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RESEARCH ARTICLE

VARIABILITY AND ASSOCIATION STUDIES AMONG STOVER YIELD AND QUALITY RELATED TRAITS IN SORGHUM

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ABSTRACT

Sorghum [*Sorghum bicolor* (L.) Moench] is popular worldwide as a source of food, fiber, fuel and fodder. Sorghum is a grass plant related to Maize and Sugar cane (Paterson et al., 2009), also having great importance as fodder for cattle. Sorghum is a nutritionally rich fodder crop. For livestock production sorghum fodder usage is increasing extensively as it is a drought tolerant and water use efficient crop. Present study was aimed at studying the variation in traits related to stove yield and quality in sorghum. The recombinant inbred lines (RIL) of biparental cross CSV 20 X Pant Chari 5 were characterized for 16 traits in two seasons. All collected data pooled and statistically analysed for assessing the variation and association among traits. Plant height, seed yield, leaf length, leaf width, lignin content, fiber content, ash, digestibility and stoveryield showed increased variation. Significant association of fodder yield with days to flowering and plant height were noted. Fiber content were associated with stem girth. Lignin content was negatively correlation with digestibility. Digestibility and protein content were positively correlated. The parental lines were diverse for stover yield, lignin content and digestibility.

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INTRODUCTION

Sorghum [*Sorghum bicolor* (L.) Moench] is the most popular crop having worldwide importance. Sorghum belongs to the genus poaceae. Sorghum occupied fifth place after rice, wheat, barley, maize. Sorghum is a forage and grain crop in semi-arid regions, it is highly adaptable and stable to rain-fed conditions. Sorghum is a dual-purpose crop grown for both food and fodder. Sorghum is the most important cereal crop using for feed, bio fuel production. Sorghum stover (dry fodder left after harvesting grain) is nutritionally good feed for ruminants. Sorghum fodder is having demand in dry land agriculture due to severe fodder deficit, especially in lean seasons. Therefore, there is a need of production of sorghum fodder having high yield and quality, to cater to the demand, making the fodder affordable. The larger goal is to help the farmers with high yielding verities of sorghum useful for the animal feeding, and also improve their economic condition. Healthy cattle when fed with quality feed, will yield more milk. The present study was conducted to identify the variation in phenotypic traits that are responsible for the fodder yield and quality in a diverse biparental cross recombinant inbred lines (RILs). The 16 traits such as plant height, total number of leaves, leaf length, leaf width, stem girth, mean fresh weight, single plant weight, plant dry weight, seed weight, days of flowering, protein content, digestibility, ash, fibre and lignin content, and metabolizable energy were studied. The CSV 20 X Pant Chari 5 RILs used for the plant population production, consisted of 183 RILs. From the plant population, phenotypic data related to traits mentioned were recorded from two seasons.

MATERIALS AND METHODS

Plant material: The sorghum plant material consists of set of 275 Recombinant inbred lines (RIL) derived from the cross between CSV 20 X Pant chari 5. The field trials were conducted at the research farm of Indian Institute of Millets Research, Hyderabad, India, in a randomized block design with 3 replications in plots of 5 x 4 m spaced at 45 cm between rows and 15 cm between plants within rows, in two seasons, following the recommended package of practices. First season data were collected in kharif 2014 and second season data were collected in kharif 2015, A basal dose of 80 kg N and 40 kg P/ha was applied, with a further 40 kg N/ha 30 days after sowing. The measurement of phenotypic data recorded by taking the three uniform representing individuals in the centre of each row from the total of six tagged individuals.

Plant height (PHE): From six tagged plants in each row at the stage of maturity pant height was recorded in centimeters from the soil to the tip off plant (including sorghum panicle), average plant height was calculated.

Total number of leaves (TNL): Total number of leaves recorded by counting the leaves in anthesis stage, complete leaves in the plant including green leaves and dry leaves from the tagged 6 plants in the plot was counted and from that average value took as data for analysis.

Leaf length (LLE): From the six tagged plants in the plot fifth leaf from the bottom selected and recorded leaf length in centimeters and average value calculated for data analysis.

Leaf width (LWI): Fifth leaf from the bottom means soil selected to record in centimeters six tagged plants used to measure leaf width, average data calculated for further analysis.

