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Studies on Character Association and Path Analysis for Fodder Yield and Its Components in Sweet Sorghum [*Sorghum bicolor* (L.)]

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ABSTRACT

Correlation and path analysis for fodder yield and its attributing traits were studied in nineteen genotypes of sweet sorghum [Sorghum bicolor (L.) Moench]. Character association analysis revealed significant positive association of green fodder yield with early vigour, plant height, number of leaves per plant, leaf length, number of nodes per plant and internodal length. Path analysis revealed the positive and direct effect of early vigour, plant height, number of leaves per plant, internodal length, leaf to stem ratio and stem girth. These characters may be considered as important yield components. Hence, selection for these characters could bring improvement in yield and yield components.

Key words: *Sweet sorghum, Correlation, Path analysis, Green Fodder yield*

INTRODUCTION

In India, Sorghum (*Sorghum bicolor* (L.) Moench) is one of the most important forage crops grown widely in north western states and to a limited scale in central and southern states. Sorghum ranks first among the cereal fodder crops because of its growing ability in poor soil, faster growing habit, high yield potential, suitability to cultivate throughout the year, palatability, nutritious fodder quality, higher digestibility and various forms of its utilization. It gives uniform green fodder throughout the year and produces tonnage of dry matter having digestible nutrients (50%), crude protein (8%), fat (2.5%) and nitrogen free extracts (45%)[1].

Sweet sorghum, being a well-known crop can supply food, feed, fodder, fiber and fuel. However, it has not been studied much as a fodder crop. Sweet sorghum has high biomass production, high brix percentage, short duration, low water requirement and wider adaptability [9]. Sweet sorghum hybrids have been reported to produce higher sugar yield (21%) and higher grain yield (15%) than non-sweet sorghum hybrids.

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The area under fodder cultivation is estimated to be about 4% of the gross cropped area which remained static for the last four decades. The available fodder production is less than the actual requirement. At present, the country faces a net deficit of 61.1% green fodder, 21.9% dry crop residues and 64% concentrate feeds[3]. Hence, there is an urgent need to reduce the demand and supply gap by enhancing the productivity of fodder crops. As the performance of dairy animals depends on the availability of quality forage, there is also a necessity for improving the nutritive value of forages in order to obtain a better animal performance. Therefore, the present study was undertaken to assess the variability among genotypes and to estimate correlation among the fodder yield and related traits along with direct and indirect effects on the green fodder yield in sweet sorghum.

MATERIAL AND METHODS

The present investigation was carried out at AICRP on Forage Crops, ARI, Rajendranagar, Hyderabad, Telangana, India. The experiment material comprised of nineteen genotypes of sweet sorghum. They were obtained from Indian Institute of Millets Research, Rajendranagar, Hyderabad. The details of the genotypes are furnished in the Table.1. The nineteen genotypes were sown in randomized block design with three replications at AICRP on Forage Crops, ARI, Rajendranagar during kharif, 2016. Each entry was raised in two rows of 4 m length with a spacing of 30 cm between the rows and 10 cm between the plants with in the row. The soil was sandy loam in texture with pH of 8.13, low in available Nitrogen and medium in available phosphorous and available K_2O. All the recommended agronomical practices under AICRP on sorghum were followed and plant protection measures were applied as and when required to ensure good crop. The observations were recorded on five randomly selected plants per each entry in each replication for early vigour, days to 50 per cent flowering, plant height, number of leaves per plant, leaf length, leaf breadth, number of nodes per plant, internodal length, stem girth, leaf to stem ratio, sugar brix, green fodder yield, dry matter content, dry fodder yield, crude fibre and crude protein. Mean of five plants for each entry for each character was calculated and the data was analyzed statistically using the software WINDOSTAT version 8.1. Statistical analyses for the above characters were done following Singh and Chaudhary[11], for correlation coefficient and Dewey and Lu[2] for path analysis.

RESULTS AND DISCUSSION

Green fodder yield, being a complex character is the interactive effect of various yield attributing traits. Selection based on the detailed knowledge of magnitude and direction of association between yield and its attributes is very important in identifying the key characters, which can be exploited for crop improvement through suitable breeding programme. Correlation between yield and yield components *viz*., early vigour, days to 50 per cent flowering, plant height, number of leaves per plant, leaf length, leaf breadth, number of nodes per plant, internodal length, stem girth, leaf to stem ratio and green fodder yield were computed for sweet sorghum genotypes. The results are presented in the Table.2.

Early vigour exhibited positive and significant correlation with plant height, number of leaves per plant, leaf length, number of nodes per plant, internodal length, stem girth and green fodder yield while negative and non-significant association with days to 50 per cent flowering. Days to 50 per cent flowering showed negative correlation with all the traits but significant association was observed with number of leaves per plant, leaf length and number of nodes per plant.

