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RESEARCH PAPER

# Stability analysis for pod yield and its component traits in groundnut (*Arachis hypogaea* L.)

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Ten groundnut genotypes were evaluated to know the role of G x E interaction and also to study stability performance over three environments. Analysis of variance revealed highly significant differences among the genotypes for all the characters studied. Genotypes x environment interactions were significant for all the characters under study indicating influence of environmental conditions.Stability analysis showed that both linear and non-linear components of G x E interactions were highly significant for all the characters. Environment ($E_1$) was observed to be most suitable for better expression of yield and its contributing characters. None of the genotype was found to be average stable for all the characters. Of all the genotypes, JL-24 and Phule Unnati for fresh pod yield/plant and TPG-41 and JL-24 for dry pod yield/plant exhibited average stabilityacross the environments.

**Key words :** Groundnut, *Arachis hypogaea*, G x E interaction, Stability, Pod yield

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## INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is one of the important oilseed crops of India with oil content around 40-50 per cent and it is extensively used for cooking purposes. It is not only rich source of poly unsaturated fatty acids (oleic acid and linoleic acids) but also possess good quality easily digestible protein, mineral and vitamins. Hence, it is considered as a cheap source of nutritive food for the under nourished and poor population to overcome the protein energy malnutrition. The average productivity of groundnutin India during 2011-12 is 1305kg/ha (DAC, 2012). The current yield level in India is deplorably low as compared to 3568 kg/ha in China and 4699 kg/ha in USA (FAOSTAT, 2014). The low yield levels are attributed to the cultivation of low yielding and poorly adapted varieties on marginal and sub-marginal lands under rainfed conditions, low input use and lack of plant protection measures. Under such situations and in the fluctuating environments, it has become necessary to develop varieties with attributes such as high yield, wider adaptability, biotic and abiotic stress resistance, fertilizer responsiveness and development of low cost management practices are needed. Stability analysis is useful for the identification of stable genotypes and in predicting the responses of various genotypes over changing environments. The stable genotypes adjust their phenotypic responses to provide some measure of uniformity in spite of environmental fluctuations. Therefore, an attempt has been made in the present investigation to evaluate different groundnut genotypes across the different date of sowing to know the role of G x E interactions and also to analyze the stability of genotypes for pod yield and its contributing characters.

## RESEARCH METHODOLOGY

Ten groundnut genotypes/varieties (Table A) were evaluated at Post Graduate Research Farm, College of Agriculture, Kolhapur during *summer* 2013. A field experiment involving ten genotypes was laid out in a Randomized Block Design (RBD) with three replications on three different sowing dates *viz.*, 24.01.2013 ($E_1$), 08.02.2013 ($E_2$) and 23.23.2013 ($E_3$), thus, creating three environments. The gross plot size for each genotype was 4.00 x 1.20 $m^2$ with a spacing 30 x 10 cm between rows and plants, respectively. The recommended dose of fertilizers 25 kg N: 50 kg $P_2O_5$/ha was applied at the time of sowing. The recommended package of practices and plant protection measures were timely and uniformly followed to raise a good crop. Five competitive plants were selected from each treatment randomly per replication in each environment for recording observations on ten different characters *viz.*, plant spread (E-W), plant spread (N-S), secondary branches per plant, days to 50 per cent flowering, pegs per plant, filled pods per plant, unfilled pods per plant, fresh pod yield per plant, dry pod yield per plant and sound matured kernels. The mean of the five plants in each replication was used for statistical analysis of all the characters. The environments and genotypes were assumed to be fixed for statistical analysis. Data collected were subjected to analysis of variance and the stability parameters were computed following the model proposed by Eberhart and Russell (1966).