Stem girth (SGI): Stem girth calculated from the six tagged sorghum plants from the bottom means soil to three feet by using Vernier callipers measured in centimeters. Average value used for the analysis.

Mean fresh stove weight (MFSW): Fresh weight of the whole plant measured as mean fresh weight when the plant is in green condition. Total of six tagged plant weighed in kilograms.

Plant dry stove weight (PDSW): After harvesting the six tagged plants kept in the oven for 2-3 days to complete dry then measured the plant dry weight in kilograms, average value recorded.

Seed weight (SWE): Total seed weight of each plant from the six tagged plants weighted separately measured in kilograms and average value recorded

Days to flowering (DOF): At the stage of 50 % flowering the date was recorded among the six tagged plants which plant shows the 50 % flowering. By using the date of sowing days to flowering was calculated.

Stover quality traits: Crude protein (Protein %) and ash content of sorghum stover samples were estimated as per procedures of AOAC (1990). Fiber fractions, namely neutral detergent fiber (NDF), acid detergent fiber (ADF) and lignin, were determined following the detergent method of Van Soest et al. (1991). The in vitro organic matter digestibility (ivomd) and metabolizable energy were estimated using the 2-stage technique of Tilley and Terry (1963) by incubating 0.5 g of sample in inoculum of sheep maintained on a mixed grass hay-concentrate diet. Whole data of all the traits were statistically analysed for mean, range and standard deviation presented in Table 1.AOAC (1992)and crude protein was determined by Kjeldah technique. Fibre fractions (NDF, ADF and lignocelluloses) were determined by procedure of Goering and Van So.

RESULTS

After complete analysis of data of two parents CSV 20 X Pant Chari 5 wide range in expression of traits was observed. The RIL population showed maximum variation observed in plat height, leaf length, leaf width, days of flowering, stover yield, seed yield, digestibility, ivomd%, ash%, protein content, and fibre content, lignin, etc. The results of statistical analysis of RIL data is presented below in Table 1.

Comparison of parents and RILs for stover yield and quality traits: Table number 1 below represents the 16 phenotypic traits of RIL population means, range and standard deviation including two parents of two seasons compared with RILs data generated. Most significantly RILs showed mean performance for maximum traits except Stem girth is 1.83 cm, Fresh stover weight (FSW) improved to 1610 kg and dry stover weight (DSW) 1420 kg. RILs showed plant height 122 to 300 centimeters variation observed, days of flowering 64 to 87 days observed. Leaf length observed lower value as 39 and increased up to 87 centimeters. Leaf width increased to 9 centimeters, Seed yield showing variation minimum as 32 grams to 312 grams. Minor difference in the protein content present increased to 6.45, Invitro dry matter digestibility (IVOMD) % showed improvement as 54 %. Ash content improved to 8.6 as maximum value. NDF% maximum value 68.49%,ADP% also showing maximum value as 68.49%. Lignin content improved to 6.91 % and Metabolizable energy shoed 8.52 as highest value.

Associations among stover yield and quality traits: Based on RIL mean values obtained from two seasons correlation between genotypic and traits were estimated and presented in Table 2 below. The obtained results revealed interesting significant associations (correlations) among many of the traits in the present study. Highest correlation coefficient r=0.94 observed from the analysis between lignin (r=0.94) content and ADF (r=0.94) (Acid detergent fiber) and r= 0.93 correlation between ADF and NDF represents similarity in both the traits. Successive correlation observed between lignin content with ADF (0.94)and NDF (r=0.90) (Neutral detergent fiber), stem girth (r=16), indicating lower digestibility of fodder. Metabolizable energy correlated positivel with ivomd (r=0.46). Expectedly, dry stover weight positively correlated with fresh stover weight (r=0.60).ADF positively correlated with NDF (r= 0.93), ash (r= 0.48). NDF correlated with ash (r= 0.45), stem girth (r=0.18). Ash corelated with protein (r=0.37).

Leaf width corelated with plant height (r= 0.21) and leaf length (r= 0.23). Days of flowering corelated with plant height (r=0.16), protein corelated with number of leaves (r=0.17). Digestibility correlated with protein (r=0.18), all observed positive correlations indicating digestibility of fodder. Digestibility negatively correlated with days of flowering (r=-0.15). Stem girth negatively corelated with plant height (-0.16). ash negatively correlated with digestibility (r=0.20). NDF negatively correlated with digestibility (r= 0.38). ADF negatively correlated with protein (r=-0.19), digestibility (r=-0.44). Lignin negatively correlated with digestibility (r=-0.46). Metabolizable energy negatively correlated with ash (r=0.57), lignin (r=90), ADF (r=0.88), NDF(r=0.84). RILs derived from the parents CSV 20 X Pant Chari 5 phenotypic correlated among fodder yield and quality associated traits were explained above and presented in below Table 2.

