GENETIC VARIABILITY STUDIES IN SUMMER PEA UNDER COLD DESERT AREAS OF NORTH-WESTERN HIMALAYAS

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ABSTRACT

A field experiment was conducted during summer 2004 to find out genetic variability, heritability and genetic advance for marketable pod yield and its seven other associated traits in nine diverse genotypes of garden pea under cold desert conditions of North-Western Himalayas. Sufficient genetic variability was observed for marketable pod yield, no. of pods per plant, durations of availability of pods and grains per pod. The magnitude of phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all the traits. Marketable pod yield exhibited high heritability associated with high genetic advance as per cent of mean, whereas, no. of pods per plant, grains per pod and duration of marketable pods had high heritability with moderate genetic advance. The marketable pod yield ranged from 17.88 q (Lincoln) to 42.64 q/ha (Kukumseri Selection) and it exhibited 96.56% heritability with high genetic advance of 50.91 as percentage of mean. For improvement of such traits, suitable breeding methods have been suggested.

Garden pea (Pisum sativum L.) is one of the major cash crops of cold desert regions of Himachal Pradesh. The region is well known for off-season production of peas, as the green pods from these areas are available from second fortnight of May to first fortnight of September. Since the crop cannot be grown in the plains during summer due to high temperature. Peas produced in this region are sold at higher prices in plains. In Himachal Pradesh Azad P-1 variety is predominately cultivated. For the last many years, very little emphasis has been given for the development of other comparatively higher yielding genotypes. The exploration of genetic variability in the available germplasm is a pre-requisite in any breeding programme for effective selection of superior genotypes. The identification of genotypes with wide genetic variability and high heritability for desired characters is indeed useful in the development of new varieties with increased yield potential (Kader et al. 1982). Since, the polygenic characters like yield and its component traits are highly influenced by the environment, it is essential to partition the total variability into heritable and non-heritable components. The objectives of the investigation, is to understand the magnitude of genetic variability and heritability for eight characters in nine diverse genotypes of garden pea for obtaining maximum and accurate effect of selection.

The present investigation was undertaken with nine diverse genotypes of garden pea viz., Lincoln, Palam Priya, Azkel, 9418-17, 9418-6, Matar Ageta, Azad P-1, Kukumseri Selection and VRPMR-9 maintained genetically pure through self-pollination. The experiment was conducted during summer 2004 at the experimental farm of Research Sub-Station, Lari in Spiti Valley of Himachal Pradesh (30° – 30°42’ N latitude, 77° 37’ -78° 35’ E longitude and 3300 m above msl). The soil of the experimental field was silty loam in texture, alkaline in reaction (pH 8.3), low in nutrients especially available N (178 kg/ha) and organic matter content (0.55%). The experiment was laid out in a randomized complete block design with three replications during summer 2004. The sowing was done on April 24th, 2004, in experimental plots consisted of 2m length and plants were spaced at 40x10 cm apart between and within rows. The observations were recorded on ten randomly marked competitive plants for days to 50%
flowering, days to first picking, number of pods/plant, pod weight (g), pod length (cm), grains/pod, duration of availability of marketable pods and marketable pod yield (q/ha). The data were analyzed for each character and variance components were calculated as per (Panse and Sukhatme, 1967). The formulae suggested by (Burton, 1952; Johnson et al., 1955 and Comstock and Robinson, 1952) were used for calculating the genotypic (GCV) and phenotypic coefficient of variation, heritability (h2) and genetic advance (GA).

The mean performance of different genotypes and analysis of variance revealed significant differences among genotypes for all the traits studied (Table 1). The extent of variability for eight polygenic traits in nine diverse genotypes of garden pea measured in terms of range, coefficient of variation (CV), genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), environmental coefficient of variation (ECV) along with heritability (h2) and genetic advance (GA) are presented in Table 2.

The coefficient of variation ranged from 1.64 (pod length) to 5.68% (duration of availability of marketable pods). Phenotypic variance (Vp) was observed greater than genotypic (Vg) and environmental variances (Ve) amongst all the characters. The magnitude of heritable components to a greater extent determines the transmissibility of a character from parents to offspring. In the present study, the differences between the genotypic and phenotypic variances were relatively low for all the traits studied. This indicated the highly heritable and comparatively stable nature of the characters. This further suggested that selection based on phenotypic performance would be quite effective in the improvement of these traits.

