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GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE FOR SEED QUALITY PARAMETERS IN SOME OF THE LAND RACES OF SORGHUM

V. V. KALPANDE*, P. A. KHADE, R. B. GHORADE, A. M. DANGE AND S. B. THAWARI
All India Coordinated Sorghum Improvement Project, Akola Centre,
Sorghum Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola - 444 001 (M.S.)
e-mail: vvvkalpande@rediffmail.com

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***Corresponding author**

ABSTRACT

Highest GCV was observed for threshed grain mold rating (38.97%) while lowest for the specific gravity of seed (1.66%). While for PCV, the highest value was recorded by one thousand seed weight (44.99%) while specific gravity of seed (2.00%) recorded the lowest value. The highest heritability estimate in broad sense was observed for threshed grain mold rating (99.08%) while the character 1000 seed weight (16.56%) recoded low heritability estimates. The highest values of expected genetic advance over mean was recorded for the characters threshed grain mold rating (79.90%) and lowest for specific gravity of seed (2.85%).The threshed grain mold rating and seed hardness exhibited high heritability along with high value of expected genetic advance per cent over mean which indicated the importance of these traits for selection. High value of heritability along with low value of expected genetic advance was observed for the characters like electrical germination percentage of seed, vigour index of seed and specific gravity of seed and heterosis breeding can be fruitfully exploited improving these characters.

INTRODUCTION

Sorghum is one of the important crops of dry land agriculture. In a systematic breeding programme, collection and evaluation of germplasm is the first step. The adequacy of germplasm collection is determined by the amount of genetic variability with their nature and magnitude in it. Variability is the prerequisite for the effective selection. The success of any crop improvement programme not only depends on the amount of genetic variability present in the population but also on the extent to which it is heritable, which sets the limit of progress that can be achieved through selection. Knowledge of heritability influences the choice of selection procedures used by the plant breeder to decide which selection methods would be most useful to improve the character, to predict gain from selection and to determine the relative importance of genetic effects (Narasimharao *et al.,* 1964). Characters with high heritability can easily be fixed with simple selection resulting in quick progress. However, it has been accentuated that heritability alone has no practical importance without genetic advance (Mallinath *et al.,* 2004). Genetic advance shows the degree of gain obtained in a character under a particular selection pressure. High genetic advance coupled with high heritability estimates offers the most suitable condition for selection. Mahdy *et al.* (2011) reported the limitation of estimating heritability in narrow sense, as it included both additive and epistatic gene effects and thereby suggested that heritability estimates in the broad sense will be reliable if accompanied by a high genetic advancement.

There is need to conserve and study the characteristics of land races and their further utilization in the breeding programme. Therefore the present study was undertaken with the objective to study the genetic parameters such as variance, coefficient of variation, heritability and genetic advance in the kharif sorghum land races.

MATERIALS AND METHODS

Ninety nine land races of kharif sorghum received from Directorate of Sorghum Research (DSR), Hyderabad were sown at Sorghum Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (MS) during kharif 2011-2012. Material was sown in randomized block design. Observations were recorded on the seven characters like seed hardness (kg/cm^2), threshed grain mold rating (%), specific gravity of seed (g/ml), germination percentage of seed, vigour index of seed, electrical conductivity (dsm^{-1}) and 1000 seed weight (g). Seed hardness was measured as the physical strength required in kg/cm^2 to break the kernel using kiya hardness tester. Grains of same moisture content were used for observations. Five kernels of each genotype were tested for their strength to break and mean was calculated and hardness is expressed in kg/cm^2.Electrical conductivity of the grain leachates was measured using the method of Hendricks and Tylorson (1976). Analysis of variance was done as per the method suggested by Panse and Sukhatme (1967). Genotypic and phenotypic coefficients of variation were estimated as per formulae given by Burton (1951). Heritability and genetic advance were estimated as per Johnson *et al.* (1955).

RESULTS AND DISCUSSION

The analysis of variance indicated highly significant differences among the genotypes for all the characters under study. High magnitude of variation in the experimental material was also reflected by wider range for all the characters under study (Table 1).

Seed hardness ranged from 4.03 to 10.13 kg/cm^2 (Table 1). Lowest seed hardness of 4.03 kg/cm^2 was observed in genotype EB-6 and highest seed hardness was exhibited by the genotype GGUB-57 (10.13 kg/cm^2). Threshed grain mold rating ranged from 3.06 to 11.36 %. The lowest rating of 3.06 % was recorded in genotype GGUB-57 and highest rating was recorded in genotype GGUB-21(11.36 %).Specific gravity of seed varied from 0.98 to1.08 g/ml. Minimum specific gravity of seed was shown by the genotype EA-10 (0.98 g/ml) and maximum specific gravity of seed was shown by the genotype GGUB-57(1.08 g/ml).Germination percentage of seed ranged from 71.50 to 86.00. Lowest germination was observed in the genotype GGUB-21 (71.50%) and the highest germination was observed in the genotype E-106 (86.00%).Vigour index of seed varied from 10.01 to 16.84. Minimum vigour index of seed was observed in the genotype GGUB-51 (10.01) and maximum vigour index of seed was observed in the genotype ERN-11 (16.84).Electrical conductivity ranged from 0.79 to 1.46 dsm^{-1}. Lowest electrical conductivity was observed in the genotype GGUB-21 (0.79 dsm^{-1}) and highest electrical conductivity was observed in the genotype GUB-29 (1.46 dsm^{-1}). One thousand seed weight varied from 14.75 g to 40.08 g. Minimum one thousand seed weight was observed in the genotype GGUB-34 (14.75g) and maximum one thousand seed weight was observed in the genotype E-163 (40.08 g).

