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# Evaluation of Groundnut (*Arachis hypogaea* L.) Genotypes for Multiple Diseases Resistance

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**ABSTRACT**

The present investigation was carried out to study the reaction to multiple diseases (*Aspergillus* seed colonization, late leaf spot and rust) and their yield potential in 18 groundnut genotypes. Significant variation existed among the genotypes, and between seasons with genotype × season interaction for diseases, yield and yield related parameters. The high heritability with high genetic advance was observed for diseases and test weight. *Aspergillus* seed colonization had highly significant desirable negative association with test weight. Popular cultivars TMV 2, JL 24 and TAG 24 were susceptible to all the three diseases whereas GPBD 4 was resistant to foliar diseases. Germplasm lines *viz*., ICGV 86699, ICG 8760 and ICG 13787 exhibited moderate to high level of resistance to all the three diseases but possessed undesirable agronomic features indicating a need for improvement through hybridization.

**Key words :** *Aspergillus*, Colonization, Groundnut, Late leaf spot, Rust, Test weight.

Groundnut (*Arachis hypogaea* L.) is largely a smallholder crop grown under rainfed conditions in semi-arid tropics, where several diseases affect it. Late Leaf Spot (*Phaeoisariopsis personata*) and Rust (*Puccinia arachidis*) are the most destructive diseases normally occur together and can cause yield losses up to 70 per cent (Subrahamanyam *et al.*, 1980). Aflatoxin contamination caused by *Aspergillus flavus* is another serious quality problem which makes the produce unfit for consumption and is a major obstacle in the export. As a result, identification of groundnut genotypes carrying multiple diseases resistance with high yield potential helps in the sustainable cultivation of groundnut.

## MATERIAL AND METHODS

The material used for the study comprised of eighteen diverse groundnut genotypes *viz.,* released cultivars (TG 41, TGLPS 3, M 28-2, GPBD 4, TAG 24, JL 24, TMV 2 and J 11), breeding lines (GPBD 5, GPBD 6, TG 19 and TG 49) and germplasm lines (ICG 14985, ICG 8760, ICG 13787, ICG 6027, ICGV 86155 and ICGV 86699). These genotypes were screened under *in vitro* condition for reaction to *Aspergillus* seed colonization and also subjected to field evaluation to study their response to other foliar fungal diseases (late leafspot and rust) and productive traits during rainy and post rainy(2007) seasons. The pure culture of *A. flavus* strain Af 11-4, a highly aggressive and toxigenic strain was used for *in vitro* seed colonization following the procedure and 1-4 seed colonization severity scale of Thakur *et al*. (2000). The experimental materials were sown in Randomized Complete Block Design (RCBD) with two replications during rainy 2006 and post rainy 2007, at Botanical garden of University of Agricultural Sciences, Dharwad. Seeds of each entry were grown in three rows, each 2.25 m long, spaced 30 cm apart and 10 cm plant-to-plant distance was maintained. All the recommended package of practices for groundnut cultivation for respective seasons was adopted. The modified 9- point scale for rust and late leaf spot (Subbarao *et al.,* 1990) was used for screening genotypes in the field. The yield and yield components namely hundred kernel weight, shelling percentage and SMK were recorded and the data were analyzed using software SPAR.

## RESULTS AND DISCUSSION

Analysis of variance indicated significant differences among the genotypes, seasons and genotype × season interaction for all the characters except shelling percentage due to season, indicating wide genetic variability among the genotypes with significant influence of environment (Table 1). The mean, range, phenotypic and genotypic coefficients of variation, heritability and genetic advance are presented in Table 2. All the three diseases *viz., Aspergillus* seed colonization, LLS and rust showed high PCV and GCV estimates. Whereas yield traits

