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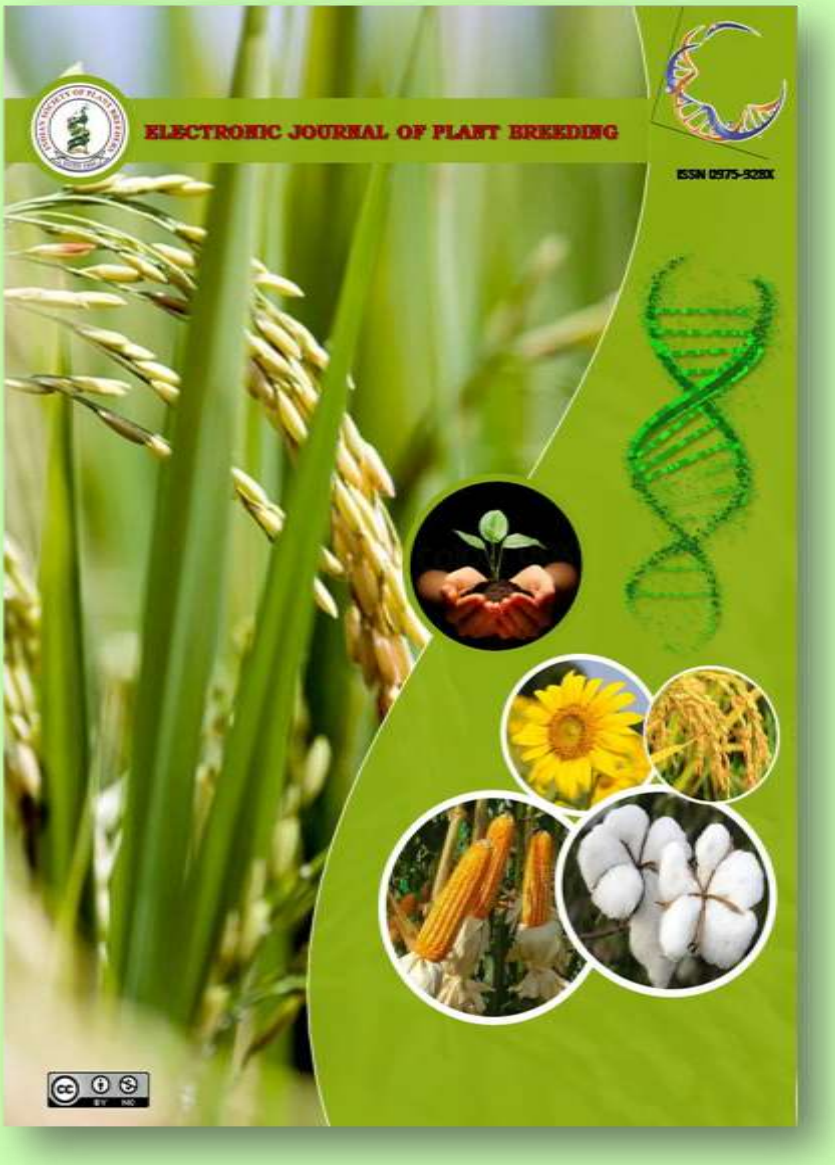

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Research Article

Relationship among grain yield and its component traits in sorghum (*Sorghum bicolor* (L.) Moench) germplasm accessions

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Abstract
The field experiment was carried out by using 101 germplasm accessions along with seven checks during *Kharif* 2018 in augmented design II to evaluate the association among grain yield and its component traits into direct and indirect effects of traits on the yield. The study was conducted for nine traits *viz.*, plant height, stem diameter, leaf length, leaf width, panicle length, days to 50% flowering, days to maturity, hundred seed weight and grain yield per plant. Association studies indicated that hundred grain weight (r = 0.294) showed a significant positive correlation with grain yield per plant. This indicates that a strong association of this trait with grain yield per plant that could be fruitfully exploited for enhancing the yield potential in sorghum**.** Partitioning of yield and yield components into direct and indirect effects revealed that the characters, hundred seed weight (0.2922), leaf width (0.074), panicle length (0.1294) and stem diameter (0.0034) showed a positive direct effect on grain yield per plant. Hence, these results revealed that the characters *viz.*, leaf width, panicle length, and hundred seed weight are important traits for grain yield improvement.

Keywords
Sorghum germplasm lines, correlation, path analysis.

Introduction

Sorghum (*Sorghum bicolor* (L.) Moench) is the fifth major cereal crop of semi-arid tropics. It is a good choice of rotation crop to maintain soil fertility and pest management. India is the major sorghum growing country in the world with total area under sorghum is 5.20 million hectares with production of 3.75 million metric tonnes and productivity of 0.72 metric tonnes per hectare (USDA, 2019). The germplasm collection of sorghum supplies enormous variability for breeding programs and also fulfills the requirement of useful biotic and abiotic resilient characters for quality improvement (Warkad, *et al*.2010). The germplasm lines express a wide range of adaptability to different conditions. Genetic diversity in sorghum species is distributed both within and among the cultivars. The study of relationships among quantitative traits is important for assessing the feasibility of joint selection of two or more traits and hence for evaluating the effect of selection for secondary traits on genetic gain for the primary trait under consideration. Selection for grain yield by the correlation between grain yield and its component traits with their direct and indirect effects on grain yield in the early stage is important for crop improvement. The correlation analysis establishes the relationship between the two traits and path analysis partitions their functional relationship into direct and indirect effects. Hence, breeder can know how far these traits are influencing the grain yield. This may be useful in the effective selection of characters that will improve yield. This technique was first described by Wright (1921). The objective of this study was to know about the correlation between grain yield and its component traits.

