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Genetic Variability, Heritability and Genetic Advance in Sweet Grain (*Hurda*) sorghum [*Sorghum bicolor* (L.) Moench]

H. V. Kalpande[1], A. W. More[2*], R. L. Aundhekar[2] and R. R. Dhutmal[2]

[1]Dept. of Agriculture Botany, Vasantrao Nauk Marathwada Krishi Vidyapeeth, Parbhani - 431 402, Maharashtra, India
[2]Sorghum Research Station, Vasantrao Nauk Marathwada Krishi Vidyapeeth, Parbhani - 431 402, Maharashtra, India
Corresponding author

Keywords

Sorghum, *Hurda* land races, GCV, PCV, Heritability, Genetic advance

A B S T R A C T

The experimental material for the present investigation comprised 24 sweet grain sorghum genotypes with 2 checks of *Sorghum bicolor* (L.) Moench. These 26 genotypes were grown at Sorghum Research Station, Vasantrao Naik Marathwada Agricultural University, Parbhani during rabi 2015-16 to evaluate sweet grain sorghum land races for grain yield and per cent threshable grains at dough (milky) stage. High GCV and PCV values were recorded for the traits % threshable grains, seed yield per plant, fodder yield, taste score, 100-seed weight, whereas, days to 50% flowering recorded low estimates of GCV and PCV. The PCV was relatively greater than GCV for all the traits; however, the magnitude of the difference was low. High degree of heritability estimates for most of the traits suggested that the characters were under genotypic control and selection could be fairly easy and improvement is possible using selection breeding for these traits. All of the characters except days to 50% flowering had high genetic advance as percent of mean in the current study. High heritability accompanied with high genetic advance was observed in case of plant height, % threshable grains, seed yield per plant 100-seed weight, fodder yield and taste score. This indicated that these traits were highly heritable and selection of high performing genotypes is possible to the improvement of the characters.

Introduction

Sorghum [*Sorghum bicolor* (L.) Moench] is the third most important grain crop in India next to rice and wheat (Jain *et al.,* 2014). Besides, as a food crop, it also provides nutritious fodder to live stocks. Thus improvement of sorghum is much emphasized owing to its importance as a food and fodder crop for many millions of people and cattle in Asia and Africa. Area under sorghum in India is 9.1 million hectare with 6.7 million tonnes of production and 783 kg productivity per hectare (e-stat 2014-15) and cultivated in both rainy and post rainy season. Rainy season sorghum is mainly used for industrial purposes due to quality deterioration by grain mold disease On the other hand, the sorghum that is harvested in the post-rainy season is of superior quality and used only for food. Sorghum is high in antioxidants and is gluten-free, providing a versatile product for individuals living with Celiac disease, which is intolerance to gluten, found in products like wheat, barley and rye.

Therefore now a day's sorghum is consumed in many alternative forms like roti, sorghum pops, flakes, papad, *hurda* (sweet grain sorghum) and other food products prepared from sorghum flour and *suji*. *hurda* (sweet grain sorghum at milky stage) is now being popularized in sorghum growing states and gaining more market price.

It is well established fact that the progress in improvement of a crop depends on the degree of variability for the desired character in the base material and the extent to which the desirable traits, are heritable. Indian sorghum possesses wide range of genetic variability.

However, there are only few germplasm lines available with special characters suitable for *hurda* purpose sorghum and very limited work is done to improve these traits which did not achieve an appreciable increase in their yielding ability. Although many Sorghum breeders have used traditional breeding methods successfully, genetic potentials have not been fully utilized.

The reason is the limited amount of genetic variability capitalized upon by traditional breeding methods (Flores *et al.,* 1986). Selection for yield is one of the most important and difficult challenge of plant breeding. Grafius *et al.,* (1976) indicated that individual yield components might contribute valuable information in breeding for yield. Johnson *et al.,* (1966) emphasized that increase in yield levels are progressively more difficult to be obtained and that evaluation of individual yield components might provide a better basis for progeny evaluation than yield itself. The present study was therefore undertaken to evaluate grain yield of sweet grain sorghum genotypes for using as parents for production of commercial hybrids.

Materials and Methods

The experimental material for the present investigation comprised 24 sweet grain sorghum genotypes with 2 checks of *Sorghum bicolor* (L.) Moench. These 26 genotypes were grown at Sorghum Research Station, Vasantrao Naik Marathwada Agricultural University, Parbhani during *rabi* 2015-16 with a spacing 45 cm x 15 cm. The experiment was laid out in randomized block design with two replications. Observations were recorded on five competitive plants in each genotype in each replication for days to 50 per cent flowering, plant height, % threshable grains (at dough stage), seed yield per plot (kg), 100-seed weight (g), fodder yield per plot (kg) and tender grain taste score (at dough stage). The mean values were used for statistical analysis. The data was analyzed statistically for genotype and phenotype coefficients of variation (Burton, 1952), Heritability (Allard, 1960) and genetic advance (Johnson *et al.*, 1955).

Results and Discussion

The analysis of variance revealed that the significant differences among genotypes for all characters, which indicated presence of variability among the lines being evaluated and ample scope of improvement by selection (Table 1). The range of variation and the estimate of genetic parameters which include heritability in broad sense, coefficient of variation (GCV and PCV) and genetic advance are presented in Table 2.

The range was highest for plant height (90.00-209.00 cm) followed by % threshable grains (3.0 to 98.15%), days to 50% flowering (69.50-82.00), tender grain taste score (0.00 to 9.00), fodder yield/plot (2.75-5.25 kg) followed by grain yield (0.54-2.00 kg) and test weight (1.99-3.88 g).

