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Correlation and path analysis studies in kharif sorghum (*Sorghum bicolor* L. Moench) inbred lines

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Abstract
The present investigation was studied in fourteen inbred lines of kharif sorghum (*Sorghum bicolor* L. Moench) hybrids. The experiment was laid out in randomized block design with three replications at Sorghum Research Station, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during kharif 2021. Fifteen yield contributing traits were evaluated for correlation and path analysis studies in fourteen genotypes. In present investigation there is existence of higher genotypic correlation when compared to phenotypic correlation that indicates the presence of inherent association among the characters. Significant and positive association was observed between grain yield and its yield contributing traits like stem dry weight, relative water content, SPAD, total chlorophyll content , fodder yield and harvest index at both genotypic and phenotypic level. In this investigation path analysis revealed at both genotypic and phenotypic level for plant height, leaf dry weight, relative water content, SPAD, total chlorophyll content, grain no per panicle, fodder yield and harvest index exhibited positive direct effect on grain yield there byit would play an important role in selection criteria for improving the character grain yield. Among the fourteen genotypes studied inbred lines *viz.* SPV 2504, CSV 27, CSV 31, CSV 39 and PVK 1025 recorded better performance and these are considered as the superior genotypes.

Keywords: Association, correlation, inbred lines, path analysis, sorghum

Introduction

Sorghum is a genus of about 25 species of flowering plants in the grass (poaceae) family. Sorghum (*Sorghum bicolor*), also called great millet, Indian millet, milo, durra, orshallu. It is high in carbohydrates, with 10 percent protein, 3.4 percent fat, and contains calcium and small amounts of iron, vitamin B1, and niacin. It is a multipurpose crop belonging to the Poaceae family, which are C4 carbon cycle plants with high photosynthetic efficiency and productivity. It is one of the five major cultivated species in the world because it has several economically important potential uses such as food (grain), feed (grain and biomass), fuel (ethanol production), fibre (paper), fermentation (methane production) and fertilizer (utilization 3 of organic by-products). Most varieties are drought- and heat-tolerant, nitrogen-efficient, and are especially important in arid regions, where the grain is one of the staples for poor and rural people.

USDA has projected world sorghum area as 40.97 million hectares (101.23 million acres) and production as 59.76 million tonnes for year 2020-21. For India, it was projected as 4.80 million hectares (11.86 lakh acres) and 4.40 million tonnes respectively. In India, as on 12 th August 2020 area under kharif sorghum during 2020-21 was 14.53 lakh hectares. Among the five states, Maharashtra stood second with 2.67 lakh ha contributing 87% of country's total area and production.

The study of relationships among traits is very essential for assessing the feasibility of joint selection for two or more traits. Path coefficient analysis partitions correlation coefficient into direct and indirect effects of various traits towards dependent variable, thus helps in effective selection.

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. Apart from correlation studies, path coefficient analysis is important to obtain information about different ways in which the component characters influences the improvement of grain yield.

This article reports the findings of a study conducted to determine the nature of relationships of grain yield and its yield contributing traits and to identify those traits with significant effects on yield with the intention of using them as selection criteria using path coefficient analysis (PCA) at both genotypic and phenotypic level.

Materials and Methods

The present investigation was undertaken to study correlation and path analysis studies in fourteen genotypes of sorghum (*Sorghum bicolor* L. Moench) inbred lines. The study was carried out at Sorghum Research Station, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani during kharif 2020-2021.The experimental material consists of fourteen inbred lines received from IIMR Hyderabad, ICRISAT Hyderabad, Akola and Parbhani listed in table 1. The experiment was laid out in randomized block design with three replications. Each line consists of four rows of 4 meters length at 45 cm apart. Plant to plant distance was maintained at 15cm. Seeds were initially treated with imidacloprid 48% FS in order to provide protection against sucking insects and pests. Field was prepared as per the requirement. The experimental material was sown by dibbling method. Recommended dose of fertilizer were applied @ 40:40:40 kg/ha N:P:K in the form of urea, single super phosphate, muriate of potash respectively as basal. The recommended agronomical and plant protection practices were followed regularly as per needed. Observations were recorded on 3 randomly selected plants from each genotype for days to fifty percent flowering, days to maturity, plant height at physiological maturity (cm), leaf dry weight at flowering (g/m^2), stem dry weight at flowering (g/m^2), leaf area at flowering (cm^2), relative water content (RWC) at flowering (%) , total chlorophyll content (TCC), chlorophyll stability index (CSI) %, 1000 grain weight (g), grain no/panicle, grain yield (q/ha), fodder yield (q/ha), harvest index (%). The data was analysed statistically for genotypic and phenotypic correlation coefficient using path coefficient analysis studies.

