Genetic Variability, Heritability, Correlation and Regression in F<sub>3</sub> and F<sub>4</sub> Segregating Generation for Traits Related to WUE and Yield in the Cross NRCG 12274 × ICG 12370 of Groundnut (*Arachis hypogaea* L.)

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**Abstract**

F<sub>3</sub> and F<sub>4</sub> segregating generation has been evaluated during *kharif* 2012 and *summer* 2013 respectively in the augmented design along with parents and check. Estimate the variability, heritability, intergeneration correlation and regression across F<sub>3</sub>, F<sub>4</sub>, F<sub>5</sub> and F<sub>6</sub> generation during, *kharif* 2013 and *summer* 2014 respectively. Results revealed that presence of higher PCV and GCV for all the characters in all the four generations further, high heritability coupled with high genetic advance was observed for most of the traits indicates involvement of additive gene action in controlling of these traits. Presence of significant positive correlation between F<sub>4</sub> to F<sub>5</sub> and F<sub>5</sub> to F<sub>6</sub> for pods per plant, pod yield per plant, kernel yield per plant, kernels per plant, SCMR and SLA implies the these traits can be used as a selection criteria from F<sub>4</sub> generation onwards.

**Key words** Heritability, Parent off-spring regression, Intergeneration correlation and Groundnut.

**Introduction**

Groundnut (*Arachis hypogaea*) is one of the world important oilseed crop grown mainly in the arid and semiarid region where occurrence of drought is very frequent therefore productivity of the crop in the world and India are been declining. Hence, increasing the yield under the drought is an important breeding objective for the groundnut breeder. Further, identification of genotypes that have a greater ability to use limited available water to enhance productivity of the crop hence Water Use Efficiency (WUE) is one such important trait available to the breeder to augment the yield under drought environment. However WUE is quantitative characters governed by many genes with small effect coupled with high environmental effect therefore traits related to WUE would be an important traits for the breeder to enhance the WUE coupled with high yield hence Specific Leaf Area (SLA) and Soil Plant Analysis development (SPAD) Chlorophyll Meter Reading (SCMR) are been used in the study. Further results from the previous study on SLA have shown the consistent and significant inverse correlation of WUE and yield. However SCMR shown the positive association with WUE and yield (Farquar *et al.*, 1989; Wright, 1994; Nageshwara Rao *et al.*, 2001).
Breeders very often use segregating populations as source population to exercise selection for identifying homozygous lines with better performance to develop varieties. At the same time, the breeding lines from the advanced generations are also used as parental lines for developing commercially exploitable heterotic hybrids. But, most often the source of early generations i.e., F₃, F₄, F₅ and F₆ segregating populations offer wider opportunities for achieving high success, because of wider genetic base.

Materials and Methods

For developing superior segregants for high pod yield with high water use efficiency the genotypes such as NRCG12274 and ICG12370 were selected. These genotypes are enough diverse for traits related to pod yield and WUE. Hybridization was made between these two genotypes to develop F₁ hybrid, selfing upon these hybrids was made get F₂ plants and all F₂ plants were forwarded to get F₃ progenies. As a procedure of plant to row progeny method 108 F₃, 84 F₄, 72 F₅ and 52 F₆ along with parents and checks were sown during kharif 2012, summer 2013, kharif 2013 and summer 2014 respectively. All recommended agronomic practices and plant protection measures were followed during the crop growth period of ever segregating generation to ensure better growth and yield. The observations were recorded on all the plants in all the four segregating generations.

Narrow sense heritability estimates were made based on the regression of F₄ on F₃, F₅ on F₄ and F₆ on F₅ generation using the following formula (Cahaner and Hillet, 1980).

Results and Discussion

Analysis of Variance for growth, traits related to WUE and yield attributing traits F₃, F₄, F₅ and F₆ segregating generations

Analysis of variance in F₃, F₄, F₅ and F₆ segregating populations of the cross NRCG12374 × ICG12370 revealed significant differences (Table 1) among the lines in all the four generations for all the characters except shelling percentage in F₃, F₄ and F₆ generations. Further, segregating progenies and checks also recorded presence of high variability for all the characters in all the four generations, which indicating the presence of enormous genetic variability and the choice of the material for the investigation is appropriate. This was further supported by the fact that range has been also quite wider for all the characters pointing out extreme segregates are found in population for selection.

