Yield and Quality of Groundnut (Arachis hypogaea L.) as Affected by Planting Geometry and Number of Plants Per Hill

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Abstract: An experiment was conducted to find out the effect of planting geometry and number of plants hill\(^{-1}\) on the yield and quality of groundnut seeds. The experiment consisted of two planting geometry, viz., square planting (22.4 x 22.4 cm\(^2\)) and rectangular planting (30.0 x 16.7 cm\(^2\)) and three levels of number of plants hill\(^{-1}\), viz., one, two, and three plants hill\(^{-1}\). Results showed that planting geometry affected the yield and yield components significantly. Rectangular planting gave significantly higher yield than did square planting system. But square planting system gave significantly higher percentage of both protein and oil in seed. Two plants hill\(^{-1}\) gave significantly higher yield than that of one plant and three plants hill\(^{-1}\). Protein content was significantly affected due to the number of plants hill\(^{-1}\) where two plants hill\(^{-1}\) gave the maximum result (26.88%) which was insignificantly followed by that of three plants hill\(^{-1}\) while oil content remained unaffected. The crops planted in rectangular system (30 x 16.7cm\(^2\)) with two plants hill\(^{-1}\) showed maximum pod yield (2.49 t ha\(^{-1}\)). Both protein (26.06%) and oil (56.08%) content was found higher with the crops of square planting system with two plants hill\(^{-1}\). Therefore, the crops planted in rectangular system (30 x 16.7 cm\(^2\)) with two plants hill\(^{-1}\) emerged out as the promising practice for the improvement of yield in groundnut.

Key words: Groundnut, hill, planting geometry, quality, yield

Introduction
Groundnut (Arachis hypogaea L.) is one of the most important oleaginous crops. It occupies the fourth place in the world among the oilseed crops in respect to both area and production next to soybean, sunflower and cotton (Weiss, 1983). Its kernel is rich in protein (25 to 30%) and edible oil (48 to 50%) as against other oilseed crops grown in Bangladesh (Khaleque, 1966). Being a legume crop, groundnut enriches soil by fixing nitrogen without draining the non-renewable energies and without upsetting the agro-ecological balance (Reddy and Kaul, 1996). Thus, its intensive as well as extensive cultivation might save a huge amount of foreign currency which is spent for importing about two-third of the edible oil consumed in Bangladesh (Hossain and Haque, 1994). Since, groundnut is a less photosensitive crop, it can be grown round the year and help supplement the edible oil, food and fodder shortage in Bangladesh.

Yield of a crop is a function of genotype and environment. Environment includes management and climatic factors. Cultural practices have been considered to be the most important management factors that affect the yield and quality of a crop. Among the cultural practices, many authors have emphasized on the importance of planting geometry with optimum number of plants hill\(^{-1}\). Kaika et al. (1984) recorded the highest pod yield of 3.6 t ha\(^{-1}\) at the spacing of 30 x 15 cm in rectangular planting system. Thorat et al. (1988) found significantly more dry pods with the spacing of 30 x 15 than 45 x 15 and 30 x 30 cm\(^2\) spacing. Alam et al. (1982) reported that the variety Acc-12 produced significantly highest pod yield of 2.80 t ha\(^{-1}\) with the spacing of 30 x 15cm\(^2\) in rectangular planting system. Number of plant hill\(^{-1}\) plays a notable role in groundnut production. Sani et al. (1971) found that yield increased with the increase in number of seeds hill\(^{-1}\) (from 1 to 3 seeds hill\(^{-1}\) at all spacing of 30 x 15, 22.5 x 22.5, 30 x 30, 37.5 x 37.5 or 45 x 45 cm\(^2\). Thosman et al. (1985) found the highest yield (285 kg rai\(^{-1}\)) at the spacing of 30 x 20 cm\(^2\) with 2 plants hill\(^{-1}\). Evidences also indicate that higher intrarow distance increases both oil and protein content in groundnut seeds (Kumar and Venkatachari, 1971; Bhan and Misra, 1971). However, Agasimani et al. (1989) recorded the highest oil content in groundnut seeds with the spacing of 20 x 6 cm\(^2\) with one plant hill\(^{-1}\).

