Study of Some Important Morpho-Physiological Feature and Yield Attributes In Three Pea Genotypes

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Abstract: The experiment was carried out in the field of Bangladesh Institution of Nuclear Agriculture (BINA), Mymensingh, during the period from 15 November 2012 to 10 March 2013 to study the morpho-physiological characters, yield and yield attributes of three genotypes of pea, viz., Exotic-1, IPSA-2 and IPSA-3. The experiment was conducted in a Randomized Complete Block Design with seven replications. Data were collected at 20, 40, 60, 80, 108 and 115 days after sowing (DAS). Varieties showed significant differences in plant height, branch number, leaf area, fresh and weights of roots, chlorophyll, aminoacid, soluble protein content, number of pods/plant, 1000-seed weight, pod size, harvest index and pod yield at harvest. Among the varieties, IPSA-3 attained the highest pod yield at harvest. Exotic-1 had the lowest protein content in leaf, highest pods weight/plant, 1000-seed weight, harvest index, pod and seed yield. Exotic-1 had higher yield than the other two genotypes.

Keywords: Pea, Morpho-physiological characteristics, Randomize Complete Block Design, Yield attribute

1. Introduction

The garden (Pisum sativum L.) is a widely grown legume belonging to the subfamily of Papilionaceae under the family Leguminosae. It is probably originated in southern Asia but is one of the important legume vegetables in Bangladesh and mostly grown for garden pods and seeds. The crop becomes popular for its high nutritive value and good taste. It contains 13-35% protein, 25-50% starch, 4-10% sugar, 0.6-1.5% fat and 2-4% minerals [12]. Globally, 8.06 million hectare of crop land was covered by peas with a production of 15 million metric tons in 1999 [6]. People in Bangladesh consume 23g vegetables per head per day but the minimum requirement is 200g per head per day [10]. Being a legume, pea has unique ability to fix atmospheric nitrogen through symbiosis. Field pea can fix about 64 kg nitrogen per hectare per annum [6]. Bangladesh soils are generally poor in nitrogen and organic matter. The incorporation of legume crops including field pea in the cropping pattern of such soils can help to maintain equilibrium when the nitrogen is fixed through Rhizobia at root zone and the organic matter deposited through crop residues. The agro ecological condition of Bangladesh is favorable for the cultivation of this crop. Field pea can be grown in rabi season. It takes about 45 to 50 days for showing for its green pod harvest and 90 to 100 days for mature seed harvest. Pea research in Bangladesh has been neglected [10]. Over the past decades, there has been a dramatic improvement in the yield of cereal grains. This was achieved by manipulation of the genetic makeup and physiological characteristics of these crops. Optimum density and row spacing are essential for attaining desired yield also [11]. Before going develop good high yielding varieties of peas, it is necessary to select the morpho-physiologically better characters to be incorporated in the future during the development of the pea cultivars. With this aim in view, the present experiment was conducted to study some important morphological features, investigate some physiological attributes and envisage yield attributes in three pea genotypes. The present investigation was designed to select some morpho-physiological and yield parameters responsible for higher yield of peas and be helpful to develop high yielding varieties.

2. Material and Methods

The experiment was conducted at the Bangladesh Institute of Nuclear Agriculture farm, Mymensingh, geographically located at 24º75’N latitude and 90º50’E longitudes at the elevation of 18m above the sea level [6]. The land was further ploughed and cross ploughed several times followed by laddering until a good tilth was achieved. After ploughing and laddering, weeds and stubbles were collected and removed from the field during field preparation. Urea, TSP, and Muriate of Potash (MP) were applied to the plots as a source of nitrogen, phosphorus and potassium, respectively. Cow dung was also applied to the soil. Seeds of exotic line were collected from BINA, Mymensingh and IPSA from BSMARU, Gazipur. Seeds were sown by hand at 3 cm depth at a spacing of 25×10 cm. Germination of seeds was examined in the laboratory before showing in the field to ensure proper population in the plot before showing in the field. Thinning was done after 7 days of emergence for keeping desired plant density and to avoid competition. Weeding and irrigation were done as and when needed. The sample plants were harvested at three different times at 20, 40 and 60 days after showing (DAS). These plants were uprooted carefully to investigate rooting and shooting characteristics. Flower and pod production and percentage of floral abscission were estimated at 60, 80 and 100 DAS following the method of Fakir [6]. Chlorophyll in leaves by HG-AAS, soluble protein by UV-VIS spectrophotometer was determined. Total nitrogen content by Kjeldahl method and total Ca, Mg, and K were determined by Di-acid
3. Result and discussion

