GENETIC VARIABILITY FOR QUANTITATIVE TRAITS IN RECOMBINANT INBRED LINES OF GROUNDNUT (ARACHIS HYPOGAEA L.) GROWN UNDER INTERMITTENT DROUGHT STRESS

P. Srivalli* and H. L. Nadaf

Department of Genetics and Plant Breeding, University of Agricultural Sciences, Dharwad-580 005 (Karnataka), India.

Abstract

The present investigation was undertaken to study the extent of genetic variability for pod yield and other quantitative in groundnut during summer 2012-13 and summer 2013-14. Analysis of variance for individual seasons of summer 2012-13 and 2013-14 indicated that genotypes included in the study differed for all traits in each season. High PCV, GCV and wide range of variation was recorded by most of the quantitative traits viz., number of secondary branches per plant, number of pegs per plant, number of mature pods per plant, number of immature pods per plant, sound mature kernel per cent and 100 seed weight in both the irrigation levels in each season. Moderate to high heritability and genetic advance as per cent of mean were observed for majority of characters except for days to 50% flowering, days to maturity and number of primary branches per plant indicating that these traits were mainly governed by additive gene action and response to selection could be effected for further improvement of these traits through simple selection under water stress conditions to improve the groundnut for drought tolerance.

Key words : Groundnut, drought tolerance, genetic variability, heritability and genetic advance.

Introduction

Groundnut (Arachis hypogaea L.) is an important legume grown for the extraction of edible oil and used as a nutritional ingredient of human and animal foods. It ranks fifth in the world among oilseeds with an area of 24.48 million hectares, production of 42.74 million tonnes (with shell) and productivity of 1.68 tonnes/hectare (FAOSTAT, 2013). China, India and USA are the major producers of the crop, of which India accounts for area of 5.24 million hectares with 9.47 million tonnes of production (FAO, 2013). Though, India is a leading producer of the crop but its productivity is lower (1804 kg/ha) compared to USA (4496 kg/ha) and China (3658 kg/ha). The low productivity of the crop in India and several African countries is ascribed to many biotic and abiotic stresses in the cultivation of the crop.

Drought is by far the most important abiotic stress contributing to crop yield loss in the semi-arid tropics (SAT) characterized by low and erratic rainfall. More than half of the production area, that accounts for 70%

*Author for correspondence : E-mail-srivalli.pothula@gmail.com
heritability estimates would give the best picture of the amount of advance to be expected from selection. Keeping the aforesaid in view the present study has been undertaken to determine the estimates of genetic variability, heritability and genetic advance for yield and yield components in recombinant inbred line (RIL) population of groundnut under two water regimes.

**Materials and Methods**

The experimental material for the present study consists of RILs in F2 generation derived from the TMV-2 × GM 6-1 cross. A total number of 299 RILs were available for present study, which were evaluated along with the parents and eight checks. The experiments were carried out under well watered (WW) as well as water stress (WS) conditions during summer 2012-13 and summer 2013-14 at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad to evaluate RILs for quantitative traits.

A factorial experiment was planned in a randomized complete block design (RCBD) with two replications. The two water regimes of Well Watered (WW) and Water Stress (WS) conditions were assigned as Factor A, whereas the genotypes (2 parents + 299 RILs + 8 checks) were considered as Factor B. All the entries were sown in one row of 1m length with a spacing of 30 cm between rows and 10 cm between the plants. The recommended packages of practices were followed for raising a good crop. Observations were recorded on randomly chosen ten competitive plants for characters viz., plant height (cm), number of primary branches per plant, number of secondary branches per plant, number of pegs per plant, number of mature pods per plant, number of immature pods per plant, pod yield per plant (g), kernel yield per plant (g), shelling per cent, sound mature kernel per cent (%) and hundred seed weight. The characters viz., days to 50% flowering and days to maturity were recorded on per plot basis.

**Management of irrigation for treatment application**

The plants were exposed to intermittent stress in the WS plot from the time of flowering (30-45 DAS) until pod filling stage (75 DAS) in field as well as raised beds. In the field drought stress was imposed by irrigating both the plots (WW and WS) equally upto the time of flowering. Imposition of stress was initiated after the flowering for WS plot while, irrigation was supplied to the WW plot at 7-10 days interval.

The genotypic and phenotypic co-efficient of variations were computed as suggested by Burton and Devane (1953). Heritability in broad sense was computed as suggested by Hanson et al. (1956) and expressed as percentage while genetic advance was worked out as per the method outlined by Johnson et al. (1955).

**Results and Discussion**

**Analysis of variance (ANOVA)**

Pooled ANOVA across the two seasons (table 1) indicated significant difference between genotypes, seasons, irrigation level and also their interactions for all the traits studied.

