RESEARCH PAPER International Journal of Agricultural Sciences, January to June, 2010, Vol. 6 Issue 1 : 100-104

Character association and path analysis in sorghum [Sorghum bicolor (L.)] Moench

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ABSTRACT

The present investigation was conducted to determine correlation between yield and yield contributing components and to assess the direct and indirect effects of yield components on yield. The experimental material comprised of sixty four genotypes of sorghum collected by *in situ* selection from Vidarbha region. The present investigation revealed that the only character 1000 seed weight showed highly significant association with grain yield per plant at both genotypic and phenotypic level. This indicates that strong association of this trait with grain yield per plant could be fruitfully exploited for enhancing the yield potential in sorghum. Among the yield components themselves, days to 50% flowering showed highly significant positive association with days to maturity, plant height, dry fodder weight per plant and number of leaves per plant. The character number of internodes per plant exhibited very strong positive correlation with number of leaves per plant and stem girth while number of leaves showed moderately significant positive association with stem girth. The character days to 50% flowering exhibited positive direct effect of very high magnitude on grain yield per plant followed by earhead length and 1000 seed weight, while number of leaves per plant and number of primaries per whorl. It can be concluded that the character days to 50% flowering had very high direct positive effect on grain yield per plant, also this character had maximum positive indirect effect via number of internodes per plant. While most of the characters had their positive and direct effect on grain yield per plant via days to 50% flowering and days to maturity. Hence, days to 50% flowering, number of internodes per plant and days to maturity are the promising characters for selection.

Key words : Sorghum germplasm lines, Correlation and path coefficient analysis

INTRODUCTION

Sorghum [*Sorghum bicolor* (L.) Moench] a dryland millet crop mainly grown in Semi-arid Tropics of Africa, South Asia and Central America. Similarly Sorghum is a risk aversion crop and cannot be completely eliminated from cropping system as it is a sustainable fodder source for meeting huge livestock demand under water scarce/ drought conditions, which is a common feature of sorghum growing regions. Further, it offers a good choice of rotation crop to maintain soil fertility and pest management. Germplasm of any crop supply plentiful gene pool in breeding programme for the development of present day cultivar, it also fulfils the requirement of various adverse biotic and abiotic resistance characters and valuable genes for quality improvement. The amount of genetic variability available in sorghum [*Sorghum bicolor* (L.) Moench] is immense. The genetic variability is available in both cultivated species and wild progenitors of the crop. The challenge to sorghum improvement will be to concentrate on utilization of desirable traits that may aid in evolved superior improved lines aiming to surpass the present productivity plateau combined with better drought, disease and pest resistance and improved grain quality. Genetic variability in yield contributing characters is essential for developing high yielding genotypes in sorghum. The observed variability is a combined measure of genetic and environmental causes.

Similarly, correlation analysis measures the intensity and direction of associations among characters that are important in a breeding programme, when selection is based on several plant characters. Hence, computation of phenotypic and genotypic correlation between grain yield and its attributes along with their relative direct and indirect effects on yield are of immense value in selection of superior genotypes. Path coefficient analysis provides an aid for sorting out the total correlation into direct and indirect effect of different characters on yield. The objective of the study was to determine the extent of variability, association among grain yield and other yield related traits along with their direct and indirect effects in 60-64 sorghum local germplasms/ landraces collected from three districts of Vidarbha region in Maharashtra.

MATERIALS AND METHODS

The experiment was conducted at Sorghum Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during *Kharif* 2006 in Randomized Block Design in four replications with 63 varieties and one check (SPV-669).The experimental unit was a 16 row plot of 3.00 x 0.90 m^2 spaced at 0.75 m apart and plant to plant distance of 0.15m.NPK was applied as a basal dose at the rate of 40:40:40 kg/ha and 40 kg N /ha was applied after 30 days

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of sowing. Observations were recorded on five randomly selected plants from net plot for almost all the traits except days to 50% flowering and maturity. These two observations were recorded on plot basis. Observations were recorded on days to 50 per cent flowering, Plant height (cm), Number of internodes, Number of leaves per plant, Leaf length (cm),Leaf breadth (cm), Stem girth (cm), Days to maturity, Earhead length (cm), Earhead breadth (cm), Number of whorls per earhead, Number of primaries per whorl,Number of primaries per ear head, Dry fodder weight /plant (g) Grain yield per plant (g) and1000 seed weight (g). The relationship between two or more quantitative characters is of great interest and carried much practical significance. Correlation is a measure of the degree to which characters are associated with yield or among themselves (Burton, 1951). Path coefficients were calculated by the method used by Dewey and Lu (1959) by solving simultaneous equations which express the basic relationship between path coefficient and correlation coefficient.

