PHENOTYPIC EVALUATION OF BACKCROSS POPULATION FOR YIELD AND FOLIAR DISEASES IN GROUNDNUT (ARACHIS HYPOGAEA L.)

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INTRODUCTION

Groundnut is major rain fed oilseed crop, affected by several biotic and abiotic stresses, leading to wide fluctuations in annual production and productivity. Among the biotic stresses, rust and late leaf spot (LLS) are two economically important diseases of groundnut. Incidence of foliar diseases occur in most of the groundnut growing states in India but predominantly in south Indian states as conditions favour the development and spread of diseases. These diseases often occur together and cause yield losses up to 50-70% in the crop (Subrahmanym et al.1985). Therefore, the use of groundnut resistant varieties to rust and leaf spot is considered to be an effective way to manage these diseases to reduce the additional cost of production as well as hazardous effect of fungicides on the soil and environment.

Several sources (wild arachis species and interspecific derivatives) of resistance to foliar diseases have been identified (Subrahmanym et al. 1982; Walls et al. 1985; Anderson et al.1993 and Singh et al. 1997). These sources known to be associated undesirable traits like poor yield and late maturity(Mehanet al.1996 and Singh et al.1997). Both, simple and complex inheritance of resistance to foliar diseases is reported in literature.

There is a need to break these unfavourable linkages and release the genetic variability to recombine different desirable traits in genotypes. Hence backcross programme was attempted to recombine foliar disease resistance with agronomic traits. The success of plant breeding programmes relies heavily on the existence of genetic variability in plants for a particular trait (Arunkumar, 2013). The information of nature and magnitude of variability and associations among disease resistance, yield and yield components will help the plant breeders to choose the appropriate breeding schemes to combine desirable features. The present study has aimed at evaluating the two backcross population for the genetic variability components and interrelationships among productive and foliar diseases.

MATERIALS AND METHODS

The material for present study consists of two backcross population derived from the cross between GPBD 4 and GM 4-3. GPBD 4 used as recurrent parent, possessing higher yield with foliar disease resistance, whereas GM 4-3 is a high oleate parent. Two backcross generations (BC1F1 and BC2F2) of cross (GPBD 4 × GM 4-3)-38 × GPBD 4 consists of 329 and 82 respectively were evaluated following the augmented design with three checks at experimental plots of Department of Genetics and Plant Breeding, Main Agricultural Research Station, University of Agricultural Sciences, Dharwad. Backcross population were evaluated for days to 50 per cent flowering, plant height (cm), number of primary branches per plant, reaction to rust (90 DAS), late leaf spot (LLS) incidence at 90 days and Spodoptera litura damage and pod yield per
plant. The modified 9 point scale for rust and late leaf spot as given by Subba Rao et al. (1990) was used for screening backcross population. Backcross population were screened for *Spodoptera litura* under the natural epiphytotic condition as per the visual score as described by Ranga Rao and Wightman (1997). Genotypic and phenotypic coefficient of variation were worked out as per the method suggested by Burton and De Vane (1953), heritability and genetic advance were calculated according to Johnson (1955) and Robinson et al. (1949). The simple correlation coefficient was calculated as per Panse and Sukhatme (1967).

**RESULTS AND DISCUSSION**

Both backcross (BC$_{F_1}$ and BC$_{F_2}$) generations exhibited significant variation for productive and foliar disease traits under study indicating the presence of adequate variability created through backcross programme. The analysis of variance revealed significant differences among in BC$_{F_1}$ generation of cross (GPBD 4 × GM 4-3)-38 × GPBD 4 for all the characters (Table 1). The estimates of range, phenotypic coefficient of variance (PCV) and GCV (Genotypic coefficient of variance), Genetic advance as per cent of mean (GAM) are indicated in the Table 3. Days to 50 per cent flowering ranged from 30 to 35 days with an average of 30 days. Backcross population matured in minimum duration of 93 days and maximum of 109 days with average of 97 days. Lowest value of plant height recorded was 8.25 cm and highest was 34 cm with mean value of 21.34 cm. Primary branches per plant ranged from 2 to 10 with an average of 5. Lowest rust incidence in BC$_{F_1}$ population was 3 and maximum score was 8 with average of 3, whereas LLS incidence was lowest score of 2 to highest score 9 with an average score of 3. *Spodoptera litura* damage was ranged from 18 to 90 per cent with average damage of 61 per cent in BC$_{F_1}$ generation. Pod yield per plant ranged from 6.5 g to 49 g with average weight of 29 g per plant in BC$_{F_1}$ generation.