**Table A : Source of groundnut genotypes**

| Genotype | Pedigree |
|---|---|
| TPG-41 | BARC, Trombay |
| AK-303 | Groundnut breeder, Akola |
| JL-24 | Oilseed Research Station, Jalgaon |
| SB-11 | Groundnut breeder, M.P.K.V., Rahuri |
| RHRG-6055 | Groundnut breeder, M.P.K.V., Rahuri |
| JL-501 | Oilseed Research Station, Jalgaon |
| RHRG-6021 | Groundnut breeder, M.P.K.V., Rahuri |
| Koyana (B-95) | Groundnut breeder, M.P.K.V., Rahuri |
| Phule Unnati | Groundnut breeder, M.P.K.V., Rahuri |
| TAG-24 | BARC, Trombay |

## RESEARCH FINDINGS AND ANALYSIS

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

### Analysis of variance for phenotypic stability :

The pooled analysis of variance (Table 1) over three different environments showed that genotypic (G) and environmental (E) variances were significant for all the characters, when tested against G X E interaction, pooled deviation and pooled error. Significant genotypic variances for all the traits, when tested against G x E interaction revealed the presence of substantial amount of variation in the genotypes evaluated. Whereas, significant

**Table 1 : ANOVA for phenotypic stability as per Eberhart and Russell model (1966) in groundnut**

| Source of variation | d.f. | Plant spread (E-W) (cm) | Plant spread (N-S) (cm) | Secondary branches / plant | Days to 50 % flowering | Pegs / plant | Filled pods / plant | Unfilled pods / plant | Fresh pod yield / plant(g) | Dry pod yield / plant (g) | Sound matured kernels (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Genotype (G) | 9 | 37.111 ++,**,## | 43,133 ++,**,## | 61.678 ++,**, ## | 15.488 ++,**, ## | 64.293 ++,**,## | 39.80 ++,**,## | 4.658 ++,**,## | 125.462 ++,**,## | 56.443 ++,**,## | 108.198 ++,**,## |
| Environment (E) | 2 | 17.739 ++,**,## | 16.709 ++,**,## | 0.206 +,**,## | 10.343 ++,*,## | 0.737 ++,**,## | 30.241 ++,**,## | 4.411 ++,**,## | 92.864 ++,**,# | 79.638 ++,**,## | 3.619 ++,**,## |
| G x E | 18 | 0.993# | 0.609* | 0.004** | 0.991## | 0.013* | 0.306** | 0.145## | 1.078## | 0.183* | 0.421*,## |
| E + (G x E) | 20 | 2.667 +,## | 2.219 ++,**,## | 0.002** | 1.926## | 0.085 ++,**,# | 3.300 ++, **,## | 0.571 ++,**,## | 10.257 ++,**,## | 8.129 ++,**,## | 0.741 |
| E (Linear) | 1 | 35.477 **,## | 33.418 **,## | 0.411 **,## | 20.686 **,## | 1.474** | 60.483 **,## | 8.822 **,## | 185.73 **,# | 159.27 **,## | 7.239 **,## |
| G x E (Linear) | 9 | 0.621 | 0.982* | 0.007** | 0.476 | 0.022** | 0.557++,## | 0.185# | 1.473## | 0.319## | 0.701*,# |
| Pooled deviation | 10 | 1.228## | 0.213 | 0.001 | 1.355## | 0.004 | 0.050 | 0.094# | 0.616 | 0.042## | 0.127## |
| Pooled error | 54 | 0.435 | 0.807 | 0.042 | 0.484 | 0.048 | 0.182 | 0.037 | 0.320 | 0.115 | 1.100 |

+,++ = Significant at P=0.05 and 0.01, respectively against G × E
*,* * = Significant at P=0.05 and 0.01, respectively against the pooled deviation
#,## =Significant at P=0.05 and 0.01, respectively against the pooled error

environmental variances for all the traits, when tested against G x E interaction indicated the influence of variable environments on the expression of genotypes. Significant differences among genotypes and environments were also reported by Kumar *et al*.(1984); Bhole *et al*.(1987); Patra *et al*.(1995); Begum *et al*. (1998) and Minimol *et al*.(2001). G x E interactions were found significant when tested against pooled error for the traits *viz*., plant spread (east-west), days to 50 per cent flowering, unfilled pods per plant, fresh pod yield per plantand sound matured kernels percentage, whereas, significant G x E interactions were also found for the traits *viz*., plant spread (north-south), secondary branches per plant, pegs per plant, filled pods per plant, dry pod yield per plant and sound matured kernels percentage,when tested against pooled deviation indicating the influence of environment on the genotypes evaluated. The similar results were also reported by Chandra *et al*. (1995); Singh and Singh (2001); Senapati and Sarkar (2002) and Pradhan *et al*. (2010) in groundnut.

