

COMPONENT ANALYSIS FOR GRAIN YIELD IN SORGHUM

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Variability and path coefficient analysis were carried out in 170 germplasm lines of sorghum. The study revealed high estimates of genotypic coefficient of variation (GCV), heritability and genetic gain for plant height, stover yield, leaf area, flag leaf area, peduncle length and harvest index. Grain yield/plant showed positive and significant association with plant height, flag leaf area, panicle weight, panicle girth, number of primaries and whorls of primaries per panicle. Characters like panicle weight, panicle girth and days to 50% flowering revealed higher positive direct effect on grain yield in path coefficient analysis.

Key words : Sorghum, germplasm, variability

Sorghum (*Sorghum bicolor* (L.) Moench), locally known as jowar is grown as food, feed and fodder crop. Since last few years the yield level of sorghum varieties have stagnated. Variability in the population, especially for the characters where improvement is sought for, is important for successful crop improvement programme, whereas character association and path coefficient analysis helps in indirect selection for the trait. Although reports on evaluation of the germplasm of sorghum are quite frequent in literature, yet an attempt has been made in the present study to evaluate the exotic germplasm of different eco-geographic sources for genetic variability in some agro-morphological traits.

MATERIAL AND METHODS

The experimental material comprised 170 accessions (including 158 exotic and 12 indigenous) obtained from ICRISAT and five standard checks *viz.*, CSH-9, CSV-10, CSV-13,

SPV-96 and SPH-468. In all 175 germplasm lines were grown in an Augmented Complete Randomized Block Design at the experimental field of Rajasthan College of Agriculture, Udaipur. Each entry was grown in single row plot of 4m long spaced 45 cm apart. Plant to plant distance was maintained at 10 cm. Observations were recorded on five randomly selected plants for sixteen different traits and were used to compute the analysis of variance and covariance as prescribed by Federer (1956). Path coefficient analysis was carried out according to Dewey and Lu (1959).

RESULTS AND DISCUSSION

Analysis of variance revealed significant variability for all the characters studied. The highest percentage of Phenotypic Coefficient of Variation (PCV) (61.18) and Genotypic co-efficient of variation (GCV) (60.39) were observed for stover yield per plant while these were lowest (5.17 and 4.99) for days to maturity (Table 1). The heritability in broad sense was highest for days

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Table 1. Estimates of genetic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability (H), genetic advance (GA) and genetic gain (GG) for different characters studied in Sorghum (*Sorghum bicolor* (L.) Moench)

| S.No. | Character | GCV | PCV | H(%) | GA | GG |
|-------|---|------|------|------|--------|-------|
| 1. | Days to 50 per cent flowering | 12.5 | 12.6 | 98.1 | 16.1 | 25.6 |
| 2. | Days to maturity | 5.0 | 5.2 | 92.9 | 9.9 | 9.9 |
| 3. | Plant height (cm) | 25.2 | 25.7 | 95.8 | 112.9 | 50.7 |
| 4. | Number of leaves per plant | 16.5 | 17.3 | 90.7 | 3.8 | 32.4 |
| 5. | Leaf area per plant (cm ²) | 31.3 | 33.2 | 89.0 | 2627.2 | 60.2 |
| 6. | Flag leaf area per plant (cm ²) | 33.3 | 36.0 | 85.1 | 1054.4 | 63.2 |
| 7. | Peduncle length (cm) | 27.4 | 29.7 | 85.1 | 19.2 | 52.0 |
| 8. | Panicle length (cm) | 21.0 | 22.9 | 84.2 | 6.7 | 39.7 |
| 9. | Panicle girth (cm) | 17.9 | 20.6 | 75.4 | 3.5 | 32.0 |
| 10. | Panicle weight (g) | 37.7 | 43.6 | 75.1 | 19.2 | 67.4 |
| 11. | Number of primaries per panicle | 22.1 | 25.5 | 75.4 | 20.2 | 39.6 |
| 12. | Number of whorls of primaries per panicle | 13.7 | 18.4 | 55.2 | 2.1 | 21.0 |
| 13. | Stover yield per plant (g) | 60.4 | 61.2 | 97.4 | 112.5 | 112.8 |
| 14. | Harvest index | 39.3 | 42.7 | 84.8 | 15.6 | 74.5 |
| 15. | 500-grain weight (g) | 17.4 | 19.0 | 83.7 | 4.0 | 32.9 |
| 16. | Grain yield per plant (g) | 38.9 | 47.4 | 67.4 | 14.4 | 65.8 |

to 50 per cent flowering (98.14%) followed by stover yield per plant, plant height days to maturity and number of leaves per plant. Number of whorls of primaries per panicle recorded lowest estimate of heritability (55.17%). The estimate of genetic gain ranged from 9.91 per cent for days to maturity to 122.79 per cent for stover yield per plant. To formulate an efficient breeding programme, heritability along with genetic gain should be considered (Johnson *et al.*, 1955). In the present study, plant height, stover yield, leaf area, flag leaf area, peduncle length and harvest index showed high GCV, high heritability and high genetic gain. Hence selection based on these traits would be more effective for their improvement.

