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EFFECT OF SPACING AND K_2O ON THE GROWTH AND YIELD OF BROCCOLI (*Brassica oleracea* L. var. *italica*)

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ABSTRACT

The experiment was conducted at Horticulture Farm, Sher-e-Bangla Agricultural University, Dhaka, during October 2007 to February 2008. The experiment was consisted of two factors, viz. three levels of spacing such as 60 cm x 40 cm; 60 cm x 50 cm and 60 cm x 60 cm and four levels of K_2O such as 0; 60; 90 and 120 kg/ha fertilizer application. Results revealed that different spacing and K_2O levels significantly influenced on growth parameters and yield of broccoli. The maximum plant height, number of leaves, primary curd weight, secondary curd weight and yield per plant were recorded from the widest spacing but the highest yield (14.02 t/ha) was recorded from the closest spacing. On the other hand, all the parameters under study showed better performance with the application of 120 kg K_2O/ha. The highest yield (14.70 t/ha) was obtained from this treatment. Combined effect of the closest spacing and the highest dose of K_2O also gave the highest yield (16.61 t/ha). The results suggested that 60 cm x 40 cm spacing along with 120 kg K_2O/ha may be used for higher yield of broccoli.

Key words: Broccoli, spacing, K_2O, yield.

INTRODUCTION

Broccoli (*Brassica oleracea* L. var. *italica*) is one of the non- traditional vegetable crops in Bangladesh which belongs to the family Cruciferae. It is originated from west Europe (Prasad and Kumar, 1999) and is a very popular vegetable in the United States of America. Broccoli is fairly rich in vitamin A and C and contains appreciable amounts of calcium, phosphorus, riboflavin, thiamin, niacin, and iron (Thompson and Kelly, 1997). So, it can contribute significantly to improve our diet. Broccoli is grown by a small percentage of home gardeners in Bangladesh during the winter season. It is environmentally better adapted than cauliflower as reported to withstand comparatively higher temperature (Rashid, 1993). Growth and yield of broccoli in Bangladesh are seriously impeded compared to other countries. Main reason for such poor growth and yield might be due to lack of judicious application of fertilizers and proper cultural management practices. It is evident that balanced application of fertilizer is the prerequisite for obtaining higher yield and better quality of broccoli (Brahma *et al.*, 2002). Ying *et al.* (1997) observed that potassium was the most important element for yield and dry weight of broccoli. Optimal plant spacing is very important for crop production through efficient utilization of light, nutrients and water by the plants. In some cases, higher plant population adversely affects on yield per unit area by hampering the vegetative and reproductive growth of plant. Closer spacing and higher densities of broccoli shows increased yield per hectare but the quality of crops is decreased (Gorski and Armstrong, 1985). Considering these facts the present study was undertaken to find out optimum spacing and K_2O levels for higher growth and yield of broccoli.

MATERIALS AND METHODS

The research work was conducted at Horticulture Farm, Sher-e-Bangla Agricultural University, Dhaka during October 2007 to February 2008. The experiment was consisted of 12 treatment combinations of 3 spacing (S_1: 60 cm x 40 cm, S_2: 60 cm x 50 cm and S_3: 60 cm x 60 cm) and 4 levels of K_2O (K_0: 0 kg K_2O/ha, K_1: 60 kg K_2O/ha, K_2: 90 kg K_2O/ha and K_3: 120 kg K_2O/ha) fertilizer application.

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Seedlings of broccoli were raised at the Horticulture Farm, Sher-e-Bangla Agricultural University, Dhaka under special care in two seedbeds of 3 m x 1 m size under the polythene tunnel. Two-factor experiment was laid out at randomized complete block design (RCBD) with three replications. Ten plants were randomly selected from the middle rows of each unit plot for avoiding border effect except yields of curds, which was recorded plot wise. Data were recorded on different parameters to assess plant growth and yield as affected by different treatments of the experiment. Data on height of the plant, number of leaves were recorded at 20, 40 and 60 days after transplanting (DAT). All other parameters were recorded during harvest and after harvest. Collected data from the experimental plot in respect of various characteristics were tabulated and statistically analyzed using the MSTAT computer package program. Least significant difference (LSD) technique at 5% level of significance was used to compare the mean differences among the treatments according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Main effect of spacing

Plant height and number of leaves per plant was significantly influenced by plant spacing at different days after transplanting (DAT). The tallest (68.57 cm) plant was recorded from S_3 spacing followed by S_2 spacing and the shortest (64.59 cm) plant was recorded from the closest spacing S_1 at 60 DAT (Fig. 1). The maximum number of leaves (15.77) per plant was recorded from S_3 spacing followed by (14.45) at S_2 and the minimum number of leaves (13.92) per plant was found from the closest spacing S_1(Fig. 2). Primary curd weight per plant, secondary curd weight per plant, yield per plant, and yield per hectare were significantly influenced by plant spacing during the cropping season. It was observed that higher plant spacing S_3 produced the highest primary curd weight per plant (253.80 g), secondary curd weight per plant (115.4 g), yield per plant (372.80 g).

