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Assessment of Genetic Variability, Heritability and Genetic Advance for yield and Quality Attributes in Grain Sorghum

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ABSTRACT

Fifty sorghum genotypes were studied with objective of estimating the genetic variability, heritability and genetic advance for yield and quality attributes. The high PCV and GCV value observed for the characters *viz.,* plant height, panicle length, 1000 seed weight, fat content, fibre content, total phenol content, total antioxidant activity, free amino acid content and grain yield, whereas low for total carbohydrate content. High heritability coupled with high genetic advance was observed for all the characters studied except total carbohydrate content is suggesting the predominance of additive type of gene action in controlling these traits and simple selection would be sufficient for these traits to bring genetic improvement in desired direction.

Keywords: *Genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability, genetic advance and quality attributes.*

Sorghum [*Sorghum bicolor (L.) Moench*] is popularly called as jowar, is the "king of millets" and is the fifth in importance among the world's cereals in terms of production and utilization. It sustains the lives of the poorest rural people and often referred to as "coarse grain" or "poor people crop". It is cultivated in more than 100 countries, out of which 59 percent of world sorghum area is in Africa and 25 percent in Asia. Asia alone contributes to 45 percent of world sorghum production. Sorghum is the fourth most important cereal crop cultivated extensively in India after wheat, rice and maize due to its drought resistance and relatively low input costs. India stands second globally for the area under sorghum cultivation of 5.624 million hectares and its production of 4.56 million tonnes in 2017 (INDIASTAT, 2017).

Sorghum grain is gluten-free, a quite interesting characteristic for the consumers in Western countries, where different forms of gluten intolerance are spreading. Sorghum is an excellent source of energy, typically it contains 349 kcal, 10.4 g of protein, 1.9 g of fat and 72.6 g of carbohydrate, 2.4 g of crude fibre content and also has good amount of minerals particularly iron (4.1 mg/100g) and zinc (1.6 mg/100g). As sorghum is digested slowly it is an excellent health food for people suffering from diabetes in India.

Developing genotypes with high yield potential coupled with nutritionally superior quality grains is the prime objective of the breeding program. Crop improvement programs have become increasingly conscious of these factors that affect sorghum production and quality. Improvement in sorghum yield and quality mainly depends on the nature and extent of genetic variability, heritability and genetic advance in the base population.

Therefore, this study was conducted to determine the degree of genetic variability, heritability, genetic advance among sorghum genotypes for yield and quality traits.

MATERIAL AND METHODS

The study was conducted during *kharif* 2017 at Agricultural College farm, Bapatla. Fifty genotypes were grown in a Randomized Block design with two replications. The experimental unit was a four-row plot of 4 m long, spaced at 0.45 m apart and plant-to-plant distance of 0.15 m. The data was collected on 5 plants randomly selected plants for 5 yield related traits *viz*., days to 50% flowering, plant height, panicle length,1000 seed weight and grain yield and eight quality traits *viz.,* total carbohydrate content (g/100g), protein content (g/100g), fat content (g/100g), crude fibre content (g/100g), total phenol content (mg/100g), total antioxidant activity (mg/100g), free amino acid content (mg/100g), water absorption capacity (ml/100g). Sample from each entry were dried, cleaned, grounded and sieved. The fine flour was used for analysis of quality parameters at Biochemistry laboratory of AICRP on Post Harvest Engineering and Technology, Bapatla.

Total carbohydrate content was estimated by anthrone method (Hedge and Hofreiter, 1962), protein content by Lowry's method, (Lowry *et al.,* 1951), fat content using Soxhlet apparatus (Thimmaiah, 1999), crude fibre content as per Maynard (1970), total phenol content by Folin-Ciocalteau method (Malick and Singh, 1980), total antioxidant activity by DPPH method

Table 1. Mean, Range, Variance, Heritability and Genetic advance as percent of mean for 13 different character in 50 sorghum genotypes

