dry matter per cent, dry matter yield and green fodder yield. Dry matter per cent was positively and significantly correlated with plant height, number of primary branches per plant, number of leaves per plant, internode length, leaf: stem ratio, dry matter yield and green fodder yield. Dry matter yield was positively and significantly correlated with plant height, number of primary branches per plant, number of leaves per plant, internode length, leaf: stem ratio, dry matter per cent and green fodder yield. Green fodder yield was positively and significantly correlated with plant height, number of primary branches per plant, number of leaves per plant, internode length, leaf: stem ratio, dry matter per cent and dry matter yield. Genotypic correlation coefficient may be more than one due to subtraction effect arising from sampling error.

The correlation analysis provides information which is incomplete in the sense that it does not throw light on the underlying causes that are operative for the various interrelationships. The expression of a complex character such as green fodder yield depends upon the interplay of a number of component attributes. A better picture of the contribution of each component building up the total genetic architecture of a complex character may be obtained through the analysis of causal schemes. Hence, in such a situation, path coefficient analysis devised by Wright (1921) had been useful in partitioning direct and indirect causes of association which allow a detailed examination of specific forces acting to produce a given correlation and measures the relative importance of each causal character. Such a study provides a realistic basis for allocation of weightage to each attribute in deciding a suitable criterion for genetic improvement. The aim of the analysis in the present investigation was to compare the results obtained from simple correlation to determine the true nature of character association.

In the present study, path coefficient analysis was computed both at genotypic and phenotypic levels for all the characters. Path coefficient analysis was carried out by taking green fodder yield as dependent variable to partition the correlation coefficient into direct and indirect effect in order to determine the contribution of different characters towards the green fodder yield. Direct and indirect effect of various characters on green fodder yield indicated that there is agreement between direction and magnitude of direct effect of various characters and correlation with green fodder yield. Thus a significant improvement in green fodder yield can be expected through selection in the component traits with high positive direct effect. At phenotypic level, highest direct positive effect on green fodder yield was observed for dry matter yield followed by plant height and ash content. While highest direct negative effect was recorded for dry matter per cent followed by number of leaves per plant, stem thickness, leaf width, number of primary branches per plant, leaf length, internode length and leaf: stem ratio. These findings support the observation made earlier by Kumar (1980), Kumar *et al.* (2002) and Singh *et al.* (2010).

At genotypic level, the highest direct positive effect on green fodder yield was observed for dry matter yield followed by internode length and leaf length. While the highest direct negative effect was recorded for dry matter per cent, number of primary branches per plant, plant height, number of leaves per plant, stem thickness, leaf width, leaf: stem ratio and ash content.

Path analysis further revealed that direct effect of dry matter yield (qha^{-1}) and plant height were of high magnitude. The high positive association of other characters with green fodder yield (qha^{-1}) was also due to high indirect effect through these characters. This indicated that green fodder yield was mainly a product of direct and indirect effects. Dry matter per cent, number of leaves per plant and stem thickness were negatively associated with green fodder yield which was due to the negative indirect effects. If direct effect is more and positive then put more emphasis on the use of that character in selection programme. Otherwise restricted selection is to be used for characters having high indirect effects.

Table 1 Estimation of phenotypic (P) and genotypic (G) correlation coefficients for 12 characters in cowpea

Characters		**Plant height**	**No. of primery branches per plant**	**No. of leaves per plant**	**Leaf length**	**Leaf width**	**Internode length**	**Stem thickness**	**Leaf : Stem ratio**	**Ash content %**	**Dry matter %**	**Dry matter yield**	**Green fodder yield**
Plant height	**P**	1.000	0.922**	0.890**	-0.862**	-0.871**	0.892**	-0.651**	0.619**	0.049	0.727**	0.855**	0.795**
	G	1.000	0.950	0.902	-0.890	-0.909	0.959	-0.683	0.840	0.066	1.053	0.979	0.919
No. of primery branches per plant	**P**		1.000	0.889**	-0.924**	-0.918**	0.847**	-0.760**	0.619**	0.091	0.744**	0.891**	0.851**
	G		1.000	0.904	-0.962	-0.950	0.950	-0.792	0.867	0.150	1.035	0.991	0.965
No. of leaves per plant	**P**			1.000	-0.808**	-0.837**	0.929**	-0.521**	0.566**	0.205	0.696**	0.843**	0.764**
	G			1.000	-0.828	-0.855	0.996	-0.532	0.792	0.312	0.953	0.925	0.857
Leaf length	**P**				1.000	0.944**	-0.795**	0.839**	-0.662**	-0.104	-0.672**	-0.832**	-0.843**
	G				1.000	0.986	-0.859	0.880	-0.988	-0.153	-1.005	-0.969	-0.979
Leaf width	**P**					1.000	-0.836**	0.793**	-0.636**	-0.138	-0.727**	-0.849**	-0.818**
	G					1.000	-0.910	0.835	-0.926	-0.207	-1.026	-0.957	-0.941
Internode	**P**						1.000	-0.524**	0.569**	0.137	0.715**	0.828**	0.733**

