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Correlation and Path Analysis in Sweet Sorghum [*Sorghum bicolor* (L.) Moench] Hybrids For Green Fodder Yield and Its Components

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ABSTRACT
Correlation and path analysis of fodder yield and its attributing traits were studied in 48 hybrids of sweet sorghum (Sorghum bicolor (L.) Moench) to understand the interrelationship between green fodder yield and its attributing traits. Character association analysis revealed significant positive association of green fodder yield with early vigour, leaf length, leaf breadth and internodal length. Path analysis revealed Positive and high direct effect of early vigour, plant height, internodal length, leaf length and leaf breadth. These characters may be considered as important yield components. Hence, selection for these characters could bring improvement in yield and yield components.
Keywords: *Sweet sorghum, Correlation, Path analysis, Green Fodder yield*

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INTRODUCTION

Agricultural crops and livestock play a vital role in the national economy since they fulfill the basic needs of life. Agriculture accounts for 54.6% of total employment in India and contributes 15.2% of total GDP. Livestock occupies a crucial position in Indian agriculture and directly contributes 27% of agricultural GDP. India, with 2.29% of the world land area, is maintaining about 10.71% of world's livestock population. The number of milch animals have increased from 62 million in 2000 to 83.15 million in 2012 resulting in 4.04% year-on-year growth rate of milk [5]. Thus, to sustain this growth rate and for further expansion to meet the demands of ever growing human population, livestock needs sustainable supply of feed material.

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.

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. Therefore, the present study was undertaken to assess the correlation among the fodder yield and related traits 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 forty eight hybrids were obtained from Indian Institute of Millets Research, Rajendranagar, Hyderabad. The details of the hybrids are furnished in the Table.1. The forty eight hybrids 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 (cm), number of leaves per plant, leaf length (cm), leaf breadth (cm), number of nodes per plant, internodal length (cm) leaf to stem ratio, stem girth and green fodder yield (t/ha). 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 [10] for correlation coefficient and Dewey and Lu [2] for path analysis.

RESULTS AND DISCUSSION

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 (cm), number of leaves per plant, leaf length (cm), leaf breadth (cm), leaf to stem ratio, number of nodes, internodal length, stem girth and green fodder yield (t/ha) were computed for sweet sorghum hybrids. The results are presented in the Table.2.

Early vigour exhibited positive and significant correlation with green fodder yield while negative and significant association with days to 50 per cent flowering. Days to 50 per cent flowering showed positive and significant correlation with plant height, number of leaves and number of nodes. This result is in consonance with the findings of Jadhav *et al*. [4] for plant height and number of leaves per plant and Singh *et al*. [11] for plant height and number of leaves per plant.

Plant height had significant positive correlation with days to 50 per cent flowering, number of leaves per plant, leaf length, number of nodes per plant and internodal length. Similar results were reported by Yadav *et al*. [12] for leaf length and number of leaves plant and Ravikumar *et al*. [8] in for leaf length and number of leaves plant. Number of leaves per plant exhibited positive and significant correlation with days to 50 per cent flowering, plant height, leaf length, leaf breadth, number of nodes per plant and internodal length. Number of leaves per plant had non-significant but positive association with stem girth. This finding is in conformity with the results reported by Singh *et al*. [11] for leaf breadth.

Leaf length showed positive and significant correlation with days to 50 per cent flowering, plant height, number of nodes per plant, number of leaves per plant and internodal length where as its association was negative with early vigour and stem girth. Leaf breadth had positive and significant correlation with number of leaves per plant, internodal 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 days to 50 per cent flowering, plant height, leaf length, number of leaves per plant and internodal length but it had negative association with stem girth and leaf to stem ratio. Internodal length exhibited positive and significant correlation with plant height, leaf length, leaf breadth, number of leaves per plant and number of nodes per plant and negative association with days to 50 per cent flowering and leaf to stem ratio. Stem girth showed positive and significant correlation only with leaf breadth but negative correlation with days to 50 per cent flowering, plant height and leaf length.

Traits like early vigour, leaf length, leaf breadth and internodal length manifested significant and positive association with green fodder yield. Green fodder yield had positive but non-significant association with plant height, number of leaves per plant, number of nodes, stem girth and leaf to stem ratio. These results are in consonance with Yadav *et al*. [12] for leaf length and plant height, Patel *et al*. [6] in forage maize for leaf length and stem girth, Ravikumar *et al*. [8] in sweet sorghum for leaf length, Prakash *et al*. [7] 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* leaf breadth, internodal length and stem girth. Days to 50 per cent flowering had negative direct effect on green fodder yield but its influence on green fodder yield was observed to be in positive direction through all other characters. Plant height registered direct positive influence of 0.1656 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 and stem girth. Number of leaves per plant had a direct positive effect and indirect positive influence on green fodder yield through plant height, leaf length, leaf breadth, internodal length, number of nodes and stem girth.