Table 1: List of kharif inbred lines used for study

Sr. no	Inbreds	Remarks	Source
1	AKSV 318	Inbred	Akola
2	AKSV 346	Inbred	Akola
3	PDKV Kalyani	Inbred	Akola
4	PVK 1025	Inbred	Parbhani
5	CSV 31	Inbred	-
6	CSV 34	Inbred	-
7	CSV 36	Inbred	-
8	CSV 39	Inbred	-
9	SPV 2509	Adv Inbred	-
10	SPV 2510	Adv Inbred	-
11	CSV 32F	Forage inbred SC	-
12	CSV 20	Check	-
13	CSV 23	Check	-
14	CSV 27	Check	

Results and Discussion

Genotypic and Phenotypic correlation coefficient matrix between different traits are represented in (table 2). Results showed that most of genotypic correlations were found to be higher than phenotypic correlations, which indicate that though there is strong inherent association between the characters and its expression is minimized due to influence of environment. The non-significant values of studied characters at both phenotypic and genotypic levels clearly indicates the independent nature of the character.

Correlation

The dependent variable i.e grain yield has recorded positive significant correlation with stem dry weight (G=0.996, P=0.427), relative water content (G=0.509, P=0.361), SPAD (G=0.578, P=0.442), total chlorophyll content (G=0.343, P=0.312), fodder yield (G=0.667, P=0.630) and harvest index (G=0.426, P=0.407) at both genotypic and phenotypic level. Negative significant correlation found with 1000 grain weight (G=-0.541, P=-0.512) at both genotypic and phenotypic level.

Table 2: Genotypic (G) and Phenotypic (P) correlation coefficient matrix between different traits in kharif sorghum inbred lines.

		DFIF	DTM	PH	LDW	SDW	LA	RWC	SPAD	TCC	CSI	TW	GN/P	FY	HI	GY
DFIF	G															
	P															
DTM	G	0.961**														
	P	0.796**														
PH	G	-0.005NS	0.036NS													
	P	0.004NS	0.038NS													
LDW	G	-0.063NS	-0.140NS	-0.092NS												
	P	-0.075NS	-0.144NS	-0.076NS												
SDW	G	0.929**	1.105**	0.907**	0.017NS											
	P	0.346*	0.407**	0.396**	0.029NS											
LA	G	0.113NS	0.205NS	-0.462**	0.043NS	0.029NS										
	P	0.100NS	0.199NS	-0.456**	0.036NS	0.001NS										

