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BV Vara Prasad
Department of Genetics and Plant Breding, PJTSAU, College of Agriculture Rajendranagar, Hyderabad, Telangana State, India

V Sridhar
Agricultural Research Station, Madhira, Khammam District, Telangana state, India

Corresponding Author:
BV Vara Prasad
Department of Genetics and Plant Breding, PJTSAU, College of Agriculture Rajendranagar, Hyderabad, Telangana State, India

Character association studies in yellow pericarp sorghum (*Sorghum bicolor* (L.) Moench) genotypes

BV Vara Prasad and V Sridhar

Abstract
Forty yellow pericarp sorghum ICRISAT lines were evaluated in deep black soil under rainfed situation at ARS, Madhira during early rabi 2016. Moderate to high genotypic and phenotypic coefficients of variation observed for various traits suggested the existence of sufficient amount of genetic variability for the traits studied. Plant height showed positive significant correlation with days to 50% flowering, days to maturity, number of leaves per plant, leaf length, 100 seed weight and grain yield per plant. Path analysis studies indicated that plant height, days to 50% flowering, days to maturity, number of leaves per plant, leaf length and 100 seed weight exhibited positive direct effect coupled with positive correlation with grain yield per plant in the present material.

Keywords: Character association studies, yellow pericarp sorghum, *Sorghum bicolor* (L.) Moench

Introduction
Sorghum (*Sorghum bicolor* (L.) Moench) is an important staple food for more than 300 million people and feed for cattle in Asian and African countries. It is the fourth most important cereal crop following rice, wheat and maize. It is known for its drought tolerance and is an indispensable crop of vast rainfed areas in semi-arid regions of India. It is also grown in nutrient deficient soils and possesses tolerance to pests and diseases. Yield improvement in sorghum is an indispensable task for breeders since long time. Yield gain is correlated with improvement in other yield attributing traits. The correlation and path analysis in combination, can give a better insight, into cause and effect relationship between different pairs of characters that are contributing to yield either directly or indirectly in any crop.
The correlation measures the relationship existing between pairs of traits. But dependent traits are an interaction product of many mutually associated components. The path analysis takes into account the cause and effect relationship between the variables by partitioning the association into direct and indirect effects through other independent variables. The path analysis helps to resolve these correlations, further it throws more light on the way in which component traits contribute towards specifically identifying important component traits. Grain yield is the product of interaction of component traits. Apart from correlation studies, path coefficient analysis is important to obtain information about different ways in which the component characters influences the grain yield.

Materials and methods
In present study, 40 yellow pericarp sorghum ICRISAT lines were evaluated in deep black soil under rainfed situation at ARS, Madhira during early rabi 2016. The randomized block design was followed with three replications and each entry was sown in two rows of 3 m length with inter row spacing of 45 cm and intra row spacing of 15 cm. All the recommended practices were followed to raise good crop. From each entry of every replication, five randomly selected plants were tagged for recording observations on all the quantitative characters. Days to 50 per cent flowering and days to maturity were recorded at plot level. Mean of five plants for each entry for each character was calculated and used for statistical analysis. Estimation of variation components and phenotypic and genotypic correlations were calculated by using the formulae given by Burton (1952) [2] and Johnson *et al.* (1955) [5]. The simple correlation coefficient was subjected to path analysis (Dewey and Lu, 1959) [3]. The list of genotypes included in the study are presented in Table 1.

Results and Discussion

Moderate to high genotypic and phenotypic coefficients of variation observed for various traits suggested the existence of sufficient amount of genetic variability for the traits studied (Table 2). High heritability was observed for plant height, leaf length, ear length and grain yield suggesting the scope for improvement of these traits upon selection. Plant height (Table 3) showed positive significant correlation with days to 50% flowering, days to maturity, number of leaves per plant, leaf length, 100 seed weight and grain yield per plant. Days to 50% flowering showed positive significant association with days to maturity, number of leaves per plant, leaf length, 100 seed weight and grain yield per plant. Number of leaves per plant and leaf length shower negative correlation with leaf width and positive association with 100 seed weight and grain yield per plant. Negative significant association of leaf width with straw weight, 100 seed weight and grain yield indicated that leaf width is not an important criterion for selection for higher yield in this material under present study. Similar results were reported by Iyanar *et al* 2001 [4] and Ramaling *et al.*, 2016 [6].