Genetic variability parameters

Higher GCV and PCV has been observed (Table 2) for plant height, SCMR, total number of pods per plant, pod yield per plant, number of kernels per plant and kernel yield per plant in F₃, F₄, F₅ and F₆ generations. Similar findings of higher estimates of GCV & PCV for pods per plant, kernel yield per plant and pod yield per plant were observed by Sharma & Varshney (1995), Sumathi & Ramanathan (1995), Gowda et al., (1996), Makhan lal et al., (2003), Golkia et al., (2005), Ganeshan and Sudhakar (1995) Veeramani et al., (2005), John et al., (2007) and Parameshwarappa et al., (2007) in groundnut.
Table 1: Analysis of variance for growth parameters, traits related to WUE, yield and its component characters in four segregating generations (F₃, F₄, F₅ and F₆) of the cross NRCG12274 × ICG12370 in groundnut

| Source of variance | Df | Days to Flowering | Plant height (cm) | Primary branches/plant | SLA (cm²/g) | SCMR | Pods/plant (g) | Pod yield/plant (g) | Kernels/plant | Kernel yield/plant (g) | Shelling Percentage |
|--------------------|----|-------------------|------------------|------------------------|-------------|------|---------------|---------------------|---------------|------------------------|---------------------|
| Progenies + Checks | F₃ | 3                | 40.81*           | 20.25                  | 1584.29     | 91.12* | 24.08*        | 5.06                 | 46.20         | 4.06                   | 13.13               |
|                    | F₄ | 4                | 3.09             | 3.93*                  | 406.88      | 23.23* | 35.39*        | 19.74**              | 22.37**       | 1.17                   | 42.49**             |
|                    | F₅ | 3                | 11.33            | 1.41                   | 282.23      | 23.63** | 4.08          | 20.07                | 33.01         | 2.66                    | 2.53                |
|                    | F₆ | 6                | 11.33            | 1.41                   | 282.23      | 23.63** | 4.08          | 20.07                | 33.01         | 2.66                    | 2.53                |
| Block (eliminating Check + Va.) | F₃ | 110           | 58.55**          | 29.76                  | 5035.69*    | 288.17** | 112.90**      | 200.71*              | 374.93**      | 76.139                  | 169.92              |
|                    | F₄ | 86              | 50.84*           | 25.23**                | 4957.34*    | 242.15* | 93.22**       | 134.99**             | 288.99**      | 62.95**                 | 93.54**             |
|                    | F₅ | 78              | 48.00**          | 28.36*                 | 5275.84*    | 180.33** | 79.80**       | 164.04**             | 242.40*       | 53.84*                  | 107.01              |
|                    | F₆ | 54              | 34.00*           | 19.36**                | 6333.72**   | 103.56** | 196.64**      | 177.947**            | 479.91**      | 125.59**                | 163.13**            |
| Checks | F₃ | 3                | 37.51**          | 43.57**                | 1161.24**   | 97.47*   | 115.20**      | 146.38               | 167.67**      | 111.83                  | 126.31              |