Grain yield per plant showed positive and significant correlation with plant height, flag leaf area, panicle weight, panicle girth, number of

whorls of primaries and number of primaries per panicle (Table 2). Mutual correlations among traits panicle weight, panicle girth, stover yield and grain yield per plant were positive and significant. It suggests that simultaneous selection for these characters should have a better efficiency for improving the grain yield. Patil *et al.*, (1990) and Cheralu and Rao (1989) also reported similar results for panicle height and number of primaries per panicle.

Path coefficient analysis indicate that out of six traits which were positively correlated with grain yield, only three traits *viz.*, panicle weight, panicle girth and days to 50 per cent flowering had positive and high direct effects (Table 3). Borikar *et al.*, (1985) and Patil *et al.*, (1990) observed higher direct effect of panicle weight while, Sisodia *et al.*, (1982) noticed maximum direct influence due to panicle girth on yield.

Table 2. Genotypic (rg) and phenotypic (rp) correlation coefficient between different characters studied in Sorghum (*Sorghum bicolor* (L.) Moench)

| S. No. | Name of variety (Entry) | Days to maturity (cms) | Plant height (cms) | No. of leaves/plant | Leaf area per plant (cm ²) | Flag leaf area/plant (cm ²) | Peduncle length (cms) | Panicle length (cms) | Panicle girth (cms) | Panicle weight (gms) | No. of primaries/panicle | No. of whorls of primaries/panicle | Stover yield per plant (gms) | Harvest index | 500-grain weight (gms) |
|--------|---|------------------------|--------------------|---------------------|--|---|-----------------------|----------------------|---------------------|----------------------|--------------------------|------------------------------------|------------------------------|---------------|------------------------|
| 1. | Days of 50% flowering | rg 0.82 | rp 0.17 | 0.92 | 0.79 | 0.55 | -0.66 | -0.08 | 0.18 | 0.14 | 0.08 | 0.4 | -0.54 | 0.04 | 0.09 |
| 2. | Days to maturity | rg 0.79 | rp 0.17 | 0.86 | 0.74 | 0.50 | -0.61 | -0.07 | 0.15 | 0.11 | 0.07 | 0.45 | -0.50 | 0.03 | 0.07 |
| 3. | Plant height (cm) | rg | rp | 0.76 | 0.68 | 0.42 | -0.55 | 0.08 | 0.09 | 0.17 | 0.09 | 0.25 | 0.25 | 0.45 | -0.46 |
| 4. | Number of leaves per plant | rg | rp | 0.68 | 0.60 | 0.36 | -0.48 | 0.06 | 0.08 | 0.1 | 0.03 | 0.14 | 0.14 | 0.42 | -0.40 |
| 5. | Leaf area per plant (cm ²) | rg | rp | 0.29 | 0.35 | 0.34 | -0.12 | -0.02 | 0.44 | 0.43 | 0.46 | 0.31 | 0.51 | -0.38 | 0.46 |
| 6. | Flag leaf area per plant (cm ²) | rg | rp | 0.28 | 0.35 | 0.35 | -0.07 | 0.04 | 0.43 | 0.41 | 0.43 | 0.28 | 0.5 | 0.31 | 0.41 |