Path analysis studies (Table 4) indicated that plant height, days to 50% flowering, days to maturity, number of leaves per plant, leaf length and 100 seed weight exhibited positive direct effect coupled with positive correlation with grain yield per plant (Fig 1). Similar results were reported by Shilpa and Kajjidoni (2017) [7] and Ashwini and Kajjidoni (2019) [1]. Positive indirect effects were manifested through other traits resulting in positive correlation with grain yield. Leaf width and ear length shower negative direct effect whereas straw weight and 100 seed weight showed positive direct effect on grain yield per plant. Hence, selection should be exercised on those traits having positive direct as well as indirect effects for having yield gain in yellow pericarp sorghum genotypes under study.

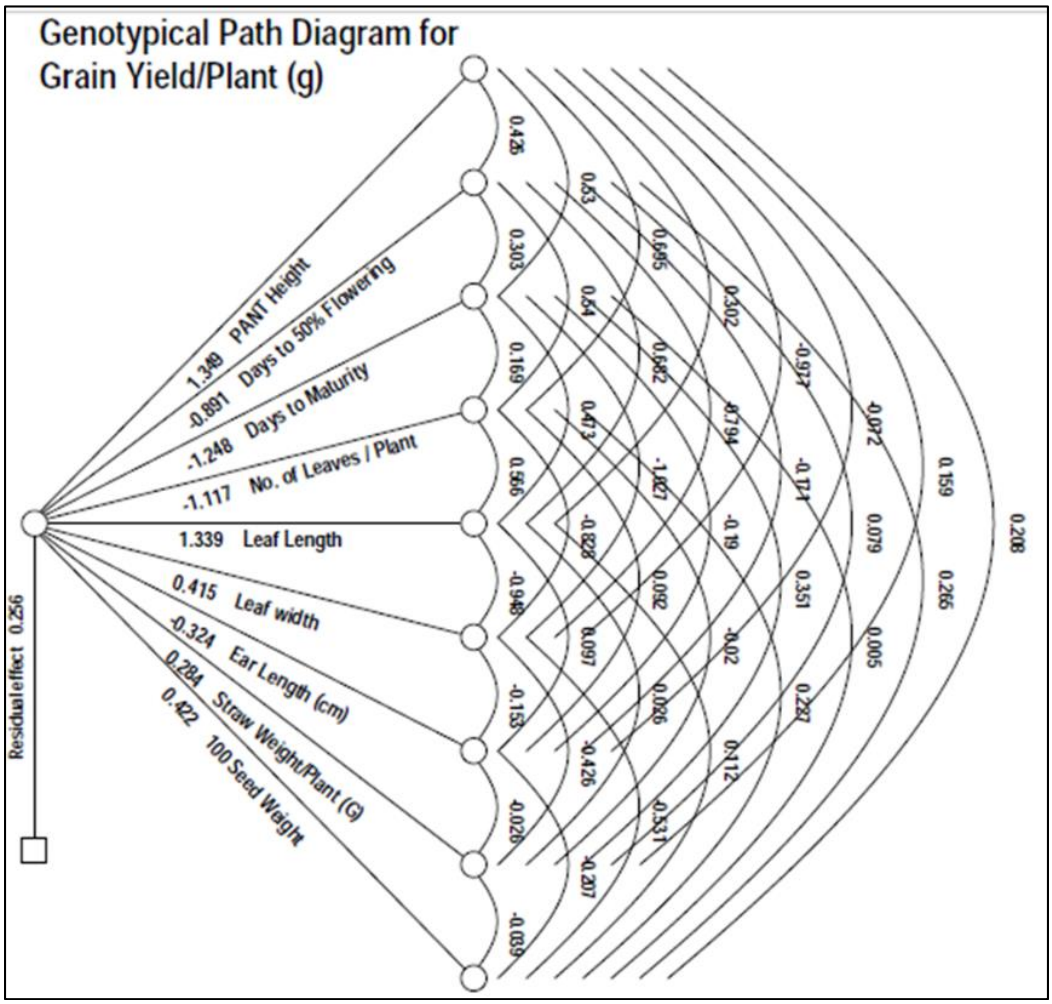

Fig 1: Genotypic path diagram for yield traits in yellow pericarp sorghum lines

Table 1: List of genotypes in the present study

S. No	Genotype	S. No	Genotype	S. No	Genotype	S. No	Genotype
1	IS-10932	11	IS-19003	21	IS-25039	31	IS-22998
2	IS - 23422	12	IS-535	22	IS-21728	32	IS-24805
3	IS - 19105	13	IS-19125	23	IS-19278	33	IS-3979
4	N-32518	14	IS-22426	24	IS-1053	34	IS-22375
5	IS-2394	15	IS-16200	25	IS-19261	35	IS-24867
6	IS-3691	16	IS-22963	26	IS-21736	36	IS-12038
7	IS-19290	17	IS-22944	27	IS-19126	37	IS-10799
8	IS-24685	18	IS-84	28	IS-23047	38	IS-21735
9	IS-23479	19	IS-18333	29	IS-10973	39	IS-23014
10	IS-935	20	IS-2951	30	IS-16210	40	IS-22978