|                    | F₄ | 3                | 37.22*           | 15.28**                | 6314.86*    | 226.89*  | 103.85**      | 104.81**             | 135.63**      | 71.91**                 | 54.30*              |
|                    | F₅ | 3                | 48.00*           | 57.70                  | 4105.19*    | 70.69*   | 124.62**      | 127.50**             | 382.04*       | 155.59**                | 367.39*             |
|                    | F₆ | 3                | 20.58            | 13.01**                | 2210.08     | 35.41    | 94.24**       | 131.05**             | 260.09*       | 66.48                   | 392.55**            |
| Progenies | F₃ | 107           | 59.44**          | 29.78                  | 4956.89*    | 293.88** | 113.83**      | 203.64*              | 362.12**      | 76.08                   | 172.18              |
|                    | F₄ | 83              | 51.60*           | 25.77**                | 4867.23*    | 245.26*  | 93.71*        | 137.30**             | 294.31**      | 63.03**                 | 95.29**             |
|                    | F₅ | 71              | 48.44**          | 17.64**                | 5338.97*    | 186.40** | 79.378**      | 167.19**             | 240.34*       | 51.06**                 | 100.28              |
|                    | F₆ | 51              | 35.86*           | 19.46**                | 4978.61**   | 109.40** | 138.42**      | 141.75**             | 368.80**      | 82.50**                 | 86.11**             |
| Checks vs Progenies | F₃ | 1              | 8.25*            | 0.21                   | 6520.99     | 75.78*   | 11.53*        | 4.64                 | 69.12*        | 9.80                   | 21.39               |
|                    | F₄ | 1              | 15.00            | 0.72                   | 9722.17*    | 14.81    | 31.01*        | 3.29                 | 153.62**      | 37.94**                 | 26.09               |
|                    | F₅ | 1              | 20.68            | 0.23                   | 3703.11     | 22.93    | 16.46*        | 41.92*               | 90.81         | 22.42                   | 3.73                |
|                    | F₆ | 1              | 6.18             | 0.31**                 | 8809.51**   | 11.70    | 35.39**       | 21.51**              | 86.08**       | 25.30**                 | 32.51**             |
| Error | F₃ | 6              | 0.52             | 2.29                   | 641.97      | 6.28     | 1.11          | 26.81                | 13.71         | 24.04                   | 30.99               |
|                    | F₄ | 4              | 5.01             | 0.41                   | 663.00      | 23.43    | 3.84          | 1.03                 | 5.42          | 1.78                    | 4.48                |
|                    | F₅ | 4              | 2.84             | 18.35                  | 546.66      | 7.49     | 1.91          | 5.38                 | 21.66         | 7.50                    | 22.60               |
|                    | F₆ | 6              | 5.58             | 0.98                   | 355.63      | 2.29     | 4.08          | 14.64                | 27.50         | 2.36                    | 1.56                |

