EFFECT OF PLANT SPACINGS ON THE YIELD AND YIELD ATTRIBUTES OF GROUNDNUT

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ABSTRACT

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The study was conducted at the farmers' field of farming System Research and Development Site, Razakhali, Patuakhali district under Ganges Tidal Floodplain Zone (AEZ-13) during late rabi in 2005-2006 to find out suitable plant spacing for two groundnut varieties, viz., Dhaka-1, an erect Spanish type and DG-2, a semi-spreading Virginia type. The experiment was laid out in a split plot design with six dispersed replications. The result of the experiment revealed that erect type groundnut variety, like Dhaka-1 required closer spacing (30 cm × 10 cm) to express its maximum yield potentiality, on the other hand spreading or semi-spreading type groundnut variety required wider plant spacing (40 cm × 20 cm) to express its maximum yield potentiality.

Keywords: Plant spacing, yield, groundnut

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is the second important oilseed crop that covered a considerable area in Bangladesh. In Bangladesh, an adult needs about 37g of fats and oil/day, but the people are getting about 12.8g of which 4.2 are coming from vegetable sources (Khaleque, 1985). Among the vegetable sources, groundnut can play a important role as it contains the highest amount of oil (48% in seed) with the highest yield compared to other oil seed crops of Bangladesh. (Khaleque, 1986). Several research reports established the fact that the proper row and plant spacing determined the yield of a particular variety in a specific agro-ecological environment (Patel *et. al.*, 1985). The varieties Dhaka-1 (Maizchar badam) and DG-2 (Basanti badam) are widely grown in char belts, especially in Kishoreganj, Noakhali, Faridpur, Shandip, Ishurdi and Patuakhali compared to other varieties in Bangladesh.

Under local condition, the optimum row and plant spacing for the varieties Dhaka-1 (Spanish type, erect) and DG-2 (Virginia type, semi-spreading) were not well established in different agro ecological regions. As the two varieties had different growth habits, the optimum spacing (row and plant) was likely to vary to express their full yield potentials. The present experiment was conducted to determine the proper arrangement of row and plant spacing for higher yield of two groundnut varieties having different growth habits.

MATERIALS AND METHODS

The experiment was conducted during 2005-2006 in the late *rabi* season at On- Farm Research Division (OFRD), Bangladesh Agricultural Research Institute (BARI), Patuakhali. The soil contained 1.3% OM with a pH of 5.9. Initial Ca, Mg and K contents were 5.9, 1.52 and 0.28 meq/100g, total nitrogen 0.15% and P, S and Zn contents were 10.6, 28.7 and 1.2 µg/g, respectively. Fertilizers were applied at the rate of 25-30-40 kg N-P-K/ha supplied from Urea, Triple Super Phosphate (TSP) and Muriate of Potash (MP), respectively. Fifty percent of urea and 100% of TSP and MP were applied during final land preparation. The remaining 50% of the urea was top dressed at flower initiation stage. The experiment was conducted in a split- split- plot design with 3 replications. The two varieties (Dhaka-1 and DG-2) were assigned to the main plots, three row spacing (20 cm, 30 cm and 40 cm) were in sub plots and three plant spacing (10 cm, 15 cm and 20 cm) were in sub-sub-plots. The unit plot size was 4m × 5m.

The variety Dhaka-1, an erect and DG-2, a semi spreading type were sown at 5 cm depth on 22 December 2005. Missing hills were replanted within the first week of germination and three additional irrigations were given on 25 January, 20 February and 2 April 2006. There was negligible incidence of insects and pests. Ten plants were selected randomly at the initial growth stage in each plot for sampling. Observations were made on pod yield/ha, dry weight of pods/plant (g), number of mature pods/plant, shelling percentage, 1000-seed weight (g), pod bearing length of stem/ plant (cm), number of primary branches/plant and harvest index (%). Shelling percentage was calculated as weight of seeds/weight of pods × 100. The variety Dhaka-1 and DG-2 were harvested on 30 May 2006 and sun dried up to 9% moisture level. The data on all the parameters were analyzed and mean differences were measured by LSD (Gomez and Gomez, 1984).

