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GENETIC VARIABILITY AND HERITABILITY STUDIES IN *RABI* SORGHUM DROUGHT TOLERANT GENOTYPES

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ABSTRACT

The present study was conducted to assess genetic variability, heritability and genetic advance for grain yield and its component characters in 16 drought tolerant germplasm of rabi sorghum aimed at improving grain yield under moisture deficit condition at sorghum Research Station, Parbhani during rabi 2012. Results revealed that the leaf dry weight (26.19 g), seed vigor (22.45), stem dry weight (17.20 g), panicle dry weight (17.12 g), grain yield / plant (13.98 g), and total biomass / plant (13.60 g) exhibited high to moderate genotypic coefficient of variation. The high estimates of heritability in broad sense were observed for days to 50 % flowering (97.30), stem dry weight (93.60 g), days to physiological maturity (93.50) panicle dry weight (92.70 g), total biomass (92.9), leaf dry weight (89.00), SCMR (88.20), 1000 grain weight (81.8), grain yield (80.40) and plant height (0.62). The highest value of expected genetic advance, expressed as per cent of mean was obtained for leaf dry weight (65.25), stem dry weight (43.95), panicle dry weight (43.53), grain yield (33.12), total biomass (34.61) and seed vigor (32.53). High heritability coupled with high genetic advance and high GCV were observed for grain yield, leaf dry weight, stem dry weight, panicle weight and total biomass and SCMR indicating that these characters are controlled by additive gene action.

Key words: *Rabi* sorghum, variability, heritability, expected genetic advance, GCV and PCV

INTRODUCTION

Sorghum, the fifth most important crop, is the dietary staple of people of Maharashtra. In Maharashtra, *rabi* sorghum productivity is low due to cultivation of crop on residual soil moisture. Plant breeding and introducing drought resistant varieties as well as improvement of drought resistance mechanisms will be useful to solve this problem. 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). Estimates of heritability in broad sense and genetic advance will help in knowing the nature of gene action affecting the concerned trait. According to Narasimharao *et al.* (1964) 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. House (1985) suggested the predictive role to indicate the reliability of phenotypic value as a guide to breeding value, as the most important function of heritability in genetic studies of quantitative character. 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). 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. 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. Considering above points the present investigation was conducted aiming to assess the range of variability, heritability and genetic advance in *rabi* sorghum genotypes under moisture deficit condition.

MATERIALS AND METHODS

This study was conducted at the Experimental Farm of Sorgum Research Station, Vasantrao Nike Marthwada Krishi Viyaapeeth, Pabhani, during *rabi* season of 2012. The breeding materials used in this study comprised of 16 advanced breeding lines for post flowering drought tolerance of *post rainy* sorghum (*Sorghum bicolor* L.), available with Sorghum Breeder, Sorghum Research Station, Parbhani. The experimental material was cultivated in randomized block deign with three replications. Each genotype had 6 rows of 4 m length with 45 cm row to row and 15 cm plant to plant spacing. The recommended cultural practices were adopted for raising the good crop. The observations were

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recorded for 12 different characters on five randomly selected plants for each genotype in each replication, except early vigor which was recorded on population basis. Data were collected on plant stand, plant height (cm), seed vigor , days 50% flowering, days to physiological maturity, total number of leaves per plant, leaf dry weight per plant at physiological maturity , stem dry weight per plant at physiological maturity, panicle dry weight per plant at physiological maturity, relative water content (%), SCMR at 50% flowering, total biomass per plant (at physiological maturity), 1000 grain weight, grain yield per plant. leaves, panicle and stem were separated from 5 randomly selected plants from each entry, were sun-dried and weighed by electronic balance again to record air-dry weight. The replication wise mean values of the genotypes were subjected to analyses. Phenotypic and genotypic coefficients of variation were calculated according to Burton (1952). Heritability and expected genetic advance were estimated according to Burton (1952), the estimates of direct and indirect contribution of various characteristics to seed yield were calculated through path coefficient analysis as suggested by Wright (1921) and elaborated by Dewey and Lu (1959).

RESULTS AND DISCUSSION

Analysis of variance (Table 1) revealed significant differences among the genotypes for all characters studied. PCVs were slightly higher than GCVs for all the characters, suggesting the least influence of environment in the expression of these characters (Table 2). Similar results have also been reported by Wankhede *et al.* (1985) and Dhutmal *et al.* (2014). Since most of the economic characters (grain yield) are complex in inheritance and are greatly influenced by several genes interacting with various environmental conditions. The study of phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) is not only useful for comparing the relative amount of phenotypic and genotypic variations among different traits but also very useful to estimate the scope for improvement by selection as the differences between genotypic and phenotypic coefficient of variability indicate the environmental influence.

