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Variability studies on grain yield and yield attributes in sorghum germplasm [*Sorghum bicolor* (L.) Moench]

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Abstract
The study was undertaken to evaluate genetic variability, heritability and genetic advance as percent of mean among the 47 sorghum germplasm accessions for seven yield and yield attributes during 2015-16. The values of PCV were observed higher than the values of GCV for all the traits, indicating the environmental influence on the expression of these characters. High values of PCV and GCV were noted for plant height, grain yield (kg/ha) and dry fodder yield (kg/ha) implying high degree of variability in these traits among the genotypes under study. High heritability in addition to high GAM was observed for the traits *viz*., ear head length, plant height, grain yield (kg/ha) and 100-seed weight suggesting the functioning of additive gene action in the inheritance of these traits. Therefore, simple phenotypic selection is sufficient for improving these traits.

Keywords: PCV, GCV, heritability and genetic advance as percent of mean

Introduction
Sorghum [*Sorghum bicolor* (L.) Moench] is the 5th most important cereal crop grown in the world with chromosome number, 2n=20 and belongs to the family Poaceae. In India, it occupies 3rd place among the food grains after rice and wheat. It is an important crop of resource for poor, small and marginal farmers in arid and semi-arid regions. It has several economically important uses such as food, feed, fodder, fuel, and fiber (Laavanya *et al*., 2017) [7]. The basis for genetic advancement in any crop is systematic assessment of genetic variability and diversity available in the germplasm. More chance of heterotic groups is performed if diversity is broad and breeding for biotic and abiotic resistances will be productive (Elangovan and Babu, 2015) [3]. The extent of variability is measured by phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV), which provides the information about relative amount of variation in different characters. Since heritability is also influenced by environment, the information on heritability alone may not help in pin pointing the characters enforcing selection. Nevertheless, the heritability estimates in conjunction with the predicted genetic advance will be more reliable (Johnson *et al*., 1955) [6].

Materials and Methods
The field experiment was conducted during *kharif* (rainy season), 2015 at Agricultural research station, Podalakur, Nellore district in Randomized block design with 47 sorghum germplasm accessions to study the extent of genetic variability, heritability and genetic advance as percent of mean. Each genotype was planted in 4.5m row with 45 x 15cm spacing. The standard agronomic practices were followed throughout the crop growth period. The observations were noted on five randomly selected plants from each entry for the traits, days to 50% flowering, days to maturity, plant height (cm), ear head length (cm), 1000-seed weight (g), dry fodder yield (kg/ha) and grain yield (kg/ha). Analysis of variance for different characters was done as per standard statistical procedure given by Federer (1956) [4]. The current experiment was laid out comprising of 47 germplasm lines to determine the genetic variability and heritability for Grain yield and its attributes.

Results and Discussion
The analysis of variance revealed significant differences among 47 genotypes for all the characters under study except 100-seed weight, intimating the presence of high degree of genetic variability. The details related to analysis of variance for grain yield and its attributing characters are presented in table 1.

The PCV values were higher than GCV values for all the traits, suggesting the environmental influence on the expression of these traits but the difference between PCV and GCV estimates is very less for all the traits, thereby indicating very little environmental influence on the expression of these characters. High PCV and GCV values were observed for plant height, grain yield (kg/ha) and dry fodder yield (kg/ha) thereby denoting the presence of high quantum of variability for these traits. Similar results of high PCV and GCV values for grain yield per plant were reported by Badigannavar *et al*. (2017) [1]. Moderate PCV and GCV values were noticed for days to 50% flowering, ear head length and 100-seed weight which represents moderate variation thereby indicating moderate chance for selection of these traits among the genotypes under study. Similar results of moderate PCV and GCV values for days to 50% flowering were recorded by Badigannavar *et al*. (2017) [1] and Elangovan and Babu (2015) [3]. Low values of PCV and GCV were noticed for days to maturity that represents less quantum of variation for these traits. Similar results of low PCV and GCV values for days to maturity were observed by Usman and Adeyenju (2010) [9].

High heritability together with high GAM was obtained for the traits *viz*., ear head length, plant height, grain yield (kg/ha) and 100-seed weight indicating the functioning of additive gene action in controlling these traits. Hence, simple phenotypic selection is effective for improving these traits. Similar results of high heritability and high GAM for 100-seed weight and grain yield (kg/ha) were observed by Badigannavar *et al*. (2017) [1]. While the trait, days to 50% flowering exhibited high heritability associated with moderate additive gene actions hence further improvement of this trait would be easier through mass selection, progeny selection or any other modified selection procedure aiming to exploit additive gene action rather than simple phenotypic selection. Estimates of (Lush *et al*., 1940) [8], PCV and GCV (Burton *et al*., 1952) [2], heritability (Hanson *et al*,. 1956) [5] and genetic advance as percent of mean (Johnson *et al*., 1955) [6] for grain yield and quality characters in sorghum [*Sorghum bicolor* (L.) Moench are presented in table 2.

Table 1: Analysis of variance for the characters studied

Sl. No.	Character(s)	Mean sum of squares		
		Replications (df: 2)	Treatments (df: 46)	Error (df: 92)
1	Days to 50% flowering	66.4**	142.7**	14.7**
2	Days to maturity	79.6**	88.4**	22.0**
3	Plant height (cm)	7379.5**	5729.3**	235.1**
4	Ear head length (cm)	11.09**	49.4**	5.3**
5	100-seed weight (g)	0.3	0.1	0.05
6	Dry fodder yield (kg/ha)	506206.8**	25907712.1**	7125896.9**
7	Grain yield (kg/ha)	98453.2**	809841.1**	55177.6**

* Significant at 5% level
** Significant at 1% level

Table 2: Mean, Coefficient of variability, Heritability (broad sense), Genetic advance as per cent of mean for Seven characters of sorghum

Sl. No.	Character(s)	Mean	Range		Variance		Coefficient of Variation		Heritability (Broad sense) (%)	Genetic Advance as percent of mean (%)
			Min.	Max.	Genotypic	Phenotypic	Genotypic	Phenotypic		
1	Days to 50% flowering	55.62	43	71	42.7	57.4	11.7	13.6	74.4	20.9
2	Days to maturity	111.08	100	123	22.1	44.1	4.2	6.0	50.1	6.2
3	Plant height (cm)	189.10	80	269	1831.4	2066.5	23.0	24.4	88.6	44.6
4	Ear head length (cm)	20.90	9.3	28.3	14.7	20.1	18.4	21.5	73.2	32.4
5	1000-seed weight (g)	2.84	2.0	3.8	0.15	0.2	13.8	15.9	75.4	24.7
6	Dry fodder yield (kg/ha)	11917.31	4529.3	17644.3	6260605.0	13386502.0	21.0	30.7	46.8	29.6
7	Grain yield (kg/ha)	1812.60	1124.3	3356.3	251554.5	306732.2	27.7	30.5	82.0	51.6

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