Plant height had significant positive correlation with number of leaves per plant, leaf length, number of nodes per plant, internodal length, stem girth and green fodder yield. Similar results were reported by Yadav *et al*.[13], for leaf length and number of leaves plant and Ravikumar *et al*.[10], in for leaf length and number of leaves plant. Number of leaves

per plant exhibited positive and significant correlation with leaf length, leaf breadth, number of nodes per plant, internodal length, stem girth and green fodder yield. This finding is in conformity with the results reported by Singh *et al*.[12], for leaf breadth.

Leaf length showed positive and significant correlation with early vigour, plant height, number of leaves per plant, leaf breadth, number of nodes per plant, internodal length, stem girth and green fodder yield where as its association was significantly negative with days to 50 per cent flowering. This finding is in conformity with the results reported by Singh *et al*.[12] for leaf breadth. Leaf breadth had positive and significant correlation with number of leaves per plant and leaf length and stem girth whereas, it showed negative association with days to 50 per cent flowering. Number of nodes per plant exhibited positive and significant correlation with early vigour, days to 50 per cent flowering, plant height, leaf length, number of leaves per plant, internodal length, stem girth and green fodder yield but it had negative association with days to 50 per cent flowering and leaf to stem ratio.

Internodal length exhibited positive and significant correlation with early vigour, plant height, number of leaves per plant, leaf length, number of nodes per plant, stem girth and green fodder yield and negative non-significant association with days to 50 per cent flowering and leaf to stem ratio. Stem girth exhibited positive and significant correlation with early vigour, plant height, leaf length, leaf breadth number of leaves per plant, number of nodes per plant. These results are in consonance with the findings of Singh *et al*.[12], and Iyanar *et al*.[4]. Leaf to stem ratio correlation with the other traits either positively or negatively was not significant.

Traits like, early vigour, plant height, number of leaves per plant, leaf length, number of nodes per plant and internodal length manifested significant and positive association with green fodder yield. Green fodder yield had positive but non-significant association with leaf breadth and stem girth. These results are in consonance with Yadav *et al*.[13] for leaf length and plant height, Patel *et al*.[8] in forage maize for leaf length, Ravikumar *et al*.[10], in sweet sorghum for leaf length, Prakash *et al*.[9], for leaf length. Hence, selection for these traits can improve yield.

Path Coefficient Analysis

Green fodder yield is the result of direct and indirect effects of yield contributing characters. As simple correlation does not provide the true contribution of characters towards the green fodder yield, the correlation of different characters with green fodder yield were divided into direct and indirect effects through path coefficient analysis and helps in understanding the cause and effect relationship. The estimates of path coefficient analysis are presented in Table 3.

Early vigour had a direct positive effect on green fodder yield. It also had positive and indirect influence on green fodder yield *via* all the characters except days to 50 per cent flowering and leaf to stem ratio. Days to 50 per cent flowering had positive direct effect on green fodder yield but its influence on green fodder yield was observed to be in negative direction through all other characters. Similar results of direct contribution of days to 50 per cent flowering on green fodder yield were reported by Singh *et al*.[12,] Jadhav *et al*.[5] and Jain and Patel[6]. in forage sorghum.

Plant height registered direct positive influence towards green fodder yield. It exhibited positive indirect effect on green fodder yield through number of leaves per plant, leaf length, leaf breadth, internodal length, number of nodes per plant and stem girth. Positive effect of plant height on green fodder yield was also reported earlier by Singh *et al*.[12], Prakash *et al*.[9] and Jain and Patel[6]. Number of leaves per plant had a direct positive effect and indirect positive influence on green fodder yield through plant height, number of leaves per plant, leaf length, leaf breadth, internodal length, number of nodes per plant and stem girth. Singh *et al*.[12], Jadhav *et al*.[5], and Iyanar *et al*.[4] also reported direct positive effect of number of leaves per plant on green fodder yield.

Leaf length registered direct negative influence and indirect positive effect on green fodder yield through days to 50 per cent flowering and leaf to stem ratio. Its indirect effects via rest of the characters were negative. Leaf breadth showed direct negative effect on green fodder yield. Its indirect effect through days to 50 per cent flowering and leaf to stem ratio was positive while indirect effects via rest of the traits were negative.

Number of nodes per plant registered direct negative influence towards green fodder yield. It exhibited positive indirect effect on green fodder yield leaf to stem ratio and through the other characters effects were negative. Internodal length exhibited positive direct effect on green fodder yield and showed positive indirect effect through all the traits except days to 50 per cent flowering and leaf to stem ratio through which the effects were negative. Leaf to stem ratio exhibited direct positive effect on green fodder yield. Its indirect effects on green fodder yield through other traits was negative with lower magnitude. Stem girth had a direct positive effect on green fodder yield. It showed positive indirect contribution towards green fodder yield through all the traits except days to 50 per cent flowering and leaf to stem ratio through which the effects were negative. Iyanar *et al*.[4], Prakash *et al*. [9] and Jain[7], also reported direct positive effect of stem girth on green fodder yield.

