Correlation and Path Coefficient Analysis for Yield and It's Attributing Traits in Forage Sorghum [*Sorghum bicolor* (L) moench]

ABSTRACT

This research was conducted in *kharif* during 2017 at research farm of SVPUA&T, Meerut, U.P. India. Total 30 genotypes were grown with recommended plant spacing and its collected from different agriculture universities of India. The studies of genotypic and phenotypic correlation coefficient for 10 traits, observed that phenotypic correlation coefficient was higher than the genotypic coefficient and it exhibited modifying effect of environments on the binding of the traits. Green fodder yield showed significant and strong positive correlation with leaf area at both genotypic and phenotypic levels. Therefore, this character is useful to the breeders in selecting suitable plant type. Path analysis showed that plant height displayed maximum order of direct effect on green fodder yield followed by stem girth, leaf breadth and leaf stem at genotypic level.

KEYWORDS- Sorghum, Green fodder, phenotypic correlation, Path Analysis

INTRODUCTION

"Sorghum is the fifth important cereal crop grown after Rice, Wheat, Maize and Barley in the world. Grain of Sorghum is used for human consumption in Asia and Africa as well as in India, the rainy season sorghum grain is used mostly for animal/poultry feed" (Price et al., 2005). "Sorghum also has great potential to supplement fodder resources in India because of its wide adaptation, various agro-ecological conditions, rapid growth, high green and dry fodder yields. Its dual-purpose crop used as food and fodder crop. It's generally called Jowar and behavior of this, often cross-pollinated crop containing 2n = 20 chromosome number. Family of it's belonging to grass family *Poaceae".* **(Price *et al.*, 2005)**. The *kharif* sorghum gives good yield but the quality of *rabi* sorghum is greater and market price is also excellent (**Singh *et al.*, 2017**).

Important objective of forage breeding programme is incensing of productivity of green fodder yield. Fulfilment of this objective, it must be known that direct and indirect effect of yield contributing character impacts on green fodder yield. The present study was conducted to assess the correlation coefficient analysis between green forage yield and traits contributing to yield. Path analysis allows the investigation of direct effects for the different traits on green forage yield as well as their indirect effects through other component traits.

MATERIALS AND METHODS

This research was conducted in *kharif* during 2017 at research form of SVPUA&T, Meerut, U.P. India. Total 30 genotypes were grown with recommended plant spacing (plant to plant and row to row are 30 cm and 10 cm respectively) and its collected from different agriculture universities of India. Randomly selected five plant were recorded for ten different observation namely, days to 50% flowering, plant height, leaf length, leaf breadth, leaf area, stem girth, number of leaves per plant, leaf stem ratio, total soluble solids and green fodder yield are studied. Correlation was estimated by statistically method proposed by **Searle (1961)** and path analysis was analysed by **Wright (1921)** and elaborated by **Dewey and Lu (1959)**.

RESULTS AND DISCUSSION

The correlation coefficient provides information about the degree and direction of the association between two or more variables. The correlation coefficient was calculated to find out correlation of green fodder yield with various attributes in both genotypic and phenotypic levels and their significance was compared with tabulated values at 1 and 5 % level of significance. All the attributes showed significant variability in screening of the materials under investigation namely, days to 50% flowering, plant height (cm), leaf length (cm), leaf breadth (cm), leaf area (cm^2), stem girth (mm), number of leaves per plant, leaf stem ratio (w/w), total soluble solids (%) and green fodder yield (q/ha). The studies of genotypic and phenotypic correlation coefficient for 10 traits observed that phenotypic correlation coefficient was higher than the genotypic coefficient and it showed modifying effect of environments on the binding of the traits. Similar result estimated by **(Talmale *et. al.*, 2020), Sirohi *et al.* (2019) and Prasad and Sridhar (2020)** while in some case genotypic correlation coefficient was marginally larger than phenotypic correlation, it exhibited strong inherent attachment between different traits.

Leaf area showed positive and highly significant relationship with green fodder yield at both levels. This type of correlation helps in increasing green fodder yield in forage sorghum. Similar result found by (**Jain *et al*., 2010), (Talmale *et. al.*, 2020) and (Singh *et al*., 2022)** as well as suggested that contribution of individual characters to fodder yield is important in planning good breeding Program for development of high yielding varieties. **(Patil *et. al*., 2023).**

"At phenotypic level, partitioning of the correlation coefficient of various attributes under investigation was done with the help of the path coefficient analysis to express the direct and indirect effect of all these traits on green fodder yield. Plant height displayed maximum order of direct effect on green fodder yield followed by stem girth, leaf breadth and leaf stem ratio while maximum negative direct effect showed for leaf area followed by leaf length". **Singh *et. al.* (2022)**. The characters which contributed indirectly high to green fodder yield were observed Days to 50% flowering through leaf area, leaves per plant, plant height and leaf length; Leaf area via stem girth, leaf stem ratio and leaf breadth (Table-2a).

