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Original Research Article

Character Association and Path Analysis Studies in Sorghum [*Sorghum bicolor* (L.) Moench] Genotypes

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A B S T R A C T

This investigation was conducted in randomized block design with three replications using sixty sorghum genotypes during *Kharif* 2018 to evaluate **c**haracter association and path analysis for grain yield per plant.Grain yield per plant exhibited positive and significant association with harvest index, dry fodder yield per plant and green fodder yield per plant. Whereas, association of grain yield per plant was negatively significant with days to maturity and days to 50 per cent flowering. The highest positive direct effect on grain yield per plant was displayed by dry fodder yield per plant followed by protein content and leaf breadth. While highest negative direct was exhibited by plant height followed by test weight. The traits *viz.*, dry fodder yield per plant, harvest index, green fodder yield per plant, leaf breadth, protein content and plant height can be tactically used to improve the grain yield of sorghum.

Keywords

Sorghum, Character association, Path analysis and Grain yield per plant

Introduction

Sorghum [*Sorghum bicolor* (L.) Moench] is the fifth most important cereal crop originated from West Africa and staple food for millions of poor in semi-arid tropics of Africa and Asia (Haussmann *et al.*, 2002). It is an important source of food, feed, fiber and fuel. Sorghum crop displays considerable differences in plant traits including physiological responses to selection and is greatly influenced by environmental factors (Ezeaku *et al.*, 1997). Thus, the momentous improvement in economic traits like grain yield should be stand on the genetic information because this trait is greatly affected by the variations in environment and hence selection of genotypes based directly on yield may not be very believable because yield, being quantitative in nature is a complex character leans on several other components (Grafius, 1959). Thus, to bring about any improvement in any crop, a sound knowledge of association of yield with other traits would be of great help and for this aspect correlation coefficient suggests a reliable measure of association among the characters and assist to distinguish desirable associations beneficial in breeding from those of the undesirable ones (Falconer, 1981). Due to mutual cancellation of component traits, the judgment of correlation alone may beambiguous, thus it is necessary to study the path coefficient analysis, which separates the entire correlation coefficient into direct and indirect effects and evaluates the relative value of the causal factor individually (Dewey and Lu, 1959). Therefore, in present experiment an attempt was made to study the significance of correlation and path analysis for grain yield per plant in sixty sorghum genotypes.

Materials and Methods

The experimental plant material comprised of 60 sorghum genotypes was used for current study. The experiment was laid out in randomized block design (RBD) with three replications during *kharif* 2018 at Instructional Farm, Department of Genetics and Plant Breeding, Rajasthan College of Agriculture (MPUAT), Udaipur in collaboration with All India Coordinated Research Project (AICRP) on Sorghum. Each genotype in each replication was grown in two rows of three meter length, spaced at 15 cm within plants and 45 cm between plants. The observations were taken for 14 traits.

Observations on 12 traits *viz.*, plant height (cm), stem girth (mm), number of leaves per plant, leaf length (cm), leaf breadth (cm), total soluble solids (%) green fodder yield per plant (g), grain yield per plant (g), dry fodder yield per plant (g), test weight (g), harvest index (g) and protein content (%) were recorded on ten randomly selected plants for each entry in each replication while observations on days to 50% flowering and days to maturity were recorded on the basis of total population in each plot. Protein content (%) in grains was computed using micro kjeldahl's method as given by Linder (1944). The analysis of variance and covariance was worked out for all the traits using standard statistical procedure given by Panse and Sukhatme (1985). Genotypic and phenotypic Correlation coefficients were computed from variance and covariance as per method suggested by Al-Jibouri *et al.*, (1958). Path coefficients were estimated by principles and techniques given by Wright (1921) and Dewey and Lu (1959).

Results and Discussion

Correlation coefficients worked out at both genotypic (r_g)and phenotypic (r_p) levels for 14 different characters are presented in Table 1. In general, the magnitudes of genotypic correlation coefficients were higher than their counterparts at phenotypic levels for most of the characters under study which is an indication of strong inherent relationship between various traits studied(Johnson, 1955). Similar result was reported by (Khandelwal *et al.*, 2015 and Girish *et al.*, 2016).