Looking at the factors contributing directly to the green fodder yield, the contributions were in positive direction for all the characters except leaf length, leaf breadth and number of nodes per plant. Positive and high direct effect was observed for early vigour, plant height, leaf to stem ratio, internodal length, number of leaves per plant and stem girth. This result is in consonance with the findings of Prakash *et al*.[9], Singh *et al*.[12], Jadhav *et al*.[5].

CONCLUSION

Critical analysis of the results obtained from character association studies and path analysis indicated that early vigour, plant height, number of leaves per plant, leaf length and internodal length possessed both positive association and positive direct and indirect effects. Hence, selection for these characters could bring improvement in green fodder yield and yield components.

Table 1: List of genotypes used in the study

S.No.	Genotypes	Source
1	185A	MPKV, Rahuri
2	ICS38A	ICRISAT
3	27A	IIMR
4	PMS71A	MAU, Parbhani
5	PMS130	MAU, Parbhani
6	KR135	MAU, Parbhani
7	SSV74	IIMR
8	SSV84	MPKV, Rahuri
9	NSSV14	IIMR
10	RSSV138-1	MPKV, Rahuri
11	RSSV404	MPKV, Rahuri
12	RSSV466	MPKV, Rahuri
13	IS18542	ICRISAT
14	6NRL	IIMR
15	BNM16	IIMR
16	UK81	IIMR
17	CSH22SS	IIMR
18	CSV30F	MPKV, Rahuri
19	CSV32F	IIMR

Table 2: Estimation of correlation coefficients between green fodder yield and its components

	EV	DF	PH	NL	LL	LB	NON	IL	SG	LSR	GFY
EV	1.000	-0.297	0.595**	0.621**	0.546*	0.414	0.609**	0.479*	0.528*	0.065	0.819**
DF		1.000	-0.435	-0.466*	-0.536*	-0.164	-0.580**	-0.348	-0.128	-0.040	-0.232
PH			1.000	0.766**	0.774**	0.315	0.928**	0.893**	0.523*	-0.070	0.624**
NL				1.000	0.831**	0.519*	0.812**	0.640**	0.692**	-0.031	0.603**
LL					1.000	0.547*	0.730**	0.632**	0.636**	0.149	0.471*
LB						1.000	0.260	0.247	0.712**	0.158	0.222
NON							1.000	0.752**	0.482*	-0.036	0.616**
IL								1.000	0.367	-0.272	0.541*
SG									1.000	0.152	0.441
LSR										1.000	-0.153
GFY											1.000

** significant at 1% level * significant at 5% level

EV: Early vigour, DTF: Days to 50 per cent flowering, PLH: Pplant height (cm), NLP: Number of leaves per plant, LL: Leaf length (cm), LB: Leaf breadth (cm), NON: Number of nodes per plant, IL: Internodal length (cm), LSR: Leaf to stem ratio, SG: Stem girth, GFY: Green fodder yield (t/ha).

Table 3: Estimates of direct and indirect effects between green fodder yield and yield components

	EV	DF	PH	NL	LL	LB	NON	IL	SG	LSR	GFY
EV	**0.6599**	-0.1838	0.2790	0.3435	0.2682	0.2269	0.3310	0.2732	0.2482	-0.1771	0.7204
DF	-0.0483	**0.1734**	-0.0177	-0.0122	-0.2682	-0.0852	0.0058	-0.0132	-0.0338	-0.0050	-0.0500
PH	0.1289	-0.0311	**0.3050**	0.1803	0.1568	0.1053	0.2423	0.2089	0.1165	-0.1212	0.5284
NL	0.0590	-0.0080	0.0670	**0.1133**	0.0608	0.0503	0.0783	0.0495	0.0508	-0.0335	0.4854
LL	-0.0473	0.0267	-0.0598	-0.0623	**-0.1163**	-0.0594	-0.0711	-0.0561	-0.0547	0.0167	0.3184
LB	-0.0192	0.0275	-0.0193	-0.0249	-0.0286	**-0.0560**	-0.0154	-0.0142	-0.0285	0.0087	0.1924
NON	-0.0789	-0.0053	-0.1249	-0.1087	-0.0962	-0.0433	**-0.1573**	-0.0971	-0.0611	0.0512	0.5096
IL	0.1115	-0.0206	0.1846	0.1178	0.1300	0.0683	0.1664	**0.2695**	0.0943	-0.1599	0.4723
SG	0.0144	-0.0075	0.0147	0.0172	0.0181	0.0195	0.0149	0.0134	**0.0384**	-0.0137	0.2922
LSR	-0.0617	-0.0066	-0.0913	-0.0680	-0.0330	-0.0355	-0.0748	-0.1363	-0.0819	**0.2298**	-0.1885

** significant at 1% level * significant at 5% level

EV: Early vigour, DTF: Days to 50 per cent flowering, PLH: Pplant height (cm), NLP: Number of leaves per plant, LL: Leaf length (cm), LB: Leaf breadth (cm), NON: Number of nodes per plant, IL: Internodal length (cm), LSR: Leaf to stem ratio, SG: Stem girth, GFY: Green fodder yield (t/ha).

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