*Significant @ P =0.05 ** Significant @ P = 0.01
Table 2 Genetic variability parameters for growth, traits related to WUE, yield and its component traits in four segregating generations (F3, F4, F5 and F6) of the cross NRPG12274 x ICG12370 in groundnut

| CHARACTERS | MEAN | RANGE | GCV (%) | PCV (%) | h²bs(%) | GAM |
|------------|------|-------|---------|---------|---------|------|
| Days to first flowering | F3 | 39.08 | 20.55 | 48.80 | 19.01 | 19.10 | 99.06 | 38.98 |
| | F4 | 39.61 | 23.77 | 44.80 | 16.55 | 17.49 | 89.56 | 32.26 |
| | F5 | 37.07 | 25.71 | 49.80 | 17.27 | 17.86 | 93.51 | 34.40 |
| | F6 | 35.13 | 30.25 | 42.15 | 14.44 | 15.93 | 82.17 | 26.96 |
| Plant height (cm) | F3 | 20.50 | 12.00 | 36.23 | 24.76 | 25.84 | 91.84 | 48.87 |
| | F4 | 18.89 | 12.60 | 42.94 | 25.60 | 25.83 | 98.27 | 52.28 |
| | F5 | 19.91 | 12.60 | 29.80 | 23.43 | 25.78 | 82.59 | 43.86 |
| | F6 | 22.28 | 14.28 | 32.25 | 17.79 | 18.34 | 94.17 | 35.56 |
| Primary branches/plant | F3 | 5.27 | 4.06 | 6.49 | 8.28 | 10.42 | 63.15 | 13.54 |
| | F4 | 5.09 | 3.25 | 6.36 | 9.97 | 10.18 | 95.91 | 20.11 |
| | F5 | 5.21 | 4.11 | 6.20 | 7.53 | 9.82 | 58.72 | 11.87 |
| | F6 | 4.53 | 3.41 | 5.48 | 10.47 | 10.93 | 91.84 | 20.68 |
| SLA (cm²/g) | F3 | 199.31 | 89.65 | 365.26 | 31.90 | 34.34 | 86.30 | 61.04 |
| | F4 | 211.82 | 93.25 | 312.05 | 29.40 | 31.81 | 85.40 | 55.96 |
| | F5 | 239.47 | 95.32 | 365.23 | 27.40 | 29.09 | 88.74 | 53.17 |
| | F6 | 243.58 | 102.13 | 385.26 | 25.73 | 26.87 | 91.70 | 50.85 |
| SCMR | F3 | 44.83 | 11.95 | 89.98 | 36.62 | 37.04 | 97.72 | 74.56 |
| | F4 | 41.49 | 22.56 | 78.57 | 34.48 | 36.40 | 89.72 | 67.27 |
| | F5 | 34.74 | 14.43 | 77.73 | 36.50 | 37.34 | 95.55 | 73.48 |
| | F6 | 31.18 | 13.88 | 68.87 | 30.60 | 30.98 | 97.55 | 62.26 |
| Pods/Plant | F3 | 26.83 | 11.92 | 62.00 | 38.30 | 38.50 | 98.96 | 78.48 |
| | F4 | 27.86 | 15.39 | 71.00 | 32.68 | 33.43 | 95.57 | 65.8 |
| | F5 | 28.17 | 15.39 | 55.00 | 29.61 | 30.02 | 97.33 | 60.18 |
| | F6 | 40.95 | 13.22 | 67.22 | 26.09 | 26.55 | 96.55 | 52.82 |
| Pod yield/plant (g) | F3 | 31.27 | 10.14 | 94.48 | 41.17 | 44.38 | 86.04 | 78.67 |
| | F4 | 30.29 | 12.63 | 57.50 | 37.01 | 37.16 | 98.18 | 75.92 |
| | F5 | 35.27 | 12.63 | 63.84 | 34.19 | 34.82 | 96.43 | 69.16 |
| | F6 | 28.17 | 15.39 | 62.00 | 29.61 | 30.02 | 97.33 | 60.18 |
| Kernels/plant | F3 | 48.59 | 18.23 | 98.29 | 37.01 | 37.20 | 98.95 | 75.83 |
| | F4 | 51.03 | 27.73 | 95.72 | 31.99 | 32.31 | 98.01 | 65.23 |
| | F5 | 52.86 | 28.16 | 89.00 | 26.52 | 27.94 | 90.07 | 51.84 |
| | F6 | 62.50 | 22.66 | 116.97 | 27.25 | 28.51 | 91.34 | 53.65 |
| Kernel yield/plant(g) | F3 | 21.00 | 8.45 | 45.02 | 33.26 | 40.64 | 66.97 | 56.06 |
| | F4 | 21.39 | 11.25 | 43.48 | 35.14 | 35.69 | 96.94 | 71.27 |
| | F5 | 21.09 | 10.43 | 42.50 | 29.67 | 32.39 | 83.93 | 55.99 |
| | F6 | 29.64 | 10.23 | 53.56 | 27.84 | 28.32 | 96.65 | 56.39 |
| Shelling percentage | F3 | 66.76 | 44.18 | 95.80 | 17.23 | 19.14 | 81.02 | 31.94 |
| | F4 | 66.25 | 44.25 | 85.41 | 13.81 | 14.18 | 94.25 | 27.72 |
| | F5 | 57.00 | 40.29 | 83.12 | 14.66 | 16.87 | 75.54 | 26.24 |
| | F6 | 75.59 | 46.77 | 86.46 | 11.21 | 11.33 | 97.88 | 22.85 |
**Table 3** Phenotypic correlation coefficients among growth parameters, traits related to WUE, yield and its component traits in four segregating generations (F$_3$, F$_4$, F$_5$ and F$_6$) of the cross NRCG12274 × ICG12370 in groundnut.