Considerable interactions of genotypes with environments were obtained as the E + (G x E) were significant when tested against G x E, pooled deviation and pooled error for all the characters except sound matured kernels (%), which suggested the distinct nature of environments and genotype x environment interactions in phenotypic expression. Partitioning of E + (G x E) interaction showed that all the characters were significant for environment (linear) when tested against pooled deviation and pooled error, indicating that macro environmental differences were present under all three environments studied. The G x E (linear) component was also found significant for all the traits except plant spread (east-west) and days to 50 per cent flowering. The higher

**Table 2 : Estimates of stability parameters for yield and its component characters**

| Sr. No. | Genotypes | Mean | bi | $S^2di$ | Mean | bi | $S^2di$ | Mean | bi | $S^2di$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Fresh pod yield / plant (g) | | | Dry pod yield / plant (g) | | | Sound matured kernels (SMK %) | | |
| 1. | TPG-41 | 62.67 | 1.286 | 0.465* | 42.95 | 1.000 | -0.020 | 94.45 | 1.087 | -1.011 |
| 2. | AK-303 | 46.40 | 1.340** | -0.263 | 31.67 | 0.810 | 0.014 | 74.33 | 1.108* | -1.117 |
| 3. | JL-24 | 57.46 | 0.968 | 0.046 | 37.85 | 0.981 | 0.017 | 92.22 | 0.575 | -1.061 |
| 4. | SB-11 | 45.53 | 0.850 | -0.107 | 31.51 | 0.884 | -0.112 | 83.11 | 1.395** | -1.117 |
| 5. | RHRG-6055 | 47.83 | 1.260** | -0.335 | 30.76 | 0.848 | -0.088 | 90.56 | -1.331 | -0.547 |
| 6. | JL-501 | 45.16 | 1.098 | -0.282 | 32.65 | 0.930 | -0.108 | 87.89 | 1.682** | -1.089 |
| 7. | RHRG-6021 | 45.42 | 1.062 | -0.216 | 31.71 | 1.123** | -0.098 | 87.56 | 0.575 | -1.061 |
| 8. | Koyana (B-95) | 44.40 | 0.770 | 0.085 | 30.93 | 1.062** | -0.107 | 89.44 | 2.194* | -0.969 |
| 9. | Phule Unnati | 48.76 | 0.963 | 0.000 | 39.15 | 1.086** | -0.114 | 84.22 | 0.821 | -1.087 |
| 10. | TAG-24 | 41.84 | 0.402 | 3.245** | 30.97 | 1.276** | -0.114 | 93.67 | 1.907 | -0.859 |
| | Mean | 48.55 | 1.0000 | | 34.01 | 1.0000 | | 87.75 | 1.0000 | |
| | S.E.± | 0.56 | 0.1821 | | 0.15 | 0.0516 | | 0.25 | 0.4187 | |
| | | Branches/plant | | | Pegs/plant | | | Filled pods/plant | | |
| 1. | TPG-41 | 12.67 | 0.930 | -0.040 | 43.64 | 0.373 | -0.048 | 21.00 | 0.564 | -0.172 |
| 2. | AK-303 | 11.56 | 1.626** | -0.039 | 34.42 | 0.991 | -0.048 | 14.04 | 0.520 | -0.174 |
| 3. | JL-24 | 11.82 | 1.161 | -0.039 | 36.27 | 0.877 | -0.046 | 16.47 | 1.140 | -0.032 |
| 4. | SB-11 | 11.56 | 0.696 | -0.039 | 42.78 | 0.617 | -0.048 | 13.84 | 0.827 | -0.100 |
| 5. | RHRG-6055 | 14.18 | 0.235 | -0.039 | 44.09 | 0.946 | -0.026 | 15.56 | 0.988 | -0.175 |
| 6. | JL-501 | 13.76 | 0.934 | -0.037 | 34.71 | 1.250 | -0.044 | 17.33 | 1.096* | -0.162 |
| 7. | RHRG-6021 | 13.00 | 0.930 | -0.040 | 44.07 | 1.121 | -0.047 | 21.31 | 1.093 | -0.141 |
| 8. | Koyana (B-95) | 12.36 | 0.696 | -0.039 | 44.78 | 1.494** | -0.045 | 20.20 | 1.336* | -0.031 |
| 9. | Phule Unnati | 26.56 | 1.627** | -0.039 | 46.67 | 1.609** | -0.048 | 24.47 | 1.476** | -0.116 |
| 10. | TAG-24 | 16.60 | 1.168 | -0.034 | 45.05 | 0.717 | -0.041 | 21.87 | 0.959 | -0.152 |
| | Mean | 14.41 | 1.000 | | 41.65 | 1.000 | | 18.61 | 1.000 | |
| | S.E.± | 0.03 | 0.184 | | 0.05 | 0.165 | | 1.16 | 0.091 | |