Leaf length registered direct positive influence and indirect positive effect on green fodder yield through early vigour, 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 positive effect on green fodder yield. Its indirect effect through days to 50 per cent flowering was negative while indirect effects via rest of the traits were positive. Number of nodes per plant registered direct positive influence towards green fodder yield. It exhibited positive indirect effect on green fodder yield through plant height, number of leaves per plant, leaf length, leaf breadth, internodal length and stem girth 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. Stem girth had a direct and indirect negative effect on green fodder yield. It showed positive indirect contribution towards green fodder yield only through days to 50 per cent flowering. Leaf to stem ratio exhibited direct positive effect on green fodder yield. Its positive and negative indirect effects on green fodder yield through other traits were with lower magnitude.

Looking at the factors contributing directly to the green fodder yield, the contributions were in positive direction for all the characters except days to 50 per cent flowering and stem girth. Positive and high direct effect was observed for early vigour, plant height, internodal length, leaf length and leaf breadth This result is in consonance with the findings of Prakash *et al*. [7], Singh *et al*. [11], Jadhav *et al*. [4].

Table.1. List of hybrids used in the study

S. No.	Hybrids	S. No.	Hybrids
1	185A X PMS130	25	27A X PMS130
2	185A XKR135	26	27A X KR135
3	185A XSSV74	27	27A X SSV74
4	185A XSSV84	28	27A X SSV84
5	185A XNSSV14	29	27A X NSSV14
6	185A XRSSV138-1	30	27A X RSSV138-1
7	185A XRSSV404	31	27A X RSSV404
8	185A XRSSV466	32	27A X RSSV466
9	185A XIS18542	33	27A X IS18542
10	185A X6NRL	34	27A X6NRL
11	185A XBNM16	35	27A X BNM16
12	185A X UK81	36	27A X UK81
13	ICS38A X PMS130	37	PMS71A X PMS130
14	ICS38A X KR135	38	PMS71A X KR135
15	ICS38A X SSV74	39	PMS71A X SSV74
16	ICS38A X SSV84	40	PMS71A X SSV84
17	ICS38A X NSSV14	41	PMS71A X NSSV14
18	ICS38A X RSSV138-1	42	PMS71A X RSSV138-1
19	ICS38A X RSSV404	43	PMS71A X RSSV404
20	ICS38A X RSSV466	44	PMS71A X RSSV466
21	ICS38A X IS18542	45	PMS71A X IS18542
22	ICS38A X6NRL	46	PMS71A X6NRL
23	ICS38A X BNM16	47	PMS71A X BNM16
24	ICS38A X UK81	48	PMS71A X UK81

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

	EV	DTF	PLH	NLP	LL	LB	NON	IL	SG	LSR	GFY
EV	1.000	-0.519**	-0.112	-0.163	-0.385**	0.268	-0.212	0.214	0.093	-0.236	0.556**
DTF		1.000	0.420**	0.396**	0.580**	-0.463**	0.421**	-0.062	-0.468**	0.227	-0.528**
PLH			1.000	0.611**	0.570**	0.040	0.778**	0.652**	-0.034	-0.333*	0.075
NLP				1.000	0.484**	0.342*	0.693**	0.351*	0.188	-0.109	0.091
LL					1.000	-0.120	0.592**	0.345*	-0.150	-0.094	0.202
LB						1.000	0.130	0.314*	0.539**	0.180	0.370**
NON							1.000	0.410**	-0.050	-0.154	0.058
IL								1.000	0.230	-0.153	0.371**
SG									1.000	0.269	0.228
LSR										1.000	0.029
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	**0.2972**	-0.0047	-0.0040	-0.0207	-0.0593	0.0691	-0.0283	0.0408	0.0382	-0.0504	0.3978
DF	0.0012	**-0.0741**	0.0079	0.0169	0.0050	0.0157	0.0194	0.0084	0.0068	-0.0023	-0.1462
PH	-0.0022	-0.0177	**0.1656**	0.0730	0.0050	0.0427	0.1034	0.0829	0.0146	-0.0467	0.1567
NL	-0.0023	-0.0074	0.0144	**0.0326**	0.0126	0.0093	0.0171	0.0086	0.0070	-0.0027	0.1133
LL	0.0091	0.0031	-0.0238	-0.0177	**0.0457**	-0.0088	-0.0193	-0.0136	-0.0009	0.0007	0.0597
LB	0.0116	-0.0106	0.0129	0.0142	0.0096	**0.0499**	0.0139	0.0120	0.0217	0.0014	0.2900
NON	-0.0004	-0.0011	0.0027	0.0022	0.0018	0.0012	**0.0043**	0.0011	0.0001	-0.0006	0.0884
IL	0.0146	-0.0121	0.0534	0.0282	0.0316	0.0256	0.0273	**0.1066**	0.0212	-0.0140	0.2390
SG	-0.0105	0.0075	-0.0072	-0.0175	-0.0016	-0.0356	-0.0020	-0.0163	**-0.0817**	-0.0086	0.2028
LSR	-0.0007	0.0001	-0.0011	-0.0003	-0.0001	0.0001	-0.0005	-0.0005	0.0004	**0.0040**	- 0.0172

** 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).

CONCLUSION

Critical analysis of the results obtained from correlation studies and path analysis indicated that early vigour, leaf length, leaf breadth and internodal length possessed both positive association and high positive direct effects. Hence, selection for these characters could bring improvement in green fodder yield and yield components.

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