The Genotypic coefficient of variation, phenotypic coefficient of variation, heritability in broad sense and expected genetic advance per cent over mean for various characters are presented in Table 2.

The genotypic coefficient of variation (GCV) ranged from 1.66 to 38.97 % for different character under study (Table 2). The highest order value of genotypic coefficient of variation was observed for threshed grain mold rating (38.97%) followed by seed hardness (26.78%), one thousand seed weight (17.94%),electrical conductivity (15.75%), vigour index of seed (11.23%), germination percentage of seed (4.30%) and specific gravity of seed (1.66%).

The phenotypic coefficient of variation (Table 2) ranged from 2.00 to 44.99 percent for various characters under study. Highest phenotypic coefficient of variation was observed for the character one thousand seed weight (44.99%) followed byThreshed Grain Mold Rating (39.15%),seed hardness (27.25%), plant height (20.20%), electrical conductivity (15.99%), vigour index of seed (13.07%), germination percentage of seed (4.64%) and specific gravity of seed (2.00%).

The characters threshed grain mold rating and seed hardness showed high GCV and PCV values indicating thereby large amount of variation for these characters. Low GCV and PCV values were found for the characters electrical conductivity, vigour index of seed, germination parentage of seed and specific gravity of seed indicating small amount of variation. For the character one thousand seed weight, moderate value of GCV along with high value of PCV was observed. For threshed grain mold rating similar results were obtained by Rathod (2005) and Deepalaxmi and Ganeshmurty (2007). For seed hardness Rathod (2005) recorded the similar results.Low GVC and PCV for electrical conductivity, germination percentage of seed and specific gravity of seedwere reported by Rathod (2005).The moderate values of GCV for 100 seed weight was reported by Arunkumar (2013).All the characters except the character 1000 seed weight showed close GCV and PCV values. The narrow differences between PCV and GCV suggested their relative resistance to the environmental

Table 1: Range, mean and the best genotype for different characters

SN	Character	Range	Mean	Best genotype
1	Seed hardness (kg/cm^2)	4.03 -10.13	7.08	GGUB-57
2	Threshed grain mold rating (%)	3.06 - 11.36	7.21	GGUB-57
3	Specific gravity of seed (g/ml)	0.98 -1.08	1.03	GGUB-57
4	Germination % of seed	71.50 – 86.00	78.75	E-106
5	Vigour index of seed	10.01-16.84	13.42	ERN-11
6	Electrical conductivity (dsm^{-1})	0.79 - 1.46	1.12	GGUB-21
7	1000 seed weight (g)	14.75-40.08	27.41	E-163

Table 2: Estimation of genetic parameters - GV, PV, GCV, PCV, h^2 and EGA

SN	Character	Genotypic variance	Phenotypic variance	Genotypic coefficient of variation	Phenotypic coefficient of variation	h^2 %	EGA as % over mean
1	Seed hardness (kg/cm^2)	3.517	3.643	26.78	27.25	96.53	54.19
2	Threshed grain mold rating (%)	5.599	5.561	38.97	39.15	99.08	79.90
3	Specific gravity of seed (g/ml)	0.0003	0.0004	1.66	2.00	69.28	2.85
4	Germination % of seed	11.446	15.150	4.30	4.64	75.56	7.70
5	Vigour index of seed	2.474	3.353	11.23	13.07	73.81	19.88
6	Electrical conductivity (dsm^{-1})	0.030	0.0316	15.75	15.95	97.08	31.97
7	1000 seed weight (g)	21.727	131.233	17.94	44.99	16.56	15.04

alterations. The high PCV along with low GCV for the character 1000 seed weight denoted the role of environment on the expression of this character.

With the genotypic coefficient of variation, it is difficult to determine the relative amounts of heritable and non heritable components of variation present in the population. Estimates of heritability and genetic advance would supplement this parameter. The heritability in broad sense ranged from 16.56 to 99.08 percent (Table 2). The high heritability estimate in broad sense was observed for threshed grain mold rating (99.08%) followed by electrical conductivity (97.08%), seed hardness (96.53%), germination percentage of seed (75.56%), vigour index of seed (73.81%) and specific gravity of seed (69.28%) (Table 2). These characters would respond positively to selection because of their high broad sense heritability. The character 1000 seed weight (16.56%) recoded low heritability estimates. High heritability estimates for threshed grain mold rating were reported by Rathod (2005) and Deepalaxmi and Ganeshmurty (2007). For characters electrical conductivity and seed hardness, high heritability estimates were reported by Rathod (2005). For the character germination percentage of seed, similar results were reported by Thorat *et al.* (2005). High heritability estimates in broad sense for the character specific gravity of seed, was reported by Rathod (2005) and Thorat *et al.* (2005).Dhutmal *et al.* (2014) reported moderate heritability for the character 1000 seed weight.

