The Bioscan 8(4): 1311-1314, 2013
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

STUDIES ON GENETIC PARAMETERS AND INTER-RELATIONSHIPS AMONG YIELD AND YIELD CONTRIBUTING TRAITS IN SORGHUM (*SORGHUM BICOLOR* L. MOENCH)

B. ARUN KUMAR*
Agricultural Research Station, Bidar - 585 102, Karnataka (UAS, Raichur), INDIA
e-mail: b.arunkumar@rediffmail.com

KEYWORDS
Sorghum
Genetic variability
Correlation
Path analysis
Green yield

Received on :
29.06.2013

Accepted on :
19.10.2013

***Corresponding author**

ABSTRACT

Experiment was conducted on sorghum to study the genetic variability, association among the yield component traits, their direct and indirect effects on the yield. Genotypic coefficient of variation was played a major role for the expression of the traits ranged from 4.12 (seed set percent) to 25.29 (fodder yield). Heritability in narrow sense ranged from 50.00 (seed set percent, test weight) to 82.00 (grain yield). High genetic advance was observed for the traits, grain yield (485.19) and fodder yield (40.16) coupled with high heritability (82 and 86), indicating the preponderance of the non-additive gene action; suggesting that hybridization breeding will be effective. General the genotypic correlation was generally of higher magnitude than phenotypic correlation. Ear head length (0.454*) and fodder yield (0.441*) were positively and significantly associated with grain yield per hectare and grain yield per plant respectively at genotypic level, indicating increase in ear head length will increase the yield. Negative and significant association at genotypic level was noticed between days to 50% flowering and ear head breadth (-0.447*) and seed set per cent with ear head length (-0.603*) and fodder yield per plant (-0.497*). Days to 50% flowering (0.055 and 0.142), ear head length(0.177 and 0.028) and test weight (0.332 and 0.125) at both genotypic and phenotypic level have positive direct effect on yield indicating importance of these characters and can be strategically used to improve the yield of sorghum.

INTRODUCTION

Sorghum is one of the important food crops of the world. To exploit the potentiality of sorghum several crop improvement programmes have been undertaken. Yield is a complex character, which depends upon many independent contributing characters. Knowledge of the magnitude and type of association between yield and its components themselves greatly help in evaluating the contribution of different components towards yield. Yield being a polygenic character is highly influenced by the fluctuations in environment. Hence, selection of plants based directly on yield would not be very reliable. Improvement in sorghum yield depends on the nature and extent of genetic variability, heritability and genetic advance in the base population. Besides, the information on the nature of association between yield and its components helps in simultaneous selection for many characters associated with yield improvements. (Mahajan *et al.*, 2011)

Grain yield is complex trait, depend on many attributes characters. Yield potential accompanied with desirable combination of traits has always been the major objective of sorghum breeding program. Correlation measure the level of dependence traits and out of numerous correlation coefficient it is often difficult to determined the actual mutual effects among traits (Ikanovic *et al.*, 2011). The estimates of correlations alone may be often misleading due to mutual cancellation of component traits. So, it becomes necessary to study path coefficient analysis, which takes in to account the casual relationship in addition to degree of relationship (Mahajan *et al.*, 2011).The path coefficient analysis initially suggested by Wright, 1921 and described by Dewey and Lu, 1959 allows partitioning of correlation coefficient into direct and indirect contributions (effects) of various traits towards dependent variable and thus helps in assessing the cause-effect relationship as well as effective selection. Path analysis is necessary for better understanding of correlations among traits, which is a pathway for knowledge on specificity of the genetic material being studied. Ikanovic, 2011 concluded that even if correlation values are similar for certain pairs of traits, direct effects for some of them and especially indirect effects via other traits can differ for some traits.

Therefore, the present study aims to analyze and determine the traits having greater interrelationship with grain yield utilizing the correlation and path analysis.

MATERIALS AND METHODS

The present field experiment on sorghum (*Sorghum bicolor* L. Moench) was conducted in Agricultural Research station, Bidar (Karnataka) during kharif 2009-2010.The genotypes include in the study were SPH-1618, SPH-1620, SPH-1647, SPH-794, SPH-1795, SPV-1829, SPV-1830, SPV-1833, SPV-1835, SPV-1891, SPV-1905, M-35-1, CSH15R, CSV18, CSV22, JP-5-1, SVD-0806, BJV-80, SVD-0802, BJV-385, SVD-0768, BJV-402, BJV-05, DSH-4.The genotypes were evaluated in a field experiment under randomized block design with three replications. Each entry was raised in six rows of 4 m length adopting a spacing of 45 cm between rows and 15 cm between plants. The standard agronomic practices were followed throughout the period of crop growth.

