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# GENETIC VARIABILITY USING PHENOTYPIC AND GENOTYPIC VARIABLES SIMULTANEOUSLY IN GROUNDNUT (*ARACHIS HYPOGAEA* L.)

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**ABSTRACT**
Studies on genetic variability parameters were carried out in groundnut genotypes at the Instructional Farm, CTAE, MPUAT, Udaipur, Rajasthan, India during kharif 2014-15 various traits. The experimental material consisting of 90 genotypes and three standard checks *viz.,*TG37A, PM-2 and UG-5 was raised in Augmented Design. The mean sum of squares due to genotypes was highly significant for all the characters studied, except 100-kernel weight and biological yield per plant. Higher estimates of GCV were observed for dormancy (20.18 %), kernel yield per plant (18.58 %), number of mature pods per plant (18.40 %) and dry pods yield per plant (17.50 %). However, maximum heritability was found for protein content (92.74 %) followed by oil content (92.17 %). While, maximum genetic gain was observed for dormancy (36.62 %) followed by kernel yield per plant (34.99 %). Kernel yield per plant (83.54), Dry Pod yield per plant (82.94) and Number of mature pods per plant (71.59) expressed high heritability coupled with high genetic advance as per cent of mean. This indicates that genetic variances for these traits are probably owing to their high additive gene effects and thus there is better scope for improvement of these traits through direct selection.

## INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is a self-pollinated, annual, herbaceous, allotetraploid legume with 2n = 40 chromosomes and belongs to the family Fabaceae (Patil *et al.,* 2014). The low production and productivity of groundnut in India is due to seasonal variability, low amount of rainfall, poor soil moisture conservation, poor stand resulting from lack of pest control and low yield potential genotypes. Different methods could be used to increase groundnut productivity, such as effective cultural practices and using improved cultivars. The concept of heritability explains whether differences observed among individuals arose as a result of differences in genetic makeup or due to environmental forces. Genetic variability gives an idea of possible improvement of new population through selections, when compared to the original population (Raikwar *et al.,* 2014).

One of the most important objectives of any breeding program is to produce high-yielding and better-quality lines. The prerequisite to achieve this goal is to find sufficient amount of genetic variability, in which desired lines are to be isolated for further breeding programme to achieve the target. Development of high-yielding cultivars requires a thorough knowledge of the existing genetic variation for yield and its components. The observed variability is a combined estimate of genetic and environmental causes, of which only the former one is heritable. The genetic variability is determined with the help of certain genetic parameters viz. genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV) and heritability estimates. For predicting the effect of selection, heritability estimates along with genetic advance are more useful than the heritability estimates alone (Cholin *et al.,* 2010; Shinde *et al.,* 2010 and Meshram *et al.,* 2013). The present investigation was carried with objective to estimate the variability parameters for yield and its component traits in groundnut genotypes and this study will be helpful for harnessing present variability among them which in turn can support the ongoing and future groundnut breeding programs.

## MATERIALS AND METHODS

The present investigation was carried out in Groundnut (*Arachis hypogaea L.*) during *kharif*, 2014 at the Instructional Farm, College of Technology and Engineering (CTAE), Maharana Pratap University of Agriculture and Technology, Udaipur. Geographically, Udaipur is situated at an elevation of 582.17 meter above the mean sea level on latitude of 24º 34′ North and longitude of 73º 42′ East. The experimental material consisted of 90 diverse genotypes along with 3 checks (Table 1) were sown in six blocks in Augmented Design. Each genotype was accommodated in a one row plot of 5.0 m length with a spacing of 30 cm between rows and 10 cm between plants. The fertilizer in the experimental area was applied at the rate of 20 kg N $ha^{-1}$ and 60 kg P $ha^{-1}$ as it is a recommended dose for kharif cultivation of groundnut in the region. Estimation of oil content and protein content were done as per method suggested by Soxhlet's Ether Extraction method developed by A.O.A.C. (1965) and Micro kjeldahl's

method given by Lindner (1944), respectively. Observations for all fifteen traits (days to 50% flowering, days to maturity, plant height, number of branches per plant, number of mature pods per plant, dry pod yield per plant, shelling percentage, 100-kernel weight, sound mature kernel, biological yield per plant, kernel yield per plant, harvest index, dormancy, oil content and protein content) were recorded on five randomly selected competitive plants of each entry in each replication except for days to 50% flowering and dormancy. The analysis of variance for different characters in augmented RBD was done method suggested by Federer (1956), GCV and PCV by the Burton (1952), Heritability ($h^2$) by Burton and Devane (1953) and Genetic gain (genetic advance as per cent over mean) by Johnson *et al*. (1955).

