Yield and Quality of Groundnut (Arachis hypogaea L.) as Affected by Hill Density and Number of Plants per Hill

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Abstract: An experiment was conducted to find the effect of hill density and number of plants hill\(^{-1}\) on the pod yield and seed quality of groundnut. A density of 200000 hills ha\(^{-1}\) gave the highest yield compared with 100000 and 400000 hills ha\(^{-1}\). Seed quality expressed through protein and oil contents remained unaffected due to plant density. Two plants hill\(^{-1}\) gave significantly higher yield than that of one plant and three plants hill\(^{-1}\). Protein contents were significantly affected due to the number of plants hill\(^{-1}\) while oil content remained unaffected. The crops of 200000 hills ha\(^{-1}\) with two plants hill\(^{-1}\) showed maximum pod yield (2.65t ha\(^{-1}\)). Both protein and oil contents were found higher with the crops of 100000 hills ha\(^{-1}\) with two plants hill\(^{-1}\). A density of 200000 hills ha\(^{-1}\) with two plants hill\(^{-1}\) emerged as the promising practice for the improvement of yield in groundnut.

Key words: Arachis hypogaea, hill, plant density, ground nut, shellinig percentage

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 of 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 in other oilseed crops grown in Bangladesh (Khaleque, 1986). Being a legume crop, groundnut enriches soil by fixing nitrogen without draining the non-renewable energies and without upsetting the agro-ecological balance (Riedy and Kaul, 1998). Thus, its intensive as well as extensive cultivation might save a huge amount of foreign currency which is spent for importing about two-thirds 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 may help to supplement the edible oil, food and fodder shortage in Bangladesh.

Yield of a crop is a function of genotypes and environment. Environment includes management and climatic factors. Among the cultural practices, many authors have emphasized on the importance of plant density. Roy et al. (1980) recorded optimum pod yield with plant density ranging from 180000 to 300000 ha\(^{-1}\), although, Lomte and Khuspe (1987) obtained significantly higher yield with plant population of 177000 ha\(^{-1}\) against that of 148000, 222000 and 266000 ha\(^{-1}\), Mercure-Quarshie (1972); and Toomson et al. (1985) conversely recorded maximum yield using plant spacing 61cm x 15cm and 30cm x 20cm both with two plants hill\(^{-1}\). Evidences also indicate that low population increases both oil and protein contents in groundnut seeds (Kumar and Venkatachari, 1971; Bhan and Misra, 1971). However, Agasimani et al. (1989) recorded the highest oil content in groundnut kernel using plant spacing 20 cm x 5 cm with one plant hill\(^{-1}\).

All the above evidences indicate that number of hills unit\(^{-1}\) area and number of plants hill\(^{-1}\) are two important yield and quality determinant factors among the cultural practices. However, information in this respect is scanty, which become the way of perpetuating its large-scale cultivation especially in perspective to Bangladesh condition. Therefore, the present study was designed to determine appropriate hill density and number of plants hill\(^{-1}\) for high 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, 12ppm available P, 0.23mmag/100g exchangeable K and 14ppm available S. The treatments included three hill densities (D\(_1\) = 100000 hills ha\(^{-1}\) (33.1 x 33.1 cm\(^2\)), D\(_2\) = 200000 hills ha\(^{-1}\) (22.4 x 22.4 cm\(^2\)) and D\(_3\) = 400000 hills ha\(^{-1}\) (15.8 x 15.8 cm\(^2\))) and three levels of number of plants hill\(^{-1}\) (N\(_1\) = 1 plant hill\(^{-1}\), N\(_2\) = 2 plants hill\(^{-1}\) and N\(_3\) = 3 plants hill\(^{-1}\)). The experiment was laid out in randomized complete block design and replicated three times. The size of each unit plot was 4.0 x 4.5 m\(^2\). The plots were fertilized with urea, triple super phosphate, muriate of potash, gypsum and zinc oxide at the rate of 70, 160, 85, 110 and 6kg ha\(^{-1}\), respectively as recommended by Anonymous (1990). The groundnut variety ‘Jhinga Badam’ (Accl-12) was used as the study material. Seeds were sown on 26 December 1995, maintaining plant spacing as per 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 160 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, 1993). Protein and oil contents of shelled nuts were determined through chemical analysis by ‘Micro Kjeldahl method’ and ‘Soxhlet Analytical method’, respectively (Hamilton and Simpson, 1967).

Results and Discussion
Plant density greatly affected pod yield of groundnut (Table 1). The treatment consisting of 200000 hills ha\(^{-1}\) produced maximum pod yield of 2.401t ha\(^{-1}\) which was significantly superior to that of 100000 and 400000 hills ha\(^{-1}\). However, yield between 100000 and 400000 hills ha\(^{-1}\) was statistically identical. Among the pod yield attributes, number of total 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. Although, the treatment 400000 hills ha\(^{-1}\) had double initial population than that of 200000 hills ha\(^{-1}\) but drastic reduction in the magnitude of yield components hampered pod yield. All the yield attributes were flourished favourably with the treatment of 100000 hills ha\(^{-1}\), still this treatment could not substantially compensate the yield loss of low population. Thus, resultant effect of hill density and flourishment of yield attributes was the best with the treatment of 200000 hills ha\(^{-1}\), which immensely helped to increase pod yield.