* and ** indicate significance of values at P==0.05 and 0.01, respectively

magnitude of variances for environment (linear) as compared to genotype x environment (linear) indicated that linear response of environment account for the major part of total variation for all the characters studied and which may be responsible for high adaptation in relation to yield and other traits. Therefore, prediction of performance of genotypes over environments would be possible for the various characters. These findings are in accordance with the findings of Senapati and Sarkar (2002); Thaware (2009) and Patil *et al*. (2014). The variances due to pooled deviation (non-linear) were significant for the traits *viz.,* plant spread (east-west), days to 50 per cent flowering, unfilled pods per plant, dry pod yield per plant and sound matured kernels (%), when tested against pooled error. The significant pooled deviations (non-linear) for various traits were also reported by Senapati *et al*. (2004) and Patil *et al*. (2014). This suggested that both linear and non-linear components played important role in building up total G x E interaction for these traits.

**Stability parameters :**

The stability parameters *i.e.* mean (x), regression co-efficient (bi) and deviation from regression ($S^2$di) were estimated for each genotype separately for each trait. Both linear regression (bi) and deviation from regression ($S^2$di) components of genotype x environment (G x E) interaction should be considered along with mean, while judging the phenotypic stability of a genotype (Table 2).

Predictable response among the genotypes was found to be larger for all the traits under study as they exhibited non-significant deviation from regression. Only two genotypes *viz.,* TPG-41 and TAG-24 showed unpredictable response across environments for fresh pod yield per plantas they exhibited significant deviation from regression. However, some workers demonstrated that even for unpredictable traits, prediction could be still made when the stability parameters of individual genotypes were considered (Singh, 1981).

A genotype with unit regression co-efficient (bi ~ 1 or not significantly deviating from unity) and deviation not significantly differing from zero ($S^2$di = 0) with mean values higher than population mean is said to be stable one. In the present study, the genotype JL-24 and Phule Unnati exhibited regression co-efficient near to unity with non-significant $S^2$di and higher mean performance than population mean indicating general adaptability to fresh pod yield per plant. Similarly, TPG-41 and JL-24 exhibited average stability for dry pod yield per plant. The desirable genotypes for average environments wereTPG-41, JL-24, RHRG-6021 and TAG-24 for sound matured kernels (%), TAG-24 and RHRG-6055 for branches per plant, TPG-41, SB-11, RHRG-6021and TAG-24 for pegs per plant and TPG-41, RHRG-6021 and TAG-24 for filled pods per plant. These genotypes were observed to be stable and generally suitable across the environments.