| Characters                  | Generations | Pods / plant | Kernels / plant | Kernel yield/plant (g) | Shelling percentage | SLA (cm$^2$/g) | SCMR    | Pod yield (g) |
|-----------------------------|-------------|--------------|-----------------|------------------------|---------------------|--------------|---------|--------------|
| Pods / plant                | F$_3$       | 1.00         | 0.93**          | 0.94**                 | 0.20*               | -0.24*       | 0.28*   | 0.84**       |
|                             | F$_4$       | 1.00         | 0.93**          | 0.89**                 | 0.07                | -0.45**      | 0.55*   | 0.83**       |
|                             | F$_5$       | 1.00         | 0.94**          | 0.81**                 | 0.01                | 0.59**       | -0.34*  | 0.81**       |
|                             | F$_6$       | 1.00         | 0.71**          | 0.95**                 | 0.54**              | -0.70        | 0.79**  | 0.87**       |
| Kernels / plant             | F$_3$       | 1.00         | 0.91**          | -0.03                  | -0.23*              | 0.26*        | 0.89*   |              |
|                             | F$_4$       | 1.00         | 0.89**          | -0.25*                 | -0.53**             | 0.63*        | 0.89*   |              |
|                             | F$_5$       | 1.00         | 0.75**          | -0.10*                 | 0.62**              | -0.35*       | 0.79**  |              |
|                             | F$_6$       | 1.00         | 0.76**          | 0.30*                  | -0.58**             | 0.66**       | 0.73*   |              |
| Kernel yield / plant (g)    | F$_3$       | 1.00         | 0.15*           | -0.01                  | 0.29*               |              |         |              |
|                             | F$_4$       | 1.00         | -0.11*          | -0.52**                | 0.61*               | 0.94*        |         |              |
|                             | F$_5$       | 1.00         | 0.17*           | 0.59**                 | -0.38*              | 0.86*        |         |              |
|                             | F$_6$       | 1.00         | 0.40**          | -0.78**                | 0.86**              | 0.97*        |         |              |
| Shelling percentage         | F$_3$       | 1.00         | 0.01            | -0.01                  | -0.18*              |             |         |              |
|                             | F$_4$       | 1.00         | 0.32*           | -0.31*                 | -0.37*              |             |         |              |
|                             | F$_5$       | 1.00         | -0.09           | -0.05                  | -0.12*              |             |         |              |
|                             | F$_6$       | 1.00         | -0.23*          | 0.25*                  | -0.23*              |             |         |              |
| SLA (cm$^2$/g)              | F$_3$       | 1.00         |                 | 1.00                   | -0.88**             | -0.24*       |         |              |
|                             | F$_4$       | 1.00         |                 | 1.00                   | -0.72**             | -0.55**      |         |              |
|                             | F$_5$       | 1.00         |                 | 1.00                   | -0.56**             | -0.64**      |         |              |
|                             | F$_6$       | 1.00         |                 | 1.00                   | -0.92**             | -0.81**      |         |              |
| SCMR                        | F$_3$       |              |                 | 1.00                   | 0.27*               |             |         |              |
|                             | F$_4$       |              |                 | 1.00                   | 0.63**              |             |         |              |
|                             | F$_5$       |              |                 | 1.00                   | 0.39*               |             |         |              |
|                             | F$_6$       |              |                 | 1.00                   | 0.88**              |             |         |              |
| Pod yield / plant (g)       | F$_3$       |              |                 | 1.00                   |                     |             |         |              |
|                             | F$_4$       |              |                 | 1.00                   |                     |             |         |              |
|                             | F$_5$       |              |                 | 1.00                   |                     |             |         |              |
|                             | F$_6$       |              |                 | 1.00                   |                     |             |         |              |

*Significant @ P =0.05 ** Significant @ P = 0.01
Table 4 Intergeneration correlation coefficients for growth parameters, traits related to WUE, yield and its component traits from F3 to F6 segregating generations of the cross NRCG12274 × ICG12370 in groundnut