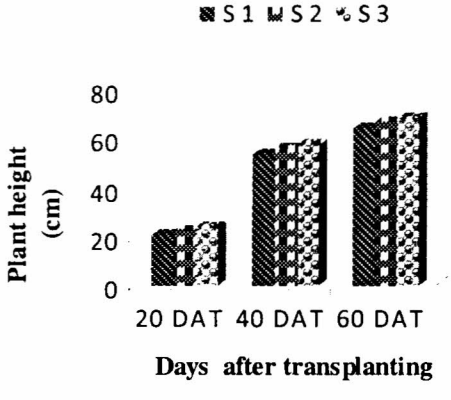

Fig. 1. Effect of different plant spacing on plant height of broccoli

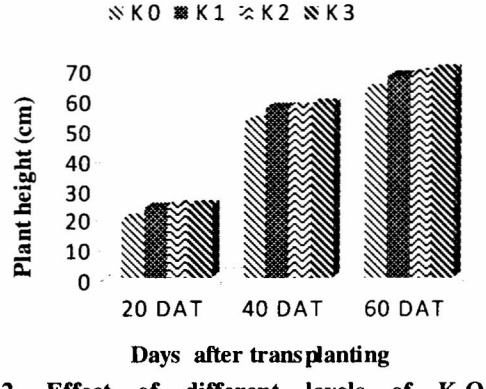

Fig. 2. Effect of different levels of K_2O application on plant height of broccoli

The closer plant spacing (60 cm x 40 cm) gave the lowest primary curd weight (244.00 g), secondary curd weight per plant (108.40 g), yield per plant (323.50 g) but produced the highest yield (14.02 t/ha), whereas the lowest yield per unit plot as well as the lowest yield per hectare was observed from the closest plant spacing (Table 2). In case of higher spacing plant receive more light, moisture and nutrient than closer spacing which might be enhanced plant growth. The medium plant spacing S_2 (60 cm x 50 cm) always showed intermediate results. Mourao *et al.* (2007) worked with broccoli and reported that the highest plant spacing produced the highest leaf length and leaf breadth and as a result the highest

plant height but the highest yield was obtained from the lowest spacing which are in line with the present results.

Main effect of K_2O

The application of different levels of K_2O markedly influenced the height of plants and the number of leaves per plant. The maximum plant height (69.24 cm) and number of leaves per plant (15.90) were recorded from the highest dose of K_2O (K_3) which was followed by K_2 treatment and minimum plant height (62.9 cm) and the number leaves per plant (12.41) were recorded from the control K_0 treatment at 60 DAT (Fig. 3 & 4).

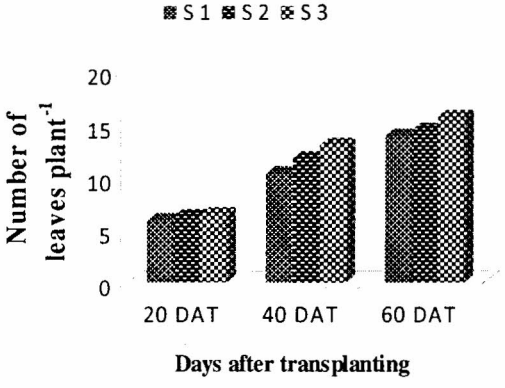

Fig. 3. Effect of different plant spacing on number of leaves per plant of broccoli

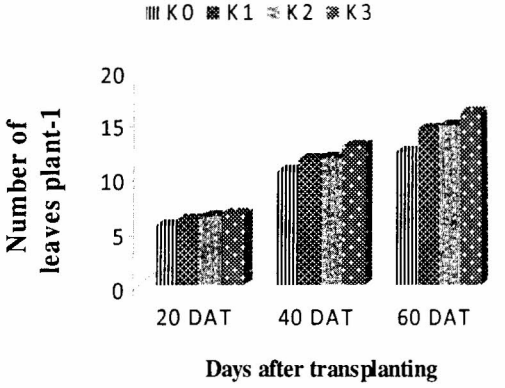

Fig. 4. Effect of different levels of K_2O application on number of leaves per plant of broccoli