Materials and Methods

In the present study, 101 germplasm lines from the Department of Plant Genetic Resources, Tamil Nadu Agricultural University and IIMR, Hyderabad along with seven checks were studied (Table 1).

The experiment was laid out during *Kharif* 2018 in Department of Millets, Tamil Nadu Agricultural University, Coimbatore. The Augmented design II was followed with four-meter row length with the spacing of 45 X 15 cm. The experimental plot was subdivided into three blocks. All the recommended package of practices was followed for the betterment of crop. From each entry, five plants were tagged for recording observations on biometric traits. Mean of five plants from each entry were used for statistical analysis. Observations were recorded on the following traits *viz.*, Plant height (cm), Stem diameter (cm), Leaf length (cm), leaf width (cm), Panicle length (cm), Days to 50% flowering, Days to maturity, hundred seed weight (g) and grain yield per plant (g). The analysis of variance was performed and significance for these characters was studied. The correlation coefficient and path analysis were carried out using TNAU STAT.

Results and Discussion

The investigation was carried out to study the correlation and path analysis in nine characters. The results of correlation (Table 2) revealed that hundred seed weight showed high significant positive correlation (r = 0.294) with grain yield per plant. This indicates the strong association of this trait with grain yield per plant and this could be fruitfully exploited for enhancing the yield potential in sorghum. Similar findings were reported by Hundekar *et al.* (2016), Arunah *et al*.(2015), Warkad *et al*.(2010), Patil *et al*.(2014). The characters leaf width (r = 0.055) and panicle length (r = 0.088) showed positive but non-significant association with grain yield per plant. These were also reported by Patil *et al*.(2014) for leaf width and Khandelwal *et al*.(2015) for panicle length. While characters like plant height (r = -0.131), stem diameter (r= -0.027), leaf length (r = -0.061), and days to 50% flowering (r = -0.172) showed negative association with grain yield per plant. Similar findings were reported by Deshmukh *et al*.(2018) for plant height, and Prakash *et al*.(2010) for days to 50% flowering. For days to maturity (r = -0.197) negative and significant association with grain yield per plant was observed. This states about the possibility of breeding early maturing high yielding varieties (Khandelwal *et al*.2015, Deshmukh *et al*.2018).

The trait stem diameter exhibited highly significant positive association with plant height (r = 0.380). Leaf length exhibited highly significant positive correlation with plant height (r = 0.356) and stem diameter (r = 0.290). Leaf width exhibited highly significant positive correlation with leaf length (r = 0.262), also positive but non-significant association with stem diameter (r = 0.056), but negative correlation with plant height (r = 0.006). Panicle length showed highly significant positive association with plant height (r = 0.255) and also positive but non – significant association with stem diameter (r = 0.007), leaf length (r = 0.153) and leaf width (r = 0.116). Days to 50% flowering showed positive correlation with leaf width (r = 0.185) but negatively significant correlation with plant height (r = - 0.191) and leaf length (r = -0.227) and also negative association with stem diameter (r = -0.167) and panicle length (r = -0.015). Days to maturity showed highly significant positive correlation with days to 50 % flowering (r = 0.919) and also positive non- significant association with leaf width (r = 0.094) and panicle length (r = 0.020) but negatively associated with plant height (r = -0.146), stem diameter (r = -0.171) and leaf length (r = - 0.160). hundred seed weight exhibited stem diameter (r = 0.019), leaf width (r = 0.026), panicle length (r= 0.024), days to 50% flowering (r = 0.046) and days to maturity (r = 0.036) and negatively associated with plant height (r = -0.005) and leaf length (r = -0.129).

From the correlation study, it was concluded that the traits such as plant height, stem diameter, leaf width, panicle length and hundred seed weight are highly inter-correlated. Hence, selection for these characters will improve the yield. In order to know the functional relationship among these traits, path analysis was performed.

Partitioning of yield and its component traits into direct and indirect effects (Table 3) revealed that the characters hundred seed weight (0.2922), leaf width (0.074), panicle length (0.1294) and stem diameter (0.0034) showed a positive direct effect on grain yield per plant. Similar result was reported by Khadakabhavi *et al*.(2017) and Ezeaku *et al*.(2006) for panicle length. The characters' leaf width showed the indirect effect on grain yield via plant height, stem diameter, panicle length, and hundred seed weight. Panicle length showed the indirect effect on grain yield via leaf width, days to 50% flowering and hundred seed weight. hundred seed weight showed an indirect effect on grain yield via plant height, stem diameter, leaf length, and leaf width. Thus, the present study indicated that the characters *viz.*, leaf width, panicle length, and hundred seed weight are important characters for grain yield improvement. Hence, these traits can be considered as selection indices for sorghum improvement programme. The highest residue effect (0.9069) revealed that other characters contributing to grain yield per plant has to be further explored.