**Mean, range and components of variation**

The nature and magnitude of variation for quantitative traits was assessed by phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability and genetic advance as per cent of mean along with mean and range for individual irrigation levels during both the seasons were indicated in table 2.

During summer 2012-13, days to 50 per cent flowering recorded low GCV (2.14), PCV (2.54) and high heritability (71.2%) with low genetic advance as per cent of mean (3.72%). Similarly during summer 2013-14, low PCV (2.61), GCV (2.39) and high heritability (83.43) with low genetic advance as per cent of mean (4.49) was recorded for days to 50% flowering. Days to maturity recorded low GCV (0.51, 0.61), PCV (0.63, 0.71) and high heritability (65.96%, 73.34%) with low genetic advance as per cent of mean (0.86%, 1.07%) during the two seasons respectively. This is in accordance with the reports of Rao et al. (2012).

Moderate GCV (10.28, 11.06), PCV (18.79, 20.71), heritability (29.92, 28.51) and GAM (11.58, 12.16) were recorded for plant height in both seasons respectively. During summer 2012-13, number of primary branches per plant recorded moderate PCV (19.11) but low GCV (7.63), heritability (15.96%) and genetic advance as per cent of mean (6.28%). In contrast, moderate GCV (19.81) but high PCV (25.42), heritability (60.76%) and GAM (31.81) was recorded by this trait during summer 2013-14. Similar kind of results plant height was reported by Rao et al. (2012) and for number of primary branches per plant by John et al. (2011).

High PCV, GCV and heritability with high GAM was recorded by most of the quantiative traits viz., number of secondary branches per plant, number of pegs per plant, number of mature pods per plant, number of immature pods per plant, pod yield per plant, kernel yield per plant, sound mature kernel per cent and 100 seed weight except shelling per cent during summer 2012-13, where it has recorded moderate GCV and PCV. During summer 2013-14, High PCV, GCV and heritability with
Table 1: Pooled analysis of variance for pod yield and its component traits in groundnut RILS of TMV-2 x GM 6-1 population over both seasons of summer 2012-13 and 2013-14.

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>DF</th>
<th>Days to 50% flowering</th>
<th>Days to maturity</th>
<th>Plant height</th>
<th>No of primary branches</th>
<th>No of secondary branches</th>
<th>No of pegs per plant</th>
<th>No of mature pods</th>
<th>No of immature pods</th>
<th>Pod yield per plant</th>
<th>Kernel yield per plant</th>
<th>Shelling per cent</th>
<th>Sound mature kernel %</th>
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<td>Season</td>
<td>1</td>
<td>110507.60**</td>
<td>60220.23**</td>
<td>44316.23**</td>
<td>1269.07**</td>
<td>1061.78**</td>
<td>3058.15*</td>
<td>682.29*</td>
<td>12380.67**</td>
<td>128.908**</td>
<td>11.44</td>
<td>11634.2</td>
<td>1092.53*</td>
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<tr>
<td>Genotype</td>
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<td>1.43**</td>
<td>1.92**</td>
<td>58.19**</td>
<td>2.50**</td>
<td>3.37**</td>
<td>292.78**</td>
<td>115.99**</td>
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<td>21.70**</td>
<td>1.32</td>
<td>78.10</td>
<td>185.34**</td>
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<td>490.37**</td>
<td>58961.37**</td>
<td>333.52**</td>
<td>154.35**</td>
<td>60515.74**</td>
<td>53792.68**</td>
<td>310.36**</td>
<td>18545.59**</td>
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<td>91031.19**</td>
<td>112174.00**</td>
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<td>7153.60**</td>
<td>34.02**</td>
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<td>1479.94**</td>
<td>5078.30**</td>
<td>1550.40**</td>
<td>228.05**</td>
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<td>1.26**</td>
<td>1.32**</td>
<td>60.87**</td>
<td>2.16**</td>
<td>3.29**</td>
<td>244.77**</td>
<td>94.73**</td>
<td>27.14**</td>
<td>8.57**</td>
<td>3.70**</td>
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<td>147.85**</td>
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<td>0.49**</td>
<td>36.57**</td>
<td>1.94**</td>
<td>5.56**</td>
<td>458.44**</td>
<td>176.77**</td>
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<td>83.19**</td>
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<td>Season* Irrigation Level* Genotype</td>
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<td>0.52**</td>
<td>0.46**</td>
<td>33.50**</td>
<td>2.36**</td>
<td>5.31**</td>
<td>421.85**</td>
<td>180.88**</td>
<td>13.50**</td>
<td>9.55**</td>
<td>4.30**</td>
<td>61.36**</td>
<td>74.85**</td>
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<td>Pooled Error</td>
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<td>0.14</td>
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<td>7.37</td>
<td>3.89</td>
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<td>CD 5%</td>
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<td>4.174</td>
<td>0.929</td>
<td>0.56</td>
<td>2.663</td>
<td>1.936</td>
<td>1.477</td>
<td>0.962</td>
<td>0.622</td>
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In contrast to the above traits, shelling per cent recorded low to moderate GCV, heritability and genetic advance estimates were reported by Reddy and Gupta (1992) for high GAM made by Reddy and Gupta (1992) for high GCV and CVC in two seasons. The results were in accordance with the observation of Chinnadurai et al. (1990). These estimates were reported by Rana et al. (2012) for 100 seed weight and kernel yield per plant by Reddy and Gupta (1992) for primary branches per plant during the two seasons. Shelling per cent flowering and heritability estimates were recorded for plant height and number of secondary branches per plant in both seasons.