3.1 Morphological characteristics

3.1.1 Plant height
Plant height varied significantly at different days after sowing (DAS) among the varieties. At 20 DAS, the tallest plant (13.04 cm) was observed in IPSA-3 and the shortest plant was recorded in Exotic-1 (9.09 cm), which was statically similar to IPSA-2 (9.11 cm). At 40 DAS, the tallest plant (34.26 cm) was found again in IPSA-3 which was statistically different from other varieties. The second highest plant (30.21 cm) was observed in IPSA-2 and the shortest plant was found in Exotic-1 (19.78 cm) (Table 5). At 60 DAS, the tallest plant (42.74 cm) was obtained in IPSA-3 which was statistically different from Exotic-1. It was evident that plant height significantly differed from variety to variety. Rahman [15] also observed a quite high degree of variability in plant height among different pea varieties.

3.1.2 Number of branches per plant
At 20 DAS, the higher branch per plant was observed in Exotic-1 than IPSA-3. At 40 DAS, the maximum branches per plant were obtained in IPSA-2 (2.40) which was statically similar to IPSA-3 but different from Exotic-1. At 60 DAS, the higher branches per plant (3.10) were observed in Exotic-1 than IPSA-3 (2.74). Akhter [3] also noted differences in branch number in varieties.

3.1.3 Number of leaves per plant
The maximum number of leaves per plant was obtained in IPSA-3 in all sampling dates. At 20 DAS, the greater number of leaves per plant was observed in IPSA-3 (13.17) compared to IPSA-2 (10.71) and Exotic-1 (9.35). The second highest number of leaves per plant was obtained in IPSA-2 and the lowest number of leaves per plant was obtained in IPSA-2 and the lowest number of leaves per plant was found in Exotic-1.

3.1.4 Leaf area
Leaf area was smaller in Exotic-1 than in the other varieties between 40 and 60 DAS. Leaf area increased from 220 cm² at 40 DAS to 500 cm² at 60 DAS in IPSA-2 and from 297 cm² at 40 DAS to 601 cm² at 60 DAS in IPSA-3. Varietal differences in garden pea in leaf area were also reported by Akhter [3].

3.1.5 Fresh weight of roots
Results showed that fresh root weight in all varieties increased with the advancement of time. At 20 DAS, there were little differences in fresh root weight between the varieties. At 40 DAS, the fresh root weight was greater in Exotic-1 (6.9 g) than IPSA-3 (5.61 g) and IPSA-2 (4.70 g). At 60 DAS, fresh weight of root was greater in IPSA-3 than in the others.

3.1.6 Dry weight of roots
At 20 DAS, there was little variation in root dry weight. At 40 DAS, root dry weight was greater in IPSA-3 (1.21 g) than in the others (average of .78 g). At 60 DAS, the root dry weight was greater in IPSA-3 (1.32 g) than others genotypes. Variation in root dry weight might be due to the difference in their genetic make-up. Sawatsky and Soper [17] observed different dry weight in pea varieties.

3.1.7 Number of nodule
Number of nodule/plant was recorded at different stages of plant growth (20, 40, 60 DAS). At all growth stages, nodule number was significantly high in Exotic-1, medium in IPSA-2 and low in IPSA-3. At 20 DAS, number of nodule/plant was 185 in Exotic-1, 160 in IPSA-2 and 147 in IPSA-3. The trend was being similar at 40 and 60 DAS.

3.1.8 Pod length
The longer pod was observed in Exotic-1 (8.12 cm) than IPSA-2 and IPSA-3 (average 6.25 cm) (Table 3). Rahman [15] observed similar result in different types of pea.

