Original Research Article

Correlation and path analysis study of different morphological characters for grain yield and fodder purpose in sorghum [*Sorghum bicolor* (L.) Moench]

Abstract

The present study was carried out to find the correlation and path coefficient analysis of 33 advanced line of sorghum for forage and grain yield and its attributes.The experimental material was planted in field during Kharif in the year 2019-20 at Crop Research Centre, Modipuram, SVPUA&T, Meerut - 250110 (U.P.).Association and path analysis betweendays to 50% flowering, plant height, leaf length, leaf breadth, leaf area, stem girth, leaves per plant, leaf stem ratio, total soluble solids and green fodder yield per plant.There is significantly and positively correlated with green fodder yield per plant was exhibited with stem girth (0.68), leaves per plant (0.67), leaf length (0.64), leaf breadth (0.47), leaf stem ratio (0.27) and total soluble solids (0.20) at genotypic level and leaf area (0.64) displayed maximum order of direct effect on green fodder yield followed by stem girth (0.51), leaves per plant (0.49) and leaf stem ratio (0.17).

Key words: Genetic variability, Correlation, Path Coefficient, quantitative traits

Introduction

Sorghum or Great millet [Sorghum bicolor (L.) Moench] is one of the most important cereal crop in the world because of its adaptation to a wide range of ecological conditions, suitability for low input cultivation and diverse uses (Doggett, 1988). It is a C4 plant with higher photosynthetic efficiency and higher abiotic stress tolerance (Nagy et al.,1995; Reddy et al.,2009). The height of cultivated sorghum varieties varies from 0.5 m to 6.0 m. Cultivated sorghum have been classified into 5 races viz., Bicolor, Guinea, Caudatum, Durra and Kafir and ten intermediate races corresponding to the pair wise combination of major races. These are identified according to the morphological traits, especially panicle, grain and glume traits (Harlan and de Wet, 1972).Sorghum is fifth most important cereal crop globally and is the dietary staple of more than 500 million people in 30 countries. It is grown on The area under this crop in India is about 5.14 million hectares with an annual production of 4.57 million tonnes and productivity of 889 kg/ha. The major states in the country where this cereal grain is produced are Maharashtra, Karnataka, Madhya Pradesh, Andhra Pradesh, Rajasthan and Gujarat. In Gujarat, area, production and productivity of sorghum is 0.10 million hectares, 0.15 million tonnes and 1408 kg/ha, respectively (Anonymous, 2018).

It is the fourth important cereal in India after rice, wheat and pearl millet. In India sorghum mainly used as food, feed and forage crop. Besides this it also provides raw material for the production of starch, fibre, dextrose syrup bio fuels, vinegar, alcohol, and other products.Available scientific evidences indicated that the improved sorghum hybrids and cultivars were less diverse as compared to wild and weedy relatives and landraces (**Karadi and Kajjidoni 2019**). During the last 30 years the role of sorghum as a major source of fodder has not diminished while its importance as a forage crop has increase. The average fodder yield of sorghum in Uttar Pradesh is low because major area covered by local and out dated varieties and selection which are not responsive to improved cultural and fertility practices.

In order to make sorghum as an enterprising and remunerative crop, obviously there is an urgent need to initiate research to develop varieties and hybrids having faster growth, early to medium maturity and higher grain and fodder yield with good quality parameters. To improving the genetic potential for grain and fodder yield in sorghum is a prime concern for the breeder. It is noted that the cultivated sorghums are highly variable and suggested that to enhance the productivity levels of sorghum, prior information on the nature and the magnitude of genetic variability present in germplasm collection is a prerequisite. Assessment of genetic variability in the base population is the first step in any breeding programme. Variability should be determined with the help of certain parameters, such as genotypic and phenotypic coefficient of variation, heritability estimates and genetic advance. This study aims at finding the variability presented among the selected genotypes. A path coefficient is simply standardized partial regression coefficient and as such measures the direct influence of one variable upon another and permits the separation of the correlation coefficient into components of direct and indirect effects. Grain yield and dry fodder yield per plant is the result of direct and indirect effects of severalyield contributing characters. To know the contribution of various characters towards grain yield, the significant genotypic correlations of different traits with grain yield per plant were partitioned into their direct and indirect effects. This will provide more precise information for the selection of important traits, which may contribute more towards grain yield.