The analysis of variance revealed significant differences among in BC$_{F_2}$ generation of cross (GPBD 4 × GM 4-3)-38 × GPBD 4 for all the characters (Table 2). The estimates of range, PCV and GCV, GAM indicated in the Table 3. Days to 50 per cent flowering ranged from 29 to 36 days with an average of 31 days. Backcross population matured in minimum of 92 days and maximum of 109 days with average of 97 days. Plant height ranged from 10 cm to 34 cm with mean value of 22.15 cm. Primary branches per plant was ranged from 3 to 7 with an average of 5. Rust incidence in BC$_{F_2}$ population ranged from 3 to 8 score with average of 3, whereas LLS incidence ranged from 3 to 9 with an average score of 3. *Spodoptera litura* damage ranged from 30 to 88 per cent with average damage of 57 per cent. Pod yield per plant ranged from 2.5 g to 54 g with average weight of 22.19 g per plant in BC$_{F_2}$ generation.

**PCV and GCV estimates**

The phenotypic coefficient of variation (PCV) had higher estimates than corresponding GCV for all traits and there was a narrow difference between PCV and GCV values for all traits except rust and LLS incidence at 90 days in both generations (Table 3). The narrow differences between PCV and GCV values indicated that variability was mainly due to genotypic differences and little influence of environment in the expression of traits.

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**Table 1: Analysis of variance for pod yield and its components in groundnut genotypes (Arachis hypogaea L.) in BC$_{F_1}$ generation of (GPBD4 × GM 4-3)-38 × GPBD 4 cross**

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>df</th>
<th>Days to 50 per cent flowering</th>
<th>Days to maturity</th>
<th>Plant height (Cm)</th>
<th>Primary branches per plant</th>
<th>Rust incidence at 90 DAS</th>
<th>LLS incidence at 90 DAS</th>
<th>Spodoptera damage (%)</th>
<th>Pod yield per plant (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block (eliminating Checks + Genotypes)</td>
<td>9</td>
<td>0.81</td>
<td>0.308</td>
<td>0.134</td>
<td>0.133</td>
<td>0.133</td>
<td>0.37</td>
<td>0.09</td>
<td>0.283</td>
</tr>
<tr>
<td>Entries (ignoring Blocks)</td>
<td>332</td>
<td>3.723**</td>
<td>7.736**</td>
<td>23.43**</td>
<td>1.672**</td>
<td>0.870**</td>
<td>1.41**</td>
<td>199.54**</td>
<td>72.446**</td>
</tr>
<tr>
<td>Checks</td>
<td>2</td>
<td>12.7**</td>
<td>248.03**</td>
<td>279.11**</td>
<td>2.8**</td>
<td>36.3**</td>
<td>81.7**</td>
<td>1300.2**</td>
<td>21.033**</td>
</tr>
<tr>
<td>Genotypes</td>
<td>329</td>
<td>3.68**</td>
<td>2.009**</td>
<td>18.28**</td>
<td>1.658**</td>
<td>0.534</td>
<td>0.659**</td>
<td>172.79**</td>
<td>68.517**</td>
</tr>
<tr>
<td>Checks vs. Genotypes</td>
<td>1</td>
<td>0.057</td>
<td>1411.2**</td>
<td>1200.5**</td>
<td>4.089**</td>
<td>40.6**</td>
<td>90.002**</td>
<td>6797.4**</td>
<td>1467.9**</td>
</tr>
<tr>
<td>Error</td>
<td>18</td>
<td>0.293</td>
<td>0.257</td>
<td>0.322</td>
<td>0.281</td>
<td>0.3</td>
<td>0.293</td>
<td>0.566</td>
<td>0.403</td>
</tr>
</tbody>
</table>

**Table 2: Analysis of variance for pod yield and its components in groundnut genotypes (Arachis hypogaea L.) in BC$_{F_2}$ generation of (GPBD 4 × GM 4-3)-38 × GPBD 4 cross**