Partitioning of the correlation coefficients into direct and indirect effects was done at the genotypic level which was given in Table-2b. A critical perusal of result showed that plant height displayed maximum order of direct effect on green fodder yield followed by stem girth, leaf breadth and leaf stem ratio whereas maximum negative direct effect exhibited for leaf area followed by leaf length. The direct and indirect effects also recorded at the genotypic level were generally similar to those shown at the phenotypic level with slight differences in magnitude. The residual effects were observed to be small in magnitude at both the phenotypic and genotypic levels.

Phenotypic path coefficient and genotypic path coefficient found positive and direct contribution of plant height, stem girth, leaf breath, leaf length, days to 50% flowering, total soluble solids and leaves plant^{-1}, selection of these characters also beneficial for improving the green fodder yield in forage sorghum. Similar result was found by **(Chavhan *et al*., 2022) and (Patil *et. al*., 2023).** This will play an important role in selection criteria for improving the green fodder yield. High indirect positive involvement by Days to 50% flowering via leaf area, number of leaves per plant, plant height and leaf length; Leaf area through leaf stem ratio, stem girth and leaf breadth; stem girth via leaf breadth and leaf area were observed which is in line with **Chavan *et al*. (2011), Arunah *et al.* (2015), Girish *et al.* (2016), Khandelwal *et al* (2016), Rana *et al.* (2016), Singh *et al*. (2016), Jain *et al.* (2017) and Damor *et al.* (2018)**.

"The contribution of residual effects affecting green fodder yield was very low at both the levels, showing that the traits included in the present study were sufficient to account for the variability in the dependent trait, i.e., green fodder yield. To practice an appropriate selection programme, it is advisable to focus on traits such as plant height, leaf width, stem girth and leaf-stem ratio which directly control green fodder yield while days to 50% flowering and leaf area indirectly control the yield of green fodder" [Kumar et al. 2022]. In the current study, considering the correlation and path coefficient analysis together, it can be concluded that plant height, leaf width, stem girth, leaf stem ratio, days to 50% flowering and leaf area in fodder are the most important properties for improving the yield of green fodder.

CONCLUSION

Green fodder yield exhibited significant stable and positive association with leaf area at both genotypic and phenotypic level and these traits may be considered as important of yield component in forage sorghum. Plant height displayed high order of direct effect on green fodder yield followed by stem girth, leaf breadth and leaf stem ratio, suggested that these characters should be used for selection of desirable genotype after hybridization between the accessions for creating wide spectrum of favourable genetic variability for improvement of green fodder yield in sorghum**.**

Conference disclaimer:

Some part of this manuscript was previously presented in the conference: 6th International Conference on Strategies and Challenges in Agricultural and Life Science for Food Security and Sustainable Environment (SCALFE-2023) on April 28-30, 2023 in Himachal Pradesh University, Summer Hill, Shimla, HP, India. Web Link of the proceeding: https://www.shobhituniversity.ac.in/pdf/Souvenir-Abstract%20Book-Shimla-HPU-SCALFE-2023.pdf

Table-1a Estimates of correlation coefficients for phenotypic 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)	No. of leaves per plant	Leaf stem ratio (w/w)	Total soluble solids (%)	Green fodder yield (q/ha)
Days to 50% flowering	1.00	0.21	-0.07	0.07	-0.08	-0.21	-0.02	-0.19	-0.01	-0.39**
Plant height (cm)		1.00	0.02	0.39**	-0.21	-0.18	0.37**	0.20	-0.08	-0.22
Leaf length (cm)			1.00	0.07	0.46**	0.05	0.17	0.17	0.04	0.15
Leaf breadth (cm)				1.00	0.90**	0.60**	0.18	-0.16	0.27	0.05
Leaf area (cm^2)					1.00	0.64**	0.14	-0.15	0.38**	0.55**
Stem girth (mm)						1.00	-0.05	-0.11	0.07	0.16
No. of leaves per plant							1.00	0.45**	0.05	-0.73**
Leaf stem ratio (w/w)								1.00	-0.01	-0.01
Total soluble solids (%)									1.00	-0.09
Green fodder yield (q/ha)										1.00