Material and methods

The experimental material consisting of 33 advanced line were grown in the Randomized Block Design (RBD) with three replications. The experimental material was planted in field during Kharif in the year 2019-20 at Crop Research Centre, Modipuram, SVPUA&T, Meerut - 250110 (U.P.). All the recommended agronomic practices were followed to raise a good crop of sorghum with 4 row plot of 5 meter length. The row to row spacing was 30 cm and plant to plant distance was 10 cmrespectively.Observations were recorded on yield and yield attributing characters. All the observations were taken from each plot, on randomly five selected plants from each genotype. The data were recorded for the following characters *viz.*days to 50% flowering, plant height, leaf length, leaf breadth, leaf area, stem girth, leaves per plant, leaf stem ratio, total soluble solids and green fodder yield per plant.The correlations at genotypic, phenotypic and environmental levels were estimated from the analysis of variance and covariance as suggested by **Searle (1961)**.The Path analysis was performed according to the method suggested by **Dewey and Lu (1959**).

Result and discussion

The correlation coefficients between yield and its component traits among themselves were estimated at genotypic and phenotypic levels. The correlations at genotypic level were relatively greater than their corresponding phenotypic correlations. The results of genotypic and phenotypic correlation coefficients between yield and its components are given in Table 1. In most of the cases the direction and magnitude of genotypic and phenotypic correlations between different characters remained almost same. In the present study, grain yield per plant was found to be significantly and positively correlated withgreen fodder yield per plant was exhibited with stem girth (0.68), leaves per plant (0.67), leaf length (0.64), leaf breadth (0.47), leaf stem ratio (0.27) and total soluble solids (0.20) at genotypic level whereas showed negative significant association of green fodder yield per plant with days to 50% flowering (-0.25) while negative but non significant correlation of green fodder yield per plant revealed with plant height (-0.12) and leaf area (-0.19) at genotypic level.

Hence, enhancement of green fodder yield can be achieved by improving these characters in forage sorghum. These result are in general agreement with the finding of**Arunah*et al.* (2015),Dubey*et al.* (2016),Girish*et al.* (2016),Khandelwal*et al.* (2016),Rana*et al.* (2016),Singh *et al.* (2016)**and**Jain *et al.* (2017)**.

Partitioning of the path coefficients in to direct and indirect effects was done at the phenotypic level results is presented in Table-2. A critical perusal of result in the table showed that leaf area (0.64) displayed maximum order of direct effect on green fodder yield followed by stem girth (0.51), leaves per plant (0.49) and leaf stem ratio (0.17) whereas maximum negative direct effect exhibited for leaf breadth (-0.19) followed by plant height (-0.14) and leaf length (-0.15). At phenotypic level also recorded direct and indirect effects were generally similar to those showed at genotypic level with little variation in magnitudes. The magnitudes of residual effects at both phenotypic and genotypic levels were observed to be low. The direct contribution ofleaf area, stem girth, leaves per plant and leaf stem ratio with green fodderyield per plant observed in this study is also in confirmation with the findings**Khandelwal*et al.* (2016),Singh *et al.* (2016),Jain *et al.* (2017),Endalamaw*et al.* (2017),Damor*et al.* (2018),Malaghan and Kajjidoni (2019),Mengesha*et al*. (2019),Dev*et al*. (2019), Srivastava*et al*. (2019)**,**Singh *et al.* (2019)**and**Prasad and Sridhar (2020)**.

The contribution of residual effects that influenced green fodder yield was very low at both genotypic and phenotypic levels, indicating that the characters included in the present investigation were sufficient enough to account for the variability in the dependant attribute*i.e.* green fodder yield.

CONCLUSION

Green fodder yield per plant had highly significant positiveassociation with leaf length, leaf breadth, stem girth, leaves per plant, leaf stem ratio and total soluble solids at both genotypic and phenotypic level. Hence, enhancement of green fodder yield can be achieved by improving these characters in forage sorghum.

Genotypic and phenotypic path coefficient analysis of green fodder yield per plant and its component attributes showed that leaf area had the highest positive direct effect on green fodder yield per plant followed by stem girth, leaves per plant and leaf stem ratio, indicates that these traits could be considered as most important characters for improving fodder yield.