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Table 1. The list of germplasm accessions used for the study

S.NO	Germplasm entry	S. No	Germplasm entry
1	SOR 6885	56	SOR 1891
2	KO5 25	57	SO3 519
3	SO3 200	58	SPV 194
4	SO3 294	59	IS 545
5	SO3 173	60	IS 9753
6	KO5 128	61	SPV 887
7	SO3 287	62	SPV 162
8	SO3 194	63	SPV 195
9	SOR 6894	64	SPV 178
10	SPV 753	65	SOR 7091
11	R 2578/87	66	SPV 126
12	KO5 7	67	SPV 86
13	SPV 772	68	SPV 459
14	SPV 763	69	R 2317
15	SOR 6971	70	M 472
16	R 2176	71	SO3 256
17	SPV 759	72	KO5 33
18	R 2258	73	SPV 132
19	SPV 754	74	SPV 341/1
20	IS 19606	75	IS 29528
21	SPV 749	76	IS 8528
22	IS 1036	77	KO5 11
23	IS 88	78	IS 4136
24	IS 26685	79	SOR 7609
25	IS 8120/1	80	SO3 253
26	IS 165	81	IS 3585
27	HC 308	82	SPV 602
28	SO3 208	83	SPV 29/2
29	SO3 266	84	SPV 707
30	KO5 75	85	KO5 26
31	SOR 711	86	SPV 583
32	SPV 750	87	SPV 740
33	IS 18459	88	SO3 299
34	SO3 251	89	SPV 590
35	KO5 44	90	SPV 586
36	R 2448	91	SPV 741
37	SPV 168	92	R 2501
38	SSG 59-3	93	SPV 37
39	KO5 14	94	SPV 587
40	SO3 225	95	R 3026-32
41	SO3 259	96	SPV 766
42	IS 4124	97	SPV 541
43	SPV 105/1	98	R 2294
44	SOR 6942	99	R 3063
45	SPV 156	100	SPV 747
46	KO5 110	101	R 2476
47	SPV 594		**CHECKS**
48	SPV 768	1	TNS 648
49	SO3 280	2	CO 28
50	SPV 99	3	CO 30
51	IS 2688	4	K 12
52	SPV 558	5	TNS 663
53	IS 19560	6	TNS 667
54	SOR 7014	7	PAIYUR 2
55	SOR 166		

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Table 2. Phenotypic correlation coefficient (r) between yield and its contributing characters

	PH	SD	LL	LW	PL	DAF	DAM	hundred SW	GYPP
PH	1.000								
SD	0.380**	1.000							
LL	0.356**	0.290**	1.000						
LW	-0.006	0.056	0.262**	1.000					
PL	0.255**	0.007	0.153	0.116	1.000				
DAF	-0.191*	-0.167	-0.227*	0.185	-0.015	1.000			
DAM	-0.146	-0.171	-0.160	0.094	0.020	0.919**	1.000		
hundred SW	-0.005	0.019	-0.129	0.026	0.024	0.046	0.036	1.000	
GYPP	-0.131	-0.027	-0.061	0.055	0.088	-0.172	-0.197*	0.294**	1.000

*Significant @ 5% level ** Significant @ 1% level

Table 3. Path coefficient showing the direct and indirect effect of various traits on grain yield

	PH	SD	LL	LW	PL	DAF	DAM	hundred SW	GYPP
PH	**-0.1899**	0.0013	-0.015	-0.0004	0.0329	0.0151	0.0261	-0.0015	-0.1313
SD	-0.0721	**0.0034**	-0.0122	0.0042	0.0009	0.0132	0.0305	0.0055	-0.0265
LL	-0.0676	0.001	**-0.0421**	0.0194	0.0198	0.0179	0.0285	-0.0377	-0.0607
LW	0.0011	0.0002	-0.011	**0.074**	0.015	-0.0146	-0.0169	0.0076	0.0554
PL	-0.0483	0.0000	-0.0064	0.0086	**0.1294**	0.0012	-0.0036	0.0071	0.088
DAF	0.0363	-0.0006	0.0096	0.0137	-0.002	**-0.0788**	-0.1642	0.0136	-0.1724
DAM	0.0277	-0.0006	0.0067	0.007	0.0026	-0.0724	**-0.1787**	0.0106	-0.1971*
hundred SW	0.001	0.0001	0.0054	0.0019	0.0031	-0.0037	-0.0065	**0.2922**	0.2936**

Residue: 0.9069
*Significant @ 5% level ** Significant @ 1% level

[PH – Plant height (cm), SD- stem diameter (cm), LL- leaf length (cm), LW- leaf width (cm), PL-panicle length (cm), DAF- days to 50% flowering, DAM- days to maturity, hundred SW- hundred seed weight (g) and GYPP- grain yield per plant (g)]

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