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>df</th>
<th>Days to 50 per cent flowering</th>
<th>Days to maturity</th>
<th>Plant height (Cm)</th>
<th>Primary branches per plant</th>
<th>Rust incidence at 90 DAS</th>
<th>LLS incidence at 90 DAS</th>
<th>Spodoptera damage (%)</th>
<th>Pod yield per plant (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block (eliminating Checks + Genotypes)</td>
<td>11</td>
<td>0.172</td>
<td>0.333</td>
<td>0.72</td>
<td>0.202</td>
<td>0.121</td>
<td>0.242</td>
<td>0.081</td>
<td>0.323</td>
</tr>
<tr>
<td>Entries (ignoring Blocks)</td>
<td>85</td>
<td>2.5**</td>
<td>31.12**</td>
<td>37.89**</td>
<td>0.955**</td>
<td>2.654**</td>
<td>4.512**</td>
<td>326.77**</td>
<td>146.58**</td>
</tr>
<tr>
<td>Checks</td>
<td>2</td>
<td>13.44**</td>
<td>304.03**</td>
<td>336.11**</td>
<td>3.44**</td>
<td>42.33**</td>
<td>100**</td>
<td>1573.44**</td>
<td>24.11**</td>
</tr>
<tr>
<td>Genotypes</td>
<td>82</td>
<td>2.139**</td>
<td>14.13**</td>
<td>14.13**</td>
<td>1.434**</td>
<td>1.434**</td>
<td>1.434**</td>
<td>236.98**</td>
<td>150.1**</td>
</tr>
<tr>
<td>Checks vs. Genotypes</td>
<td>1</td>
<td>10.54**</td>
<td>1760.01**</td>
<td>1413.75**</td>
<td>0.002</td>
<td>24.604**</td>
<td>69.004**</td>
<td>5286.02**</td>
<td>43.481**</td>
</tr>
<tr>
<td>Error</td>
<td>22</td>
<td>0.293</td>
<td>0.242</td>
<td>0.293</td>
<td>0.273</td>
<td>0.242</td>
<td>0.535</td>
<td>0.354</td>
<td>0.354</td>
</tr>
</tbody>
</table>
of these traits. In both generations (BC$_{F_1}$ and BC$_{F_2}$) days to 50 per cent flowering and days to maturity exhibited low estimates of PCV and GCV values, whereas pod yield per plant and Spodoptera litura damage exhibited higher PCV and GCV estimates. Plant height showed moderate PCV and GCV estimates in both (BC$_{F_1}$ and BC$_{F_2}$) generations. Primary branches per plant showed moderate PCV and GCV estimates in BC$_{F_1}$ generation and high estimates of PCV and GCV values in BC$_{F_2}$ generation. The results are in conformity with the earlier findings of Venkateshemurthy et al. (2005), Korat et al. (2009), Zaman et al. (2011), Rao et al. (2012), Vishnuvardhan et al. (2012) and Sunday and Omalayo (2013) for days to 50 per cent flowering, days to maturity, pod yield per plant, plant height and primary branches per plant. Rust and LLS incidence at 90 days showed moderate to high estimates of PCV and GCV values. Similar kind of moderate to high PCV and GCV estimates for rust and LLS incidence at 90 days was also observed by Jakkeral et al. (2014), Padmaja et al. (2013) and Azaruddin (2010). In both generations, high heritability coupled with low genetic advance as per cent of mean was observed for days to 50 per cent flowering and days to maturity (Rao et al. 2012; Vishnuvardhan et al. 2012) and Sunday and Omalayo (2013) suggesting the non-additive gene control in the expression of these traits.

**Correlation among yield components and foliar diseases**

Association among yield and foliar diseases are indicated in Table 4. Days to 50 per cent flowering correlated significant positively with days to maturity in both (BC$_{F_1}$ and BC$_{F_2}$) generations. Similar kind of positive association was also noticed by Channayya (2009). Days to 50 per cent flowering correlated negatively with plant height and rust and LLS incidence at 90 days in BC$_{F_1}$ generation. Days to maturity correlated significant positively with days to 50 per cent flowering and plant height in both generations. Similar kind of positive correlation between days to maturity and plant height was also noticed by Alam et al. (1985b). It is also associated significant negatively with pod yield per plant in BC$_{F_1}$ generation. Negative relation between days to maturity and pod yield per plant was also observed by Wu et al. (1993), Korat et al. (2009) and Sunday and Omalayo (2013).

