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# Genetic variability and drought tolerant studies in sorghum

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**SUMMARY**

Genetic variability and drought tolerant measures were worked out for fifteen characters in 100 genotypes of sorghum *(Sorghum bicolor* L.) of diverse origin. Based on mean performance and drought tolerance indices, the genotypes such as B35, CO21, CO22, AS5078, K3, Murungapatti local, VS1564, VS1560, AS6616, AS8038, Tenkasi1, MS7819, AS2059 AS8021 AS4289, CO24, AS2752, CO1 were found to be promising for drought. For all the characters studied, phenotypic co-efficient of variation (PCV) was higher than the genotypic co-efficient of variation (GCV) indicating the influence of environment on the expression of these traits. The characters *viz.*, stay green, root volume, leaf area index, plant height and harvest index showed high value for phenotypic and genotypic co-efficient of variation showed higher estimates of heritability and expected genetic gain indicating the presence of additive gene effect.

**Key words :** Sorghum, Genetic variability, Drought tolerance, Coefficient of variation.

Sorghum is one of the most important crops grown for food and feed. It is a dual purpose crop and is valued both for its grain as well as for its excellent fodder. It forms the major source of staple food among the rural population in Tamil Nadu. It is the crop suited to hot and dry ecologies where it is difficult to grow other food grains. Owing to its drought tolerance capacity, its cultivation in drought prone areas is effectively providing food and fodder through on sustainable basis. The potential of this low input demanding crop for diverse uses such as feed and biofuel crop besides as a supplier of raw materials for other industrial uses is anticipated to bring significant benefits to the farmers in the years to come. Hence, to meet out the need of sorghum based industries and to cater the basic requirement of the farming community, identification of genotypes with high, stable yields with drought tolerance capacity is essential. In the present investigation, a total of 100 sorghum germplasm accessions was screened for drought tolerance using drought tolerance indices and an attempt was made to study the genetic variability in germplasm accessions for biometrical traits in order to gather knowledge of yield and yield component characters towards drought tolerance in sorghum crop.

## MATERIALS AND METHODS

The present investigation comprised of 100 accessions of sorghum, which include local land races, adapted to different agroclimatic zones of Tamil Nadu. The trial was laid out in a randomized block design (RBD) with two replications under two different situations at Department of millets, Tamil Nadu Agricultural University, Coimbatore during 2006-2007. The first set was under irrigation and another set was treated as drought imposed. Water stress was imposed by with-holding irrigation at anthesis stage and continued till maturity. One set of treatments with normal irrigations from planting to maturity served as control. The drought indices like drought susceptibility index, relative yield, yield stability ratio were recorded for characterizing the drought tolerant genotypes. Observations on metric traits like plant height, days to 50% flowering, earhead length, leaf area index, relative water content, SPAD chlorophyll reading, root length, root volume, root dry weight, earhead weight, 1000 grain weight, biological weight, stay green score, harvest index and grain yield were recorded on single plant basis for five randomly selected competitive plants in each genotype from replication of each set separately. The genetic information has been sought through analysis of genetic variability, heritability in broad sense and genetic advance as per cent of mean was estimated according to Allard (1960). Phenotypic and genotypic co-efficient variation was estimated as per Burton (1952). Genetic advance as % of mean was estimated according to Johnson *et al.* (1955).

## RESULTS AND DISCUSSION

The mean, phenotypic ($\sigma^2p$) and genotypic variances, the co-efficient of phenotypic and genotypic variation, heritability and expected genetic advance are given in Table 1 and 2. The results furnished hereunder only for the stress condition. The analysis of variance for the

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various component traits of drought tolerance revealed significant differences among genotypes under study. Based on the mean performance, the genotypes such as CO 21, CO 22, Tenkasi 1, AS 2059, AS 2752, AS 5078, AS 5057, AS 8021, AS 4289, AS 8038, AS6616, K 3, MS 7819, MS 7837, Murungapatti local, Uppam cholam, VS 1564, VS 1560, CO 24 and CO 1 recorded good performance and had high mean values for relative water content, SPAD chlorophyll reading, root length, root volume, root dry weight, ear head weight, 1000 grain weight, harvest index, grain yielding and had low score for stay green when compared to other genotypes under stress and they have been reported at par with the drought resistant check, B 35. Earlier findings of Nour and Weible (1978), Blum *et al.* (1989) Jordan and Miller (1980), Xu *et al*. (2000), Dale *et al*. (1980) on phenotypic and physiological traits for drought resistance were in agreement with the present investigation.