According to Deshmukh *et al.,* (1986), phenotypic coefficient of variance (PCV) and Genotypic Coefficient of Variation (GCV) can be categorized as low (<10%), moderate (10-20%) and high (>20%). Accordingly, high PCV values were recorded for % threshable grains, seed yield per plant, fodder yield, tender grain taste, 100-seed weight while traits with moderate PVC value was Plant height whereas, days to 50% flowering recorded low estimates of PCV. Considering GVC, % threshable grains, seed yield per plot, 100-seed weight, fodder yield and taste categorized as high, Plant height categorized as moderate and Days to 50% flowering as low. The PCV was relatively greater than GCV for the traits; however, the magnitude of the difference was low. This suggested that the marked influence of environmental factors for the phenotype expression of genotypes was low and the higher chance of improvement of these traits through selection based on the phenotype performance. High GCV and PCV values for grain yield were reported by Kumar and Singh (1986), Sharma *et al.,* (2006). However, low GCV and PCV for days to 50 per cent flowering was also reported by Mallinath *et al.,* (2004). The difference between PCV and GCV was relatively high for tender grain taste score (Table 2). This implies greater influence of environmental factors for the phenotypic expression of these characters that make difficult or practically impossible to exercise selection based on phenotypic performance of the genotypes to improve the characters.

According to Singh (2001), heritability of a trait is considered as very high or high when the values is 80% or more and moderate when it ranged from 40-80% and when it is less than 40%, it is low. Accordingly, high heritability was computed for all the traits under study (Table 2). High degree of heritability estimates for most of the traits suggested that the characters were under genotypic control and selection could be fairly easy and improvement is possible using selection breeding for these traits improvement. High estimates of heritability in broad sense were obtained for days to 50% flowering, plant height, seed yield and 1000- seed weight by Ali *et al.*, (2006), Kumer and Singh (1986) and Mahdy *et al.*, (1987).The parity of heritability values reported by different authors is due to heritability of a character was computed for different genotypes and refers to a particular population under particular environmental conditions (Dabholkar, 1992).

Genetic advance as percent mean ranged from 8.73% for days to 50% flowering to 92.21% for tender grain taste score. This result showed that selecting the top 5% of the genotypes could result in an improvement range of 8.73% for days to 50% flowering to 92.21% for taste. Deshmukh *et al.,* (1986) classified genetic advance as percent of mean as low (<10%), moderate (10-20%) and high (>20%). Based on this classification, all of the characters except for days to 50% flowering had high genetic advance as percent of mean in the current study. Moderate genetic advance as percent of mean was computed for days to 50% flowering. This refers to improvement of this character in genotypic value for the new population compared with the base population with one cycle of selection is not rewarding. Kumar *et al.,* (2013) also recorded nearly similar genetic advance for thousand kernel weight. It was suggested that the importance of considering both the genetic advance and heritability of traits rather than considering separately in determining how much can progress be made through selection (Johnson *et al.*, 1955).

Table.1 Mean sum of squares for characters in sorghum

Source	d.f.	Days to 50% flowering	Plant height	% threshable grains	Seed yield per plant	100-seed weight	Fodder yield	Tender grain Taste score
Replication	1	0.076	145.55	14.33	0.11	0.10	1.02	4.92
Treatment	25	627.07**	50292.94**	71937.92**	5.32**	15.05**	33.50**	248.07**
Error		72.92	912.94	429.47	0.54	0.83	2.00	39.07

Table.2 Parameters of genetic variability for yield and yield contributing characters in sorghum

Parameters	Range	Mean	Genotypic variance	Phenotypic variance	GCV	PCV	Heritability	Genetic advance	Expected genetic advance (%)
Days to 50% flowering	69.50-82.00	73.80	11.08	12.54	4.51	4.79	0.88	6.44	8.73
Plant height (cm)	90.00-209.00	162.17	987.60	1005.85	19.37	19.55	0.98	64.14	39.55
% threshable grains	3.00-98.15	51.17	1430.16	1438.75	73.89	74.11	0.99	77.67	151.76
Seed yield per plot (kg)	0.54-2.00	1.09	0.096	0.106	28.13	29.68	0.89	0.60	54.91
100-seed weight (g)	1.99-3.88	2.74	0.28	0.30	19.45	20.02	0.94	1.06	38.95
Fodder yield/ plot (kg)	2.75-5.25	3.90	0.63	0.67	20.30	20.93	0.94	0.84	40.55
Tender grain Taste score	0.00-9.00	4.19	4.18	4.96	48.76	53.13	0.84	3.86	92.21

In this study, high heritability accompanied with high genetic advance was observed in case of plant height, % threshable grains, seed yield per plant 100-seed weight, fodder yield and taste. This indicated that these traits were highly heritable and selection of high performing genotypes is possible to improve these characters. Most likely the heritability of these traits is due to additive gene effects and selection may be effective in early generations for these traits (Ali *et al.,* 2007). Likewise, Salman *et al.,* (2014) reported high and moderate heritability and genetic advance for days to flowering, and thousand kernel weight. Days to 50% flowering showed high heritability but, did not show equally high genetic advance. The characters with high heritability coupled with high genetic advance would respond to selection better than those with high heritability and low genetic advance.

On the basis of present investigation it may be concluded that selection based on % threshable grains, seed yield, tender grain taste score and fodder yield is effective as genotypic variance of these traits took relatively greater proportion of the total variance. Secondly, traits *viz*. plant height, % threshable grains, seed yield per plant 100-seed weight, fodder yield and tender grain taste score manifested high heritability coupled with high genetic advance hence these traits were highly heritable and selection of high performing genotypes is possible to the improvement of the characters.

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