RWC	G	0.498**	0.559**	-0.003NS	-0.132NS	1.139**	0.237NS									
	P	0.361*	0.416**	-0.022NS	-0.092NS	0.280NS	0.176NS									
SPAD	G	0.215NS	0.395**	0.108NS	-0.402**	0.839**	-0.013NS	0.468**								
	P	0.112NS	0.303NS	0.065NS	-0.252NS	0.103NS	-0.010NS	0.185NS								
TCC	G	-0.075NS	-0.008NS	0.807**	0.123NS	0.785**	-0.104NS	-0.011NS	0.218NS							
	P	-0.044NS	-0.007NS	0.784**	0.115NS	0.292NS	-0.099NS	0.013NS	0.172NS							
CSI	G	0.408**	0.339*	0.083NS	0.529**	0.497**	-0.201NS	0.128NS	0.063NS	0.139NS						
	P	0.354*	0.322*	0.091NS	0.490**	0.193NS	-0.180NS	0.077NS	0.086NS	0.137NS						
TW	G	0.223NS	0.133NS	0.284NS	0.034NS	0.281NS	-0.327*	0.130NS	-0.277NS	0.195NS	0.674**					
	P	0.197NS	0.113NS	0.275NS	0.032NS	0.095NS	-0.323*	0.092NS	-0.161NS	0.191NS	0.634**					
GN/P	G	-0.270NS	-0.305*	0.105NS	-0.183NS	-0.092NS	-0.220NS	-0.071NS	0.441**	0.223NS	0.202NS	0.243NS				
	P	-0.256NS	-0.276NS	0.095NS	-0.178NS	-0.015NS	-0.218NS	-0.039NS	0.299NS	0.208NS	0.186NS	0.239NS				
FY	G	0.361*	0.381*	0.758**	0.154NS	1.255**	-0.153NS	0.303NS	0.487**	0.797**	0.232NS	-0.019NS	-0.006NS			
	P	0.313*	0.372*	0.730**	0.144NS	0.460**	-0.139NS	0.210NS	0.316*	0.753**	0.225NS	-0.024NS	-0.009NS			
HI	G	-0.168NS	-0.029NS	-0.627**	-0.070NS	-0.391*	0.296NS	0.310*	0.172NS	-0.582**	-0.513**	-0.706**	-0.071NS	-0.401**		
	P	-0.170NS	-0.076NS	-0.571**	-0.060NS	-0.006NS	0.257NS	0.132NS	0.104NS	-0.535**	-0.445**	-0.621**	-0.061NS	-0.398**		
GY	G	0.152NS	0.290NS	0.285NS	0.126NS	0.996**	0.032NS	0.509**	0.578**	0.343*	-0.149NS	-0.541**	-0.031NS	0.667**	0.426**	
	P	0.129NS	0.263NS	0.269NS	0.120NS	0.427**	0.033NS	0.361*	0.442**	0.312*	-0.112NS	-0.512**	-0.034NS	0.630**	0.407**	

* Significant at 5 per cent. ** Significant at 1 per cent, NSnon-significant.

Note :DFIF-Days to fifty % flowering, DTM-Days to maturity, PH-Plant height at physiological maturity (cm), LDW-Leaf dry weight at flowering (g/m^2), SDW-Stem dry weight at flowering (g/m^2), LA-Leaf area (cm^2), RWC-Relative water content (%), SPAD-SPAD value, TCC-Total chlorophyll content (mg/ml), CSI-Chlorophyll stability index (%), TW-Test weight i.e 1000 grain wt (g), GN/P-Grain no per panicle, FY-Fodder yield (q/ha), HI-Harvest index (%), GY-Grain yield (q/ha).

Similar results observed by Godbharle *et al*., (2010) [1] recorded positive significant correlation for fodder yield and harvest index at both genotypic and phenotypic level.

Non-significant positive association with grain yield was observed for days to fifty % flowering (G=0.152, P=0.129), days to maturity (G=0.290, P=0.263), plantheight (G=0.285, P=0.269), leaf dry weight (G=0.126, P=0.120), leaf area (G=0.032, P=0.033) at both genotypic and phenotypic level. Similar results observed by Hundekar *et al.* (2016) [2] recorded non-significant positive association with grain yield for days to fifty % flowering at both genotypic and phenotypic level. Non-significant negative association was observed with chlorophyll stability index (G=-0.149, P=-0.112) and grain no per panicle (G=-0.031, P=-0.034) at both genotypic and phenotypic level.

Path Analysis

Path coefficient analysis was carried out using genotypic and phenotypic level in order to find out the direct and indirect effects of various traits on the grain yield. Table 3 and 4 represents the direct (diagonal) and indirect (non-diagonal) effects of yield components on grain yield for inbred lines at both genotypic and phenotypic level.