Table 2: Variability estimates for ten morphological characters in ICRISAT yellow pericarp sorghum genotypes

	Plant height	Days to 50% flowering	Days to maturity	No. of leaves per plant	Leaf length	Leaf width	Ear length	Straw weight	100 seed weight	Grain yield per plant
GCV	23.988	8.315	4.345	16.610	15.269	13.341	31.494	65.192	20.765	24.403
PCV	24.010	8.996	4.915	21.913	15.385	19.130	32.901	67.199	30.134	25.359
h^2(broad sense)	0.998	0.854	0.782	0.575	0.985	0.486	0.916	0.941	0.475	0.926
GA (5%)	166.949	11.724	8.256	3.031	21.311	1.383	12.692	622.382	0.935	24.429
GA (1%)	213.954	15.025	10.581	3.885	27.311	1.773	16.266	797.616	1.199	31.307
GA as % of mean 5%	49.369	15.834	7.914	25.938	31.217	19.166	62.105	130.283	29.477	48.373
GA as % of mean 1%	63.269	20.293	10.142	33.241	40.006	24.563	79.591	166.964	37.776	61.993

Table 3: Genotypic correlation coefficients for ten morphological characters in ICRISAT yellow pericarp sorghum genotypes

	Plant height	Days to 50% flowering	Days to maturity	No. of leaves per plant	Leaf length	Leaf width	Ear length	Straw weight	100 seed weight	Grain yield per plant
Plant height	1.0000	0.4263**	0.5301**	0.6954**	0.3020*	-0.9766**	-0.0717	0.1585	0.2079*	0.3146**
Days to 50% flowering		1.0000	0.3034*	0.5403**	0.6824**	-0.7944**	-0.1707	0.0788	0.2654*	0.5250**
Days to maturity			1.0000	0.1687	0.4726**	-0.0270	-0.1904	0.3511*	0.0046	0.6222**
No. of leaves per plant				1.0000	0.5664**	-0.8277**	0.0924	-0.0201	0.2266*	0.3968**
Leaf length					1.0000	-0.9484**	0.0970	0.0256	0.1117	0.4555**
Leaf width						1.0000	-0.1530	-0.4260**	-0.5308**	-0.4471**
Ear length							1.0000	-0.0260	-0.2073	-0.1629
Straw weight								1.0000	-0.0386	-0.1382
100 seed weight									1.0000	0.1926

Table 4: Path analysis estimates for ten morphological characters in ICRISAT yellow pericarp sorghum genotypes

	Plant height	Days to 50% flowering	Days to maturity	No. of leaves per plant	Leaf length	Leaf width	Ear length	Straw weight	100 seed weight	Grain yield per plant
Plant height	1.3491	0.5752	0.7152	0.9381	0.4075	-1.3176	-0.0967	0.2138	0.2805	0.3146**
Days to 50% flowering	-0.3799	0.8912	-0.2704	-0.4815	-0.6081	0.7079	0.1521	-0.0702	-0.2365	0.5250**
Days to maturity	-0.6617	-0.3787	1.2483	-0.2106	-0.5899	1.2820	0.2377	-0.4383	-0.0057	0.6222**
No. of leaves per plant	-0.7771	-0.6037	-0.1885	1.1175	-0.6329	0.9250	-0.1033	0.0224	-0.2532	0.3968**
Leaf length	0.4043	0.9135	0.6326	0.7582	1.3387	-1.2696	0.1299	0.0343	0.1496	0.4555**
Leaf width	-0.4055	-0.3298	-0.4264	-0.3437	-0.3938	-0.4152	-0.0635	-0.1769	-0.2204	-0.4471**
Ear length	0.0232	0.0553	0.0617	-0.0300	-0.0314	0.0496	-0.3241	0.0084	0.0672	-0.1629
Straw weight	0.0451	0.0224	0.0999	-0.0057	0.0073	-0.1212	-0.0074	0.2845	-0.0110	-0.1382
100 seed weight	0.0878	0.1120	0.0019	0.0957	0.0472	-0.2241	-0.0875	-0.0163	0.4222	0.1926

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