Grain yield per plant exhibited positive and significant correlation at both genotypic and phenotypic levels with harvest index, dry fodder yield per plant and green fodder yield per plant.

These characters can be taken in to consideration as vital yield factor in sorghum. The analogous findings were reported by Yazdani (2012), Kalpande *et al.*, (2015) for harvest index, Khandelwal *et al.*, (2015) for harvest index and fresh weight per plant, Patted *et al.*, (2011) and Jain and Patel (2014)for dry fodder yield per plant.Grain yield per plant showed negative and significant correlation at both genotypic and phenotypic levels with days to maturity and only genotypic level with days to 50 per cent flowering. These outcomes were in agreement with outcomes recorded by Khandelwal *et al.*, (2015) and Deshmukh *et al.*, (2018).

Table.1 Genotypic and phenotypic correlation coefficients among various traits in sorghum (P\G)

Character	Days to 50 per cent flowering	Days to maturity	plant height (cm)	Stem girth (mm)	Number of leaves per plant	Leaf length (cm)	Leaf breadth (cm)	Total soluble solids (%)	Green fodder yield per plant (g)	Grain yield per plant (g)	Dry fodder per plant (g)	Test weight in (g)	Harvest index (%)	Protein content (%)
Days to 50 per cent flowering	1	0.78**	0.19	-0.24	0.33**	0.05	-0.22	-0.22	-0.33*	-0.32*	-0.39**	-0.15	-0.07	-0.07
Days to maturity	0.67**	1	0.15	-0.32*	0.25	-0.22	-0.45**	-0.29*	-0.38**	-0.36**	-0.46**	-0.19	-0.08	0.03
plant height (cm)	0.19	0.13	1	0.22	0.45**	0.40**	0.24	-0.02	0.23	-0.25	0.17	-0.22	-0.42**	-0.31*
Stem girth (mm)	-0.17	-0.26*	0.20	1	0.09	0.33*	0.55**	0.34**	0.44**	0.15	0.42**	0.30*	-0.14	-0.29*
Number of leaves per plant	0.28*	0.22	0.38**	0.07	1	0.44**	0.15	0.06	-0.03	-0.16	-0.07	-0.22	-0.13	-0.22
Leaf length (cm)	0.07	-0.20	0.33*	0.26*	0.33**	1	0.60**	0.14	0.28*	0.05	0.24	0.03	-0.11	-0.26*
Leaf breadth (cm)	-0.16	-0.40**	0.22	0.48**	0.15	0.54**	1	0.36**	0.46**	0.21	0.45**	0.26*	-0.10	-0.32*
Total soluble solids (%)	-0.16	-0.27*	-0.02	0.30*	0.05	0.15	0.34**	1	0.25	0.17	0.24	0.22	0.01	-0.15
Green fodder yield per plant (g)	-0.24	-0.31*	0.19	0.38**	-0.01	0.22	0.42**	0.22	1	0.46**	1.00**	0.15	-0.27*	-0.11
Grain yield per plant (g)	-0.25	-0.32*	-0.23	0.16	-0.14	0.04	0.19	0.15	0.37**	1	0.48**	0.11	0.71**	0.23
Dry fodder per plant (g)	-0.31*	-0.37**	0.15	0.36**	-0.04	0.19	0.41**	0.20	0.96**	0.41**	1	0.17	-0.25	-0.08
Test weight in (g)	-0.12	-0.17	-0.21	0.25	-0.20	0.02	0.24	0.20	0.11	0.08	0.14	1	-0.00	0.14
Harvest index (%)	-0.04	-0.07	-0.35**	-0.08	-0.12	-0.08	-0.10	0.02	-0.34**	0.69**	-0.33*	-0.01	1	0.37**
Protein content (%)	-0.03	0.04	-0.29*	-0.26*	-0.19	-0.21	-0.29*	-0.14	-0.09	0.22	-0.07	0.14	0.33*	1