Table 1. Analysis of variance for productive parameters and disease reactions in groundnut

| Source | D.F. | Pod yield (kg/ha) | Pod yield / plant (g) | Kernel yield / plant (g) | Test weight (g) | Shelling percentage | Sound mature kernel (%) | *A. flavus* score (1-4 scale) | Late leaf spot(1-9 scale) | Rust (1-9 scale) |
|---|---|---|---|---|---|---|---|---|---|---|
| Season (S) | 1.00 | 922176.00** | 149.41** | 75.07** | 678.70** | 13.47 | 880.25** | 0.02** | 82.35** | 1.68* |
| Genotype (G) | 17.00 | 844400.94** | 16.26** | 11.51** | 456.21** | 68.65** | 52.06** | 6.06** | 14.02** | 10.30* |
| G x S | 17.00 | 301415.53** | 15.29** | 10.07** | 76.62** | 68.88** | 91.38** | 0.01** | 2.32** | 1.80* |
| Error | 34.00 | 178682.35 | 1.86 | 1.07 | 13.20 | 7.36 | 20.38 | 0.02 | 0.19 | 0.24 |

*, **: Significant at 5% and 1% level of probability, respectively

Table 2. Components of variation for different traits over two seasons in groundnut germplasm.

| Character | MEAN | RANGE | GCV | PCV | H (%) | GAM |
|---|---|---|---|---|---|---|
| Pod yield (kg/ha) | 2392.58 | 1626.00 – 3254.00 | 15.40 | 23.44 | 43.20 | 20.84 |
| Test weight (g) | 52.95 | 35.66 – 74.42 | 18.40 | 19.63 | 87.80 | 35.50 |
| Shelling percentage (%) | 68.63 | 57.24 – 74.68 | 0.05 | 3.95 | 0.00 | 0.00 |
| Sound mature kernel percentage (%) | 87.15 | 80.00 – 93.31 | 0.04 | 5.18 | 0.00 | 0.00 |
| *A. flavus* score (1 - 4 scale) | 2.10 | 1.00 – 4.00 | 58.71 | 59.07 | 98.80 | 120.00 |
| Late leaf spot (1 - 9 scale) | 5.07 | 2.00 – 8.00 | 33.75 | 34.81 | 94.00 | 67.46 |
| Rust (1 - 9 scale) | 5.88 | 2.00 – 7.50 | 24.82 | 26.18 | 89.90 | 48.51 |

GCV – Genotypic Coefficient of Variation; PCV – Phenotypic Coefficient of Variation;
H (%) – Estimate of broad sense heritability GAM – Genetic advance as percent of mean

*viz.,* pod yield and test weight also showed moderate to high magnitude of variation coupled with moderate to high heritability and genetic advance. This suggests that the selection based on these characters would facilitate successful isolation of desirable genotypes. Shelling percentage and sound mature kernel (%) on other hand exhibited large difference between PCV and GCV indicating higher environmental influence. It was also confirmed by the estimates of heritability and genetic advance.

Coefficients of correlation (Table 3) indicated a desirable negative association between *Aspergillus* seed colonization and test weight while it was undesirable and positive between *Aspergillus* seed colonization and shelling percentage during rainy season, revealing that the resistant genotypes in general had higher seed size but lower shelling outturn. Late leaf spot showed positive association with rust indicating that many genotypes were either resistant or susceptible to both the diseases. Shelling percentage and sound mature kernel also showed positive association with pod yield in post rainy season indicating the possibility of simultaneous improvement in these productivity traits.

The mean performance of genotypes for productive traits and disease reaction revealed that TG 19 (1), TG 49 (1), ICG 8760 (1), ICG 14985 (1.08), ICG 6027 (1.10), ICG 13787 (1.11) and ICGV 86699 (1.20) had high level of resistance to *in vitro* seed colonization by *A. flavus* (IVSCAF) confirming the observations of Harish Babu *et al.,* (2005) and Yugandhar (2005) (Table 4). GPBD 6 (1.35), TG 41 (1.38) and M 28-2 (1.48) were the other genotypes that were superior followed by TGLPS 3 (2.03), ICGV 86155 (2.10) and GPBD-5 (2.25) showing moderate level of resistance. Among them GPBD 6, ICG 6027 and M 28-2 had resistance to late leaf spot coupled with high test weight, sound mature kernel (%) and pod yield. The popular cultivars TMV 2, JL 24 and TAG 24 were susceptible to all the three diseases but, GPBD 4 had shown resistance to LLS and rust

