J. Sher-e-Bangla Agric. Univ., 2(2): 65-69, July 2008 ISSN 1997-6038

EFFECT OF SPACING ON GROWTH AND YIELD OF RADISH (*Raphanus sativus* L.)

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ABSTRACT

An experiment was conducted at Horticultural Farm of Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during the period from October to December 2006 to study the effect of spacing on growth and yield of radish. Three spacing viz. S_0=20cm × 30cm, S_1=30cm × 30cm and S_3=40cm × 30cm were used in the study. The experiment was conducted in Randomized Complete Block Design with three replications. Different spacing significantly influenced all the parameters. S_3 spacing gave the maximum plant height (60.03cm plant^{-1}), number of leaves (24.00), fresh weight of leaves (155.0g), weight of individual root (347.2g), largest leaf (42.52cm), longest root (27.0cm length and 7.70cm in diameter) at 75 days after sowing(DAS). But the maximum leaves yield (15.53 t/ha) and root yield (40.93 t ha^{-1}) were recorded in S_1 spacing at 75 DAS. On the other hand, the minimum plant height (37.11 cm), number of leaves (13.0) per plant, leaf length (25.84 cm), weight of leaves per plant (46.80g), root size (11.0cm) and length (2.26 cm in diameter), individual root weight (88.53g) were recorded in S_1 spacing at 45 DAS and the minimum leaves yield (4.96 t ha^{-1}) and root yield (9.40 t ha^{-1}) were recorded in S_3 spacing at 45 DAS.

Key words : Spacing, growth, yield, radish

INTRODUCTION

Radish (*Raphanus sativus* L.) is a member crop of *Brassicaceae* family. It is a popular and important winter vegetable crop in Bangladesh, but now-a-days it can be grown any time of the year in Bangladesh (Rashid, 1983). The crop is becoming popular day by day among all classes of people like poor or rich, urban or rural. The fleshy root and young leaves are used as edible part and nutritionally not so poor as commonly believed. Radish is cultivated everywhere in Bangladesh and is grown mainly as a kitchen garden crop for table purposes. Now-a-days it grows commercially in our country. Radish has a cooling effect on human body and is suitable for patients suffering from piles, liver troubles, enlargement of splin and jaundice (Katyal and Chadha, 1985). The recommended plant spacing of BARI mula-2 (Pinky) is 50cm × 30cm (Rashid, 1999). Radish produces very large roots due to this spacing. Such big roots may not always be desirable to the consumers. Some buyers always prefer medium sized of even small roots for their small families. By using closer spacing than recommended, it may be possible to obtain higher yield, sacrificing root size to some extent. A little investigation has been reported on the influences of spacing and using organic manure alone on radish yield in Bangladesh. Therefore the present investigation was undertaken to assess the appropriate spacing of radish in order to get a maximum yield.

MATERIALS AND METHODS

The experiment was conducted at Horticultural Farm of Sher-e-Bangla Agricultural University,

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Dhaka during October 2006 to December 2006. The area had sub tropical climate characterized by high temperature (28°-32°C) accompanied by moderately high rainfall during Kharif (April-September) season and low temperature (15°-20°C) in the Rabi (October-March) season. The soil belongs to the "Modhupur Tract", AEZ-28 (FAO, 1988). Soil pH ranges from 5.4-5.6 and have organic carbon 0.82%. BARI Mula-2 (Pinky) was selected for investigation. Seeds of BARI Mula-2 (Pinky) were collected from the Citrus and Vegetable Seed Research Center, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur. The experiment was laid out in Randomize Completely Block Design (RCBD) with three replications. Three spacing viz., S_1=20cm × 30cm, S_2=30cm × 30cm and S_3=40cm × 30cm were used in the experiment. The seeds were sown on 9 October 2006 on raised bed. The plot size was 5m x 1m and spacing was maintained as per treatment. There were three plots contained each replication. Irrigation and weeding were done at ten days interval. There was no incidence of insects and diseases. Randomly selected 10 plants were harvested from each plot for data collection for three times. First harvest was done at 45 DAS (days after sowing) and second at 60 DAS and finally at 75 DAS. Data were collected on plant height (cm), number of leaves per plant, largest leaf (cm), weight of leaves per plant, leaves yield (t ha^{-1}), root length, root diameter (cm), weight of root (g), root yield (t ha^{-1}).The means were separated by DMRT at 5% level of significance (Gomez and Gomez,1984).

RESULTS AND DISCUSSION

Plant height: The plant height was recorded at different stages of growth i.e. 45, 60 and 75 days after sowing (DAS). The plant height varied significantly due to different spacing. During the period of plant growth, the maximum plant height (60.03 cm) was observed in widest spacing (S_3) at 75 DAS and the minimum plant height (37.11 cm) was observed in closest spacing (S_1) at 45 DAS. In general the plant height increased gradually in the early stages and became sloth at the later stages of the plant growth (Fig. 1).