High GAM was recorded for number of secondary branches per plant in both seasons. The results were in accordance with the reports of Zaman et al. (2011). Hence, simple directional selection may be effective.
<table>
<thead>
<tr>
<th>Character</th>
<th>Season</th>
<th>Mean of WW</th>
<th>Mean of WS</th>
<th>Range in WW</th>
<th>Range in WS</th>
<th>PCV (%)</th>
<th>GCV (%)</th>
<th>$h^2$ (Broad Sense)</th>
<th>GA</th>
<th>GAM</th>
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<td>Days to 50% flowering</td>
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<td>24.33</td>
<td>23.29</td>
<td>23 - 26</td>
<td>22 - 25</td>
<td>2.54</td>
<td>2.14</td>
<td>71.02</td>
<td>0.89</td>
<td>3.72</td>
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<td></td>
<td>S 2013-14</td>
<td>38.31</td>
<td>36.05</td>
<td>37 - 41</td>
<td>33 - 38</td>
<td>2.61</td>
<td>2.39</td>
<td>83.43</td>
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<td>4.49</td>
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<td>Days to maturity</td>
<td>S 2012-13</td>
<td>98.46</td>
<td>97.3</td>
<td>97 - 102</td>
<td>96 - 99</td>
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<td>0.51</td>
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<td>0.86</td>
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<td>107.44</td>
<td>106 - 112</td>
<td>106 - 109</td>
<td>0.71</td>
<td>0.61</td>
<td>73.34</td>
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<td>Plant height</td>
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<td>33.08</td>
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<td>13 - 55</td>
<td>10 - 51</td>
<td>18.79</td>
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<td>29.92</td>
<td>3.46</td>
<td>11.58</td>
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<td>28.02</td>
<td>14.85</td>
<td>8.5 - 54</td>
<td>0.5 - 37</td>
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<td>28.51</td>
<td>2.61</td>
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<td>No of Primary branches</td>
<td>S 2012-13</td>
<td>6.75</td>
<td>5.78</td>
<td>4 - 12</td>
<td>3 - 10</td>
<td>19.11</td>
<td>7.63</td>
<td>15.96</td>
<td>0.39</td>
<td>6.28</td>
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<td></td>
<td>S 2013-14</td>
<td>5.08</td>
<td>4.58</td>
<td>2.4 - 12</td>
<td>1.7 - 9.5</td>
<td>25.42</td>
<td>19.81</td>
<td>60.76</td>
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<td>31.81</td>
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<td>3.88</td>
<td>3.11</td>
<td>0.4 - 13</td>
<td>1 - 9</td>
<td>44.09</td>
<td>39.3</td>
<td>79.48</td>
<td>2.53</td>
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<td></td>
<td>S 2013-14</td>
<td>2.3</td>
<td>2.07</td>
<td>0 - 9</td>
<td>0 - 6.5</td>
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<td>33.16</td>
<td>76.19</td>
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<tr>
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<td>23.77</td>
<td>15.42</td>
<td>0 - 98</td>
<td>0 - 50</td>
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<td>23.09</td>
<td>11.65</td>
<td>3.4 - 86</td>
<td>1 - 83</td>
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<td>49.06</td>
<td>91.07</td>
<td>16.75</td>
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<td>No of mature pods</td>
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<td>18.83</td>
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<td>2 - 31</td>
<td>35.55</td>
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<td>8.45</td>
<td>2 - 40</td>
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<td>11.26</td>
<td>2 - 21</td>
<td>1 - 24</td>
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<td>6.07</td>
<td>5.2</td>
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<td>3.95</td>
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<td>0.15 - 10</td>
<td>31.04</td>
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<td>2.88</td>
<td>1.4 - 21</td>
<td>0 - 8.6</td>
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<td>6</td>
<td>2.22</td>
<td>0.6 - 13</td>
<td>0 - 6.4</td>
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<td>77.56</td>
<td>2.08</td>
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<td></td>
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<td>6.2</td>
<td>1.76</td>
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to improve these traits. The other traits with low or moderate values for these genetic parameters suggested that the lesser scope of improvement by selection process as non-additive gene effects were found predominant in their genetic control.

References