Table 3. Phenotypic correlation coefficients among yield attributes and disease resistance traits in groundnut pooled over two seasons

| Characters | Pod yield (kg/ha) | Test weight (g) | Shelling percentage | Sound mature kernel percentage | *A. flavus* score (1-4 scale) | Late leaf spot(1-9 scale) | Rust (1-9 scale) |
|---|---|---|---|---|---|---|---|
| Pod yield / plant (g) | 1.00 | -0.32 | -0.01 | -0.42 | 0.25 | -0.20 | 0.19 |
| Test weight (g) | 0.29 | 1.00 | -0.23 | 0.44 | -0.76** | -0.25 | 0.10 |
| Shelling percentage | 0.47* | 0.05 | 1.00 | 0.35 | 0.56* | 0.16 | -0.04 |
| Sound mature kernel percentage | 0.51* | 0.03 | 0.96** | 1.00 | -0.21 | -0.10 | -0.04 |
| *A. flavus* score (1 - 4 scale) | 0.20 | 0.66** | 0.38 | 0.40 | 1.00 | 0.33 | 0.11 |
| Late leaf spot (1 - 9 scale) | 0.01 | 0.20 | 0.17 | 0.20 | 0.08 | 1.00 | 0.20 |
| Rust (1 - 9 scale) | 0.07 | 0.16 | 0.26 | 0.26 | 0.10 | 0.78** | 1.00 |

Below diagonal – Post-rainy season, Above diagonal – Rainy season
*, ** indicate the significance of 5% and 1% level of probability, respectively

Table 4. Mean performance of genotypes for productive parameters and disease reaction over two seasons.