Present study revealed presence of positive direct effect on grain yield for traits like days to maturity (0.330) at genotypic and days to fifty % flowering (0.049) at phenotypic level. While plant height (G=0.318, P=0.288), leaf dry weight (G=0.379, P=0.105), relative water content (G=0.165, P=0.159), SPAD (G=0.129, P=0.121), total chlorophyll content (G=0.011, P=0.065), grain no per panicle (G=0.121, P=0.001), fodder yield (G=0.441,P=0.528) and harvest index (G=0.563, P=0.705) at both genotypic and phenotypic level. Similar results observed by Tirkey *et al.*, (2021) [3] recorded positive direct effect on grain yield for fodder yield at both genotypic and phenotypic level.

At genotypic level, negative direct effects were observed for traits like days to fifty percent flowering (-0.141) and chlorophyll stability index (-0.210) at only genotypic and days to maturity (-0.013) only at phenotypic level while stem dry weight (G=-0.010, P=-0.015), leaf area (G=-0.090, P=-0.026) and 1000 grain weight (G=-0.153,P=-0.235) at both genotypic and phenotypic level. Similar results observed by Tirkey *et al.*, (2021) [3] recorded negative direct effects for days to fifty % flowering at genotypic level only.

Positive indirect effects on grain yield were obtained for plant height, stem dry weight, relative water content, SPAD, total chlorophyll content, days to fifty percent flowering, days to maturity, leaf dry weight, leaf area, fodder yield and harvest index at both genotypic and phenotypic level. Negative indirect effects on grain yield were obtained for chlorophyll stability index, 1000 grain weight and grain no per panicle at both genotypic and phenotypic level. Similar results were observed by Tirkey *et al.* (2021) [3] recorded positive indirect effects for plant height, days to fifty percent flowering and days to maturity at both genotypic and phenotypic level.

Table 3: Direct (diagonal) and indirect (non diagonal) effects of yield components on grain yield for kharif sorghum inbred lines at genotypic level.

Characters	Dfif	DTM	PH (cm)	LDW (g/m2)	SDW (g/m2)	LA (cm2)	RWC (%)	SPAD	TCC (mg/ml)	CSI (%)	1000 GW (g)	Grain no/ panicle	Fodder yield (q/ha)	HI (%)	Grain yield (q/ha)
Dfif	-0.141	0.31725	-0.00172	-0.02397	-0.00909	-0.01021	0.08216	0.02765	-0.00083	-0.08544	-0.03410	-0.03266	0.15922	-0.09476	0.152^{NS}
DTM	-0.13554	0.330	0.01156	-0.05305	-0.01082	-0.01846	0.09228	0.05094	-0.00009	-0.07104	-0.02041	-0.03686	0.16813	-0.01647	0.290^{NS}
PH (cm)	0.00076	0.01199	0.318	-0.03475	-0.00888	0.04159	-0.00053	0.01391	0.00884	-0.01749	-0.04344	0.01270	0.33460	-0.35279	0.285^{NS}
LDW (g/m2)	0.00893	-0.04624	-0.02921	0.379	-0.00017	-0.00389	-0.02178	-0.05172	0.00135	-0.11080	-0.00526	-0.02207	0.06800	-0.03946	0.126^{NS}
SDW (g/m2)	-0.13102	0.36489	0.28893	0.00646	-0.010	-0.00263	0.18792	0.10802	0.00859	-0.10423	-0.04289	-0.01118	0.55378	-0.22030	0.997**
LA (cm2)	-0.01599	0.06763	-0.14697	0.01635	-0.00029	-0.090	0.03919	-0.00168	-0.00113	0.04216	0.04993	-0.02655	-0.06761	0.16674	0.032^{NS}
RWC (%)	-0.07022	0.18461	-0.00102	-0.05000	-0.01115	-0.02140	0.165	0.06029	-0.00012	-0.02673	-0.01988	-0.00856	0.13366	0.17461	0.509**
SPAD	-0.03028	0.13057	0.03438	-0.15209	-0.00821	0.00118	0.07725	0.129	0.00239	-0.01331	0.04228	0.05331	0.21480	0.09709	0.578**
TCC (mg/ml)	0.01065	-0.00265	0.25701	0.04674	-0.00768	0.00933	-0.00181	0.02806	0.011	-0.02908	-0.02974	0.02695	0.35173	-0.32781	0.343*
CSI(%)	-0.05750	0.11190	0.02657	0.20025	-0.00487	0.01812	0.02105	0.00818	0.00152	-0.210	-0.10302	0.02443	0.10235	-0.28862	-0.149^{NS}
1000 GW (g)	-0.03146	0.04407	0.09047	0.01302	-0.00275	0.02942	0.02145	-0.03562	0.00213	-0.14122	-0.153	0.02936	-0.00860	-0.39778	-0.540**
Grain no/panicle	0.03810	-0.10063	0.03343	-0.06914	0.00090	0.01978	-0.01168	0.05679	0.00244	-0.04234	-0.03713	0.121	-0.00259	-0.03979	-0.031^{NS}
Fodder yield (q/ha)	-0.05090	0.12581	0.24147	0.05838	-0.01229	0.01381	0.04999	0.06271	0.00873	-0.04862	0.00298	-0.00071	0.441	-0.2255	0.667*
HI (%)	0.02374	-0.00966	-0.19950	-0.02655	0.00383	-0.02668	0.05117	0.02221	-0.00637	0.10743	0.10801	-0.00855	-0.17670	0.563	0.425**