The biometrical observations recorded on five randomly selected plants from each entry per replication. The replication wise mean values of the genotypes were subjected to statistical analysis. Observations were recorded on the following characters viz., days to 50 per cent flowering, plant height, ear head length, ear head breadth, seed set percent, test weight, grain yield per plant, fodder yield per plant.

The genotypic and phenotypic correlation co-efficient, path co- efficient analysis was done to partition the genotypic correlation co-efficient into direct and indirect effects. Knowledge of the relationship among yield components is essential for the formulation of breeding programmes aimed at achieving the desired combinations of various components of yield. The estimates of correlation coefficients among the different characters indicate the extent and direction of association. The correlation co-efficient provide a reliable measure of association among the characters and help to differentiate vital associations useful in breeding from those of the non-vital ones (Falconer, 1981).

RESULTS AND DISCUSSION

Mean sum of squares ,error and coefficient of variation (%) for all the characters studied are presented in Table 1.All most all the genotypes showed considerable amount of differences or variation in their mean performances with respect to the characters studied. This indicates that there is presence of sufficient variability for the characters in the genotypes studied indicating scope for further selection and breeding superior and desirable genotypes or varieties. Similar results were observed by Arunkumar *et al.* (2004).

Genotypic and phenotypic variation

The results of estimates of genetic variability, heritability, genetic advance for grain yield per plant and other characters are presented in Table 2. The PCV was higher than GCV for all the characters studied showing that all the traits were highly influenced by environment. However differences between them were not of high magnitude. High estimates of genotypic and phenotypic coefficient of variation were observed for grain yield per plant, ear head length, plant height. The results are in accordance with Hemalatha Sharma *et al.* (2006). Low GCV and PCV were noticed for seed set percent and ear head breadth, test weight and also for days to 50% flowering. Similar results were observed by Mallinath *et al.* (2004).

The effectiveness of selection for any character depends, not only the extent of genetic variability but also in the extent to which it will be transferred from one generation to the other generation. High heritability was observed for fodder yield per plant followed by grain yield. Moderate heritability was observed for ear head length and days to 50% flowering (Chavan *et al.,* 2010). However low heritability for plant height, ear head breadth, seed set percent and test weight were recorded in the present study.

High and low genetic advance was observed for grain yield per hectare and test weight and ear head respectively. High heritability coupled with high genetic advance was recorded for grain yield per hectare, fodder yield revealing that characters are governed by additive gene action and phenotypic selection for these characters will be effective. High heritability and high genetic advance for grain yield per hectare and fodder yield have been reported by Roa and Patil (2006).

Correlation

Correlation coefficient is a statistical measure, which denotes the degree and magnitude of association between any two casually related variables. This association is due to pleitropic gene action or linkage or more likely both. In plant breeding

Table 1: Mean sum of squares for characters in sorghum

Characters	Replication	Genotypes	Error	SEm ±	CV (%)
Days 50% flowering	6.06	69.55**	12.56	2.89	4.18
Plant height (cm)	13.25	1203.45**	290.30	13.91	7.18
Ear head length (cm)	0.69	14.60**	1.97	1.14	7.05
Ear head breadth (cm)	0.04	0.74**	0.18	0.35	5.75
Seed set percent	6.38	53.81**	13.63	3.01	4.16
Test weight (g)	0.09	0.17**	0.04	0.17	4.81
Grain yield/plant (g)	7.04	78.09**	6.78	2.13	11.11
Fodder yield/plant (g)	46.19	1397.26**	71.85	6.92	10.20
Grain yield/ha (kg)	4416.00	218981.12**	15233.92	100.78	7.08