Table 1 : The genotypes utilized for the present investigation are listed below

Sr. No.	Genotype	Sr. No.	Genotype
1	Ambikapur	33	Buldana-1
2	Apatapa (NT)	34	Lakhpuri-1
3	Yeoda	35	Lakhpuri-2
4	SPV-669	36	Ramgadh-1
5	Karodi-1	37	Ramgadh-2
6	Karodi-2	38	Pimpalkhuta-1
7	Karodi-3	39	Pimpalkhuta-2
8	Karodi-4	40	Jainpur-1
9	Karodi-5	41	Jainpur-2
10	Karodi-6	42	Jainpur-3
11	Karodi-7	43	Rustampur
12	Tandulwadi-1	44	Bhamod-1
13	Karla-1	45	Bhamod-2
14	Karla-2	46	Bhamod-3
15	Bhandaraj-1	47	Bhamod-4
16	Bhandaraj-2	48	Bhamod-5
17	Ugawa-1	49	Bhamod-6
18	Ugawa-2	50	Katyar
19	Ugawa-3	51	Apoti-1
20	Ugawa-4	52	Apoti-2
21	Nimbi-1	53	Apoti-3
22	Nimbi-2	54	Lotwada-1
23	Jawala-1	55	Lotwada-2
24	Jawala-2	56	Lotwada-3
25	Jawala-3	57	Khandala-4
26	Shrirampur-1	58	Lotwada-5
27	Dasala-1	59	Lotwada-6
28	Dasala-2	60	Lotwada-7
29	Shegaon Wani-1	61	Nandrun-1
30	Ramtirth-1	62	Nandrun-2
31	Ramtirth-2	63	Pimplod-1
32	Ramtirth-3	64	Pimplod-2

(Source: Sorghum Research Unit, Dr. PDKV, Akola)

RESULTS AND DISCUSSION

The investigation was carried to study the correlation and path analysis (Table 2) in 16 characters in selected 64 Sorghum germplasm lines. The character 1000 seed weight showed highly significant association with grain yield per plant at both genotypic(r=0.481) and phenotypic(r=0.360) level. This indicates that strong association of this trait with grain yield per plant could be fruitfully exploited for enhancing the yield potential in sorghum. Similar findings were reported by Thorat *et al*. (2004), Elangovan (2006) and Sharma *et al*. (2006) for 1000 seed weight. The characters Earhead length (r=0.206), dry fodder weight per plant(r=0.183), leaf length (r=0.182), number of whorls per Earhead (r=0.103), plant height(r=0.075), stem girth(r=0.045), number of primaries per Earhead(r=0.022), Earhead breadth(r=0.022) and leaf width (r=0.013) showed positive but non significant association within grain yield per plant. While negative association with grain yield was exhibited by the characters, number of internodes per plant(r=- 0.090), number of leaves per plant(r=-0.087), number of primaries per whorl(r= - 0.079), days to maturity(r=- 0.010) and days to 50 per cent flowering (r=-0.007) at genotypic level. Days to 50 per cent flowering showed highly significant positive association with days to maturity (r=1.000), plant height (r=0.548), dry fodder weight per plant (r=0.395), number of leaves per plant (r=0.327) whereas days to maturity exhibited highly significant positive genotypic correlation with plant height (r=0.548), dry fodder weight per plant (r=0.392), number of leaves pr plant (r=0.337).Days to maturity exhibited highly significant but negative genotypic correlation with number of whorls per Earhead (r=-0.519).Plant height with dry fodder weight per plant (r= 0.529), number of internodes per plant (r= 0.421), number of leaves per plant (r=0.418), number of internodes per plant with number of leaves per plant (r=1.000),leaf length with number of primaries per whorl (r=0.486), leaf width with stem girth (r=0.339), number of whorls per earhead showed with number of primaries per Earhead (r=0.623),number of primaries per whorl with number of primaries per earhead (r=0.818) showed highly significant positive association. Partitioning of yield and yield components into direct and indirect effects (Table

Table 2 : Genotypic, phenotypic correlation coefficient (r) between yield and yield contributing characters