In BC$_{F_2}$ generation, Primary branches per plant associated significantly with rust and LLS incidence at 90 days, whereas in BC$_{F_1}$ generation it correlated negatively with plant height. This is in accordance with Prabhu et al. (2015). Spodoptera litura damage correlated negatively with days to maturity in

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### Table 3: Estimates of genetic parameters for pod yield and its component traits in BC$_{1F_3}$ and BC$_{2F_2}$ generations of groundnut

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Generation</th>
<th>Days to 50 per cent flowering</th>
<th>Days to maturity</th>
<th>Plant height (cm)</th>
<th>Primary branches per plant</th>
<th>Rust incidence at 90DAS</th>
<th>LLS incidence at 90DAS</th>
<th>Spodoptera damage (%)</th>
<th>Pod yield per plant (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>BC$_{F_1}$</td>
<td>30</td>
<td>93</td>
<td>8.25</td>
<td>2.25</td>
<td>3</td>
<td>2</td>
<td>18.33</td>
<td>6.5</td>
</tr>
<tr>
<td></td>
<td>BC$_{F_2}$</td>
<td>29</td>
<td>92</td>
<td>10</td>
<td>3.5</td>
<td>3</td>
<td>3</td>
<td>30</td>
<td>2.5</td>
</tr>
<tr>
<td>Maximum</td>
<td>BC$_{F_1}$</td>
<td>35</td>
<td>109</td>
<td>34</td>
<td>10.5</td>
<td>8</td>
<td>9</td>
<td>90.28</td>
<td>49</td>
</tr>
<tr>
<td></td>
<td>BC$_{F_2}$</td>
<td>36</td>
<td>109</td>
<td>34</td>
<td>7.25</td>
<td>8</td>
<td>9</td>
<td>88.89</td>
<td>54</td>
</tr>
<tr>
<td>Mean</td>
<td>BC$_{F_1}$</td>
<td>30.74</td>
<td>97.30</td>
<td>21.34</td>
<td>5.45</td>
<td>3.29</td>
<td>3.34</td>
<td>61.55</td>
<td>29.76</td>
</tr>
<tr>
<td></td>
<td>BC$_{F_2}$</td>
<td>31.18</td>
<td>97.98</td>
<td>22.15</td>
<td>5.11</td>
<td>3.64</td>
<td>3.84</td>
<td>57.25</td>
<td>22.19</td>
</tr>
<tr>
<td>$\sigma^g$</td>
<td>BC$_{F_1}$</td>
<td>3.18</td>
<td>1.65</td>
<td>16.88</td>
<td>1.29</td>
<td>0.22</td>
<td>0.34</td>
<td>161.89</td>
<td>64.03</td>
</tr>
<tr>
<td></td>
<td>BC$_{F_2}$</td>
<td>1.42</td>
<td>2.67</td>
<td>10.63</td>
<td>0.47</td>
<td>0.89</td>
<td>0.92</td>
<td>181.72</td>
<td>115.32</td>
</tr>
<tr>
<td>$\sigma^p$</td>
<td>BC$_{F_1}$</td>
<td>3.48</td>
<td>1.90</td>
<td>17.20</td>
<td>1.58</td>
<td>0.52</td>
<td>0.64</td>
<td>162.46</td>
<td>64.43</td>
</tr>
<tr>
<td></td>
<td>BC$_{F_2}$</td>
<td>1.71</td>
<td>2.92</td>
<td>10.93</td>
<td>0.76</td>
<td>1.16</td>
<td>1.16</td>
<td>182.25</td>
<td>115.67</td>
</tr>
<tr>
<td>GCV (%)</td>
<td>BC$_{F_1}$</td>
<td>6.06</td>
<td>1.43</td>
<td>19.95</td>
<td>22.88</td>
<td>22.64</td>
<td>25.02</td>
<td>20.28</td>
<td>26.43</td>
</tr>
<tr>
<td></td>
<td>BC$_{F_2}$</td>
<td>4.17</td>
<td>1.79</td>
<td>16.61</td>
<td>17.13</td>
<td>32.26</td>
<td>32.17</td>
<td>21.92</td>
<td>49.35</td>
</tr>
<tr>
<td>PCV (%)</td>
<td>BC$_{F_1}$</td>
<td>0.92</td>
<td>0.87</td>
<td>0.98</td>
<td>0.82</td>
<td>0.42</td>
<td>0.54</td>
<td>0.923</td>
<td>0.956</td>
</tr>
<tr>
<td></td>
<td>BC$_{F_2}$</td>
<td>0.83</td>
<td>0.92</td>
<td>0.97</td>
<td>0.62</td>
<td>0.77</td>
<td>0.79</td>
<td>99.056</td>
<td>99.42</td>
</tr>
<tr>
<td>h² (BS)</td>
<td>BC$_{F_1}$</td>
<td>3.52</td>
<td>2.46</td>
<td>8.38</td>
<td>2.12</td>
<td>0.63</td>
<td>0.89</td>
<td>0.99</td>
<td>0.994</td>
</tr>
<tr>
<td></td>
<td>BC$_{F_2}$</td>
<td>2.23</td>
<td>3.23</td>
<td>6.63</td>
<td>1.11</td>
<td>1.70</td>
<td>1.75</td>
<td>27.73</td>
<td>22.09</td>
</tr>
<tr>
<td>GA</td>
<td>BC$_{F_1}$</td>
<td>11.44</td>
<td>2.54</td>
<td>40.33</td>
<td>38.71</td>
<td>19.74</td>
<td>27.88</td>
<td>41.63</td>
<td>54.10</td>
</tr>
<tr>
<td></td>
<td>BC$_{F_2}$</td>
<td>7.12</td>
<td>3.38</td>
<td>33.30</td>
<td>21.76</td>
<td>50.90</td>
<td>32.39</td>
<td>45.02</td>
<td>99.9</td>
</tr>
</tbody>
</table>