The GCV ranged from 2.867 to 26.20 per cent and PCV from 4.74 to 40.93 per cent. Lower value of GCV generally depicts low variability among the tested sample. It was observed that the leaf dry weight (26.19 g), seed vigor (22.45), stem dry weight (17.20 g), panicle dry weight per plant (17.12 g), grain yield per plant (13.98 g), and total biomass per plant (13.60 g) exhibited high to moderate genotypic coefficient of variation. However low genotypic coefficients of variation were observed for days to 50 % flowering (7.73), test weight (7.62), plant height (6.21), days to physiological maturity (4.58), SCMR (8.90), relative water content (3.75) and leaves per plant (2.86). On the other hand, phenotypic coefficient of variation also exhibited similar trend of high, moderate and low variations with slightly higher values (Ambekar et *al.* 2000 and Dhutmal *et al.* 2014).The differences between GCV and PCV were found to be less for all the traits except plant stand. The high values of GCV and PCV for grain yield and total biomass suggested that there was a possibility of improvement of grain and fodder yield through direct selection. The estimates of GCV and PCV alone were not much helpful in determining the heritable portion. The amount of advance to be expected from selection can be achieved by estimating heritability along with coefficient of variability. Burton (1952) also suggested that GCV and heritability estimate would give better information about the efficiency of selection.

The heritability, which is a ratio of genotypic and phenotypic variance, is mainly due to the additive gene effects in narrow sense, but in the broad sense it includes both additive as well as non additive gene effects. The heritability values estimated in the present study are expressed in broad sense. Broad sense heritability, however gives only a rough estimate. If heritability was mainly due to additive effects, it would be associated with high genetic gain and if it is due to non-additive, genetic gain would be low (Panse, 1957). Results revealed that heritability in broad sense ranged from 11.10 for number of leaves to 97.30 for days to 50 % flowering. The estimates of heritability in broad sense were high for 50 % flowering (97.30), stem dry weight (93.60), days to physiological maturity (93.50) panicle dry weight (92.70), total biomass (92.9), leaf dry weight (89.00), SCMR (88.20), 1000 grain weight (81.8), grain yield (80.40) and plant height (0.62). Low heritability estimates were observed for seed vigor (30.10), relative water content (33.7) and number of leaves per plants (11.10). These findings are in agreement with those reported by Dhutmal *et al.* (2014). The high degree of heritability estimates for most of the traits suggested that the characters were under genotypic control. The highest value of expected genetic advance, expressed as per cent of mean was obtained for leaf dry weight per plant (65.25), stem dry weight per plant (43.95), panicle dry weight per plant (43.53), grain yield per plant

Table 1: Analysis of variance for quantitative characters

	df	Plant height (cm)	Seed vigor	Days 50% flowering	Days to physiol. maturity	Total number of leaves per plant	Leaf dry weight (g/plant)	Stem dry weight (g/plant)	Panicle dry weight (g/plant)	Relative water content (%)	SPAD at 50% flowering	Total biomass (g/plant)	1000 grain weight (g)	Grain yield (g/plant)
REP	2	323.29	0.54	2.17	2.00	2.04	72.0	1480.56	8619.42	7.44	19.0	11324.15	6.65	0.08
TRT	15	9785.15**	9.31**	1304.67**	1208.58**	12.81**	80343.48**	620689.97**	622600.75**	648.39**	939.10**	194957.52**	250.22**	20.10**
ERR	30	3230.04	8.13	23.83	54.67	18.63	6361.33	27714.08	31717.55	513.82	80.25	97329.85	34.49	0.31

Table 2: Variability, heritability and expected genetic advance for quantitative characters

	Range	GCV%	PCV%	Heritability	Expected Genetic Advanced
Plant height (cm)	241.33- 195.33	6.22	7.85	62.80	13.00
Seed vigor	1.0-3.0	22.46	40.93	30.10	32.53
Days 50% flowering	53-74.66	7.73	7.84	97.30	20.13
Days to physiological maturity	96.33-116.33	4.58	4.74	93.50	11.69
Total number of leaves per plant	9.0-10.0	2.87	8.59	11.10	2.53
Leaf dry weight (g/plant)	93-223.33	26.20	27.77	89.00	65.25
Stem dry weight (g/plant)	503.83-880.03	17.21	17.79	93.60	43.95
Panicle dry weight (g/plant)	872.91-419.20	17.12	17.78	92.70	43.53
Relative water content (%)	70.56-83.97	3.76	6.48	33.70	5.76
SPAD at 50% flowering	43.60-61.26	8.90	9.48	88.20	22.08
Total biomass (g/plant)	1041.867-1894.7500	13.60	14.12	92.90	34.61
1000 grain weight (g)	26.2367-34.3967	7.62	8.43	81.80	18.21
Grain yield (g/plant)	1.0533- 1.8333	13.99	15.60	80.40	33.12

characters showed moderate to low values of genetic advance as per cent of mean. Similar results were also reported by Dhutmal *et al.* (2014). High heritability coupled with high genetic advance and high GCV was observed for grain yield per plant, leaf dry weight per plant, stem dry weight per plant, panicle weight per plant and total biomass per plant and SCMR (Dhutmal *et al.* 2014) indicating that these characters are controlled by additive gene action and phenotypic selection for these characters will be effective (Rao and Patil 1996). These characters could be improved through pure line selection effectively.

From the present in investigation, it may be concluded that total ten characters namely, total biomass, grain yield, panicle dry weight, stem dry weight, plant height, SCMR at 50 % flowering, relative water content, days to 50% flowering, days to physiological maturity and leaf dry weight showed high heritability indicating these characters were less influenced by the environment. SCMR values at 50% flowering, days to physiological maturity and 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.

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