Expected genetic advance over mean ranged from 2.85 to 79.90% (Table 2). The high values of expected genetic advance over mean were recorded for the characters threshed grain mold rating (79.90%), seed hardness (54.19%) and electrical conductivity (31.97). Moderate values of expected genetic advance were recorded for vigour index seed (19.88%) and 1000 seed weight (15.04%). Whereas for the characters like specific gravity of seed (2.85%) and germination percentage of seed (7.70%) low expected genetic advance was observed. For the character threshed grain mold rating results were in conformity with results of Rathod (2005), Deepalaxmi and Ganeshmurty (2007) and Godbharle *et al.* (2010).For seed hardness similar high expected genetic advance was reported by Rathod (2005). Dhutmal (2014) reported similar moderate values of expected genetic advance for the character 1000 seed weight.

In general high heritability accompanied with high expected genetic advance for characters suggest that the genes governing these character may have additive effect. It can be mentioned here that characters threshed grain mold rating and seed hardness exhibited high heritability values along with high values of expected genetic advance. The phenotypic expression of these characters may be governed by the gene acting additively and thereby indicating the importance of these characters for selection. For threshed grain mold rating similar finding were reported by Godbharle *et al.* (2010) for high heritability estimates along with high values of expected genetic advance. For seed hardness similar findings were reported by Rathod (2005).

Moderate values of expected genetic advance percent over mean was observed for the character vigour index of seed (19.88) while low values for germination percentage of seed (7.70) and specific gravity of seed (2.85). For the character specific gravity of seed, similar results were reported by Rathod (2005) and Thorat *et al.* (2005).

High values of heritability along with low value of expected genetic advance were observed for the characters like germination percentage of seed, vigour index of seed and specific gravity of seed. Regarding these characters, the heritability is mainly due to non additive gene effect (dominance and epitasis) hence the expected genetic advance would be low. Since the characters are mainly governed by non additive component of variation which is non fixable, heterosis breeding can be fruitfully exploited improving these characters. Thorat *et al.* (2005) reported high value of heritability along with low value of expected genetic advance for specific gravity of seed.

REFERENCES

Arunkumar, B. 2013. Genetic variability, character association and path analysis studies in sorghum (Sorghum bicolar (L.) Moench). *The Bioscan*. **8(4):** 1485-1488.

Burton, G. W. 1951. Quantitative inheritance in pear millet. *Agron. J.* **43(9):** 409-417.

Deepalaxmi, A. J. and Ganeshmurthy, K. 2007. Studies on variability and character association in kharif sorghum. *Indian J. Agric. Res and Tech.* **41(3):** 177-182.

Dhutmal, R. R., Mehetre, S. P., More, A. W., Kalpande, H. V., Mundhe, A. G. and Sayyad Abu Bakar, A. J. 2014. Variability parameters in *rabi* sorghum drought tolerant genotypes. *The Ecoscan.* **VI:** 273-277.

Godbharle, A. R., MoreA. W. and AmbekarS.S. 2010. Genetic variability and correlation studies in elite 'B' and 'R' lines in kharif sorghum. *Electronic J. Plant Breeding.* **1(4):** 989-993.

Hendricks, S. B. and Taylorson, R. B. 1976. Variation in germination and amino acid linkage of seed with temperature related to membrane phase change. *Pl. Physiol.* **58(1):** 7-11.

Mahdy, E. E., Ali, M. A. and Mahmoud, A. M. 2011. The effect ofenvironment on combining ability and heterosis in grain sorghum(Sorghum bicolor L. Moench). *Asian J. Crop Science.* **3(1):** 1-15.

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

Narasimharao, D. V. and Rachie, K. O. 1964. Correlations andheritability of morphological characters in grain sorghum. *Madras Agric. J.* **51:** 156-161.

Johnson, H. W., Robinson, H. F. and Comstock, R. E.1 955. Estimate of genetic and environmental variability in Soybean. *Agron. J.* **47(6):** 314.

Panse, V. G. and Sukhatme, P. V. 1967. Statistical methods for Agri.workers. *ICAR Publication*, New Delhi.

Rathod, S. T. 2005. Evaluation of grain mold tolerant derived sorghum genotypes. *M.Sc. Thesis (Unpub.) Dr. PDKV,* Akola.

Thorat, S. T., Bhongle, S. A., Bhongle S. A. and Dudhe, M. Y. 2005. Genetic variability studies in some grain mold tolerant sorghum genotypes. *PKV Res. J.* **29(1):** 66-68.