All the above evidences indicated that planting geometry and number of plants hill\(^{-1}\) are two important yield and quality determinant factors among the cultural practices. However, information in this aspect is scanty, which became the way of perpetuating its large-scale cultivation especially in perspective to Bangladesh condition. Therefore, this study was designed to determine appropriate planting geometry and optimum number of plant hill\(^{-1}\) for higher yield and better quality seeds of groundnut crop.

Materials and Methods
The research work was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh, during the period from December 1995 to May 1996. The experimental site usually remains above the flood level. Soil type of the experimental land is sandy loam in texture with pH ranging from 5.5 to 6.0. Its chemical composition shows 0.7% total N, 0.62% organic carbon, 12 ppm available P, 0.23 mg/100g exchangeable K and 14 ppm available S. The treatments included two planting geometry viz., square planting (22.4 x 22.4cm\(^2\)) and rectangular planting (30 x 16.7cm\(^2\)) and three levels of number of plants hill\(^{-1}\) viz., 1 plant, 2 plants and 3 plants hill\(^{-1}\). The experiment was laid out in a factorial design adopting randomized complete block. Each unit plot size was 4.0 x 2.4m\(^2\). The plots were fertilized with urea, triple super phosphate, muriate of potash, gypsum and zinc oxide @ 70, 160, 85, 110 and 5 kg ha\(^{-1}\), respectively as recommended by Bangladesh Agricultural Research Institute (1990). The groundnut variety 'Jhinga badam' (Acc-12) was used as the study material. Seeds were sown on 26 December 1995, maintaining plant spacing as par treatments. Crop management practices, such as, gap filling, weeding, thinning, irrigation and mulching were accomplished as per requirements. Crops were harvested at maturity with field duration of 150 days. Analysis of variances were worked out to find the statistical significance of the treatments on yield and yield attributes. The differences in treatment means in question of significance were adjudged by the Duncan’s new multiple range test (Gomez and Gomez, 1984). Protein and oil content of shelled nuts were determined through chemical analysis by micro kjeldhal method and Soxhlet analytical method, respectively (Hamilton and Simpson, 1967).

Results and Discussion
Planting geometry greatly affected pod yield of groundnut. The treatment of rectangular planting system produced significantly...
higher pod yield of 2.26 t ha\(^{-1}\)) in comparison to that of square planting system (2.11 t ha\(^{-1}\)). Among the pod yield attributes, number of pods hill\(^{-1}\), number of mature pods hill\(^{-1}\), number of one-seeded, two-seeded, three-seeded and four-seeded pods hill\(^{-1}\), and weight of 100 pods certainly contributed directly to pod yield. All the yield attributes were associated best with the treatment of rectangular planting system, which immensely helped increase pod yield.

All the pod yield attributes showed higher dimension with rectangular planting system. Perhaps, the crops planted following rectangular system utilized better interception of sunlight, air circulation, soil nutrient and moisture, which helped accomplish photosynthetic activity better, supplied adequately to the sink, thus yield components were attributed to the higher magnitude. Similar opinion was expressed by Hossain (1998) in case of jute seed. Plant height and number of branches hill\(^{-1}\), although, did not directly contribute to pod yield, but their higher dimension might help increase yield of dry haynum, which have high fuel potential to the groundnut growers.