## RESULTS AND DISCUSSION

The mean sum of squares due to genotypes were highly

**Table 1: List of genotypes used in the present study and their pedigree**

| S.No. | Name of Genotypes | Pedigree | Palace |
|---|---|---|---|
| 1 | UG-3 | Selection from ICGV98281 | ICRISAT, Hyderabad |
| 2 | UG-4 | Selection from ICGV98221 | ICRISAT, Hyderabad |
| 3 | UG-6 | ICGV93373 X ICGV92224 | ICRISAT, Hyderabad |
| 4 | UG-9 | ICGV95322 X ICGV96398 | ICRISAT, Hyderabad |
| 5 | UG-10 | ICGV93124 X ( LI X ICGS44) | ICRISAT, Hyderabad |
| 6 | UG-15 | ICGV93134 X ( LI X ICGS44) | ICRISAT, Hyderabad |
| 7 | UG-16 | ICGV93143 X ( LI X ICGS44) | ICRISAT, Hyderabad |
| 8 | UG-17 | GAJAH X (NU X ICGS44) X (LI X ICGS44) | ICRISAT, Hyderabad |
| 9 | UG-19 | [{(ICGV86347 X ICGV8031) X JL-24} X Gajah X (NU X ICGV87883)] | ICRISAT, Hyderabad |
| 10 | UG-20 | (ICGV2411 X ICG7637) X Gajah x ICGV | ICRISAT, Hyderabad |
| 11 | UG-21 | (TAG-24 X ICG8666) | ICRISAT, Hyderabad |
| 12 | UG-22 | (ICGV87290 x ICGV87846) | ICRISAT, Hyderabad |
| 13 | UG-24 | (ICGV87290 X TAG-24) | ICRISAT, Hyderabad |
| 14 | UG-56 | B-95 X HPS20-2 | DGR, Junagadh |
| 15 | UG-57 | BAU-13 X SEL12-2 | ICRISAT, Hyderabad |
| 16 | UG-59 | GG-20 X Kadiri-3 | ICRISAT, Hyderabad |
| 17 | UG-60 | ICGV86031 X TAG-24 | DGR, Junagadh |
| 18 | UG-61 | GG-20 X Chico2 | DGR, Junagadh |
| 19 | UG-62 | PBS20176 X NRCG48291 | DGR, Junagadh |
| 20 | UG-64 | (EDRGVT X ICGV03056) | ICRISAT, Hyderabad |
| 21 | UG-65 | (EDRGVT X ICGV03206) | ICRISAT, Hyderabad |
| 22 | UG-67 | B95 X Giri-1 | DGR, Junagadh |
| 23 | UG-68 | PBS20176 X NRCG4829-1 | DGR, Junagadh |
| 24 | UG-69 | P95 X GG-2 | DGR, Junagadh |
| 25 | UG-71 | GG-2 X JCA16 | DGR, Junagadh |
| 26 | UG-85 | ICGV86031 X TAG24 | DGR, Junagadh |
| 27 | UG-86 | (ICGS44 X CSMG84-1) X GG-2 | DGR, Junagadh |
| 28 | UG-87 | TAG-24 X ICGS75 | DGR, Junagadh |
| 29 | UG-88 | PBS20176 X Code26 | DGR, Junagadh |
| 30 | UG-89 | ICG X 000102 | ICRISAT, Hyderabad |
| 31 | UG-90 | ICGS76 X ICGV86031 | DGR, Junagadh |
| 32 | UG-91 | TAG-24 X ICGV76-1 | DGR, Junagadh |
| 33 | UG-92 | PBS29017 X NRCG4829 | DGR, Junagadh |
| 34 | UG-93 | (ICGS44 X CSMG84-1) X ICGV86031 | DGR, Junagadh |
| 35 | UG-94 | TAG-24 X ICGS76 | DGR, Junagadh |
| 36 | UG-95 | ICGS44 X CSMG84-1-2 | DGR, Junagadh |
| 37 | UG-100 | PBS20176 X Code26-1 | DGR, Junagadh |
| 38 | UG-102 | ICGS44 X CSMG84-1 | DGR, Junagadh |
| 39 | UG-103 | (ICGS44 X CSMG84-1) X GG-2 | DGR, Junagadh |
| 40 | UG-104 | PBS11039 X ICGV86031 | DGR, Junagadh |
| 41 | UG-105 | PBS11039 X TAG-24 | DGR, Junagadh |
| 42 | UG-107 | (ICGV86031 X TAG-24) X CGMS84-1 | DGR, Junagadh |
| 43 | UG-108 | ICGS76 X ICGV86031-1 | DGR, Junagadh |
| 44 | UG-109 | ICG X 000103 | ICRISAT, Hyderabad |
| 45 | UG-110 | ICGS44 X CSMG84-1 | DGR, Junagadh |
| 46 | UG-111 | PBS11039 X TAG24-1 | DGR, Junagadh |
| 47 | UG-112 | PBS29031 X ICGV86031 | DGR, Junagadh |
| 48 | UG-113 | ICGS44 X CSMG84-1 | DGR, Junagadh |
| 49 | UG-114 | ICGS76 X ICGV86031-2 | DGR, Junagadh |
| 50 | UG-115 | PBS11039 X NRCG4829 | DGR, Junagadh |
| 51 | UG-116 | ICGV03063 | ICRISAT, Hyderabad |
| 52 | UG-117 | Kadiri-3 X TKG19A | DGR, Junagadh |
| 53 | UG-118 | ICGS-11 X SBX1-2 | DGR, Junagadh |