Residual effect =-0.00667

* significant at 5 per cent. ** significant at 1 per cent, ^{NS}non significant

Table 4: Direct (diagonal) and indirect (non diagonal) effects of yield components on grain yield for kharif sorghum inbred lines at phenotypic level.

Characters	Dfif	DTM	PH (cm)	LDW (g/m2)	SDW (g/m2)	LA (cm2)	RWC (%)	SPAD	TCC (mg/ml)	CSI (%)	1000 GW (g)	Grain no/panicle	Fodder yield (q/ha)	HI (%)	Grain yield (q/ha)
Dfif	0.049	-0.01012	0.00108	-0.00788	-0.00522	-0.00262	0.05744	0.01356	-0.00290	0.03796	-0.04631	-0.00037	0.16536	-0.11960	0.129^{NS}
DTM	0.03915	-0.013	0.01081	-0.01511	-0.00615	-0.00523	0.06626	0.03658	-0.00048	0.03454	-0.02660	-0.00039	0.19626	-0.05363	0.263^{NS}
PH (cm)	0.00018	-0.00048	0.288	-0.00797	-0.00598	0.01197	-0.00348	0.00783	0.05123	0.00974	-0.06454	0.00014	0.38510	-0.40253	0.269^{NS}
LDW (g/m2)	-0.00370	0.00184	-0.02188	0.105	-0.00044	-0.00095	-0.01466	-0.03043	0.00752	0.05248	-0.00751	-0.00025	0.07608	-0.04240	0.120^{NS}
SDW (g/m2)	0.01701	-0.00518	0.11399	0.00307	-0.015	-0.00003	0.04457	0.01247	0.01905	0.02070	-0.02238	-0.00002	0.24301	-0.00445	0.427**
LA (cm2)	0.00490	-0.00253	-0.13108	0.00377	-0.00002	-0.026	0.02808	-0.00121	-0.00647	-0.01931	0.07582	-0.00031	-0.07346	0.18141	0.033^{NS}
RWC (%)	0.01774	-0.00529	-0.00629	-0.00964	-0.00423	-0.00463	0.159	0.02237	0.00085	0.00823	-0.02167	-0.00006	0.11110	0.09291	0.361*
SPAD	0.00553	-0.00386	0.01867	-0.02641	-0.00156	0.00026	0.02951	0.121	0.01126	0.00917	0.03771	0.00043	0.16667	0.07332	0.441**
TCC (mg/ml)	-0.00218	0.00009	0.22562	0.01207	-0.00440	0.00260	0.00207	0.02081	0.065	0.01471	-0.04475	0.00030	0.39754	-0.37731	0.312*
CSI(%)	0.01743	-0.00410	0.02616	0.05132	-0.00292	0.00473	0.01223	0.01033	0.00897	0.107	-0.14883	0.00027	0.11897	-0.31365	-0.112^{NS}
1000 GW (g)	0.00971	-0.00144	0.07910	0.00335	-0.00144	0.00848	0.01470	-0.01940	0.01246	0.06792	-0.235	0.00034	0.01275	0.43786	-0.512**
Grain no/panicle	-0.01260	0.00352	0.02740	-0.01868	0.00023	0.00573	-0.00622	0.03610	0.01359	0.01992	-0.05603	0.001	-0.00475	-0.04321	-0.034^{NS}
Fodder yield (q/ha)	0.01541	-0.00473	0.20992	0.01510	-0.00695	0.00366	0.03353	0.03813	0.04921	0.02415	0.00567	-0.00001	0.528	-0.28054	0.630**
HI (%)	-0.00835	0.00097	-0.16426	-0.00630	0.00010	-0.00676	0.02099	0.01256	-0.03496	-0.04766	0.14578	-0.00009	-0.21001	0.705	0.407**