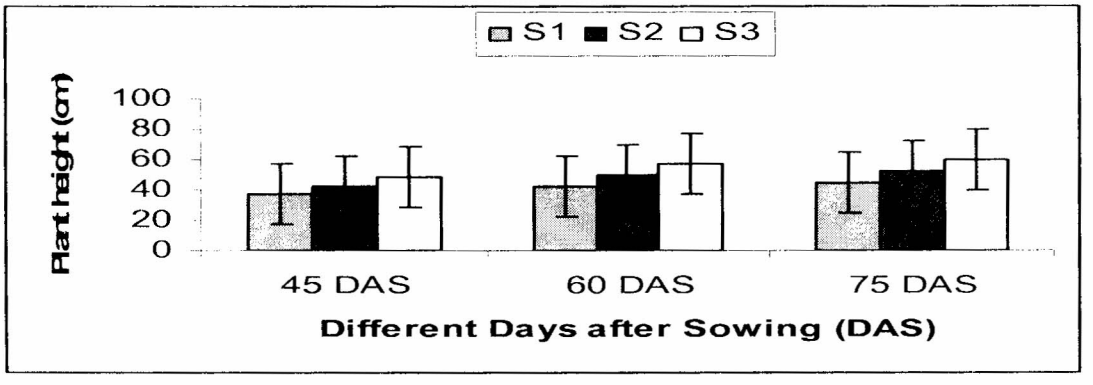

Figure 1. Effect of spacing on plant height of radish at differenti days after sowing seeds

Number of leaves per plant: The variation among the spacing in respect of number of leaves per plant was statistically significant. At 45 DAS, the maximum number of leaves per plant (20.0) was produced by the widest spacing (S_3) and the minimum (13.0) was found in closest spacing (S_1). Similar trend was found in 60 and 75 DAS (Table 1). In this experiment it was reveled that the average numbers of leaves per plant was increased in the increased spacing which, was in agreement with Absar and Siddique (1982).

Leaf length: Plant spacing had a significant influence on leaf length (Table 1). The length of leaves increased progressively with the increase of spacing. At 45 DAS, the longest leaf (36.02 cm) was produced by the widest spacing (S_3) and the minimum (25.84 cm) was found in closest spacing (S_1). At 60 DAS, the longest leaf (40.37 cm) was produced by the widest spacing (S_3) and the minimum (30.18 cm) was found in closest spacing (S_1). At 75 DAS, the longest leaf (42.52 cm) was produced by the widest spacing (S_3) and the minimum (34.16 cm) was found in closest spacing (S_1). However widest spacing gave the longest leaf at every harvest and the narrowest leaf were produced from the closest spacing.

Table 1. Effect of spacing on leaf characteristics of radish

Treatment	No. of Leaf			Leaf length (cm)			Fresh weight of leaves		
	45 DAS	60 DAS	75 DAS	45 DAS	60 DAS	75 DAS	45 DAS	60 DAS	75 DAS
S_1	13.00b	15.00b	16.00c	25.84a	30.18b	34.16a	46.80c	96.00b	100.0b
S_2	16.00b	17.00b	21.00b	30.62a	34.54ab	38.84a	60.17b	103.3b	135.0ab
S_3	20.00a	21.00a	24.00a	36.02a	40.37a	42.52a	80.23a	133.3a	155.0a
CV (%)	10.60	6.54	5.68	14.98	11.16	10.50	7.0	10.84	13.32
$LSD_{0.05}$	3.926	2.617	2.617	10.47	8.861	9.16	9.907	27.25	39.26

In column means folowed by same letter(s) are not significantly different at 5% level of significance by DMRT.

Fresh weight of leaves per plant: Every increase in spacing significantly increased the total weight of leaves per plant (Table 2). The highest weight of leaves (155.0 g) was recorded at widest spacing at 75 DAS and the lowest weight (46.80 g) was produced by plants at closest spacing (S_1) at 45 DAS. Previous reports of Absar and Siddique (1982), and Rahman and Haque (1982) indicate that the number of leaves per plant is increased in the increased spacing and these reports indirectly support the present finding in respect of leaf weight.

Root length: From table 2 it was observed that at 45 and 60 DAS, each spacing showed significant difference among others. But at 75 DAS all spacing was identical to each other. However, the widest spacing produced the longest root (27.0 cm) at 75 DAS and the shortest root (11.0 cm) was found in closest spacing at 45 DAS and S_2 produced moderate root length. In this experiment it was reveled that root length of radish significantly increased in the increased spacing.