| 7. | Peduncle length (cm) | rg | rp | 0.87 | 0.85 | 0.73 | -0.69 | -0.19 | 0.40 | 0.29 | 0.17 | 0.071 | 0.54 | -0.60 | 0.19 |
| 8. | Panicle length (cm) | rg | rp | 0.82 | 0.85 | 0.70 | -0.64 | -0.12 | 0.39 | 0.32 | 0.022 | 0.13 | 0.52 | -0.48 | 0.14 |
| 9. | Panicle girth (cm) | rg | rp | 0.81 | 0.85 | 0.82 | -0.62 | -0.09 | 0.51 | 0.46 | 0.32 | 0.21 | 0.56 | -0.51 | 0.17 |
| 10. | Panicle weight (gms) | rg | rp | -0.55 | 0.79 | 0.81 | -0.54 | 0.02 | 0.50 | 0.48 | 0.34 | 0.25 | 0.54 | -0.37 | 0.14 |
| 11. | Number of primaries per panicle | rg | rp | -0.43 | 0.79 | -0.43 | 0.07 | 0.55 | 0.57 | 0.32 | 0.29 | 0.44 | -0.39 | 0.30 | 0.46 |
| 12. | Number of whorls of primaries per panicle | rg | rp | 0.47 | 0.79 | 0.47 | 0.47 | -0.58 | -0.26 | -0.26 | 0.03 | 0.42 | -0.24 | 0.16 | 0.50 |
| 13. | Stover yield per plant (g) | rg | rp | 0.47 | 0.79 | 0.47 | 0.47 | -0.41 | -0.15 | -0.19 | 0.06 | -0.37 | 0.40 | 0.06 | -0.08 |
| 14. | Harvest index | rg | rp | -0.54 | 0.79 | -0.54 | 0.04 | -0.54 | -0.54 | 0.04 | -0.12 | 0.38 | -0.01 | 0.17 | -0.14 |
| 15. | 500-grain weight (g) | rg | rp | -0.28 | 0.79 | -0.28 | 0.18 | -0.28 | -0.28 | 0.18 | 0.00 | 0.35 | 0.03 | 0.23 | -0.11 |
| | | rg | rp | 0.77 | 0.78 | 0.77 | 0.78 | 0.77 | 0.78 | 0.77 | 0.65 | 0.39 | 0.30 | -0.10 | 0.22 |
| | | rg | rp | 0.51 | 0.48 | 0.51 | 0.48 | 0.51 | 0.48 | 0.51 | 0.58 | 0.30 | 0.30 | 0.03 | 0.19 |
| | | rg | rp | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.51 | 0.54 | 0.23 | 0.19 | 0.22 |
| | | rg | rp | 0.55 | 0.56 | 0.55 | 0.56 | 0.55 | 0.56 | 0.55 | 0.43 | 0.43 | 0.24 | 0.28 | 0.17 |
| | | rg | rp | 0.56 | 0.56 | 0.56 | 0.56 | 0.56 | 0.56 | 0.56 | 0.55 | 0.55 | 0.24 | -0.06 | 0.26 |
| | | rg | rp | 0.15 | 0.13 | 0.15 | 0.13 | 0.15 | 0.13 | 0.15 | 0.56 | 0.56 | 0.24 | 0.01 | 0.19 |
| | | rg | rp | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.15 | 0.15 | 0.15 | -0.02 | 0.06 |
| | | rg | rp | -0.61 | 0.17 | -0.61 | 0.17 | -0.61 | 0.17 | -0.61 | 0.15 | 0.13 | 0.15 | -0.02 | 0.06 |
| | | rg | rp | -0.55 | 0.17 | -0.55 | 0.17 | -0.55 | 0.17 | -0.55 | 0.17 | 0.17 | 0.17 | -0.55 | 0.17 |
| | | rg | rp | -0.14 | 0.25 | -0.14 | 0.25 | -0.14 | 0.25 | -0.14 | 0.25 | 0.25 | 0.25 | -0.14 | 0.25 |
| | | rg | rp | -0.13 | 0.35 | -0.13 | 0.35 | -0.13 | 0.35 | -0.13 | 0.35 | 0.35 | 0.35 | -0.13 | 0.35 |
| | | rg | rp | 0.27 | 0.20 | 0.27 | 0.20 | 0.27 | 0.20 | 0.27 | 0.27 | 0.27 | 0.27 | 0.27 | 0.20 |

*Significant at 5%; **Significant at 1%

Table 3. Path coefficient analysis indicating direct and indirect effects of various components on seed yield in sorghum (*Sorghum bicolor* (L.) Moench)