**Table 1: Cont.....**

| S.No. | Name of Genotypes | Pedigree | Palace |
|---|---|---|---|
| 54 | UG-119 | ICG X 020153 | ICRISAT, Hyderabad |
| 55 | UG-120 | ICGS76 X ICGV86325 | DGR, Junagadh |
| 56 | UG-122 | J-83 X TG-41 | DGR, Junagadh |
| 57 | UG-123 | ICG X 020091 | ICRISAT, Hyderabad |
| 58 | UG-124 | CSMG84-1 X ICGV4747 | DGR, Junagadh |
| 59 | UG-125 | TAG-24 X ICGV4747 | DGR, Junagadh |
| 60 | UG-126 | CSMG84-1 X ICGV86031 | DGR, Junagadh |
| 61 | UG-127 | ICG X 020093 | ICRISAT, Hyderabad |
| 62 | UG-128 | ICG X 020041 | ICRISAT, Hyderabad |
| 63 | UG-129 | ICG X 990160 | ICRISAT, Hyderabad |
| 64 | UG-130 | ICG X 010014 | ICRISAT, Hyderabad |
| 65 | UG-132 | ICGS-11 X SBX1-1 | DGR, Junagadh |
| 66 | UG-133 | ICG X 040116 | ICRISAT, Hyderabad |
| 67 | UG-134 | ICG X 040117 | ICRISAT, Hyderabad |
| 68 | UG-135 | ICG X 040119 | ICRISAT, Hyderabad |
| 69 | UG-136 | ICG X 040120 | ICRISAT, Hyderabad |
| 70 | UG-137 | ICG X 020048 | ICRISAT, Hyderabad |
| 71 | UG-138 | ICG X 070064 | ICRISAT, Hyderabad |
| 72 | UG-139 | ICG X 050061 | ICRISAT, Hyderabad |
| 73 | UG-140 | ICG X 050062 | ICRISAT, Hyderabad |
| 74 | UG-141 | ICG X 050064 | ICRISAT, Hyderabad |
| 75 | UG-142 | ICG X 050066 | ICRISAT, Hyderabad |
| 76 | UG-143 | ICG X 050069 | ICRISAT, Hyderabad |
| 77 | UG-144 | ICG X 050072 | ICRISAT, Hyderabad |
| 78 | UG-145 | ICG X 050075 | ICRISAT, Hyderabad |
| 79 | UG-146 | GG-20 X ICGV91114 | DGR, Junagadh |
| 80 | UG-147 | GG-20 X ICGV91114-1 | DGR, Junagadh |
| 81 | UG-148 | ICGV91114 X ICGV86564 | DGR, Junagadh |
| 82 | UG-149 | PBS28014 X NRCG1463 | DGR, Junagadh |
| 83 | UG-150 | PBS26002 X PBS29017 | DGR, Junagadh |
| 84 | UG-151 | AK159 X NRCG5001 | DGR, Junagadh |
| 85 | UG-152 | AK159 X NRCG5001-1 | DGR, Junagadh |
| 86 | UG-153 | AK159 X NRCG5001-2 | DGR, Junagadh |
| 87 | UG-154 | ICG X 020106 | ICRISAT, Hyderabad |
| 88 | UG-155 | (TKG19A X Kadiri-3) X TKG19A | DGR, Junagadh |
| 89 | UG-156 | GG-20 X ICGV87250 | DGR, Junagadh |
| 90 | UG-157 | TKG19A X Kadiri-3 | DGR, Junagadh |
| 91 | TG37A | TG25 X TG26 | BARC, TROMBAY |
| 92 | PM-2 | ICGV-86055 × ICG-(FDRs 10) | MPUAT, Udaipur |
| 93 | Pratap Raj Mungphali | Selection from ICGV 98223 | MPUAT, Udaipur |