Root diameter: Variation was found on root diameter due to spacing was high and the diameter was increased significantly with every increase in spacing at every harvest (Table 2). At 45 DAS, root diameter ranged from 2.26 to 5.10 cm. The maximum root diameter (5.10 cm) was found in widest spacing (S_3) and minimum root diameter (2.26 cm) was observed in closest spacing (S_1). At 60 DAS, root diameter ranged from 3.56 to 6.50cm and 4.10 to 7.70cm at 75 DAS. Similar trend was found at 60 and 75 DAS. Similar results were also reported by Hussain *et al.* (1985) with *panikachu.*

Table 2. Effect of spacing on root characteristics of radish

Treatment	Root diameter (cm)			Root length (cm)			Fresh weight of root (gm)		
	45 DAS	60 DAS	75 DAS	45 DAS	60 DAS	75 DAS	45 DAS	60 DAS	75 DAS
S_1	2.26 b	3.56c	4.10 b	11.00c	15.00c	19.00a	88.53b	250.1b	275.5a
S_2	4.500 a	5.13 b	5.42 b	14.00b	20.00b	22.17a	108.7ab	290.4ab	300.5a
S_3	5.100 a	6.50a	7.70 a	17.00a	24.00a	27.00a	126.8a	320.4a	347.2a
CV (%)	15.33	11.45	10.59	8.25	8.81	17.80	10.69	8.05	15.95
$LSD_{0.05}$	1.375	1.316	1.377	2.617	3.926	9.17	26.18	52.39	111.3

In column means folowed by same letter(s) are not significantly different at 5% level of significance by DMRT.

Fresh root weight: The spacing showed a significant influence on weight of individual roots. The weight was significantly increased with every increase in spacing (Table 2). In case of 45 DAS, the

highest weight of root (126.8 g) was produced at widest spacing and the lowest weight (88.53 g) was found at closest spacing. At 60 DAS, the maximum root weight (320.4 g) was found in widest spacing and minimum weight of root (250.1 g) was observed in closest spacing. At 75 DAS, root weight was found statistically identical to each spacing.

Dry weight of leaves: Dry matter of leaves per plant increased significantly with the increase of spacing. The dry matter of radish leaves per plant was recorded to be the highest (12.30 g) at 75 DAS, where widest spacing was maintained. The minimum dry matter (4.50) of leaves per plant was obtained from the closest spacing at 45 DAS (Table 3).

Table 3. Effect of spacing on dry weight of leaves and root of radish

Treatment	Dry weight of leaves (gm)			Dry weight of root (gm)		
	45 DAS	60 DAS	75 DAS	45 DAS	60 DAS	75 DAS
S_1	4.50 c	6.40 b	7.90 b	3.33 c	9.70 b	10.20 b
S_2	6.10 b	9.53 a	10.10ab	4.90 b	11.67ab	12.50ab
S_3	8.20 a	11.57a	12.30a	6.60 a	13.17 a	14.40 a
CV (%)	9.21	14.24	11.43	11.70	10.0	9.34
$LSD_{0.05}$	1.308	2.985	2.617	1.310	2.610	2.617

In column means folowed by same letter(s) are not significantly different at 5% level of significance by DMRT.

Dry weight of root: Significant variation was observed in case of dry matter of root per plant due to the effect of spacing. Dry matter of root was increased in the increased in spacing and the highest root dry matter (14.40g) was found in the widest spacing at 75 DAS and the lowest dry matter (3.33 g) of root per plant was obtained from the closest spacing at 45 DAS (Table 3).

Leaves yield: A significant variation was observed on leaves yield due to the different spacing. Increase in spacing significantly decreased the yield of radish leaves. The highest yield (15.53 t/ha) was found in the closest spacing (S_1) at 75 DAS and the lowest yield (7.11 t/ha) was found in the widest spacing (S_3) at 45 DAS. The leaves yield per unit area increased significantly because of accommodating higher number of plants at the closer spacing. In other words the reduced weight of leaves due to higher interplant competition, was more than compensated by the higher number of plants accommodated per unit area leading to higher yield at the closer spacing (Fig. 2).

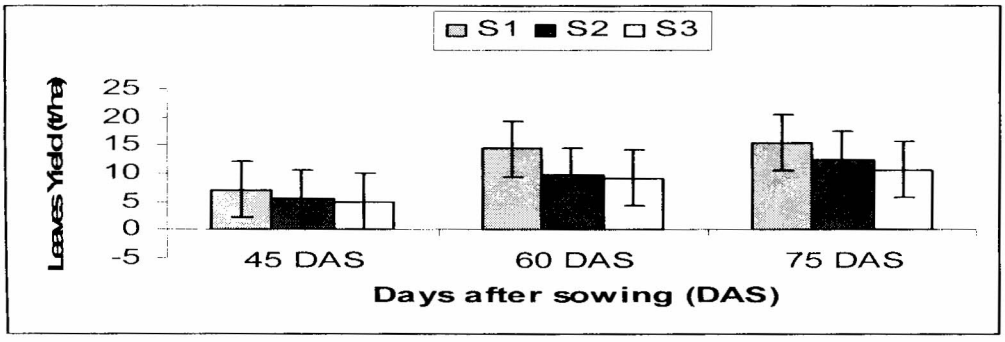

Figure 2. Effect of spacing on leaves yield of radish at different days after sowing seeds

Root yield: A significant variation was observed on root yield due to the different spacing (Fig. 3). The highest yield (40.93 t/ha) was found in the closest spacing (20cm × 30cm) at 75 DAS and the lowest yield (13.40 t/ha) was found in the widest spacing at 45 DAS.