Table 1. Different row and plant spacing treatments used in the two groundnut varieties

Row spacing (cm)	Plant spacing (cm)		
	10	15	20
20 cm	20 × 10 cm	20 × 15 cm	20 × 20 cm
30 cm	30 × 10 cm	30 × 15 cm	30 × 20 cm
40 cm	40 × 10 cm	40 × 15 cm	40 × 20 cm

RESULTS AND DISCUSSION

Treatment differences for the interactions of variety × row × plant spacing were significantly different for dry weight of pods/plant and number of mature pods/plant (Table 2). Both the varieties, Dhaka-1 and DG-2 produced higher number of mature pods/plant and higher dry weight of pods/plant with widening of row and plant spacing. The reason might be due to use of more nutrients and solar energy by the plant from the wider spacing and reduce competition for all other inputs at wider spacing. The number of mature pods/ plant was higher in Dhaka-1 compared to that of DG-2 in all spatial arrangement resulting in higher dry weight of pods/plant in Dhaka-1 except 30 cm × 20 cm (Table 2). There was not significant difference between Dhaka-1 and DG-2 at 30 cm × 20 cm spacing. Similar results were reported by Agasimani *et al*., (1984) where a cultivar DH 3-30 gave the highest pod yields followed by M-13 and TG-1 at 6 spacing (40 cm × 10 cm, 40 cm × 15 cm, 40 cm × 20 cm, 30 cm × 10 cm, 30 cm × 15 cm and 30 cm x 20 cm). The number of developed pods/plant was the highest in DH 3-30 at each spacing compared to other two cultivars. Yilmaz (1999) also reported that number of pods/ plant was decreased with increasing population densities (closer spacing). At closer spacing, the number of mature pods/ plant and dry weight of pods/ plant were drastically reduced in DG-2, the reason might be due to its spreading growth habit, as the plants, perhaps could not attain their normal growth to express their full potentials.

Interactions of variety × row × plant spacing were significantly different for pod bearing length of stems (Table 2). Pod bearing length of stem in DG-2 gradually increased with wider row and plant spacing but in Dhaka-1, different trend was found. Widening of space might have provided more nutrients thus resulted in production of pegs. Thus, higher pod bearing length was found, yielding higher number of pods/plant.

Interactions of variety × row × plant spacing were significantly different for oil content (Table 2). The maximum oil content was found at wider spacing (40 cm × 20 cm) for both Dhaka-1 and DG-2. Difference in oil content in Dhaka-1 at 20 cm and 30 cm row spacings were not significant, but at 40 cm row spacing, the variation was significant. In DG-2, at 20 cm row spacing, the variation in oil content was not significant but at 30 cm and 40 cm row spacing, the variation was significant. Yilmaz (1999) reported that oil content was significantly influenced by different row spacing. In plant spacing combinations, the trends were almost similar to that of row spacing. However, oil content in Dhaka-1 was significantly higher than that of DG-2 in all the spacing combinations. Interactions of variety × row × plant spacing were significantly different for oil yield/ha. In Dhaka-1 oil yield/ha was statistically similar at 20 cm × 10 cm and 30 cm × 10 cm spacing combinations (1180 to 1192 kg/ha) but significantly higher than that of all other spatial arrangements (762 to 1093 kg/ha). In DG-2, oil yield/ha was statistically similar at 30 cm × 20 cm and 40 cm × 20 cm spacing combinations (665 to 671 kg/ha) but significantly higher than that of all other spatial arrangements (471 to 559 kg/ha).

Table 2. Interactions of variety, row and plant spacings on mean of some characters of groundnut