Characters	Mean	Range		Coefficient of Variation (%)		Heritability broad sense (%)	Genetic advance as % of mean
		Minimum	Maximum	PCV (%)	GCV (%)		
Days to 50% flowering	79.00	55.00	96.00	12.18	11.68	91.90	23.03
Plant height (cm)	231.72	93.20	402.20	32.16	31.76	97.50	64.61
Panicle length (cm)	23.15	8.96	36.50	27.48	26.69	94.30	53.41
1000 seed weight (g)	29.66	19.35	41.60	21.01	20.23	92.70	40.15
Total carbohydrate content (g/100g)	68.69	55.55	72.27	5.30	3.46	42.60	4.66
Protein content (g/100g)	9.61	6.32	14.30	19.05	18.73	96.70	37.95
Fat content (g/100g)	2.54	1.13	4.55	30.40	27.87	83.30	52.10
Crude fibre content (g/100g)	2.12	1.19	3.22	33.35	29.11	76.00	52.21
Total phenol content (mg/100g)	74.46	31.96	198.10	73.20	60.62	67.90	101.53
Total antioxidant activity (mg AAE/100g)	54.37	16.96	107.94	60.45	53.77	79.10	98.30
Free amino acid content (mg/100g)	67.88	43.60	101.38	25.34	22.35	77.62	12.70
Water absorption capacity (ml/100g)	121.00	80.00	160.00	17.05	15.48	81.86	28.40
Grain yield per plant (g)	28.03	8.25	54.75	51.25	43.49	71.15	74.90

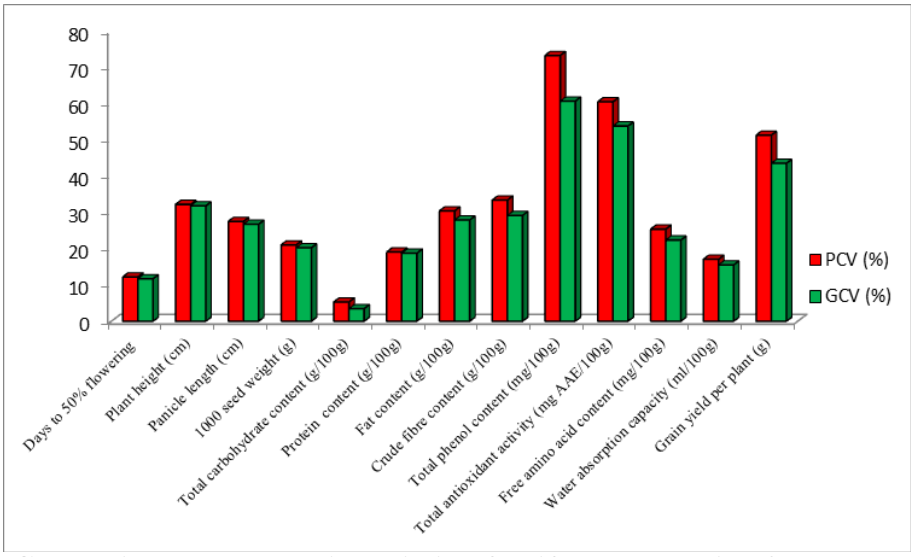

Fig. 1 Genotypic and phenotypic variation for 13 characters in 50 sorghum genotype

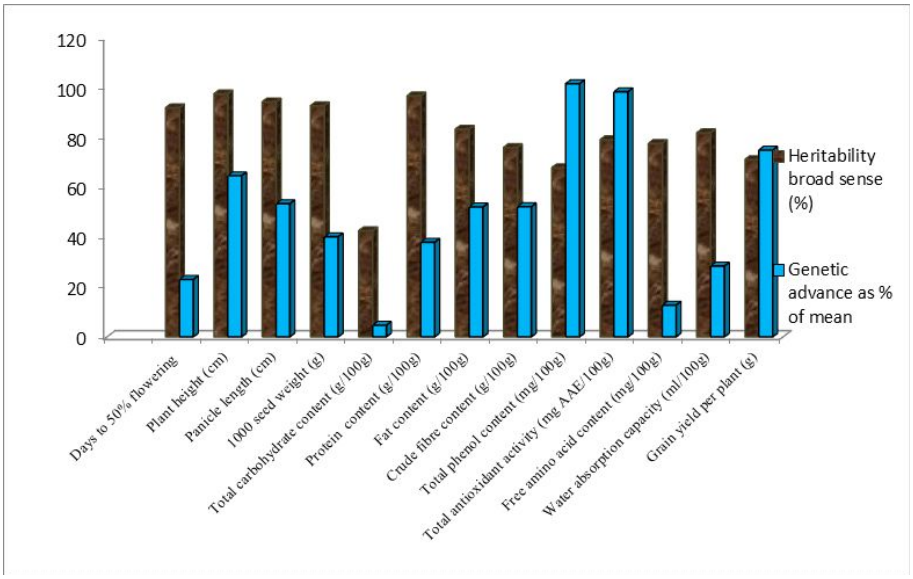

Fig. 2 Broad sense heritability and Genetic advance as percent mean for 13 characters in 50 sorghum genotype

(Liyana and Shahidi, 2005), free amino acid content by Ninhydrin method (Balasubramanian and Sadasivam, 1987) and water absorption capacity as per Sosulski *et al.* (1976).