DISCUSSION

To improve the fodder yield and quality lot of phenotypic traits were involved among them some traits checked for the present study. Total number of 275 RILs developed from the parents

Table 1. Mean, range and standard deviation of RIL lines derived from CSV 20x Pant Chari 5 in comparison of the parents

Traits	Parents		RILs			
	CSV 20	Pant Chari 5	Mean	Minimum	Maximum	Standard deviation
Plant height (cm)	254.5	234	234.21	122.5	300.83	30.73
No.of leaves	11.5	12	12.95	10.5	14.5	0.79
Leaf length (cm)	75.17	74.5	63	39	82.33	5.89
Leaf width (cm)	7.33	8	7.32	4.17	9.33	0.83
Stem girth(cm)	1.5	1.5	1.42	0.93	1.83	0.19
Fresh stover weight (g/plant)	714	660	633	293	1610	213
Dry stover weight (g/plant)	260	510	460	100	1420	200
seed yield(g)	166.5	112.5	126.58	37	312	40.84
Days of flowering	71	72.5	72.4	64.5	87	3.61
Protein content (%)	4.54	4.36	4.69	3.33	6.45	0.57
Digestibility (ivomd%)	42	48.08	47.37	37.18	54.59	3.11
Ash content (%)	8.1	6.29	6.64	4.66	8.76	0.74
NDF%	60.44	54.89	56.69	50.09	68.49	3.6
ADF%	39.89	34.71	36.7	30.15	51.01	3.66
Lignin%	5.32	4.14	4.49	3.33	6.91	0.63
me(mj/kg)	6.72	7.91	7.58	5.69	8.52	0.55

ivomd – *In vitro* organic matter digestibility; NDF – Neutral detergent fiber; ADF – Acid detergent fiber; Me – Metabolizable energy

Table 2. Correlation among fodder yield and quality associated traits in the RIL lines derived from cross CSV 20xPant Chari 5

	Plant height	No.of leaves	Leaf length	Leaf width	Stem girth	Fresh stover weight	Dry stover weight	Seed yield	Days of flowering	Protein content	Digestibility	Ash	NDF	ADF	Lignin content
No.of leaves	-0.046														
Leaf length	-0.019	0.013													
Leaf width	0.219	-0.135	0.236												
Stem girth	-0.169	0.089	0.123	-0.052											
Fresh stover weight	-0.123	-0.031	0.021	-0.02	-0.051										
Dry stover weight	-0.073	-0.020	0.043	0.008	-0.108	0.609									
seed yield	0.012	-0.098	0.083	0.047	-0.026	0.093	0.028								
Days of flowering	0.162	-0.114	-0.110	-0.06	-0.147	0.163	0.118	0.053							
Protein content	0.052	0.172	0.027	-0.08	-0.142	0.010	-0.004	0.06	-0.014						
Digestibility	0.052	0.009	-0.006	-0.063	-0.017	-0.105	-0.083	0.003	-0.155	0.189					
Ash	-0.037	0.071	0.100	-0.12	0.041	-0.010	0.051	0.078	-0.062	0.372	-0.203				
NDF	-0.025	0.073	0.056	0.002	0.184	0.024	0.066	-0.003	-0.057	-0.060	-0.383	0.45			
ADF	-0.029	0.025	0.058	0.023	0.181	0.033	0.066	0.01	-0.025	-0.190	-0.443	0.485	0.938		
Lignin content	-0.002	0.059	0.065	0.027	0.166	0.066	0.095	0.054	-0.041	-0.106	-0.464	0.466	0.903	0.943	
me(mj/kg)	0.030	-0.024	-0.094	-0.016	-0.138	-0.031	-0.063	-0.087	-0.025	0.060	0.463	-0.572	-0.844	-0.889	-0.908