length	**G**						1.000	-0.570	0.793	0.269	1.054	0.989	0.912
Stem thickness	**P**							1.000	-0.579**	-0.013	-0.619***	-0.712**	-0.742**
	G							1.000	-0.845	-0.041	-0.841	-0.780	-0.835
Leaf : Stem ratio	**P**								1.000	0.121	0.494**	0.588**	0.569**
	G								1.000	0.141	0.844	0.919	1.014
Ash content %	**P**									1.000	0.010	0.025	0.024
	G									1.000	0.122	0.165	0.178
Dry matter %	**P**										1.000	0.884**	0.617**
	G										1.000	1.017	1.055
Dry matter yield	**P**											1.000	0.905**
	G											1.000	1.004

** Significant at 1% probability level

Table 2 Phenotypic (P) and genotypic (G) path coefficients of various characters on green fodder yield

Characters		**Plant height**	**No. of primery branches per plant**	**No. of leaves per plant**	**Leaf length**	**Leaf width**	**Internode length**	**Stem thickness**	**Leaf : Stem ratio**	**Ash content %**	**Dry matter %**	**Dry matter yield**	**Correlation coefficient with Green fodder yield**
Plant height	**P**	**0.054**	-0.045	-0.127	0.025	0.061	-0.016	0.083	-0.012	0.001	-0.616	1.387	0.795**
	G	**-0.712**	-0.751	-0.546	-0.351	0.199	0.829	0.250	-0.076	-0.006	-0.853	2.936	0.919**
No. of primery branches per plant	**P**	0.049	**-0.048**	-0.127	0.027	0.064	-0.016	0.097	-0.012	0.001	-0.631	1.446	0.851**
	G	-0.677	**-0.791**	-0.548	-0.379	0.208	0.821	0.290	-0.078	-0.013	-0.838	2.969	0.965**
No. of leaves per plant	**P**	0.048	-0.043	**-0.142**	0.024	0.058	-0.017	0.067	-0.011	0.003	-0.590	1.368	0.764**
	G	-0.642	-0.715	**-0.606**	-0.327	0.187	0.861	0.195	-0.071	-0.026	-0.772	2.773	0.857**
Leaf length	**P**	-0.046	0.045	0.115	**-0.029**	-0.066	0.015	-0.107	0.013	-0.001	0.569	-1.349	-0.843**
	G	0.634	0.761	0.502	**0.394**	-0.216	-0.743	-0.322	0.089	0.013	0.814	-2.905	-0.979**
Leaf width	**P**	-0.047	0.044	0.119	-0.028	**-0.070**	0.015	-0.101	0.012	-0.002	0.616	-1.378	-0.818**
	G	0.647	0.751	0.518	0.389	**-0.219**	-0.786	-0.305	0.083	0.017	0.831	-2.867	-0.941**
Internode length	**P**	0.048	-0.041	-0.132	0.023	0.058	**-0.018**	0.067	-0.011	0.002	-0.606	1.343	0.733**
	G	-0.683	-0.751	-0.603	-0.339	0.199	**0.865**	0.208	-0.071	-0.023	-0.854	2.964	0.912**

Stem thickness	**P**	-0.035	0.037	0.074	-0.025	-0.055	0.010	**-0.128**	0.011	0.000	0.525	-1.156	-0.742**
	G	0.487	0.626	0.322	0.347	-0.183	-0.493	**-0.366**	0.076	0.003	0.681	-2.337	-0.835**
Leaf : Stem ratio	**P**	0.033	-0.030	-0.081	0.019	0.044	-0.011	0.074	**-0.019**	0.002	-0.419	0.955	0.569**
	G	-0.598	-0.686	-0.480	-0.390	0.203	0.685	0.309	**-0.090**	-0.012	-0.684	2.756	1.014**
Ash content %	**P**	0.003	-0.004	-0.029	0.003	0.010	-0.003	0.002	-0.002	**0.014**	-0.009	0.040	0.024
	G	-0.047	0.119	-0.189	-0.060	0.045	0.233	0.015	-0.013	**-0.084**	-0.099	0.495	0.178
Dry matter %	**P**	0.039	-0.036	-0.099	0.020	0.051	-0.013	0.079	-0.009	0.000	**-0.847**	1.434	0.617**
	G	-0.750	-0.818	-0.577	-0.396	0.225	0.912	0.308	-0.076	-0.010	**-0.810**	3.048	1.055**
Dry matter yield	**P**	0.046	-0.043	-0.120	0.024	0.059	-0.015	0.091	-0.011	0.000	-0.749	**1.623**	0.905**
	G	-0.697	-0.783	-0.561	-0.382	0.210	0.855	0.285	-0.083	-0.014	-0.824	**2.997**	1.004**

Digonal values in Bold are direct effects

Residual effects: Phenotypic : 0.099

Genotypic : 0.1565

Acknowledgement

The facilities provided by the Zonal Director Research, Agricultural Research Station, Bikaner for conducting the experiment are thankfully acknowledged.

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