| Sl. No | Genotype | Pod yield (Kg/ha) | Test weight (g) | Shelling percentage | Sound mature kernel (%) | IVSCAF | Rust | Late leaf spot |
|---|---|---|---|---|---|---|---|---|
| 1 | ICG 14985 | 1821$^{fg}$ | 53.06$^{de}$ | 70.54$^{ad}$ | 92.06$^{ab}$ | 1.08$^{g}$ | 5.00$^{f}$ | 4.75$^{f}$ |
| 2 | ICG 8760 | 1626$^{c}$ | 59.27$^{dc}$ | 57.24$^{c}$ | 85.38$^{d-c}$ | 1.00$^{g}$ | 4.25$^{c}$ | 4.75$^{f}$ |
| 3 | ICG 13787 | 1630$^{g}$ | 51.59$^{de}$ | 62.83$^{f}$ | 87.74$^{ad}$ | 1.11$^{g}$ | 4.00$^{g}$ | 4.25$^{fg}$ |
| 4 | ICG 6027 | 1962$^{e-g}$ | 62.02$^{b}$ | 67.10$^{de}$ | 89.48$^{a-c}$ | 1.10$^{g}$ | 5.50$^{ef}$ | 2.00$^{k}$ |
| 5 | ICGV 86155 | 2582$^{b-d}$ | 48.97$^{ef}$ | 65.45$^{ef}$ | 80.00$^{c}$ | 2.10$^{cd}$ | 7.25$^{ab}$ | 4.75$^{f}$ |
| 6 | ICGV 86699 | 2376$^{c-f}$ | 48.44$^{ef}$ | 66.64$^{d-f}$ | 83.26$^{c-e}$ | 1.20$^{fg}$ | 2.00$^{i}$ | 2.75$^{j}$ |
| 7 | GPBD 5 | 3254$^{a}$ | 58.93$^{bc}$ | 72.85$^{a-c}$ | 88.53$^{a-d}$ | 2.25$^{c}$ | 6.25$^{de}$ | 3.75$^{gh}$ |
| 8 | GPBD 6 | 2894$^{a-c}$ | 72.04$^{a}$ | 67.96$^{df}$ | 91.78$^{ab}$ | 1.35$^{cf}$ | 6.00$^{de}$ | 2.75$^{j}$ |
| 9 | TG 19 | 2336$^{c-f}$ | 74.42$^{a}$ | 68.97$^{c-e}$ | 84.93$^{be}$ | 1.00$^{c}$ | 7.25$^{ab}$ | 7.25$^{bc}$ |
| 10 | TG 49 | 2683$^{a-d}$ | 56.75$^{b-d}$ | 69.25$^{b-e}$ | 89.42$^{a-c}$ | 1.00$^{g}$ | 7.00$^{a-c}$ | 7.25$^{de}$ |
| 11 | TG 41 | 2318$^{c-f}$ | 59.02$^{bc}$ | 68.09$^{de}$ | 85.41$^{b-e}$ | 1.38$^{c-f}$ | 7.00$^{a-c}$ | 7.50$^{ab}$ |
| 12 | TGLPS 3 | 2637$^{b-d}$ | 55.47$^{cd}$ | 67.53$^{de}$ | 81.37$^{de}$ | 2.03$^{d}$ | 7.50$^{a}$ | 6.75$^{e}$ |
| 13 | M 28-2 | 2524$^{c-e}$ | 51.62$^{df}$ | 68.98$^{c-e}$ | 90.26$^{a-c}$ | 1.45$^{f}$ | 7.00$^{a-c}$ | 3.50$^{hi}$ |
| 14 | GPBD 4 | 3160$^{ab}$ | 40.41$^{hi}$ | 73.62$^{ab}$ | 86.14$^{a-e}$ | 4.00$^{a}$ | 3.00$^{h}$ | 3.00$^{ij}$ |
| 15 | TAG 24 | 2224$^{d-g}$ | 45.80$^{fg}$ | 73.29$^{a-c}$ | 93.31$^{a}$ | 4.00$^{a}$ | 7.00$^{ac}$ | 8.00$^{a}$ |
| 16 | JL 24 | 2583$^{b-d}$ | 41.90$^{gh}$ | 70.20$^{b-d}$ | 86.91$^{ae}$ | 3.70$^{b}$ | 7.00$^{a-c}$ | 6.00$^{e}$ |
| 17 | TMV 2# | 2245$^{d-f}$ | 38.06$^{hi}$ | 70.12$^{bd}$ | 85.34$^{b-f}$ | 4.00$^{a}$ | 6.25$^{c-e}$ | 6.25$^{de}$ |
| 18 | J 11## | 2213$^{d-g}$ | 35.66$^{i}$ | 74.68$^{a}$ | 87.44$^{a-c}$ | 3.95$^{a}$ | 6.50$^{b-d}$ | 6.00$^{c}$ |
| | GM | 2393 | 52.95 | 68.63 | 87.15 | 2.10 | 5.88 | 5.07 |
| | CV | 18 | 6.90 | 4.00 | 5.2 | 6.50 | 8.30 | 8.50 |
| | CD 5% | 631 | 5.40 | 4.00 | 6.7 | 0.20 | 0.70 | 0.60 |

# - Susceptible check ## - Resistant check
Values followed by same letter do not differ at 5% level of probability

along with high yield potential and there is a need to incorporate resistance to *Aspergillus* seed colonization for better exploitation of this cultivar. Among the germplasm ICGV 86699, ICG 8760 and ICG 13787 showed moderate to high level of resistance to all the three diseases but possessed some undesirable agronomic features *viz.,* late maturity (>120 days) and poor shelling out turn with many undesirable pod and kernel features, thus limiting their direct use in cultivation. These genotypes could however, be exploited for incorporation of resistance into agronomically superior background.

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