3.1.9 Seed per pod
The higher number of seeds per pod was also observed in Exotic-1 (15.01) than in IPSA-2 and IPSA-3 (average 4.385) (Table 3). Similar results were also reported by Silim et al. [18] in field pea.

3.1.10 thousand seed weight
Exotic-1 had highest seed weight (28.00 g) which was significantly different IPSA-2 (19.20 g) (Table 3). Singh and Yadav (1989) also reported higher 1000-seed weight in lower plant density, which is agreement with the present findings. Similar results are shown by Miah [13].

3.1.11 Total dry mass
Total dry mass was significantly influenced by varieties (Table 3). IPSA-2 had smaller TDM than in the others. The lowest TDM was obtained in IPSA-2 (14.59 g).

3.2 Physiological characteristics

3.2.1 Chlorophyll-a
Chlorophyll – a (at 645 nm) was significantly influenced by varieties (Table 1). At 40 DAS, the chlorophyll –a content (1.78 mg/gfw) was greater in IPSA-3 than in the IPSA-2 and Exotic-1. Similar result was observed by Akhter [3].

3.2.2 Chlorophyll-b
At 40 DAS, the highest Chlorophyll –b content (0.61 mg/gfw) was found in IPSA-3 which was statically different from IPSA-2 (0.5 mg/gfw) and Exotic-1 (0.4 mg/gfw) (Table 1). The intermediate Chlorophyll –b content was obtained in IPSA-2 (0.5 mg/gfw) and the lowest Chlorophyll –b content was found in Exotic-1. Similar result was observed by Akhter [3].

3.2.3 Soluble protein content
Exotic-1 had lower protein content (8.8 mg/g) than in the IPSA-3 and IPSA-2 (9.45 mg/g) (Table 2). Hafiz [9] reported that protein content varied in different types of pea.
The amount of amino acid in IPSA-3 (11.99) was greater than in IPSA-2 and Exotic-1 (average of 6.72) (Table 2).

### Table 1: Chlorophyll content in three pea genotypes

<table>
<thead>
<tr>
<th>Variety</th>
<th>Chlorophyll-a (mg/g)</th>
<th>Chlorophyll-b (mg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exotic-1</td>
<td>1.550c</td>
<td>0.410c</td>
</tr>
<tr>
<td>IPSA-2</td>
<td>1.636b</td>
<td>0.500b</td>
</tr>
<tr>
<td>IPSA-3</td>
<td>1.7890a</td>
<td>0.616a</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td>0.117</td>
<td>0.0117</td>
</tr>
</tbody>
</table>

In each column, figures bearing uncommon letter are significantly different at p ≤ 0.05 by DMRT.

### Table 2: Soluble protein and Amino acid content in leaves in three pea genotypes

<table>
<thead>
<tr>
<th>Variety</th>
<th>Soluble protein in leaf (mg/g)</th>
<th>Amino acid (mg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exotic-1</td>
<td>8.810b</td>
<td>6.64b</td>
</tr>
<tr>
<td>IPSA-2</td>
<td>9.430a</td>
<td>6.69b</td>
</tr>
<tr>
<td>IPSA-3</td>
<td>9.580a</td>
<td>11.99a</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td>0.912</td>
<td>0.4183</td>
</tr>
</tbody>
</table>

In each column, figures bearing uncommon letter are significantly different at p ≤ 0.05 by DMRT.

### Table 3: Yield and yield contributing characters of three pea genotypes

<table>
<thead>
<tr>
<th>Variety</th>
<th>Total no. of flower</th>
<th>Abscission (%)</th>
<th>Pod/plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exotic-1</td>
<td>22.01a</td>
<td>50.19b</td>
<td>11.01a</td>
</tr>
<tr>
<td>IPSA-2</td>
<td>16.0c</td>
<td>54.0a</td>
<td>10.0b</td>
</tr>
<tr>
<td>IPSA-3</td>
<td>20.0b</td>
<td>53.01a</td>
<td>10.0b</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td>1.553</td>
<td>2.745</td>
<td>0.776</td>
</tr>
</tbody>
</table>

In each column, figures bearing uncommon letter are significantly different at p ≤ 0.05 by DMRT.