Spacing (cm)	Dry wt. of pods/plant (g)		No. of mature pods/plant		Pod bearing length of stem (cm)		Oil content (%)		Oil yield (kg/ha)	
	Dhaka-1	DG-2	Dhaka-1	DG-2	Dhaka-1	DG-2	Dhaka-1	DG-2	Dhaka-1	DG-2
20 × 10	6.69	3.43	14.28	4.52	5.03	7.13	49.66	47.14	1192	523
20 × 15	8.18	4.60	15.83	6.58	6.90	8.81	49.02	46.44	961	471
20 × 20	10.87	6.57	22.69	7.21	9.09	8.79	49.29	46.62	979	508
30 × 10	9.48	5.02	18.88	5.39	8.73	7.24	50.86	49.91	1180	533
30 × 15	11.26	7.41	22.81	8.94	9.33	10.39	51.07	45.40	948	505
30 × 20	12.95	12.95	25.22	15.04	6.63	9.26	50.73	45.77	792	665
40 × 10	11.70	6.74	23.85	7.82	9.31	9.70	49.92	48.86	1093	532
40 × 15	13.52	10.88	26.72	12.98	11.40	9.79	49.08	48.24	805	559
40 × 20	16.04	15.96	27.23	18.73	8.30	12.18	51.10	50.38	762	671
LSD (5%)										
Varietal comparison	3.46		4.91		5.54		0.87		562	
Row spacing com.	2.59		4.63		3.54		0.86		231	
Plant spacing com.	2.22		4.90		3.65		0.79		231	

Treatment differences for the interactions of variety × row spacing and variety × plant spacing were significantly different for pod yield (t/ha) (Table 3 and 4). The yield of Dhaka-1 was the highest (2.98 t/ha) at 20 cm row spacing and 3.06 t/ha at 10 cm plant spacing, while it was reverse for DG-2. At all row and plant spacing, the yield differences were not significant for DG-2, although the trend was increasing with increasing spacing. The variety Dhaka-1 being an erect plant type needed less space to obtain its normal growth and development, while DG-2 being a semi-spreading type needed more space. Ishaq (1971) also found the highest yield from the cultivar Ashfard (alternately branched, spreading-bunch type) at wider row spacing and from the cultivar Berbeton (sequentially branched, upright bunch type) at closer row spacing. He opined that the optimum spacing for these two varieties varied because of their differences in growth habit and plant type. The same reason may also be referred to Dhaka-1 and DG-2. Similarly, Basak *et al*., (1995) reported that Jhingabadam (an erect plant type similar to that of Dhaka-1)

were sown at 30 cm, 40 cm or 50 cm × 10 cm, 15 cm or 20 cm spacing. The highest pod yield was obtained with the closest spacing of 30 cm × 10 cm, whereas the lowest yield was obtained with the widest spacing of 50 cm × 20 cm. Mishra *et al.*, (1998) reported that different spacing gave highest pod yield/ha depending on different cultivars. The yields of Dhaka-1 were significantly higher than that of DG-2 at 20 cm row spacing and at 10 cm plant spacing (Table 3 and 4). From this result, it may be concluded that for better yield in DG-2 (semi-spreading type), the wider row spacing (30 cm or 40 cm) and plant spacing (20 cm) would be required.

On the other hand, relatively wide spacings were found suitable for some varieties depending on their growth habits (Ishaq, 1971; Pawar and Bhosale, 1992) which might be similar with DG-2. Nandania *et al.* (1992) also reported that higher pod yield/ha at increasing inter row spacing.

Variety × row spacing and variety × plant spacing interactions were significant for harvest index (Table 3 and 4). Harvest index in Dhaka-1 was significantly higher at 30 cm row spacing (39.64) compared to that of 20 cm (38.03) but similar to that 40 cm (39.31). In the case of DG-2, harvest index at 30 cm and 40 cm row spacings were similar (30.11 to 31.02) but significantly higher than that of 20 cm (22.45) (Table 3). The variety Dhaka-1 showed significantly higher harvest index compared to that of DG-2 in all the row spacing. In Dhaka-1 there was no statistical difference in harvest index among the plant spacing. In DG-2 the indices at 15 cm and 20 cm plant spacing were similar (26.58 to 33.31) but significantly higher than that of 10 cm (23.64) (Table 4).