The phenotypic coefficient of variation (PCV), as expected, was higher than genotypic coefficient of variation (GCV) for all the traits studied. The GCV which provides a picture of genetic variability in the population, ranged from 6.58 (pod length) to 25.12% (marketable pod yield). The highest GCV (25.12%) associated with highest genetic advance (GA) expressed both at 5% intensity of selection (16.28%) and as percentage of mean (50.91%) for marketable pod yield. The minimum variability (GCV = 6.58%) associated with lowest genetic advance values (13.13%) expressed as percentage of mean was observed for pod length.

The relative amount of heritable portion of the variation was found with the help of heritability estimates and genetic advance

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>Days to flowering</th>
<th>Days to picking</th>
<th>No. of 50% pod/ plant</th>
<th>Pod weight (g)</th>
<th>Pod length (cm)</th>
<th>Grains/pod</th>
<th>Duration of availability of marketable pods (days)</th>
<th>Yield (q/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lincoln</td>
<td>69.3</td>
<td>85.7</td>
<td>2.9</td>
<td>4.83</td>
<td>7.2</td>
<td>5.0</td>
<td>20.67</td>
<td>17.88</td>
</tr>
<tr>
<td>Palam Priya</td>
<td>62.0</td>
<td>77.0</td>
<td>4.0</td>
<td>5.77</td>
<td>8.8</td>
<td>7.7</td>
<td>37.33</td>
<td>39.54</td>
</tr>
<tr>
<td>Axel</td>
<td>51.0</td>
<td>68.3</td>
<td>1.9</td>
<td>4.97</td>
<td>8.4</td>
<td>5.3</td>
<td>33.00</td>
<td>21.97</td>
</tr>
<tr>
<td>9418-17</td>
<td>55.7</td>
<td>71.3</td>
<td>3.8</td>
<td>5.23</td>
<td>8.7</td>
<td>5.4</td>
<td>38.67</td>
<td>28.02</td>
</tr>
<tr>
<td>9418-6</td>
<td>46.3</td>
<td>65.3</td>
<td>3.0</td>
<td>4.57</td>
<td>8.0</td>
<td>6.7</td>
<td>34.33</td>
<td>37.40</td>
</tr>
<tr>
<td>Matar Ageta</td>
<td>51.3</td>
<td>69.3</td>
<td>3.3</td>
<td>5.60</td>
<td>8.6</td>
<td>6.5</td>
<td>33.67</td>
<td>32.84</td>
</tr>
<tr>
<td>Azad P-1</td>
<td>54.0</td>
<td>71.0</td>
<td>3.0</td>
<td>5.23</td>
<td>7.8</td>
<td>6.3</td>
<td>31.00</td>
<td>33.00</td>
</tr>
<tr>
<td>Kukumseri Selection</td>
<td>51.7</td>
<td>71.0</td>
<td>4.1</td>
<td>6.33</td>
<td>8.9</td>
<td>7.8</td>
<td>38.67</td>
<td>42.64</td>
</tr>
<tr>
<td>VRPMR-9</td>
<td>55.7</td>
<td>72.7</td>
<td>3.5</td>
<td>5.93</td>
<td>8.5</td>
<td>7.0</td>
<td>32.33</td>
<td>34.49</td>
</tr>
<tr>
<td>LSD (P=0.05)</td>
<td>2.9</td>
<td>2.8</td>
<td>0.2</td>
<td>5.93</td>
<td>0.2</td>
<td>0.2</td>
<td>29.67</td>
<td>2.70</td>
</tr>
</tbody>
</table>
### TABLE 2. Mean, range, coefficient of variation, variance, heritability and genetic advance for different traits in garden pea