The planting system significantly influenced the protein and oil content of groundnut seeds (Table 1). In both the cases, the square planting system advantageously influenced these quality factors. Square planting system probably favoured some physiological processes of groundnut crops, which resulted in the increase of both protein and oil content of seeds. Pod yield of groundnut was significantly influenced due to number of plants hill\(^{-1}\) (Table 1). The treatment of two plants hill\(^{-1}\) gave the maximum pod yield (2.39 t ha\(^{-1}\)) compared to those of one plant hill\(^{-1}\) (2.12 t ha\(^{-1}\)) and three plants hill\(^{-1}\) (2.06 t ha\(^{-1}\)) and differences in each case was statistically significantly. All the yield contributing characters of groundnut such as number of mature pods hill\(^{-1}\), weight of 100 pods, weight of 100 seeds and shining percentage showed higher dimension with the treatment of two plants hill\(^{-1}\) which directly helped increase pod yield.

The number of plants hill\(^{-1}\) also significantly influenced the protein content of groundnut seeds. Two plants hill\(^{-1}\) gave the highest percentage of seed protein (25.58%), which was statistically identical to that of three plants hill\(^{-1}\). Protein content of seed was the lowest with one plant hill\(^{-1}\) (Table 1). Oil content of seeds, however, remained unaffected due to number of plants hill\(^{-1}\). Still the crops of two plants hill\(^{-1}\) gave numerically higher percentage of oil content compared to that of others. Saini et al. (1971) did not find any differences in oil content of groundnut seeds grown with different row spacing and number of plants hill\(^{-1}\). Nandana et al. (1992) also reported that row spacing did not affect the oil content of groundnut seeds.

The interaction effect of planting geometry and number of plants hill\(^{-1}\) significantly affected the pod yield of groundnut (Table 2). The interaction between rectangular planting system and two plants hill\(^{-1}\) registered the highest pod yield and it was followed significantly by that of rectangular planting with one plant hill\(^{-1}\) and square planting with two plants hill\(^{-1}\). The pod yields ranging intermediate level were received when groundnut crops were planted with increased number of plants hill\(^{-1}\) irrespective to planting geometry. The increased number of plants hill\(^{-1}\) (3 plants hill\(^{-1}\)) irrespective to planting geometry reduced the magnitude of all the yield component. So, increased number of plants hill\(^{-1}\) could not compensate the yield loss of lower dimension of component characters. But the combination of rectangular planting system with two plants hill\(^{-1}\) showed higher dimension of almost all of the yield components which directly contributed higher pod yield of groundnut. Similar results were reported by Cheema et al. (1985) when groundnut seeds were sown at rectangular system with a spacing of 45 x 15cm.

### Table 1: Effect of planting geometry and No. of plants hill\(^{-1}\) on the yield and quality of groundnut

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Plant height (cm)</th>
<th>Primary branches (No.)</th>
<th>Mature pods (No.)</th>
<th>One-seeded pods (No.)</th>
<th>Two-seeded pods (No.)</th>
<th>Three-seeded pods (No.)</th>
<th>Four-seeded pods (No.)</th>
<th>Wt. of pods (g)</th>
<th>Wt. of seed (g)</th>
<th>Shelling yield (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry yield (t ha(^{-1}))</td>
<td>100</td>
<td>100</td>
<td>Seed (g) (t ha(^{-1}))</td>
<td>Percentage (t ha(^{-1}))</td>
<td>Oil (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planning geometry</td>
<td>Squar</td>
<td>Planting</td>
<td>80.99</td>
<td>10.67</td>
<td>16.77</td>
<td>1.85</td>
<td>6.03b</td>
<td>8.32b</td>
<td>1.62b</td>
<td>124.66b</td>
</tr>
<tr>
<td>Rectangular planting</td>
<td>76.62b</td>
<td>10.48a</td>
<td>18.53a</td>
<td>1.99a</td>
<td>6.66a</td>
<td>9.14a</td>
<td>1.90a</td>
<td>126.86a</td>
<td>89.63a</td>
<td>6.32a</td>
</tr>
<tr>
<td>Number of plants hill(^{-1})</td>
<td>1</td>
<td>76.30c</td>
<td>6.77c</td>
<td>14.66c</td>
<td>1.46c</td>
<td>3.66c</td>
<td>7.62c</td>
<td>1.72a</td>
<td>123.76c</td>
<td>73.03b</td>
</tr>
<tr>
<td>2</td>
<td>76.32b</td>
<td>10.77b</td>
<td>20.11b</td>
<td>2.28b</td>
<td>6.28b</td>
<td>9.68b</td>
<td>1.67b</td>
<td>127.67b</td>
<td>40.36b</td>
<td>6.21b</td>
</tr>
<tr>
<td>3</td>
<td>82.72a</td>
<td>14.69a</td>
<td>22.32a</td>
<td>2.18a</td>
<td>6.69a</td>
<td>8.28a</td>
<td>1.92a</td>
<td>124.95b</td>
<td>37.13a</td>
<td>7.09a</td>
</tr>
</tbody>
</table>