*, ** Significant at 5 % and 1 % level of significance respectively

Table.2 Genotypic path analysis for Grain yield per plant (g) with various traits

Character	Days to 50 per cent flowering	Days to maturity	Plant height (cm)	Stem girth (mm)	Number of leaves per plant	Leaf length (cm)	Leaf breadth (cm)	Total soluble solids (%)	Dry fodder per plant (g)	Test weight in (g)	Protein content (%)	r_g
Days to 50 per cent flowering	**0.01**	-0.05	-0.06	-0.01	0.01	0.00	-0.02	-0.01	-0.19	0.02	-0.02	-0.32*
Days to maturity	0.01	**-0.06**	-0.05	-0.01	0.01	-0.00	-0.05	-0.01	-0.22	0.03	0.01	-0.36**
Plant height (cm)	0.00	-0.01	**-0.33**	0.01	0.01	0.01	0.03	-0.00	0.08	0.03	-0.08	-0.25
Stem girth (mm)	-0.00	0.02	-0.07	**0.04**	0.00	0.01	0.06	0.01	0.20	-0.04	-0.07	0.15
Number of leaves per plant	0.00	-0.01	-0.15	0.00	**0.02**	0.01	0.02	0.00	-0.03	0.03	-0.05	-0.16
Leaf length (cm)	0.00	0.01	-0.13	0.01	0.01	**0.02**	0.07	0.01	0.12	-0.00	-0.06	0.05
Leaf breadth (cm)	-0.00	0.03	-0.08	0.02	0.00	0.01	**0.11**	0.01	0.22	-0.04	-0.08	0.21
Total soluble solids (%)	-0.00	0.02	0.01	0.01	0.00	0.00	0.04	**0.04**	0.11	-0.03	-0.04	0.17
Dry fodder per plant (g)	-0.00	0.03	-0.06	0.02	-0.00	0.00	0.05	0.01	**0.48**	-0.02	-0.02	0.48**
Test weight in (g)	-0.00	0.01	0.07	0.01	-0.01	0.00	0.03	0.01	0.08	**-0.14**	0.04	0.11
Protein content (%)	-0.00	-0.00	0.10	-0.01	-0.01	-0.00	-0.04	-0.01	-0.04	-0.02	**0.25**	0.23

Residual effect = 0.7693

Bold (diagonal)valueindicates direct effect

*, ** Significant correlation at 5 % and 1 % level of significance respectively

Regarding inter correlations among above yield components, positive and significant association at both levels was found between green fodder yield per plant and dry fodder yield and between days to 50 per cent flowering with days to maturity. The analogous findings were also reported by Pahuja and Dharmveer (2013) for association between green and dry fodder yield per plant and Deshmukh *et al.,* (2018) for association between days to 50 % flowering and days to maturity.Dry and green fodder yield per plant were significantly and negatively associated with harvest index, days to 50 per cent flowering and days to maturity. Similar results were recorded by Khandelwal *et al.,* (2015) for harvest index.

In order to obtain a clear picture of the relative importance of the components on grain yield per plant (g), path coefficients analysis at genotypic level using 11 independent characters was carried out (Table 2). The high estimate of residual effect (0.7693) revealed that inadequacy of the traits included for the path analysis and indicated that 23.07 per cent variability of grain yield per plant (g) could be explained by these traits under consideration. The results revealed that maximum positive direct effect on grain yield per plant was found to be from dry fodder yield per plant followed by protein content and leaf breadth. These findings match with the studies conducted by earlier workers Khandelwal *et al.,* (2015) for dry fodder yield per plant, Patil *et al.,*(2014) for protein content in grain and Jain and Patel (2014) for leaf width. While, high negative direct effect exerted by plant height followed by test weight.

It can be concluded from the present study that an ample amount of variability was present in genetic material for all the traits studied. The traits viz., dry fodder yield per plant harvest index, green fodder yield per plant leaf breadth, protein content and plant height may be considered as indirect selection indices for improvement in grain yield of sorghum.

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