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Table-1: Estimates of correlation coefficients for genotypic (G) and phenotypic (P) levels among different characters in forage sorghum (*Sorghum bicolor* L. Moench)

Characters		Days to 50% flowering	Plant height (cm)	Leaf length (cm)	Leaf breadth (cm)	Leaf area (cm^2)	Stem girth (mm)	Leaves per plant	Leaf stem ratio	Total soluble solids (%)	Green fodder yield per plant(g)
Days to 50% flowering	G	1.00	0.12	0.11	0.30**	0.25**	0.25**	-0.02	-0.02	0.36**	-0.25**
	P	1.00	0.15	0.12	0.26**	0.22**	0.22**	-0.02	-0.02	0.31**	-0.23**
Plant height (cm)	G		1.00	0.23**	0.33**	0.41**	-0.11	0.21*	0.20*	-0.33**	-0.12
	P		1.00	0.22**	0.39**	0.42**	-0.11	0.20*	0.20*	-0.33**	-0.12
Leaf length (cm)	G			1.00	-0.09	0.40**	0.23*	0.14	0.33**	0.30**	0.64**
	P			1.00	-0.09	0.39**	0.23*	0.13	0.32**	0.30**	0.65**
Leaf breadth (cm)	G				1.00	0.94**	0.23*	0.31**	-0.03	-0.10	0.47**
	P				1.00	0.94**	0.23*	0.29**	-0.03	-0.10	0.49**
Leaf area (cm^2)	G					1.00	0.14	0.34**	-0.01	-0.13	-0.19
	P					1.00	0.18	0.39**	-0.02	-0.13	-0.19
Stem girth (mm)	G						1.00	-0.06	0.51**	0.12	0.68**
	P						1.00	-0.06	0.50**	0.12	0.69**
Leaves per plant	G							1.00	0.21	-0.10	0.67**
	P							1.00	0.16	-0.10	0.69**
Leaf stem ratio	G								1.00	0.45**	0.27**
	P								1.00	0.44**	0.27**
Total soluble solids (%)	G									1.00	0.20*
	P									1.00	0.20*
Green fodder yield per plant (g)	G										1.00
	P										1.00

*, ** significant at 5% and 1% level, respectively.

Table-2: Path coefficient analysis showing the direct and indirect effect of ten characters on the green fodder yield at genotypic and phenotypic levels of forage sorghum (*Sorghum bicolor* L. Moench)

Characters		Days to 50% flowering	Plant height (cm)	Leaf length (cm)	Leaf breadth (cm)	Leaf area (cm^2)	Stem girth (mm)	Leaves per plant	Leaf stem ratio	Total soluble solids (%)
Days to 50% flowering	G	**0.10**	-0.02	-0.01	-0.04	0.05	-0.13	-0.21	-0.06	0.01
	P	**0.03**	-0.01	-0.01	-0.05	0.05	-0.11	-0.14	-0.02	0.02
Plant height (cm)	G	0.01	**-0.15**	-0.03	-0.05	0.08	0.06	-0.07	0.04	0.01
	P	0.04	**-0.14**	-0.03	-0.06	0.10	0.06	-0.05	0.03	0.03
Leaf length (cm)	G	0.01	0.23	**-0.13**	-0.02	0.08	0.04	-0.04	0.07	-0.02
	P	0.05	0.33	**-0.15**	-0.02	0.09	0.04	-0.03	0.08	-0.02
Leaf breadth (cm)	G	0.03	0.25	-0.02	**-0.15**	0.19	-0.12	-0.10	-0.08	0.02
	P	0.09	0.24	-0.02	**-0.19**	0.23	-0.12	-0.08	-0.09	-0.02
Leaf area (cm^2)	G	0.02	-0.06	-0.05	-0.14	**0.62**	-0.07	-0.09	0.07	-0.24
	P	0.07	-0.05	-0.06	-0.18	**0.64**	-0.07	-0.07	0.06	-0.24
Stem girth (mm)	G	0.02	0.21	0.01	-0.03	0.02	**0.50**	-0.11	-0.06	-0.04
	P	0.04	0.24	0.01	-0.04	0.03	**0.51**	-0.08	-0.05	-0.09
Leaves per plant	G	0.06	0.04	-0.02	-0.04	0.05	-017	**0.44**	0.02	0.03
	P	0.07	0.06	-0.02	-0.05	0.06	-0.16	**0.49**	0.01	0.07
Leaf stem ratio	G	-0.03	0.34	-0.04	0.06	0.06	0.15	-0.03	**0.21**	0.01
	P	-0.01	0.36	-0.05	0.07	0.08	0.15	-0.02	**0.17**	0.03
Total soluble solids (%)	G	0.03	0.02	-0.04	0.02	-0.02	0.05	-0.02	-0.02	**-0.03**
	P	0.05	0.02	-0.04	0.02	-0.03	0.05	-0.02	-0.01	**-0.08**

Residual values (G) = 0.17 Residual values (P) = 0.28 *, ** significant at 5% 1% level, respectivelyBold values indicate direct effects