| Characters                       | Generations | F3     | F4     | F5     | F6     |
|----------------------------------|-------------|--------|--------|--------|--------|
|                                  |             | 1.00   | 1.00   | 1.00   | 1.00   |
| Days to flowering                |             | 0.53** | 0.48** | 0.54** | -0.15  | 0.07   |
|                                  | F3          | 1.00   |        | 0.02   | 0.12   |
|                                  | F4          | 1.00   | 0.61** | 0.35*  |        |
|                                  | F5          | 1.00   | 0.19   |        |
|                                  | F6          |        |        |        | 1.00   |
| Plant height (cm)                |             |        |        |        |        |
|                                  | F3          |        | 0.20*  | 0.23*  |        |
|                                  | F4          |        | 0.35*  | 0.28*  |        |
|                                  | F5          |        |        |        | 0.17*  |
|                                  | F6          |        |        |        | 1.00   |
| Primary branches/plant           |             |        |        |        |        |
|                                  | F3          |        | 0.40** | -0.01  | 0.06   |
|                                  | F4          |        | 0.48** | 0.13   |        |
|                                  | F5          |        | 0.97** |        |
|                                  | F6          |        |        |        | 1.00   |
| Pods/plant                       |             |        |        |        |        |
|                                  | F3          |        | 0.32*  | -0.01  | 0.14   |
|                                  | F4          |        | 0.57** | 0.04   |        |
|                                  | F5          |        |        |        | 0.84   |
|                                  | F6          |        |        |        | 1.00   |
| Kernels/plant                    |             |        |        |        |        |
|                                  | F3          |        | 0.17*  | 0.08   | 0.08   |
|                                  | F4          |        | 0.42** | 0.04   |        |
|                                  | F5          |        |        |        | 0.85** |
|                                  | F6          |        |        |        | 1.00   |
| Kernel yield/plant (g)           |             |        |        |        |        |
|                                  | F3          |        | 0.46** | 0.21*  | 0.03   |
|                                  | F4          |        | 0.38*  | 0.21*  |        |
|                                  | F5          |        |        |        | 0.03   |
|                                  | F6          |        |        |        | 1.00   |
| Shelling per cent age            |             |        |        |        |        |
|                                  | F3          |        | 0.41** | -0.20  | 0.15   |
|                                  | F4          |        | 1.00   | 0.37   | 0.08   |
|                                  | F5          |        |        |        | 0.15   |
|                                  | F6          |        |        |        | 1.00   |
| SLA (cm²/g)                      |             |        |        |        |        |
|                                  | F3          |        | 0.41** | -0.07  | 0.08   |
|                                  | F4          |        | 0.47** | 0.07   |        |
|                                  | F5          |        |        |        | 0.72** |
|                                  | F6          |        |        |        | 1.00   |
| SCMR                             |             |        |        |        |        |
|                                  | F3          |        | 0.32*  | 0.08   | 0.06   |
|                                  | F4          |        | 0.26   | 0.76** | 0.02   |
|                                  | F5          |        |        |        | 0.76** |
|                                  | F6          |        |        |        | 1.00   |

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Table 5 Correlation and regression of pod yield on growth parameters, traits related to WUE and yield component traits in four segregating generations of the NRCG12274 × ICG12370 in groundnut

| Characters       | F<sub>3</sub> generation | F<sub>4</sub> generation | F<sub>5</sub> generation | F<sub>6</sub> generation |
|------------------|--------------------------|--------------------------|--------------------------|--------------------------|
|                  | r-value | b-value | r-value | b-value | r-value | b-value | r-value | b-value |
| Days to first flowering | -0.09    | -0.09   | 0.17*   | 0.30    | 0.06    | 0.12    | 0.01    | 0.22    |
| Plant height (cm)  | -0.04    | -0.11   | -0.15*  | -0.38   | 0.15*   | 0.37    | -0.12*  | -0.84   |
| Primary branches/plant | 0.07     | 2.11    | -0.01   | -0.03   | 0.07    | 1.89    | 0.09    | -0.04   |
| SLA (cm<sup>2</sup>/g) | -0.66** | -0.13   | -0.53** | -0.09   | -0.63** | -0.11   | -0.35*  | 1.11    |
| SCMR              | 0.68**   | 0.57    | 0.56**  | 0.44    | 0.65**  | 0.61    | 0.94**  | -0.14   |
| Pods / plant      | 0.62**   | 0.83    | 0.74**  | 0.94    | 0.68**  | 0.98    | 0.95**  | 0.93    |
| Kernels / plant   | 0.69**   | 0.52    | 0.70**  | 0.50    | 0.07    | 0.01    | 0.97**  | 0.59    |
| Pods yield / plant (g) | 0.57**   | 0.94    | 0.59**  | 0.86    | 0.65**  | 1.17    | 0.98**  | 1.14    |
| Shelling percentage | -0.17*   | -0.19   | -0.11*  | -0.15   | -0.43** | -0.56   | -0.03   | -0.27   |

* Significant @ P=0.05 ** Significant @ P= 0.01

Table 6 Comparison between broad sense and narrow sense heritability for growth parameters, traits related to WUE, yield and its component traits in segregating populations for four generations in the cross of NRCG12274 × ICG12370 in groundnut