significant for all the characters studied, except 100-kernel weight and biological yield per plant, indicating considerable differences among the genotypes used in the present study (Table 2).

The mean performance of genotypes for different characters revealed that the range was considerably high for most of the characters *viz*., days to 50% flowering (27 to 36 days), days to maturity (99 to 114 days), plant height (23.86 to 38.76 cm), number of branches per plant (4.60 to 8.40), number of mature pods per plant (7 to 15.80), dry pod yield per plant (8.80 to 18.60 g), shelling percentage (60 to 75 %), 100-kernel weight (30.28 to 52.43 g), sound mature kernel (75.28 to 93.24 %), biological yield per plant (24.26 to 42.35 g), kernel yield per plant (5.40 to 13.80 g), harvest index (25.41 to 46.72 %), dormancy (4 to 10 days), oil content (34.18 to 44.86 %) and protein content (18.42 to 26.87 %) indicating an adequate variability for exercising selection and use in the breeding programmes.

Estimates of genotypic parameters revealed that differences between the estimates of GCV and PCV were found low for most of the characters. The narrow difference between GCV and PCV values for these characters indicate that, the traits are more influenced by genetic factors with minimum influence of environment and also suggest that, the selection based on such characters would facilitate and help in successful isolation of desirable genotypes. The values of PCV for all the traits are higher than GCV. Higher magnitude of PCV than GCV suggested that appreciable portion of variability has been accounted by environmental effects. These finding are in accordance with the findings of Venkatramana *et al*. (2001).

Higher estimates of GCV were observed for number of mature pods per plant (18.40 %), dry pods yield per plant (17.50 %), kernel yield per plant (18.58 %) and dormancy (20.18 %). Whereas, moderate estimates were found for number of branches per plant (13.61 %) and harvest index (10.18 %). For days to 50 per cent flowering (7.37 %), days to maturity (3.54 %), plant height (8.10 %), sound mature kernels (4.42 %), shelling percentage (5.24 %), oil content (6.28 %) and protein content (7.99 %) both GCV and PCV estimates were

**Table 2: Mean squares for various characters in Groundnut**

| SN | Character | Block | Treatment | Check | Germplasm | C v/s G | Error |
|---|---|---|---|---|---|---|---|
| 1. | Days to 50 % flowering | 1.26 | 5.66** | 0.72 | 5.77** | 6.23** | 0.46 |
| 2. | Days to maturity | 4.32 | 20.91* | 2.39 | 21.04* | 46.23* | 6.72 |
| 3. | Plant height (cm) | 2.08 | 8.43* | 6.06 | 8.27* | 27.97** | 2.31 |
| 4. | Number of branches per plant | 0.36 | 0.96** | 0.01 | 0.97** | 2.07* | 0.22 |
| 5. | Number of mature pods per plant | 4.22 | 6.99** | 2.08 | 5.54* | 145.91** | 1.57 |
| 6. | Dry pod yield per plant (g) | 1.21 | 6.11** | 4.25* | 6.03** | 16.89** | 1.03 |
| 7. | Kernel yield per plant (g) | 0.46 | 3.31** | 4.22** | 3.21** | 9.87** | 0.53 |
| 8. | 100-Kernel weight (g) | 6.22 | 27.40 | 44.89 | 24.27 | 271.11** | 11.57 |
| 9. | Sound mature kernel (SMK) % | 10.92 | 22.77* | 10.87 | 22.07* | 109.14** | 7.77 |
| 10. | Shelling percentage (%) | 8.89 | 19.85* | 22.39 | 19.95* | 6.23 | 6.92 |
| 11. | Biological yield per plant (g) | 5.74 | 16.05 | 10.72 | 15.27 | 96.33** | 9.20 |
| 12. | Harvest index (%) | 6.19 | 34.92* | 5.39 | 27.94* | 715.23** | 10.46 |
| 13. | Dormancy | 0.59 | 2.48** | 3.56* | 2.48** | 0.31 | 0.56 |
| 14. | Oil content (%) | 1.11 | 7.14** | 5.38** | 6.76** | 44.71** | 0.53 |
| 15. | Protein content (%) | 0.84* | 4.00** | 0.21 | 3.30** | 73.82** | 0.24 |