### Table 2: Interaction of planting geometry and number of plants hill\(^{-1}\) on the yield and quality of groundnut

<table>
<thead>
<tr>
<th>No. of plants hill(^{-1})</th>
<th>Plant height (cm)</th>
<th>Primary branches (No.)</th>
<th>Mature pods (No.)</th>
<th>One-seeded pods (No.)</th>
<th>Two-seeded pods (No.)</th>
<th>Three-seeded pods (No.)</th>
<th>Four-seeded pods (No.)</th>
<th>Wt. of pods (g)</th>
<th>Wt. of seed (g)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Dry yield (t ha(^{-1}))</td>
<td>100</td>
<td>100</td>
<td>Seed (g) (t ha(^{-1}))</td>
<td>Percentage (t ha(^{-1}))</td>
<td>Oil (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planning geometry</td>
<td>Square</td>
<td>Planting</td>
<td>77.45c</td>
<td>5.24c</td>
<td>14.22c</td>
<td>1.69c</td>
<td>3.78c</td>
<td>7.96c</td>
<td>1.40c</td>
<td>124.85c</td>
</tr>
<tr>
<td>Rectangular planting</td>
<td>76.32b</td>
<td>10.77b</td>
<td>20.11b</td>
<td>2.28b</td>
<td>6.28b</td>
<td>9.68b</td>
<td>1.67b</td>
<td>127.67b</td>
<td>40.36b</td>
<td>6.21b</td>
</tr>
<tr>
<td>Number of plants hill(^{-1})</td>
<td>1</td>
<td>72.66a</td>
<td>7.30a</td>
<td>14.84a</td>
<td>1.23a</td>
<td>3.96a</td>
<td>7.67a</td>
<td>2.03a</td>
<td>122.27a</td>
<td>56.93a</td>
</tr>
<tr>
<td>2</td>
<td>74.25b</td>
<td>10.76b</td>
<td>21.42b</td>
<td>2.44b</td>
<td>6.88b</td>
<td>10.37b</td>
<td>1.70b</td>
<td>130.43b</td>
<td>40.91b</td>
<td>6.35a</td>
</tr>
<tr>
<td>3</td>
<td>75.25c</td>
<td>13.55c</td>
<td>19.30c</td>
<td>1.75c</td>
<td>6.12c</td>
<td>9.52c</td>
<td>1.66c</td>
<td>134.87c</td>
<td>28.16b</td>
<td>6.77c</td>
</tr>
</tbody>
</table>

Figures in a column having dissimilar letters are significantly different at 5% level.
Alam et al.: Groundnut, hill, planting geometry, quality, yield

From the above results it may be concluded that planting geometry and number of plants hill\(^{-1}\) can increase pod yields and improve quality of groundnut seeds, but the optimal result depends on careful manipulation and optimization of planting system and number of plants hill\(^{-1}\). From the findings of the experiment it can be concluded that groundnut crops should preferably be planted in rectangular planting system (30.0 x 16.7 cm\(^2\)) with two plants hill\(^{-1}\) in order to obtain higher pod yield and better quality seeds.

References