Source		Days to 50% flowering	Days to maturity	Plant height	No. of plant internode	No. of leaves per plant	Leaf length	Leaf width	Stem girth	Earhead length	Earhead breadth	No. of whorls per earhead	No. of primaries per whorls	No. of primaries per earhead	1000 seed wt.	Total fodder wt. per plant	Grain yield per plant
Days to 50%	G	1.000	1.001**	0.548**	0.319*	0.327**	0.316*	0.077	0.227	-0.130	-0.002	-0.524**	0.153	-0.242	0.203	0.395**	-0.007
flowering	P	1.000	0.997**	0.483**	0.206	0.248	0.094	0.042	0.198	-0.140	-0.020	-0.264*	0.070	-0.174	0.133	0.363**	-0.196
Days to maturity	G		1.000	0.548**	0.323**	0.337**	0.316*	0.083	0.228	-0.137	-0.003	-0.519**	0.148	-0.224	0.194	0.392**	-0.010
	P		1.000	0.482**	0.210	0.251*	0.096	0.040	0.195	-0.130	-0.20	-0.270*	0.077	-0.180	0.133	0.352**	-0.018
Plant height	G			1.000	0.421**	0.418**	0.253*	0.144	0.109	0.311*	0.175	-0.221	0.016	-0.134	0.227	0.529**	0.075
	P			1.000	0.228	0.306*	0.143	0.072	0.111	0.232	0.202	-0.080	0.021	-0.069	0.119	0.458**	0.043
No. of plant	G				1.000	1.216**	0.134	-0.097	0.249	-0.066	0.235	0.032	0.036	0.027	-0.129	0.031	-0.090
internode	P				1.000	0.736**	0.104	-0.074	0.162	0.020	0.085	0.080	0.050	0.017	-0.048	0.008	-0.024
No. of leaves per	G					1.000	0.200	-0.053	0.251*	-0.081	0.197	-0.078	0.090	0.003	-0.103	0.078	-0.087
plant	P					1.000	0.103	-0.052	0.166	-0.076	0.098	-0.020	0.136	0.021	-0.018	0.032	-0.040
Leaf length	G						1.000	-0.235	0.134	0.027	0.107	-0.112	0.486**	0.220	0.282*	-0.005	0.182
	P						1.000	-0.035	0.080	-0.013	0.031	0.065	0.070	0.017	-0.012	-0.045	0.069
Leaf width	G							1.000	0.339**	0.005	-0.252*	0.071	0.047	0.099	-0.020	0.131	0.013
	P							1.000	0.240	0.011	-0.117	0.085	0.013	0.048	0.011	0.071	-0.038
Stem girth	G								1.000	0.075	-0.144	-0.100	-0.015	-0.070	0.023	0.191	0.045
	P								1.000	0.056	-0.096	-0.050	-0.007	-0.042	0.006	0.194	0.038
Earhead length	G									1.000	0.555**	0.136	-0.596**	-0.309*	-0.316*	-0.075	0.206
	P									1.000	0.441**	0.048	-0.286*	-0.155	-0.179	-0.043	0.188
Earhead breadth	G										1.000	-0.205	-0.265*	-0.240	-0.257*	-0.162	0.022
	P										1.000	-0.077	-0.105	-0.182	-0.166	-0.132	0.020
No. of whorls	G											1.000	-0.236	0.623**	0.158	-0.276*	0.103
per earhead	P											1.000	-0.117	0.451**	0.046	-0.152	0.021
No. of primaries	G												1.000	0.818**	0.177	0.003	-0.079
per whorls	P												1.000	0.571**	0.116	-0.017	-0.012
No. of primaries	G													1.000	0.240	-0.189	0.022
per earhead	P													1.000	0.104	-0121	0.022
1000 seed wt.	G														1.000	0.525**	0.481**
	P														1.000	0.342*	0.360**
Total fodder wt.	G															1.000	0.183
per plant	P															1.000	0.160
Grain yield per	G																1.000
plant																	

* and ** indicate significance of values at P=0.05 and 0.01, respectively

Table 3 : Path coefficient analysis showing direct (underlined) and indirect effect of various traits on grain yield