<table>
<thead>
<tr>
<th>Traits</th>
<th>Mean</th>
<th>Range</th>
<th>Coefficient of variance (CV)</th>
<th>Genotypic variance (Vg)</th>
<th>Phenotypic variance (Mp)</th>
<th>Environ. Variance (Ve)</th>
<th>Genetic Advance (GA)</th>
<th>5% Intensity of mean selection</th>
<th>% of mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of pod per plant</td>
<td>3.28±0.08</td>
<td>1.9-4.1</td>
<td>4.13</td>
<td>0.43</td>
<td>0.45</td>
<td>0.02</td>
<td>19.99 20.45 4.31 95.56</td>
<td>1.32</td>
<td>40.26</td>
</tr>
<tr>
<td>Marketable pod yield (q/ha)</td>
<td>31.98±0.90</td>
<td>17.88-42.64</td>
<td>4.88</td>
<td>64.56</td>
<td>67.0</td>
<td>2.44</td>
<td>25.12 25.60 4.88 96.56</td>
<td>16.28</td>
<td>50.91</td>
</tr>
<tr>
<td>Grains per pod</td>
<td>6.41±0.07</td>
<td>5.0-7.8</td>
<td>2.0</td>
<td>1.06</td>
<td>1.08</td>
<td>0.02</td>
<td>16.06 16.21 2.21 98.15</td>
<td>2.10</td>
<td>32.76</td>
</tr>
<tr>
<td>Days to first picking</td>
<td>72.4±0.92</td>
<td>65.3-85.7</td>
<td>2.21</td>
<td>33.92</td>
<td>36.48</td>
<td>2.56</td>
<td>8.08 8.34 2.21 92.98</td>
<td>11.57</td>
<td>15.98</td>
</tr>
<tr>
<td>Days to 50% flowering</td>
<td>55.22±0.98</td>
<td>46.3-69.3</td>
<td>3.06</td>
<td>45.49</td>
<td>48.35</td>
<td>2.86</td>
<td>12.21 12.59 3.06 94.08</td>
<td>13.48</td>
<td>24.41</td>
</tr>
<tr>
<td>Pod length (Cm)</td>
<td>8.32±0.08</td>
<td>7.2-8.9</td>
<td>1.64</td>
<td>0.30</td>
<td>0.32</td>
<td>0.02</td>
<td>6.58 6.80 1.70 93.75</td>
<td>1.09</td>
<td>13.13</td>
</tr>
<tr>
<td>Pod weight (g)</td>
<td>5.39±0.13</td>
<td>4.81-6.33</td>
<td>4.15</td>
<td>0.31</td>
<td>0.36</td>
<td>0.05</td>
<td>10.33 11.13 4.15 86.11</td>
<td>1.06</td>
<td>19.75</td>
</tr>
<tr>
<td>Duration of availability of marketable pod (days)</td>
<td>33.30±1.09</td>
<td>20.67-38.67</td>
<td>5.68</td>
<td>28.93</td>
<td>32.51</td>
<td>3.58</td>
<td>16.15 17.12 5.68 88.99</td>
<td>10.45</td>
<td>31.39</td>
</tr>
</tbody>
</table>
expressed as percentage of mean (genetic grain). All the characters displayed high heritability. High heritability estimates have been found to be helpful in making selection of superior genotypes on the basis of phenotypic performance with respect to quantitative traits. However, the heritability estimates along with genetic gain is more useful than the heritability values alone in predicting the resultant effect of selecting the best individuals. High heritability was observed for all the traits studied with highest in grains per pod (98.15%) and marketable pod yield (96.56%). Marketable pod yield exhibited high heritability associated with high genetic advance as per cent of mean whereas; number of pods per plant, grains per pod and duration of marketable pods had high heritability with moderate genetic advance. High heritability estimates coupled with low genetic advance were observed for days to 50% flowering, average pod weight, days to first picking and pod length.

In general, the characters, which exhibited high heritability with high genetic advance are controlled by additive genes and can be improved upon through simple selection procedures. However, the characters with high heritability coupled with moderate to low genetic advance can be improved upon by inter-mating the superior genotypes of the segregating population developed from multiple crosses and the desirable genes can be accumulated in the genotypes (Liang and Walter, 1968). Since the heritability gives only an idea about the proportion of total variability that is due to genetic causes, the more confirmative decision for opting any breeding procedure for the improvement of any trait can only be taken up after ascertaining the type of gene action involved in the inheritance of that particular trait.

REFERENCES