The various genetic parameters *viz*., phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability (h2) and genetic advance as per cent of mean (GAM) were calculated as suggested by Burton and Devane (1953), Singh and Chaudhary (2010), Allard (1960), Johnson *et al*. (1955) respectively.

RESULTS AND DISCUSSION

Analysis of variance revealed highly significant differences among the genotypes studied for almost all the characters, indicating the presence of substantial amount of genetic variability. The variation due to replication was non-significant for all characters. The genotypic and phenotypic coefficient of variability, heritability and genetic advance revealed the variation for range was high in all the characters observed (Table 2, Fig 1, 2).

The trait plant height (93.2 - 402.2 cm) revealed highest range while, the minimum range was observed in case of crude fibre content (1.19 - 3.22 g/ 100g). The other parameters with high range of variation were days to 50% flowering (55.00 - 96.00), panicle length (8.96 - 36.50 cm), 1000 seed weight (19.35 - 41.60 g), total phenol content (31.96 - 198.10 mg/100g), total antioxidant activity (16.96 - 107.94 mg/ 100g), free amino acid contnet (43.60 - 101.38 mg/ 100g), water absorption capacity (80 -160 ml/100g) and grain yield per plant (8.25 - 54.75 g). Hence, a breeder can concentrate more on these traits which can provide ample scope for selection.

The PCV and GCV ranged from 5.30 to 73.2 % and 3.46 to 60.62 % respectively for various characters. Difference between GCV and PCV values for all the traits was very narrow indicating lesser influence of the environment on the expression of these traits.

The high PCV and GCV value observed for the characters *viz.,* plant height, panicle length, 1000 seed weight, fat content, fibre content, total phenol content, total antioxidant activity, free amino acid content and grain yield indicating that variation in the traits contributed markedly to the total variability. It indicated that there was greater scope for improvement in these traits either by direct selection among the collection of genotypes or by involving chosen parents in hybridization. Similar findings were observed by Badigannavar *et al*. (2017) and Bhagasara *et al*. (2017) for plant height, panicle length and grain yield per plant, Kassahun *et al*. (2017) and Ranjith *et al.* (2017) for 1000 seed weight.

Moderate PCV and GCV for days to 50 % flowering, protein content and water absorption capacity indicating that these were amenable for improvement. A similar result was reported by Badigannavar *et al*. (2017) for days to 50 % flowering.

Although, the GCV and PCV is indicative of the presence of high degree of genetic variation, the amount of heritable portion of variation can only be determined with the help of estimates of heritability and genetic gain. The broad sense heritability and genetic advance as percent of mean ranged from 42.6 to 97.5 % and 4.66 to 101.53 % respectively for the characters studied.

High heritability coupled with high genetic advance as percent of mean observed for days to 50 % flowering, plant height, panicle length, 1000- seed weight, protein content, fat content, crude fibre content, total phenol, total antioxidant activity, free amino acid content, water absorption capacity, grain yield per plant suggested predominance of additive type of gene action in controlling these traits and simple selection would be sufficient for these traits to bring genetic improvement in desired direction. Similar findings were observed by Sabiel *et al*. (2015) for days to 50 % flowering, Bhagasara *et al*. (2017) and Mohamad *et al*. (2017) for plant height, panicle length and grain yield, Bhagasara *et al*. (2017) and Ranjith *et al*. (2017) for 1000 seed weight and Govindaraj *et al*. (2011) in pearl millet for fat content and protein content.

Low PCV and GCV coupled with low heritability and genetic advance as percent of mean observed for total carbohydrate content indicated the character is highly influenced by environment hence, selection would be ineffective. A similar finding was reported by Usman and Adeyenju (2010).

CONCLUSION

The result of genetic parameter revealed that high PCV, GCV, high heritability coupled with high genetic advance was observed for characters *viz.,* plant height, panicle length, 1000 seed weight, fat content, fibre content, total phenol content, total antioxidant activity, free amino acid content and grain yield is suggesting the predominance of additive type of gene action in controlling these traits and simple selection would be sufficient for these traits to bring genetic improvement in desired direction.

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