Table 2: Mean and other variability parameters for characters in sorghum

Characters	Mean	Range		GCV	PCV	h^2	GA	GAM
		Minimum	Maximum					
Days 50% flowering	84.87	78.00	97.00	5.14	6.62	60.00	6.97	8.21
Plant height (cm)	237.18	192.20	299.60	7.36	10.28	51.00	25.71	10.84
Ear head length (cm)	19.89	14.00	26.00	10.32	12.50	68.00	3.49	17.55
Ear head breadth (cm)	7.42	5.80	9.60	5.82	8.18	51.00	0.63	8.49
Seed set percent	88.78	75.00	98.00	4.12	5.85	50.00	5.31	5.98
Test weight (g)	4.30	3.38	5.20	4.85	6.84	50.00	0.31	7.21
Grain yield/plant (g)	23.42	14.54	40.77	20.81	23.60	78.00	8.86	37.82
Fodder yield/plant (g)	83.12	45.87	136.33	25.29	27.27	86.00	40.16	48.32
Grain yield/ha (Kg)	1742.13	1163.42	2390.55	14.96	16.55	82.00	485.19	27.85

correlation coefficient analysis measures the mutual relationship between two characters and it determines character association for improvement yield and other economic characters. Since the association pattern among yield components help to select the superior genotypes from divergent population based on more than one interrelated characters. Thus information on the degree and magnitude of association between characters is of prime important for the breeder to initiate any selection plan. In general the genotypic correlation was generally of higher magnitude than phenotypic correlation (Table 3), indicating that inherent association between various characters studied. In general the genotypic correlation was generally of higher magnitude than phenotypic correlation (Table 3), indicating that inherent association between various characters studied. Days to 50% flowering and ear head breadth were negatively associated (-0.447*).Ear head length was negatively associated with seed set percent (-0.603**) but positively associated with grain yield per hectare (0.454*) indicating increase in ear head length will increase the yield (Godbharle *et al.*, 2010). Seed set percent was negatively associated with fodder yield (-0.497**).Grain yield and fodder yield were positively associated (0.441*).

Path analysis

Due to mutual cancellation of component traits, the estimation of correlation alone may be often misleading so it is necessary to study the path co-efficient analysis, which takes into account the casual relationship in addition to the degree of relationship. Hence genotypic and phenotypic correlation was partitioned into direct and indirect effects to know the relative importance of the components (Table 4). Days to 50% flowering (0.055, 0.142), ear head length (0.177, 0.028), test weight (0.332, 0.125) had positive direct effect on yield at both genotypic and phenotypic level indicating importance of these characters. Hemalatha Sharma *et al. (*2006) and Iyanar *et al.* (2001) also reported direct contribution of 100 seed weight on grain yield. While indirect effects of days to 50 % flowering via days to maturity and panicle girth were also high. Likewise indirect effects of days to 50% flowering via 100 seed weight was also high.

Table 3: Phenotypic and genotypic correlation coefficient between different traits in sorghum

Characters		Days 50% flowering	Plant height (cm)	Ear head length (cm)	Ear head breadth (cm)	Seed set percent	Test weight (g)	Grain yield/plant (g)	Fodder yield/ plant (g)	Grain yield/ha (kg)
Days 50% flowering	P	1	-0.128	-0.222	-0.264	0.072	0.101	0.133	0.084	0.192
	G		-0.334	-0.326	-0.447*	0.162	0.189	0.303	0.052	0.185
Plant height(cm)	P		1	0.075	0.166	-0.135	0.007	-0.295	0.044	-0.184
	G			0.206	0.321	-0.259	0.099	-0.347	0.143	-0.333
Ear head length (cm)	P			1	0.208	-0.361	-0.132	-0.122	0.028	-0.352
	G				0.395	-0.603**	-0.307	0.108	0.032	0.454*
Ear head breadth(cm)	P				1	-0.056	-0.236	-0.073	0.059	-0.137
	G					-0.342	-0.347	0.183	0.038	0.162
Seed set percent	P					1	-0.192	-0.083	-0.309	0.267
	G						0.091	0.133	-0.497**	0.352
Test weight (g)	P						1	0.167	0.186	0.079
	G							0.281	0.269	0.173
Grain yield/plant (g)	P							1	0.381	-0.159
	G								0.441*	0.171
Fodder yield/ plant (g)	P								1	-0.342
	G									-0.375
Grain yield/ha (kg)	P									1

Table 4: Genotypic and phenotypic path analysis for direct (diagonal) and indirect (off diagonal) effects of yield components on Grain yield in sorghum