| Characters       | F<sub>3</sub>-F<sub>4</sub> | F<sub>4</sub>-F<sub>5</sub> | F<sub>5</sub>-F<sub>6</sub> |
|------------------|-----------------------------|-----------------------------|-----------------------------|
|                  | Broad sense heritability | Narrow sense heritability | Broad sense heritability | Narrow sense heritability | Broad sense heritability | Narrow sense heritability |
| Days to first flower | 89.56          | 37.02          | 93.51          | 41.16          | 82.17          | 43.68          |
| Plant height (cm)  | 98.27          | 38.02          | 82.59          | 55.74          | 94.13          | 46.80          |
| Primary branches/plant | 95.91          | 14.42          | 58.72          | 27.77          | 91.84          | 13.41          |
| Pods / plant      | 95.57          | 26.57          | 97.33          | 34.51          | 96.55          | 27.82          |
| Kernels / plant   | 98.01          | 20.01          | 90.07          | 37.74          | 91.34          | 37.59          |
| Kernel yield / plant (g) | 96.94          | 11.51          | 83.93          | 27.58          | 96.65          | 57.39          |
| Shelling percentage | 94.25          | 26.71          | 75.54          | 37.96          | 97.88          | 46.88          |
| SLA (cm<sup>2</sup>/g) | 85.40          | 30.86          | 88.74          | 32.43          | 91.70          | 18.74          |
| SCMR              | 89.72          | 28.54          | 95.55          | 35.19          | 97.55          | 49.91          |
| Pod yield/ plant (g) | 98.18          | 20.92          | 96.43          | 20.07          | 88.07          | 40.66          |
### Table 7: Performance of superior segregants for growth, traits related to WUE, yield and yield component traits in F$_6$ segregating generations of the cross NRCG12274 × ICG12370 in groundnut

| Line no   | Days to first flowering | Plant height (cm) | Primary branches/plant | SLA (cm$^2$/g) | SCMR | Pods/plant | Kernels/plant | Pod yield/plant (g) | Kernel yield/plant (g) | Shelling percentage |
|-----------|-------------------------|-------------------|------------------------|----------------|------|------------|---------------|---------------------|----------------------|----------------------|
| 13A1A1    | 30.35                   | 25.23             | 5                      | 156.25         | 45.25| 45         | 71            | 38.59               | 20.12                | 52.14                 |
| 23B1A1    | 33.75                   | 20.25             | 6                      | 145.25         | 49.25| 62         | 84            | 46.91               | 38.23                | 81.63                 |
| 32A1A1    | 42.73                   | 18.65             | 7                      | 123.25         | 54.21| 59         | 93            | 53.77               | 43.63                | 80.92                 |
| 40A1A1    | 39.79                   | 32.20             | 5                      | 145.25         | 40.23| 56         | 99            | 69.64               | 34.27                | 49.21                 |
| 52A1A1    | 43.71                   | 18.25             | 4                      | 165.25         | 39.25| 44         | 93            | 53.25               | 33.19                | 62.32                 |
| 60A1A1    | 35.00                   | 33.25             | 8                      | 176.25         | 47.21| 50         | 88            | 61.43               | 28.13                | 45.79                 |
| 63A1A1    | 30.57                   | 25.20             | 5                      | 142.65         | 56.25| 52         | 90            | 50.18               | 40.12                | 79.95                 |
| 73A1A1    | 29.64                   | 15.20             | 6                      | 132.25         | 62.32| 48         | 84            | 48.25               | 29.38                | 60.88                 |
| 83A1A1    | 32.27                   | 26.36             | 4                      | 165.25         | 48.25| 53         | 80            | 48.41               | 40.31                | 83.26                 |
| 96A1A1    | 40.64                   | 33.25             | 7                      | 125.23         | 50.12| 63         | 98            | 60.03               | 49.42                | 83.00                 |
| 98A1A1    | 44.00                   | 18.20             | 5                      | 175.42         | 48.56| 59         | 64            | 44.12               | 33.19                | 75.22                 |
| 101A1A1   | 42.21                   | 29.25             | 6                      | 125.23         | 52.32| 63         | 76            | 52.21               | 38.56                | 73.85                 |
| NRCG12274 | 45.00                   | 30.25             | 5                      | 174.25         | 30.20| 36         | 68            | 35.23               | 29.12                | 82.65                 |
| ICG12370  | 44.45                   | 18.25             | 4                      | 201.25         | 25.32| 20         | 39            | 25.36               | 20.12                | 79.38                 |
| TMV-2     | 39.36                   | 36.25             | 6                      | 142.25         | 36.25| 28         | 55            | 25.23               | 16.25                | 64.47                 |
| KCG-2     | 44.60                   | 25.20             | 5                      | 125.56         | 42.36| 32         | 59            | 36.25               | 26.25                | 72.44                 |
Heritability and Genetic Advance as Per cent mean

High heritability coupled with high genetic advance as per cent of mean was observed (Table 2) for high for yield and its attributing traits like pods per plant, shelling percentage, kernel yield per plant. It indicates the presence of additive gene action.