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	45 DAS	60 DAS	75 DAS	45 DAS	60 DAS	75 DAS
S_1	4.50 c	6.40 b	7.90 b	3.33 c	9.70 b	10.20 b
S_2	6.10 b	9.53 a	10.10ab	4.90 b	11.67ab	12.50ab
S_3	8.20 a	11.57a	12.30a	6.60 a	13.17 a	14.40 a
CV (%)	9.21	14.24	11.43	11.70	10.0	9.34
$LSD_{0.05}$	1.308	2.985	2.617	1.310	2.610	2.617

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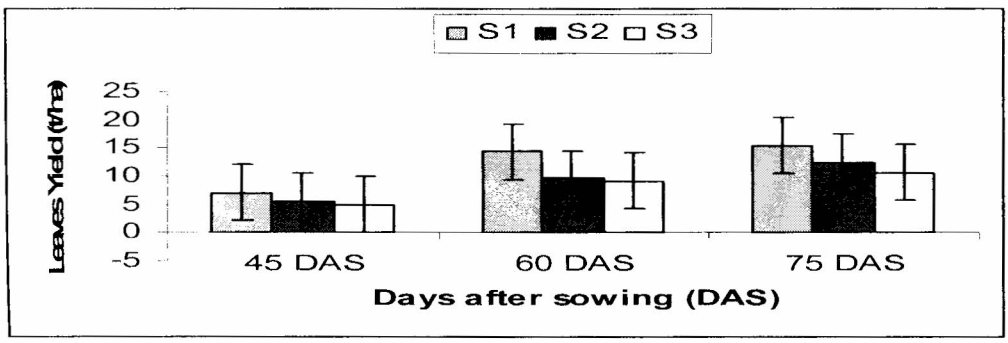
Leaves yield: A significant variation was observed on leaves yield due to the different spacing. Increase in spacing significantly decreased the yield of radish leaves. The highest yield (15.53 t/ha) was found in the closest spacing (S_1) at 75 DAS and the lowest yield (7.11 t/ha) was found in the widest spacing (S_3) at 45 DAS. The leaves yield per unit area increased significantly because of accommodating higher number of plants at the closer spacing. In other words the reduced weight of leaves due to higher interplant competition, was more than compensated by the higher number of plants accommodated per unit area leading to higher yield at the closer spacing (Fig. 2).



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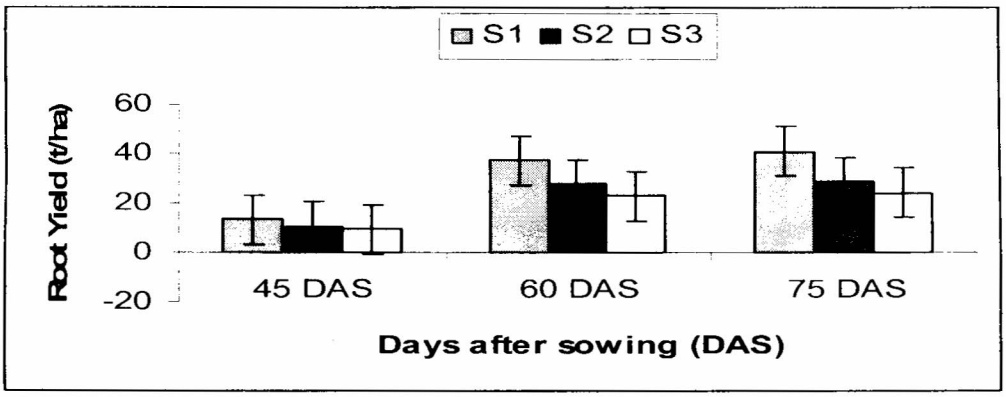

Figure 3. Effect of spacing on root yield of radish at different days after sowing seeds

The leaf size, leaf weight, root size and individual root weight decreased with decreasing spacing but the root yield per unit area increased significantly because of accommodating higher number of plants at the closest spacing. In other words the reduced weight of individual root due to higher interplant competition was more than compensated by the higher number of plants accommodated per unit area leading to higher yield at the closest spacing. The results of this study are in accord with the finding of many workers (Badruddin and Haque, 1977; Absar and Siddique, 1982 and Ahmed and Haque, 1986)

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