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

Table-1b Estimates of correlation coefficients for genotypic 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)	No. of leaves per plant	Leaf stem ratio (w/w)	Total soluble solids (%)	Green fodder yield (q/ha)
Days to 50% flowering	1.000	0.20	-0.14	0.07	-0.12	-0.21	-0.06	-0.20	-0.01	-0.32**
Plant height (cm)		1.00	0.02	0.33**	-0.20	-0.16	0.36**	0.20	-0.10	-0.20
Leaf length (cm)			1.00	0.11	0.44**	0.02	0.27	0.24	0.03	0.18
Leaf breadth (cm)				1.00	0.89**	0.55**	0.15	-0.19	0.20	0.05
Leaf area (cm^2)					1.00	0.55**	0.15	-0.17	0.36**	0.67**
Stem girth (mm)						1.00	-0.15	-0.11	0.06	0.21
No. of leaves per plant							1.00	0.36**	0.03	-0.67**
Leaf stem ratio (w/w)								1.00	-0.08	-0.01
Total soluble solids (%)									1.00	-0.14
Green fodder yield (q/ha)										1.00

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

Table – 2a Path coefficient analyses showing the direct and indirect effect of ten different characters on the green fodder yield at phenotypic level of forage sorghum (*Sorghum bicolor* L. Moench)

Character	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 (w/w)	Total soluble solids (%)	Correlation with Green fodder yield (q/ha)
Days to 50% flowering	0.18	0.24	0.23	-0.02	0.32	0.03	0.31	0.04	-0.01	-0.39**
Plant height (cm)	-0.03	0.57	-0.01	0.05	0.04	0.02	-0.04	-0.03	0.03	-0.22
Leaf length (cm)	-0.01	0.01	-0.10	0.01	0.05	-0.01	0.02	0.03	0.04	0.15
Leaf breadth (cm)	-0.01	0.05	-0.01	0.37	-0.05	-0.05	-0.03	0.03	-0.03	0.05
Leaf area (cm^2)	-0.01	-0.04	0.34	0.24	-0.16	0.36	0.02	0.31	0.09	0.55**
Stem girth (mm)	-0.01	-0.01	-0.01	0.03	0.03	0.50	-0.03	-0.01	0.08	0.16
Leaves per plant	0.01	0.01	0.01	-0.01	-0.01	-0.01	0.03	-0.01	0.01	-0.73**
Leaf stem ratio (w/w)	-0.01	-0.01	-0.01	0.01	0.01	0.01	-0.01	0.32	-0.01	-0.01
Total soluble solids (%)	0.01	-0.01	0.01	0.01	0.01	0.01	0.01	-0.01	0.06	-0.09

Residual values (P) = 0.320 *,** significant at 5% and 1% level, respectively

Bold values indicate direct effects

Table – 2b Path coefficient analyses showing the direct and indirect effect of ten characters on the green fodder yield at genotypic level of forage sorghum (*Sorghum bicolor* L. Moench)

Character	Days to 50% flowering	Plant height (cm)	Leaf length (cm)	Leaf breadth (cm)	Leaf area (cm2)	Stem girth (mm)	Leaves per plant	Leaf stem ratio (w/w)	Total soluble solids (%)	Correlation with Green fodder yield (q/ha)
Days to 50% flowering	0.17	0.24	0.22	-0.01	0.32	0.04	0.31	0.03	-0.01	-0.32**
Plant height (cm)	-0.05	0.51	-0.01	0.07	0.06	0.03	-0.07	-0.04	0.02	-0.20
Leaf length (cm)	-0.01	0.002	-0.10	0.01	0.05	-0.01	0.03	0.02	0.03	0.18
Leaf breadth (cm)	-0.02	0.12	-0.04	0.35	-0.01	-0.19	-0.05	0.07	-0.09	0.05
Leaf area (cm2)	-0.03	-0.06	0.30	0.20	-0.13	0.32	0.03	0.40	0.08	0.67**
Stem girth (mm)	-0.04	-0.03	-0.01	0.11	0.11	0.40	-0.03	-0.02	0.07	0.21
Leaves per plant	-0.01	0.01	0.01	-0.01	-0.01	-0.01	0.02	-0.01	0.10	-0.67**
Leaf stem ratio (w/w)	0.01	-0.01	-0.01	0.01	0.01	0.01	-0.01	0.32	-0.01	-0.01
Total soluble solids (%)	0.01	-0.01	0.01	0.01	0.01	0.01	0.01	-0.01	0.02	-0.14

Residual values (G) = 0.303 *,** significant at 5% and 1% level, respectively

Bold values indicate direct effects

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