A genotype with regression co-efficient greater than unity (bi > 1, below average stability) and deviation not significantly differing from zero ($S^2$di = 0) with mean values higher than population mean is expected to perform

**Table 3 : Performance of groundnut genotypes for fresh and dry pod yield under different environments**

| Sr. No. | Genotypes | Fresh pod yield /plant (g) | | | | Dry pod yield /plant (g) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | $E_1$ | $E_2$ | $E_3$ | Mean | $E_1$ | $E_2$ | $E_3$ | Mean |
| 1. | TPG-41 | 66.86 | 62.19 | 58.96 | 62.67 | 45.95 | 42.59 | 40.32 | 42.95 |
| 2. | AK-303 | 51.03 | 44.93 | 43.26 | 46.41 | 33.83 | 31.87 | 29.27 | 31.67 |
| 3. | JL-24 | 60.62 | 57.06 | 54.70 | 57.46 | 40.53 | 38.04 | 34.98 | 37.85 |
| 4. | SB-11 | 48.32 | 45.13 | 43.14 | 45.53 | 34.08 | 31.37 | 29.09 | 31.51 |
| 5. | RHRG-6055 | 52.09 | 46.76 | 44.63 | 47.83 | 33.26 | 30.53 | 28.49 | 30.76 |
| 6. | JL-501 | 48.95 | 43.94 | 42.60 | 45.16 | 35.36 | 32.47 | 30.11 | 32.65 |
| 7. | RHRG-6021 | 48.95 | 44.72 | 42.57 | 45.42 | 34.99 | 31.47 | 28.66 | 31.75 |
| 8. | Koyana (B-95) | 47.07 | 43.17 | 42.88 | 44.41 | 33.95 | 30.88 | 27.95 | 30.93 |
| 9. | Phule Unnati | 51.90 | 48.33 | 46.03 | 48.76 | 42.28 | 38.99 | 36.16 | 39.15 |
| 10. | TAG-24 | 43.61 | 39.98 | 41.95 | 41.84 | 34.65 | 30.80 | 27.46 | 30.97 |
| | Mean | 51.95 | 47.62 | 46.07 | | 36.89 | 33.90 | 31.25 | |
| | S.E.± | 0.855 | 0.556 | 0.937 | | 0.629 | 0.428 | 0.329 | |
| | C.D. (P=0.05) | 1.796 | 1.168 | 1.968 | | 1.322 | 0.900 | 0.692 | |

better under rich or favourable environmental conditions. The genotypes AK-303 and RHRG-6055 exhibited significant regression co-efficient and non-significant deviation from regression indicating their suitability in rich environments for fresh pod yield per plant. Similarly, RHRG-6021, Koyana (B-95), Phule Unnati and TAG-24 exhibited below average stability for dry pod yield per plant. The suitable genotypes for favourable environments were AK-303, SB-11, JL-501 and Koyana (B-95) for sound matured kernels (%), AK-303 and Phule Unnatifor branches per plant, Koyana (B-95) and Phule Unnati for pegs per plant and JL-501, Koyana (B-95) and Phule Unnati for filled pods per plant. These genotypes were expected to perform better under rich environmental conditions.

A genotype with regression co-efficient less than unity (bi < 1, above average stability) and deviation not significantly differing from zero ($S^2di = 0$) with mean values higher than population mean is expected to perform better under poor or unfavourable environmental conditions. In the present investigation, none of the genotypes was found suitable for unfavourable environments.

Present study revealed that the studied traits were found to be varied due to linear and non-linear components of G x E interaction. Such a varied response of different traitsdue to linear and non-linear components of G x E interaction was also reported by several workers (Bhole *et al*., 1987; Senapati and Roy, 1998;Vishwanathan *et al*., 2001 and Chavan *et al*., 2009). The studied genotypes showed differential stability performance for all the characters. None of the genotype was found stable for all the characters under study. Hence, considering mean yield performance (Table 3), the genotypes JL-24, TPG-41 and Phule Unnati were found to be promising for yield and yield contributing traits under different sowing conditions.