Values in bold are significant at $p<0.05$

namely CSV 20 X Pant Chari 5. The important phenotypic traits plant height, total number of leaves, leaf length, leaf width, stem girth, mean fresh weight, single plant weight, plant dry weight, seed weight, days of flowering, Protein, IMDVD%, Ash% NDP %, ADP and Lignin, Metabolizable energy related to sorghum fodder yield and quality were evaluated. RILs showed variation in many traits in the present study. Phenotypic data mean, range, standard deviation analysis resulted as high variation and showing maximum values in plant height (upto 300 Cm), leaf length (82.33cm), leaf width (9.33 cm)fresh stover (weight 1620 kg) maximum, dry stover weight (1420 kg), seed yield (312 g), ash% (8.76 %), NDF (68.49%), ADF (51.09%), Lignin (6.71 %), among 16 traits maximum traits showing variation as described above. These traits are completely related to fodder quality and digestibility. Correlation between the RlLs resulted as high positive correlation present in-between lignin and ash(r= 0.46), NDF(r= 0.90), ADF(r= 0.94).ADF showed positive correlation with ash (r= 0.48) and NDF (r=0.93) Dry stover weight correlated with fresh stover weight (r= 0.60). the traits observed and studied in present study represents improvement in NDF, Dry stover weigh, Fresh stover weight, ash content, ivomd% and seed yield. Plant height, seed yield, leaf length, leaf width, increased. All the above-mentioned traits were involved to improve the fodder yield and quality. Sorghum yield and quality also depends on the nitrogen level in the soil and harvesting time (Ayub *et al.,* 2003). The best combination for getting the high fodder yield depends on the sown soil prepared with deep tillage (Ayub *et al.,* 2003). Positive correlation and positive association of plant height, leaf number, and the number of tillers per plant also influence the fodder yield and digestibility (Reddy *et al.,* 2003). Positive relationship visible in the varieties dry matter yield by returned with production (Zulfiqar and Asim, 2002). sorghum verities showed significant nutrient uptake as calcium and magnesium minerals only (Singh *et al.,* 2009). Planting geometry and proper manuring place major role to get the higher forage yields in forage sorghum (Shivprasad and Singh, 2017).Stay green cultivars in sorghum had low fiber with high IVDMD, high content of crude protein (Singh *et al.,* 2009)

REFERENCES

AOAC, 1990. Official methods of analysis. 15th edn. Association of Official Analytical Chemists. Arlington, VA, USA.

Ayub M, Nadeem MA, Tanveer A. 2003. Influence of different nitrogen levels and harvesting times on dry matter yield and quality of fodder maize. *Pak. J. Life Soc. Sci.,* 1:59-61.

Ayub M, Tanveer A, Nadeem MA, Tayyub M. 2003. Fodder yield and quality of sorghum (Sorghum bicolor L.) as influenced by different tillage methods and seed rates. *Pakistan Journal of Agronomy,* 2(3):179-84.

Goering H K and VanSoest P J. 1970. Forage fiber analysis. Agriculture Hand book No. 379, AR, USDA, Washington, DC.

Paterson AH, Bowers JE, Bruggmann R, Dubchak I, Grimwood J, Gundlach H, Haberer G, Hellsten U, Mitros T, Poliakov A, Schmutz J. 2009. The Sorghum bicolor genome and the diversification of grasses. *Nature*, 457(7229):551.

Reddy BV, Reddy PS, Bidinger F, Blümmel M. 2003. Crop management factors influencing yield and quality of crop residues. *Field Crops Research,* 84(1):57-77.

Shivprasad M, Singh R. 2017. Effect of planting geometry and different levels of nitrogen on growth, yield and quality of multicut fodder sorghum (Sorghum bicolor (L.) Monech). *Journal of Pharmacognosy and Phytochemistry,* 6(4):896-9.

Singh S, Katiyar D, Theodorou M, Prasad S, Mishra U, Bhaskar R, Pandey K, Verma O, Mishra A. 2009. Nutritional and morphological attributes of stay green vis-a-vis go-brown sorghum cultivars at different stages of maturity. *Indian Journal of Animal Sciences,* 79(4):426-32.

Tilley J M and Terry R A. 1963. A two-stage technique for *the invitro* digestion of forage crops. *Journal of British Grassland society 18*: 104.

Zulfiqar AM, Asim M. 2002. Fodder yield and quality evaluation of the sorghum varieties. *J. Agron.,* 1:60-3.

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