Selection for drought tolerance involves evaluating genotypes for either high yield potential or stable performance under varying degrees of water stress. Drought susceptibility index (DSI) and relative yield (RY) values were used to describe the yield stability and yield potential. Promising drought tolerant genotypes identified through drought tolerance indices are given in Table 2. These genotypes had the low drought susceptibility index (<1) and high relative yield (> mean RY).

In general, the estimate of phenotypic co-efficient of variation was higher than those of genotypic co-efficient of variation for all the traits indicating the influence of environment on the expression of these characters (Table 1). The data further indicated that characters like stay green, root volume, leaf area index, plant height and harvest index showed high value for phenotypic and genotypic co-efficient of variation. High values of GCV for these characters suggest better scope of improvement by selection. Days to 50% flowering showed the lowest co-efficient of variation at phenotypic and genotypic levels. Similar results were

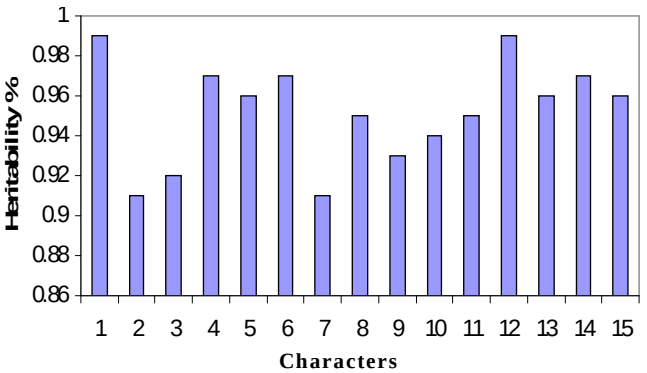
**Table 1 : Grand mean, range and genetic parameters for the drought tolerant component traits**

| Characters | | Grand mean | Range | $V_P$ | $V_g$ | PCV% | GCV% | Genetic advance |
|---|---|---|---|---|---|---|---|---|
| Plant height (cm) | S | 231.31 | 109.20 - 347.70 | 2718.94 | 2714.58 | 22.54 | 22.52 | 107.24 |
| | I | 238.41 | 114.5-358 | 2794.09 | 2789.74 | 22.17 | 22.15 | 108.72 |
| Days to 50%flowering | S | 66.35 | 58-74 | 9.53 | 8.68 | 4.65 | 4.44 | 5.79 |
| | I | 63.2 | 54-72 | 10.09 | 9.16 | 5.04 | 4.80 | 5.94 |
| Ear head length (cm) | S | 23.43 | 8.70-35 | 17.51 | 16.17 | 17.86 | 17.16 | 7.96 |
| | I | 27.03 | 13.5-37 | 14.27 | 12.75 | 13.98 | 13.21 | 6.95 |
| Leaf area index | S | 2.46 | 1-4.60 | 0.62 | 0.61 | 32.05 | 31.71 | 1.59 |
| | I | 3.04 | 1.3-5.3 | 0.69 | 0.68 | 27.46 | 27.19 | 1.69 |
| Relative water content% | S | 65.3 | 46.20-79 | 61.60 | 59.42 | 12.02 | 11.80 | 15.60 |
| SPAD Chlorophyll reading | S | 31.02 | 11-48.30 | 105.37 | 103.15 | 33.09 | 32.74 | 20.70 |
| | I | 45.06 | 30-58 | 43.38 | 41.68 | 14.61 | 14.32 | 13.03 |
| Root length (cm) | S | 24.91 | 9-39.0 | 31.39 | 28.76 | 22.49 | 21.52 | 10.57 |
| | I | 29.61 | 16.4-42.6 | 23.72 | 21.58 | 16.45 | 15.68 | 9.13 |
| Root volume (cc) | S | 21.61 | 8.40-37 | 47.63 | 45.28 | 31.93 | 31.13 | 13.51 |
| | I | 25.85 | 11.3-38 | 39.09 | 37.11 | 24.18 | 23.56 | 12.22 |
| Root dry weight (g) | S | 24 | 10.00-36 | 30.61 | 28.63 | 23.05 | 22.29 | 10.66 |
| | I | 25.82 | 12.4 -38 | 18.69 | 16.72 | 16.74 | 15.83 | 7.97 |
| Ear head weight (g) | S | 25.47 | 9.60-42.80 | 36.05 | 34.07 | 23.57 | 22.91 | 11.69 |
| | I | 32.36 | 17.3-45.0 | 24.62 | 22.50 | 15.33 | 14.65 | 9.33 |
| 1000grain weight (g) | S | 26 | 9.20-41 | 43.40 | 41.29 | 25.33 | 24.71 | 12.91 |
| | I | 29.06 | 16.1-42.6 | 27.48 | 25.38 | 18.03 | 17.33 | 9.97 |
| Biological yield (g) | S | 131.72 | 80-205.40 | 538.83 | 534.44 | 17.62 | 17.55 | 47.42 |
| | I | 141.97 | 91.3-218.6 | 563.35 | 556.94 | 16.72 | 16.62 | 48.33 |
| Stay green | S | 3.4 | 1.60-5 | 0.90 | 0.88 | 28.00 | 27.54 | 1.90 |
| | I | 2.32 | 1.3-4.3 | 0.54 | 0.52 | 31.84 | 30.96 | 1.44 |
| Harvest index | S | 0.24 | 0.09-0.43 | 0.004 | 0.004 | 28.06 | 27.67 | 0.14 |
| | I | 0.29 | 0.2-0.5 | 0.003 | 0.003 | 21.35 | 20.74 | 0.12 |
| Grain yield (g) | S | 31.02 | 16-46 | 54.00 | 51.89 | 23.69 | 23.22 | 14.54 |
| | I | 40.43 | 26.6-56.1 | 38.13 | 34.90 | 15.27 | 14.61 | 11.64 |