### Table 4: Number of flower, abscission (%) and number of pod per plant at 60 DAS in three pea genotypes

<table>
<thead>
<tr>
<th>Variety</th>
<th>Days to 50% germination</th>
<th>Plant height at harvest (cm)</th>
<th>Days to 50% flowering</th>
<th>Days to 50% pod set</th>
<th>Days to 90% pod maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exotic-1</td>
<td>6.01a</td>
<td>50.11b</td>
<td>22.01a</td>
<td>58.01c</td>
<td>105.01b</td>
</tr>
<tr>
<td>IPSA-2</td>
<td>5.44b</td>
<td>50.00b</td>
<td>59.01b</td>
<td>69.01c</td>
<td>119.01b</td>
</tr>
<tr>
<td>IPSA-3</td>
<td>5.96a</td>
<td>65.01a</td>
<td>64.01b</td>
<td>72.01c</td>
<td>124.01b</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td>0.271</td>
<td>1.941</td>
<td>0.521</td>
<td>1.401</td>
<td>1.201</td>
</tr>
</tbody>
</table>

In each column, figures bearing uncommon letter are significantly different at p ≤ 0.05 by DMRT.

### Table 5: Days to 50% germination and plant height at harvest in three pea genotypes.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Days to 50% germination</th>
<th>Plant height at harvest (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exotic-1</td>
<td>6.01a</td>
<td>50.11b</td>
</tr>
<tr>
<td>IPSA-2</td>
<td>5.44b</td>
<td>50.00b</td>
</tr>
<tr>
<td>IPSA-3</td>
<td>5.96a</td>
<td>65.01a</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td>0.271</td>
<td>1.941</td>
</tr>
</tbody>
</table>

In each column, figures bearing uncommon letter are significantly different at p ≤ 0.05 by DMRT.

### Table 6: Number of days required for 50% flowering, days to 50% pod set and days to 90% pod maturity in three pea varieties.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Days to 50% flowering</th>
<th>Days to 50% pod set</th>
<th>Days to 90% pod maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exotic-1</td>
<td>70.01a</td>
<td>80.01a</td>
<td>115.01a</td>
</tr>
<tr>
<td>IPSA-2</td>
<td>58.71c</td>
<td>64.02c</td>
<td>81.01c</td>
</tr>
<tr>
<td>IPSA-3</td>
<td>64.22b</td>
<td>70.12b</td>
<td>101.22b</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td>3.882</td>
<td>5.823</td>
<td>9.509</td>
</tr>
</tbody>
</table>

In each column, figures bearing uncommon letter are significantly different at p ≤ 0.05 by DMRT.

### Table 7: N, K, Ca and Mg contents in pea genotypes.

<table>
<thead>
<tr>
<th>Variety</th>
<th>N content (%)</th>
<th>K content (mg/g)</th>
<th>Ca content (mg/g)</th>
<th>Mg content (mg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exotic-1</td>
<td>3.76</td>
<td>1.29a</td>
<td>0.15a</td>
<td>0.16a</td>
</tr>
<tr>
<td>IPSA-2</td>
<td>3.65</td>
<td>1.08b</td>
<td>0.11b</td>
<td>0.11b</td>
</tr>
<tr>
<td>IPSA-3</td>
<td>3.61</td>
<td>1.06b</td>
<td>0.10b</td>
<td>0.10b</td>
</tr>
<tr>
<td>LSD 0.05</td>
<td>NS</td>
<td>0.074</td>
<td>0.012</td>
<td>0.017</td>
</tr>
</tbody>
</table>

In each column, figures bearing uncommon letter are significantly different at p ≤ 0.05 by DMRT. NS= Not significant

#### 3.2.4 Amino acid content

The amount of amino acid in IPSA-3 (11.99) was greater than in IPSA-2 and Exotic-1 (average of 6.72) (Table 2).

### 3.2.5 Sugar content

Significantly higher amount of sugar was found in Exotic-1 (0.52 mg/g fw) than in IPSA-3 and in IPSA-2 (0.41 mg/g fw). Similar result was observed by Akhter [3].