Hence, single plant selection could be effectively made as environment does not have any influence in the variation of traits. Similar result was reported by Reddy and Guptih (1992), Ganeshan and Sudhakar (1995), Mukhan et al. (2003) and Praveen Kumar (2004) in groundnut.

Correlation of pod yield per plant with growth parameters, traits related to WUE and yield component characters

Phenotypic correlation coefficients studies revealed that (Table 3) pod yield per plant had strong positive correlation with pods per plant, kernels per plant, kernel yield per plant and SCMR in F3, F4, F5 and F6 segregating generations indicating that improvement pods per plant, kernel yield per plant, SCMR will leads to improvement in yield.

These results are in agreement with the results of Sharma and Varsheny (1995), Moinuddin (1996) and also Singh (1999), Sabeta (2000), Nagda et al. (2001), Mahalakshmi et al. (2005), Kalmeshwar et al. (2006), John et al. (2007), Mane et al. (2008), Sudhir et al., (2008) in groundnut. Significant negative association of pod yield per plant with days to flowering and shelling percentage and SLA was observed in F5, F6, F7 and F8 segregating populations studied. Indicates that negative relationship of pod yield per plant with SLA, selection for high yielding and water use efficient segregates can be done in a single selection programme.

Intergeneration correlation and regression studies

Significant and positive correlation was obtained (Table 4) between F3 to F4, F3 to F5 and F3 to F6 generations for days to flowering, plant height and primary branches per plant which indicating that prediction would be made from F3 generation and these trait are mostly governed by additive gene action and suitability of these traits for selection in individual plant basis in the advanced generations of segregating progenies. These findings were supported by Kulkarni et al., (1976) and Reddy et al., (1985). They also find the existence of significant correlation between F3 to F4 and F3 to F5 for plant height in okra.

Significant and positive correlation were obtained for F4 to F5, F4 to F6 and F5 to F6 for pods per plant, kernels per plant, pod yield per plant, kernel yield per plant, SCMR and SLA. This indicated that prediction can be made for these characters from F4 generation to identify the lines that will give higher pod yield and higher water use efficiency.

Comparison between correlation and regression for growth parameters, traits related to WUE and yield component traits in F3, F4, F5 and F6 segregating generations

Kernel yield per plant, pods per plant, kernels per plant and SCMR consistently showed (Table 5) the positive correlation and positive effect in all the four segregating generations. Hence selection for these traits could be excised to develop high yielding with high water use efficient genotypes. Similar conclusion were made by Varsheny (1995) Moinuddin (1996) and also Singh (1999), Sabeta (2000), Nagda et al., (2001), Mahalakshmi et al., (2005), Kalmeshwar et al., (2006), John et al., (2007), Mane et al., (2008) and Sudhir et al., (2008) in groundnut.
Whereas other traits like, SLA and shelling percentage showed negative association and negative effect on pod yield per plant in all the four generations.

**Comparison of narrow sense and broad sense heritability for growth parameters, traits related to WUE and yield component traits in F₃, F₄, F₅ and F₆ segregating generations**

High broad sense heritability was observed (Table 6) for all the characters in F₃, F₄, F₅ and F₆ segregations populations for all the characters indicating that presence of high magnitude of genetic variability for the characters.

High narrow sense heritability was observed for days to flowering, number of pods per plant, kernels per plant kernel yield per plant, SLA, SCMR and shelling percentage in F₆ segregating population, which indicates that these characters were governed by additive variance. Therefore, selection will be effective for such traits based on phenotypic observations.

**Selected superior segregants in F₆ segregating generations**

Top high yielding progenies were selected from F₆ segregating populations based on important traits like SCMR, SLA, pods per plant, kernels per plant, kernel yield per plant, pod yield per plant and shelling percentage. From the selection it was observed that (Table 7) high yielding progenies are having higher SCMR coupled with lower SLA value and higher pod yield per plant. Since, these progenies were still segregating hence one more generation need to be test to predict their performance before releasing for either station trial or multi location trial.

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