Residual effect =0.05559

* significant at 5 per cent. ** significant at 1 per cent, ^{NS}non significant

Conclusion

Based on the correlation results in fourteen genotypes for fifteen characters revealed that stem dry weight, relative water content, SPAD, total chlorophyll content, fodder yield and harvest index has significant positive correlation with grain yield while negative association with 1000 grain weight. In path analysis study it can be concluded that traits like leaf area, relative water content, stem dry weight, SPAD, grain no per panicle would play an important role in selection criteria for improve the breeding efficiency of the genotypes. Hence, due consideration should be given for the traits while selecting inbred lines.

References

1. Godbharle AR, More AW, Ambekar SS. Genetic variability an correlation studies in elite ‘B’ and ‘R’ lines in kharif sorghum. Electronic Journal of Plant Breeding. 2010;1(4):989-993.
2. Ramaling Hundekar MY, Kamatar, Mallimar Maddeppa, Brunda SM. Correlation and path analysis in rainy season sorghum [*Sorghum bicolor* (L.) Moench]. Electronic Journal of Plant Breeding. 2016;7(3):666-669.
3. Tirkey S, Jawale LN, More AW. Genetic variability, correlation and path analysis studies in B parental lines of kharif sorghum (*Sorghum bicolor* (L.) Moench).The Pharma Innovation Journal. 2021;10(8):624-628
4. Singh SK, Gangwar LK, Chaudhary Mayank. Studies on character association and path analysis in forage sorghum. International Journal of Chemical Studies. 2019;7(5):2939-2942.
5. Kavya P, Satyanarayana Rao V, Vijayalakshmi B, Sreekanth B. Correlation and path coefficient analysis in sorghum [*Sorghum bicolor* (L.) Monech] for ethanol yield. Journal of Pharmacognosy and Phytochemistry. 2020;9(2):2407-2410.
6. Ravali K, Jahagirdar JE, Dhutmal RR. Correlation and path analysis in relation to drought tolerance in rabi sorghum (*Sorghum bicolor* L. Moench).The Pharma Innovation Journal. 2021;10(6):318-321
7. Jain SK, Patel PR. Characters association and path analysis in sorghum (*Sorghum bicolor* (L.) Moench) f1s and their parents. Annals of Plant and Soil Research.2014;16(2):107-110.
8. More AW, Dhutmal RR, Jawale LN, Jahagirdar JE. Character Association and Path Analysis for Drought Tolerance in Post Rainy Sorghum (*Sorghum bicolor* (L). Moench). Bull. Env. Pharmacol. Life Sci. November 2019;8(Suppl. 1):S51-S57.