All the pod yield attributes showed higher dimension with lower hill density. Perhaps, the crops of sparsely populated plots utilized better interception of sun light, air circulation, soil nutrient and moisture, which helped to accomplish photosynthetic activity properly and supply adequately to the sink, thus yield components were attributed to the higher magnitude. Similar opinion was expressed by Hossain et al. (1999) 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 certainly

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Table 1: Effect of hill density on the yield and quality of groundnut

<table>
<thead>
<tr>
<th>Hill density (No. of hills ha⁻¹)</th>
<th>Plant height (cm)</th>
<th>Primary branches hill⁻¹ (No.)</th>
<th>Total pods hill⁻¹ (No.)</th>
<th>Mature pods hill⁻¹ (No.)</th>
<th>One seeded pods hill⁻¹ (No.)</th>
<th>Two seeded pods hill⁻¹ (No.)</th>
<th>Three seeded pods hill⁻¹ (No.)</th>
<th>Four seeded pods hill⁻¹ (No.)</th>
<th>Wt. of 100 seeds (g)</th>
<th>Wt. of 100 pods (g)</th>
<th>Dry matter yield (t ha⁻¹)</th>
<th>Yield shelling percent (%)</th>
<th>Pod yield (t ha⁻¹)</th>
<th>Protein content (%)</th>
<th>Oil content (%)</th>
</tr>
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<td>13.16a</td>
<td>63.64a</td>
<td>22.39a</td>
<td>2.22a</td>
<td>6.76a</td>
<td>11.12a</td>
<td>2.44a</td>
<td>122.32a</td>
<td>34.18a</td>
<td>6.61a</td>
<td>69.74a</td>
<td>2.11b</td>
<td>25.68a</td>
<td>49.95a</td>
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<td>10.59b</td>
<td>59.28b</td>
<td>17.83b</td>
<td>1.81b</td>
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<td>8.95b</td>
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<td>125.86b</td>
<td>39.42b</td>
<td>6.76b</td>
<td>71.22b</td>
<td>2.40a</td>
<td>26.37a</td>
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Table 2: Effect of number of plants hill⁻¹ on the yield and quality of groundnut

<table>
<thead>
<tr>
<th>Number of plants hill⁻¹</th>
<th>Plant height (cm)</th>
<th>Primary branches hill⁻¹ (No.)</th>
<th>Total pods hill⁻¹ (No.)</th>
<th>Mature pods hill⁻¹ (No.)</th>
<th>One seeded pods hill⁻¹ (No.)</th>
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<tbody>
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<td>13.16a</td>
<td>63.64a</td>
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<td>25.68a</td>
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<tr>
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Table 3: Interaction of hill density and number 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 hill⁻¹ (No.)</th>
<th>Total pods hill⁻¹ (No.)</th>
<th>Mature pods hill⁻¹ (No.)</th>
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<th>Protein content (%)</th>
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<tr>
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</tr>
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Figures in a column having same letter(s) do not differ significantly whereas figures having dissimilar letter(s) are significantly different at 5% level.
development of pod yield attributes which consequently helped ameliorate the yield of groundnut.

Seed quality expressed through protein and oil content indicated that, although both the quality attributes numerically differed very low (Protein 24.97% ~ 26.06% and oil 49.02% ~ 50.04%) by the interaction effect of hill density and number of plants hill\(^{-1}\) but these differences for both the cases were highly significant. Under extreme low as well as extreme dense conditions of number of hills ha\(^{-1}\) both protein and oil content differed showing irregularity in trends. These indicated that after pegging of pods under high population conditions, microclimate below the soil surface, perhaps, acted little upon normal nourishment of quality attributes. But under optimum condition of hill density (200000 hills ha\(^{-1}\) both the component characters decreased following a regular trend with the increase of number of plants hill\(^{-1}\).

It further indicated that within the ranges of optimal population densities quality attributes in groundnut seeds decreased with the increase of population densities. The overall protein contents were also higher with lower hill densities (Table 1). These results are in partial agreement with that of Kumar and Venkatachatur (1971) who received higher percentage of protein and oil content with lower population densities. However, the highest quality seed in respect to protein and oil content was received from the interaction combination of 100000 hills ha\(^{-1}\) with two plants hill\(^{-1}\) (Table 3).

From the above result it may be postulated that hill density 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 hill density and number of plants hill\(^{-1}\). From the findings of the experiment it can be suggested that groundnut crops may preferably be planted maintaining 200000 hills ha\(^{-1}\) with two plants hill\(^{-1}\) in order to obtain higher pod yield and better quality seeds.

References