## LITERATURE CITED

**Begum, S., Samad, A., Khaleda, S. and Alam, A.K.M.S. (1998).** Genotype x environment interaction for some quantitative characters in groundnut. *Bangladesh J. Sci. Indust. Res*., **33** (1): 13-16.

**Bhole, G.R., Narkhede, B.N., Patil, S.S. and Deokar, A.B. (1987).** Phenotypic stability of pod yield in summer groundnut. *J. Oilseed Res.*, **4** : 108-110.

**Chandra, S., Sharma, B.K., Singh, J. and Pandey, D.K. (1995).** Screening and stability analysis of groundnut (*Arachis hypogaea* L.). *Indian J. Agric. Sci*., **65** (12): 876-879.

**Chavan, R.D., Toprope, V.N., Jagtap, P.K. and Aglave, B.N. (2009).** Stability analysis in groundnut for pod yield and its component traits. *Internat. J. Plant Sci*., **4**: 531-534.

DAC (2012). *Agricultural statistics at a glance*. Department of Agriculture and Co-operation, Ministry of Agriculture, Govt. of India, 128-185.

**Eberhart, S.A. and Russell, W.A. (1966).** Stability parameters for comparing varieties. *Crop Sci*., **6**: 35-40.

FAOSTAT (2014). *The statistics division*, Food and Agricultural Organization of the United Nations, ROME, ITALY.

**Kumar, P., Yadav, T.P. and Gupta, S.C. (1984).** Stability analysis in bunch group of groundnut. *Haryana Agric. J. Res*., **14** (2): 180-183.

**Minimol, J.S., Datke, S.B., Deshmukh, S.N. and Satpute, G.N. (2001).** Genotype x environment interaction in groundnut (*Arachis hypogaea* L.). *Ann. Pl. Physio*., **14** (1):74-79.

**Patil, A.S., Nandanwar, H.R., Punewar, A.A. and Shah, K.P. (2014).** Stability for yield and its component traits in groundnut (*Arachis hypogaea* L.). *Internat. J. Bio-resource & Stress Mgmt.*, **5** (2): 240-245.

**Patra, G.J., Kar, B.B. and Parhi, G. (1995).** Phenotypic stability for yield and quality factors in Spanish bunch groundnut. *Indian J. Agric. Sci*., **65** (8): 584-587.

**Pradhan, K., Das, P.K. and Patra, P.K. (2010).** Genotype x environment interaction for pod yield and components of groundnut varieties in warm sub-humid climate and moderately acidic soil. *Indian J. Genet*., **70** (2): 201-203.

**Senapati, B.K. and Roy, K. (1998).** Correlation coefficients among stability parameters of yield and yield contributing characters in groundnut (*Arachis hypogaea* L.). *Leg. Res*., **21** (1):37-40.

**Senapati, B.K. and Sarkar, G. (2002).** Genotype x environment interaction and stability of yield and yield components in groundnut (*Arachis hypogaea* L.). *J. Oilseeds Res*., **19** (1): 26.31.

**Senapati,B.K., Maity, D. and Sarkar, G. (2004).** Stability evaluation of summer groundnut (*Arachis hypogaea* L.) under coastal saline zone of West Bengal. *Leg. Res*., **27** (2): 103-106.

**Singh, P. (1981).** Phenotypic stability in upland cotton. *Curr. Sci*., **50** (23): 10-34.

**Singh, S.B. and Singh, J.P. (2001).** Genotype environment interaction effects in groundnut (*Arachis hypogaea* L.) tested in Midwestern plain zone of Utter Pradesh. *Indian J. Agric. Sci*., **71** (2): 126-127.

**Thaware, B.L. (2009).** Stability analysis for dry pod yield in Spanish bunch groundnut. *Agric. Sci. Digest*, **29** (3): 221-223.

**Vishwanathan, P.L., Mannivannan, N., Murugan, E. and Mohanasundaram, K. (2001).** Phenotypic stability analysis in groundnut (*Arachis hypogaea* L.). *Agric. Sci. Digest*, **21** (3): 164-166.