| S. No. | Character | Days to 50% flowering | Days to maturity | Plant height (cm) | Num-ber of leaves per plant | Leaf area per plant (cm ²) | Flag leaf area per plant (cm ²) | Panicle length (cm) | Panicle girth (cm) | Panicle weight (g) | Num-ber of primaries per panicle | Num-ber of whorls per panicle | Stover yield per plant (g) | Harvest index | 500-grain weight (g) | Correlati-on with grain yield per plant | |
|--------|---|-----------------------|------------------|-------------------|-----------------------------|--|---|---------------------|--------------------|--------------------|----------------------------------|-------------------------------|----------------------------|---------------|----------------------|---|--------|
| 1. | Days to 50% flowering | 0.428 | 0.140 | 0.014 | -0.465 | -0.138 | 0.055 | -0.083 | -0.004 | 0.048 | 0.132 | -0.007 | -0.003 | -0.018 | 0.000 | 0.004 | 0.094 |
| 2. | Days to maturity | 0.353 | 0.170 | 0.011 | -0.385 | -0.118 | 0.0548 | -0.069 | 0.005 | 0.023 | 0.157 | -0.008 | -0.021 | -0.018 | 0.000 | 0.003 | 0.137 |
| 3. | Plant height (cm) | 0.73 | 0.023 | 0.082 | -0.145 | -0.061 | 0.0295 | -0.019 | -0.001 | 0.113 | 0.394 | -0.042 | -0.026 | -0.021 | 0.000 | 0.051 | 0.455 |
| 4. | Number of Leaves per plant | 0.395 | 0.130 | 0.023 | -0.505 | -0.152 | 0.00 | -0.086 | -0.011 | 0.106 | 0.278 | -0.016 | -0.006 | -0.022 | 0.000 | 0.022 | 0.216 |
| 5. | Leaf area per plant (cm ²) | 0.39 | 0.115 | 0.029 | -0.442 | -0.174 | 0.079 | 0.078 | -0.005 | 0.135 | 0.436 | -0.029 | -0.018 | -0.023 | 0.000 | 0.019 | 0.373 |
| 6. | Flag leaf area per plant (cm ²) | 0.234 | 0.072 | -0.369 | -0.144 | 0.024 | -0.09 | -0.002 | 0.148 | 0.523 | -0.028 | -0.025 | -0.025 | -0.018 | 0.000 | 0.023 | 0.459 |
| 7. | Peduncle length (cm) | -0.284 | -0.094 | -0.090 | 0.349 | 0.108 | -0.055 | 0.125 | 0.026 | -0.152 | 0.244 | 0.023 | -0.003 | 0.017 | -0.000 | 0.003 | -0.180 |
| 8. | Panicle length (cm) | -0.033 | 0.04 | -0.090 | 0.099 | 0.015 | -0.033 | 0.059 | 0.056 | 0.143 | 0.034 | 0.011 | -0.033 | 0.000 | 0.000 | -0.015 | 0.062 |
| 9. | Panicle girth (cm) | 0.08 | 0.015 | 0.035 | -0.203 | -0.089 | 0.045 | -0.072 | -0.029 | 0.264 | 0.72 | -0.059 | -0.046 | -0.012 | 0.000 | 0.024 | 0.692 |
| 10. | Panicle weight (g) | 0.060 | 0.025 | 0.034 | -0.148 | -0.080 | 0.045 | -0.032 | 0.002 | 0.204 | 0.945 | -0.049 | -0.046 | -0.009 | 0.000 | 0.024 | 0.979 |
| 11. | Number of primaries per panicle | 0.033 | 0.015 | 0.038 | -0.087 | -0.056 | 0.025 | 0.032 | -0.007 | 0.172 | 0.486 | -0.091 | -0.047 | -0.047 | 0.000 | 0.029 | 0.468 |
| 12. | Number of whorls of primaries per panicle | 0.012 | 0.042 | 0.026 | -0.036 | -0.037 | 0.023 | 0.004 | 0.021 | 0.103 | 0.514 | -0.050 | -0.085 | -0.006 | 0.000 | 0.027 | 0.562 |
| 13. | Stover yield per plant (g) | 0.197 | 0.077 | 0.042 | -0.272 | -0.097 | 0.036 | -0.052 | -0.000 | 0.081 | 0.219 | -0.022 | -0.013 | -0.041 | 0.000 | 0.019 | 0.174 |
| 14. | Harvest index | -0.231 | -0.079 | -0.031 | 0.306 | 0.089 | -0.032 | 0.053 | 0.009 | -0.027 | 0.178 | 0.005 | 0.002 | 0.025 | -0.000 | -0.015 | 0.250 |
| 15. | 500-grain weight (g) | 0.016 | 0.004 | 0.038 | -0.106 | -0.039 | 0.016 | 0.003 | -0.007 | 0.058 | 0.209 | -0.024 | 0.021 | 0.007 | 0.000 | 0.111 | -0.269 |

Residual effect = 0.1203; Figures in under line indicated direct effect

*Significant at 5%; **Significant at 1%

Plant height, yield, leaf area, peduncle length and harvest index, revealed high GCV, h^2 and genetic gain also showed positive and significant correlation with grain yield. Hence, selection for the traits would be more effective to improve grain yield. Panicle weight, panicle girth and days to 50 per cent flowering showed high direct effect on grain yield. Therefore, more importance should be given for the selection of these attributes to identify better genotypes for high grain yield in sorghum.

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