*,** Significant at 5% and 1% level of significance, respectively.

**Table 3: Variability parameters for various characters in Groundnut *(Arachis hypogaea* L.)**

| SN | Character | GCV % | PCV% | $H^2$% | GG% |
|---|---|---|---|---|---|
| 1 | Days to 50 % flowering | 7.37 | 7.68 | 92.10 | 14.57 |
| 2 | Days to maturity | 3.54 | 4.29 | 68.06 | 6.01 |
| 3 | Plant height (cm) | 8.10 | 9.54 | 72.12 | 14.18 |
| 4 | Number of branches per plant | 13.61 | 15.47 | 77.43 | 24.67 |
| 5 | Number of mature pods per plant | 18.40 | 21.74 | 71.59 | 32.07 |
| 6 | Dry Pod yield per plant (g) | 17.50 | 19.21 | 82.94 | 32.82 |
| 7 | Kernel yield per plant (g) | 18.58 | 20.33 | 83.54 | 34.99 |
| 8 | 100-Kernel weight (g) | 8.54 | 11.80 | 52.32 | 12.72 |
| 9 | Sound mature kernel (SMK) (%) | 4.42 | 5.50 | 64.79 | 7.34 |
| 10 | Shelling percentage (%) | 5.24 | 6.48 | 65.30 | 8.72 |
| 11 | Biological yield per plant (g) | 7.47 | 11.85 | 39.76 | 9.70 |
| 12 | Harvest index (%) | 10.80 | 13.66 | 62.57 | 17.60 |
| 13 | Dormancy | 20.18 | 22.92 | 77.57 | 36.62 |
| 14 | Oil content (%) | 6.28 | 6.54 | 92.17 | 12.41 |
| 15 | Protein content (%) | 7.99 | 8.30 | 92.74 | 15.85 |

found low. For biological yield per plant (7.47 %) and 100-kernel weight (8.54 %) estimates of GCV were found low but PCV were found moderate (Table 3).

Only the GVC is not sufficient for the find out the amount of heritable variation. Burton (1952) suggested that, GCV together with the heritability estimates would give the best picture of the extent of advance to be expected by selection. The estimates of heritability were moderate to high for all the characters. However, maximum heritability was found for protein content (92.74 %) followed by oil content (92.17 %), days to 50 per cent flowering (92.10 %), kernel yield per plant (83.54 %) and dry pod yield per plant (82.94 %). While, maximum genetic gain was observed for dormancy (36.62 %) followed by kernel yield per plant (34.99 %), dry pod yield per plant (32.82 %) and number of matured pods per plant (32.07 %).

In the present study, most of the characters exhibited high heritability values. Heritability in broad sense is high, it indicates that though the character is least influenced by environmental effects, selection for improvement of such traits may not be useful, because it include both additive and non-additive variance.

In the present study, heritability and genetic advance as per cent of mean were low for the character Biological yield per plant (g) and 100-Kernel weight (g) while moderate heritability and low genetic advance as per cent of means were exhibited by Days to maturity indicating the predominant role of non-additive gene action and environment plays major role in governing these characters, improvement of these characters is complicated and it might be possible through heterosis breeding. High heritability along with moderate genetic advance as per cent of mean for the Oil content suggests that the careful and restricted selection will be effective for the improvement of this characters. Dry Pod yield per plant, Kernel yield per plant and Number of mature pods per plant expressed high heritability coupled with high genetic advance as per cent of mean. This situation indicates that the genetic variances for these traits are probably owing to their high additive gene effects (Johnson *et al.,* 1955) and thus there is better scope for improvement of these traits through direct selection. High heritability coupled with low genetic gain was also earlier reported by Cholin *et al*. (2010) and Yadav *et al*. (2014).

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