Characters		Days 50% flowering	Plant height (cm)	Ear head length (cm)	Ear head breadth (cm)	Seed set percent	Test weight (g)	Grain yield/plant (g)	Fodder yield/ plant (g)	Grain yield/ha (kg)
Days 50% flowering	G	0.055	0.142	0.166	-0.079	-0.046	0.063	-0.095	-0.021	0.185
	P	0.142	0.023	0.065	-0.007	0.004	0.013	-0.023	-0.024	0.193
Plant height(cm)	G	-0.019	-0.425	-0.105	0.057	0.073	0.033	0.109	-0.057	-0.334
	P	-0.018	-0.183	-0.022	0.005	-0.007	0.001	0.052	-0.012	-0.184
Ear head length(cm)	G	-0.018	-0.088	-0.508	0.07	0.171	-0.102	0.034	-0.013	-0.454
	P	-0.032	-0.014	-0.291	0.006	-0.019	-0.017	0.021	-0.008	-0.354
Ear headbreadth(cm)	G	-0.025	-0.137	-0.201	0.177	0.097	-0.115	0.057	-0.015	-0.162
	P	-0.038	-0.03	-0.06	0.028	-0.003	-0.03	0.013	-0.016	-0.136
Seed setpercent	G	0.009	0.11	0.307	-0.061	-0.283	0.03	0.042	0.199	0.353
	P	0.01	0.025	0.105	-0.002	0.052	-0.024	0.014	0.087	0.267
Test weight (g)	G	0.01	-0.042	0.156	-0.061	-0.026	0.332	-0.088	-0.108	0.173
	P	0.014	-0.001	0.038	-0.007	-0.01	0.125	-0.029	-0.052	0.078
Grain yield/plant(g)	G	0.017	0.147	0.055	-0.032	0.038	0.094	-0.313	-0.176	-0.17
	P	0.019	0.054	0.035	-0.002	-0.004	0.021	-0.175	-0.107	-0.159
Fodder yield/plant(g)	G	0.003	-0.061	-0.016	0.007	0.141	0.09	-0.138	-0.4	-0.374
	P	0.012	-0.008	-0.008	0.002	-0.016	0.023	-0.067	-0.28	-0.342

Thus, emphasis should be given during selection on traits like 100 seed weight, panicle girth, days to 50% flowering and days to maturity for effective improvement in grain yield.

REFERENCES

Arunkumar, B., Biradar, B. D and Salimath, P. M. 2004. Genetic variability and character association studies in Rabi sorghum. *Karnataka J of Agril. Sci*. **17(3):** 471-475.

Chavan S. K., Mahajan R. C. and Sangita U. Fatak 2010. Genetic variability studies in sorghum *Karnataka J. Agric. Sci.* **23(2):** 322-323.

Dewey, D. R. and Lu, K. H. 1959. A correlation and path coefficient analysis of components of crested wheatgrass seed production. *Agron. J.* **51:** 515-518.

Falconer, D. S. 1981. Introduction to Quantitative Genetics. Second edition. Longman, New York. Hussain, M. K. and Khan, M. A. 1973. Correlation studies in sorghum Sudan grass hybrid forage. *SABRAO Newsl*. **5:** 51-53.

Godbharle, A. R., More, A. W and Ambekar, S. S. 2010. Genetic Variability and Correlation Studies in elite 'B' and 'R' lines in Kharif Sorghum. *Electronic J. Pl. Br.* **1(4):** 989-993.

Hemlata Sharma, Jain, D. K. and Vithal Sharma 2006. Genetic Variability and path coefficient analysis in sorghum. *Indian J. Agric. Res.* **40(4):** 310-312.

Ikanovic, J. 2010. Genotypic and phenotypic specificity of sorghum varieties, Sudan grass and their interspecific hybrids. Ph. D. Thesis, Faculty of Agriculture in Belgrade, Belgrade University, New York.

Ikanovic, J., Djordje, J., Radojka, M., Vera, P., Dejan, Marija, S. and Sveto, R. 2011. Path analysis of the productive traits in sorghum species. *Genetika.* **43(2):** 253-262.

Mahajan, R. C., Wadikar, P. B., Pole, S. P. and Dhuppe, M. V. 2011. Variability, correlation and path analysis studies in sorghum. *Res. J. Agri. Sci.* **2(1):** 101-103

Mallinath, V., Biradar, B. D., Chittapur, B. M., Salimath, P. M., Yenagi and Patil, S. S. 2004. Variability and correlation studies in pop sorghum. *Karnataka J. Agric. Sci.* **17(3):** 463-467.

Rao, M. R. and Patil, S. J. 1996. Variability and correlation studies in F2 population of kharif × rabi crosses of sorghum. *Karnataka J. Agric. Sci.* **9(1):** 78-84.

Wright, S. 1921. Systems of Mating. *Genetics*. **6:** 111-178.