$\sigma^g$: Phenotypic variance, $\sigma^p$: Genotypic variance, GCV (%) = Genotypic coefficient of variance, h² (BS): Heritability in broad sense, GCV (%) = phenotypic coefficient of variance, GA: Genetic advance, GAM: Genetic advance as per cent of mean.
Table 4: Estimates of phenotypic correlation coefficients for pod yield and its components in BC \(_1\)F\(_3\) and BC \(_2\)F\(_2\) generation of \((\text{GPBD 4} \times \text{GM 4-3})\)-38 × GPBD 4 cross

<table>
<thead>
<tr>
<th>Character</th>
<th>Days to 50 per cent flowering (Cm)</th>
<th>LLS at 90 DAS (%)</th>
<th>Pod yield per plant (g)</th>
<th>Days to maturity (Cm)</th>
<th>Plant height (Cm)</th>
<th>Primary branches per plant</th>
<th>Rust incidence at 90 DAS (%)</th>
<th>Spodoptera litura (S) incidence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BC(_1)F(_3)</td>
<td>0.337**</td>
<td>-0.181**</td>
<td>0.051</td>
<td>0.337**</td>
<td>0.190**</td>
<td>0.051</td>
<td>0.111**</td>
<td>0.037</td>
</tr>
<tr>
<td>BC(_2)F(_2)</td>
<td>0.198*</td>
<td>0.094</td>
<td>0.034</td>
<td>0.094</td>
<td>0.094</td>
<td>0.034</td>
<td>0.094</td>
<td>0.094</td>
</tr>
</tbody>
</table>

In both generations, LLS incidence at 90 days associated positively with rust incidence at 90 days. This is in accordance with Azaruddin (2010). Both rust and LLS incidence at 90 days are correlated positively significantly with plant height in both generations.

Phenotypic correlations coefficients among characters indicated differences between BC\(_1\)F\(_3\) and BC\(_2\)F\(_2\) generations. In BC\(_1\)F\(_3\) generation, significant yield reduction observed due to biotic stresses viz., Spodoptera litura damage, rust incidence at 90 days and LLS incidence at 90 days whereas in BC\(_2\)F\(_2\) generation only rust incidence at 90 days affected significantly the pod yield per plant indicating the lower incidence of LLS incidence at 90 days and Spodoptera litura damage in BC\(_2\)F\(_2\) population as indicated in lower magnitudes of correlation coefficients and nonsignificant negative relation.

**REFERENCES**


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