(I- Irrigated, S-Stress)

**Table 2 : Promising drought tolerant genotypes**

| Sr. No. | Genotypes | DSI | RY |
|---|---|---|---|
| 1. | B35 | 0.48 | 0.91 |
| 2. | CO21 | 0.44 | 0.95 |
| 3. | CO22 | 0.40 | 0.92 |
| 4. | AS5078 | 0.40 | 0.97 |
| 5. | K3 | 0.94 | 0.96 |
| 6. | Murungapatti local | 0.81 | 0.93 |
| 7. | VS1564 | 0.42 | 0.96 |
| 8. | VS1560 | 0.92 | 0.94 |
| 9. | AS6616 | 0.66 | 0.91 |
| 10. | AS8038 | 0.58 | 0.94 |
| 11. | Tenkasi1 | 0.64 | 1.00 |
| 12. | MS7819 | 0.62 | 0.96 |
| 13. | AS2059 | 0.87 | 0.93 |
| 14. | AS8021 | 0.55 | 0.94 |
| 15. | AS4289 | 0.21 | 0.93 |
| 16. | CO24 | 0.78 | 1.00 |
| 17. | AS2752 | 0.49 | 0.95 |
| 18. | CO1 | 0.72 | 0.82 |

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|---|---|---|---|
| 1 | Plant height (cm) | 9 | Root dry weight (g) |
| 2 | Days to 50%flowering | 10 | Ear head weight (g) |
| 3 | Ear head length (cm) | 11 | 1000grain weight (g) |
| 4 | Leaf area index | 12 | Biological yield (g) |
| 5 | Relative water content% | 13 | Stay green |
| 6 | SPAD Chlorophyll reading | 14 | Harvest index |
| 7 | Root length (cm) | 15 | Grain yield (g) |
| 8 | Root volume (cc) | | |

**Fig. 1 : Heritability estimate for drought tolerance component traits under stress**

reported for theses traits with respect to PCV and GCV (Geleta and Daba, 2005).

programme.All the characters under study exhibited high heritability and expected genetic advance. Among the characters studied, high estimates of heritability (>80%) and genetic advance expected (>40%) were obtained for stay green, leaf area index, plant height, root volume and harvest index. These characters exhibited high heritability along with high genotypic co-efficient of variation indicating importance of additive genetic variance for these characters. The character days to 50% flowering recorded the lowest heritability estimate indicating larger influence of environmental conditions on these characters.

Based on above discussion, it is suggested that due weightage should be given to stay green, leaf area index, root volume, plant height and harvest index for selection of drought tolerance in sorghum. The genotypes such as B35, CO21, CO22, AS5078, K3, Murungapatti local, VS1564, VS1560, AS6616, AS8038, Tenkasi1, MS7819, AS2059 AS8021 AS4289, CO24, AS2752, CO1 were found to be promising for drought and can be used as the parents for future breeding programmes, where the sorghum varietal improvement for drought conditions could be achieved.

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