Source	Days to 50% flowering	Days to maturity	Plant height	No. of plant internode	No. of leaves per plant	Leaf length	Leaf width	Stem girth	Earhead length	Earhead breadth	No. of whorls per earhead	No. of primaries per whorls	No. of primaries per earhead	1000 seed wt.	Total fodder wt. per plant	Grain yield per plant
Days to 50% flowering	2.270	-2.211	-0.514	4.171	0.201	-0.085	0.013	-0.074	-0.227	0.001	0.364	0.048	-0.023	0.273	-0.085	-0.007
Days to maturity	2.273	-2.208	-0.515	0.042	0.206	-0.086	0.014	-0.075	-0.226	0.002	0.360	0.047	-0.023	0.161	-0.084	-0.010
Plant height	1.245	-1.212	-0.938	0.055	0.256	-0.068	0.025	-0.036	0.511	-0.101	0.153	0.005	-0.013	0.306	-0.113	0.075
No. of plant internode	0.724	-0.725	-0.396	0.130	0.745	-0.036	-0.017	-0.082	-0.109	-0.135	-0.022	0.011	0.002	-0.174	-0.006	-0.090
No. of leaves per plant	0.744	-0.744	-0.393	0.158	0.613	-0.054	-0.009	-0.082	-0.133	-0.113	0.054	0.028	0.0004	-0.139	-0.016	-0.087
Leaf length	0.718	-0.699	-0.237	0.017	0.122	-0.271	-0.041	-0.044	0.044	-0.061	0.078	0.154	0.021	0.380	0.001	0.182
Leaf width	0.176	-0.183	-0.135	-0.012	-0.032	0.063	0.175	-0.111	0.009	0.145	-0.050	0.015	0.009	-0.027	-0.028	0.013
Stem girth	0.515	-0.504	-0.102	0.032	0.154	-0.036	0.059	-0.329	0.124	0.082	0.069	-0.004	-0.006	0.032	-0.041	0.045
Earhead length	-0.314	0.304	-0.292	-0.008	-0.049	-0.007	0.001	-0.024	1.642	-0.319	-0.094	-0.189	-0.030	-0.426	0.016	0.206
Earhead breadth	-0.005	0.008	-0.164	0.030	0.121	-0.029	-0.044	0.047	0.911	-0.575	0.143	-0.084	0.023	-0.346	0.034	0.022
No. of whorls per earhead	-1.189	1.146	0.207	0.004	-0.048	-0.030	0.012	0.033	0.224	0.118	-0.694	-0.075	0.060	0.213	0.059	0.103
No. of primaries per whorls	0.348	-0.327	-0.015	0.004	0.055	-0.132	0.008	0.004	-0.979	0.152	0.164	0.317	0.079	0.239	-0.0008	-0.079
No. of primaries per earhead	-0.550	0.539	0.126	0.003	0.002	-0.059	0.017	0.023	-0.508	0.138	-0.433	0.260	0.097	0.323	0.040	0.022
1000 seed wt.	0.461	-0.429	-0.213	-0.016	-0.063	-0.076	-0.003	-0.007	-0.520	0.148	-0.110	0.056	0.023	1.346	-0.112	0.481
Total fodder wt. per plant	0.897	-0.867	-0.196	0.004	0.048	0.001	0.023	-0.062	-0.124	0.093	0.192	0.001	-0.018	0.706	-0.215	0.183

Residual effect - 59.407

3) revealed that character days to 50 per cent flowering (2.270) exhibited highest positive direct effect on grain yield per plant followed by earhead length (1.642)and 1000seed weight (1.346), while number of leaves per plant (0.613) and number of primaries per whorl (0.317). Similar results were obtained by Shanmugasundaram and Subrananian (1990) and Kishore and Singh (2005) for days to 50 per cent flowering Sunku *et al.* (2002) and Sankarapandian (2000) for number of leaves per plant. El-nagar (1997), Jayprakash *et al.* (1997) and Iyengar *et al.*(2001), Patel *et al.*(1979) and Shanmugasundaram and Subrananian (1990) for 1000 seed weight. The characters days to maturity via days to 50 per cent flowering (2.273) followed by plant height via days to 50 per cent flowering (1.245) and number of whorls per earhead via days to maturity (1.146) showed very high indirect effect on grain yield per plant. The characters days to maturity had maximum positive indirect effect via days to 50 per cent flowering (2.273) while most of the characters had their positive and direct effect on grain yield per plant via days to 50 per cent flowering. Hence days to 50 per cent flowering and days to maturity was found to be promising characters for selection.

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Received : June, 2009; Accepted : September, 2009