### 3.2.6 Protein content in grain

The protein content was greater in Exotic-1 (24.05 mg/g) than IPSA-2 (22.71 mg/g) and IPSA-3 (19.5 mg/g). Protein content increased with the delay in sowing of pea was reported by Ekeberg [4].

### 3.2.7 Number of total pods per plant

Exotic-1 produced the higher total pods/plant (11.02) than IPSA-3 (10.01) and IPSA-2 (7.06)(Table 3). Singh and Yadav (1989) reported that increased number of pods per plant was recorded due to decrease in planting density. Variation in pod yield between varieties was observed [5].

### 3.2.8 Flower and pod production and abscission

The flower production was high in Exotic-1 (22.01), medium in IPSA-3 (20.0) and low in IPSA-2 (16.0). The minimum percentage of abscission of flowers was obtained in Exotic-1 (50.19)(Table 4). Thus the increased number of flowers and decreased percentage of floral abscission produced the greater number of pods in Exotic-1.

### 3.2.9 Days of 50% germination and plant height at harvest

Exotic-1 required maximum period (6.01 days) which was statistically similar with IPSA-3 (5.96 days). The minimum period (5.44 days) was needed in IPSA-2(Table 6). Rahman [3] observed similar result in IPSA-2 and IPSA-3 genotypes.

### 3.2.10 Phenology

IPSA-2 flowered earlier (58 days) than IPSA-3 (64) and Exotic-1(70 days). The two genotypes IPSA-2 and IPSA-3 matured one or two weeks earlier than Exotic-1. IPSA-2 showed 50% pod set at 60 DAS followed by IPSA-3 (70 DAS) and Exotic-1(80 DAS). The genotype IPSA-2 and Exotic-1showed 90% pod maturity at 81, 101 and 115 DAS, respectively (Table 6).
3.2.11 N, Ca, Mg and K content of green seed

The highest amount of N (3.76%) were recorded in Exotic-1 which was statistically similar with IPSA-2 (3.65%) IPSA-3 (3.61%) (Table 7). Similar result was observed by Rahman [15]. The amount of K was higher in Exotic-1 (1.29%) than IPSA-2 (1.08%) and IPSA-3 (1.06%) (Table 7). The maximum Ca was found in Exotic-1 (0.15%) which was not statistically similar with IPSA-2 (0.11%) and IPSA-3 (0.10%) (Table 7). The intermediate Ca content was obtained in IPSA-2 and the lowest was obtained in IPSA-3. Exotic-1 possessed the higher Mg (0.16%) than IPSA-2 (0.11%) and IPSA-3 (0.10%) (Table 7).

4. Conclusion

The mean performances of the varieties under the study differed significantly. The yield contributing parameter like number of pod per plant, yield per plant, 1000-seed weight, harvest index were the highest in Exotic-1. Among the varieties, Exotic-1 showed its superiority in respect of these parameters over the other varieties. The performance of Exotic-1 was the best in respect of pod weight per plant. From the above results, it could be concluded that Exotic-1 is the short statured plant with higher pod and seed yield among the studied genotypes. However, further studies are necessary to arrive at a definite conclusion.

5. Future Scope of this Study

This study may provide great information to select pea genotype for cultivation. New researchers who interested to study at pea genotype this study may helpful to them.

References


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Dr. K.M. Delowar Hossain received the B. Sc. (honours) Degree in Agriculture from Bangladesh Agricultural University, Mymensingh, Bangladesh in 1991. Then he worked as Extension Officer at Helen Keller International, Dhamondi, Dhaka, Bangladesh from May 1992 - September 2000. He received M.Sc. and Ph.D. degree from Tottori University, Japan 2002 and 2005, respectively. Then he joined as Environmentalist, Natural Resources Planners, Utsara, Dhaka, Bangladesh from October 2005 - December 2007. From January 2008 - December 2008 he worked as Education Advisor, Japanese Universities Alumni Association in Bangladesh. After that, from January 2009 - June 2009 worked as researcher at Pabna University of Science and Technology, Bangladesh. Now he is an Assistant Professor in Jessore University of Science Technology, Bangladesh, at the Department of Environmental Science & Technology (EST) since June 29, 2009. He is also the Chairman of the department.

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