Table 3. Interactions of variety and row spacing, Interaction mean of the following characters of groundnut

Row spacing (cm)	Pod yield (t/ha)		Harvest index (%)	
	Dhaka-1	DG-2	Dhaka-1	DG-2
20	2.98	1.63	38.03	22.45
30	2.60	1.83	39.64	30.11
40	2.41	1.86	39.31	31.02
LSD (5%)				
Varietal comparison	0.85		3.95	
Row spacing comparison	0.28		1.63	

Table 4. Variety and plant spacing interaction mean of the following characters of groundnut

Plant spacing (cm)	Pod yield (t/ha)		Harvest index (%)	
	Dhaka-1	DG-2	Dhaka-1	DG-2
10	3.06	1.68	38.65	23.64
15	2.48	1.65	39.09	26.58
20	2.42	1.98	39.20	33.31
LSD (5%)				
Varietal comparison		0.85		3.90
Plant spacing comparison		0.38		1.66

Only the varietal effect significantly influenced the shelling percent and 100-seed weight (Table 5). Different spatial arrangement had no effect on these two characters as they were genetically controlled. This result was in agreement with Nandania *et al*., 1992 and Patel and Patel, 1995 where they found that shelling percentage was unaffected by different spacing and population. Shelling percent in Dhaka-1 was significantly higher (72.75%) than that of DG-2 (65.77%). Similar findings were reported by Agasimani *et al*. (1984) where they observed higher shelling percentage in one variety than that of others (Shelling percentage was highest in DH-3-30, followed by M-13 and TG-1). Thousand seed weight was significantly higher in DG-2 (425.78g) compared to that in Dhaka-1 (225.94g) because of bigger sized kernel of DG-2 (Table 5).

Considering seed cost only in Dhaka-1, the maximum benefit of Tk 84361 could be achieved from 30 cm × 10 cm spatial arrangement followed by Tk 83417 from 20 cm × 10 cm (Table 6). Basak *et al.*, (1995) also found that the closest spacing gave the highest gross return and return above variable cost in Jhingabadam (an erect plant type similar to that of Dhaka-1. In DG-2, the maximum benefit of Tk 47105 could be achieved from 40 cm × 20 cm spatial arrangement followed by Tk 45556 from 30 cm × 20 cm. But benefit cost ratio in terms of seed cost only it was highest at 40 cm × 20 cm spacing in both Dhaka-1 and DG-2 due to lower seed rate.

Table 5. Varietal mean effect of the following characters of groundnut

Varieties	Shelling percent	1000-seed weight (g)	No. of primary branches/ plant
Dhaka-1	72.75	225.94	6.00
DG-2	65.76	425.78	8.95
LSD (5%)	4.88	6.44	2.92

Table 6. Seed cost and net benefit from seed yield due to different row and plant spacing

Spacing (cm)	Amount of seeds required (kg/ha)		Seed cost/ha @ 45 (Tk/kg)		Oil yield (kg/ha)		Gross benefit from oil/ha @ 75 (Tk/kg)		Benefit (in Tk) from oil considering seed cost only		BCR (in terms of seed cost only)	
	DA-1	DG-2	DA-1	DG-2	DA-1	DG-2	DA-1	DG-2	DA-1	DG-2	DA-1	DG-2
20 x 10	112.95	212.90	5083	9581	1180	510	88500	38250	83417	28669	16.41	3.00
20 x 15	75.30	141.93	3389	6387	950	460	71250	34500	67861	28113	20.02	4.40
20 x 20	56.48	106.45	2542	4790	970	500	72750	37500	70208	32710	27.62	6.83
30 x 10	75.30	141.93	3389	6387	1170	520	87750	39000	84361	32613	24.89	5.11
30 x 15	50.20	94.62	2259	4258	940	490	70500	36750	68241	32492	30.21	7.63
30 x 20	37.56	70.97	1690	3194	780	650	58500	48750	56810	45556	33.62	14.26
40 x 10	56.48	106.45	2542	4790	1080	520	81000	39000	78458	34210	30.86	7.14
40 x 15	37.65	70.97	1694	3194	990	550	74250	41250	72556	38056	42.83	11.91
40 x 20	28.24	53.23	1271	2395	750	660	56250	49500	54979	47105	43.26	19.67

CONCLUSION

The findings suggested that varieties of different growth habits required different spacing to express their yield potentials, Dhaka-1 required closer spacing of 20 cm × 10 cm while DG-2 required wider spacing of 40 cm × 20 cm to produce maximum yield. However, considering seed cost and oil yield 30 cm × 10 cm spacing for Dhaka-1 and 40 cm × 20 cm for DG-2 may be considered as optimum spacing to get maximum benefit from cultivation of these two groundnut varieties.

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