The results depicted in Table 2 that statistically significant variation was observed in respect of primary curd weight per plant, secondary curd weight per plant, yield per plant, yield per unit plot and yield per hectare by the application of different levels of K_2O. The highest primary curd weight (253.00 g), the highest weight of secondary curd per plant (116.20 g), the highest yield per plant (400.10 g), the highest yield per unit plot (7.15 kg) and the highest yield (14.70 t/ha) were recorded from higher dose of K_2O (K_3) application. The application of higher dose of potassium might be increased the physiological activities of plant resulting increasing rate of growth and thus obtained higher yield. Mitra *et al.* (1990) reported that among the fertilizers, potassium appears to be an important factor for gaining higher yield and act as in balancing physiological activities of plants. The lowest primary curd weight (243.50 g), the lowest weight of secondary curd per plant (109.20 g), the lowest yield per plant (298.60 g), the lowest yield per unit plot (5.26 kg) and the lowest yield (10.83 t/ha) were obtained from K_0 treatment. Guan and Chen (2001) reported that higher amount of potassium contribute higher curd weight, curd diameter and secondary curd number per plant which is in agreement with present finding. It was also observed that K_1 and K_2 treatments showed intermediate result (Table 2).

Interaction effect of spacing and K_2O

Significant effect of interaction of spacing and K_2O on plant height and number of leaves per plant was also observed. The highest plant height (68.68 cm) and the highest number of leaves per plant (16.33) was observed at 60 days after transplanting (DAT) from the treatment combination of S_3K_3 which was followed S_3K_2. On the other hand the lowest plant height (63.50 cm) and the lowest number of leaves per plant (13.09) were recorded from the treatment combination of S_1K_0 at 60 DAT, which was significantly different with other treatment combination (Table 1).

Table 1. Effect of different plant spacing with potash fertilizer levels on plant height and number of leaves per plant at different days after transplanting of broccoli

Treatment	Plant height (cm)			Number of leaves per plant		
	20 DAT	40 DAT	60 DAT	20 DAT	40 DAT	60 DAT
S_1K_0	19.46 g	54.03 g	63.50 g	5.38 f	11.27 g	13.09 j
S_1K_1	23.07 e	56.47 f	67.42 e	5.83 e	11.35 fg	13.97 g
S_1K_2	23.37 de	56.67 ef	67.67 de	6.02 de	11.48 e-g	14.21 fg
S_1K_3	23.64 cd	56.89 de	67.87 cd	6.25 cd	11.57 ef	14.40 ef
S_2K_0	19.10 g	52.32 h	63.40 g	5.84 e	11.60 de	13.44 i
S_2K_1	23.18 de	56.66 ef	67.68 de	6.05 de	11.69 c-e	14.59 de
S_2K_2	23.59 cd	56.95 de	67.89 cd	6.48 bc	11.80 b-d	14.81 cd
S_2K_3	23.97 bc	57.17 cd	68.17 bc	6.62 bc	11.98 ab	14.96 bc
S_3K_0	20.40 f	53.74 g	64.79 f	5.67 ef	11.69 c-e	13.70 h
S_3K_1	24.19 ab	57.37 bc	68.31 b	6.57 bc	11.87 bc	14.88 c
S_3K_2	24.37 ab	57.53 ab	68.50 ab	6.82 b	12.09 b	15.15 b
S_3K_3	24.59 a	57.74 a	68.68 a	8.10 a	13.17 a	16.33 a
LSD $_{(0.05)}$	0.473	0.308	0.339	0.367	0.207	0.240
CV(%)	8.46	9.32	7.21	8.45	6.19	9.06

Primary curd weight, weight of secondary curd per plant, yield per plant and yield per hectare were significantly influenced by the interaction effect of spacing and K_2O application during the total cropping season. It was observed that the highest primary curd weight (252.20 g), the highest secondary curd weight per plant (117.20 g) and the highest yield per plant (439.10 g) were recorded from S_3K_3 but the highest yield per unit plot (8.07 kg) and the highest yield (16.61 t/ha) were recorded from S_1K_3 treatment combination (Table 2).

Table: 2. Effect of different plant spacing and potash fertilizer levels on yield and yield attributes of broccoli

Treatment	Primary curd weight per plant (g)	Weight of secondary curd per plant (g)	Yield per plant (g)	Yield per unit plot (kg)	Yield (t/ha)
			Spacing		
S_1	244.00 c	108.40 c	324.40 b	6.81 a	14.02 a
S_2	249.50 b	111.30 b	323.50 b	5.76 b	11.85 b
S_3	253.80 a	115.40 a	372.80 a	5.59 c	11.51 b
LSD $_{(0.05)}$	0.395	0.298	6.75	0.163	1.339
			K_2O		
K_0	243.50 d	109.20 d	298.60 c	5.26 c	10.83 d
K_1	247.50 c	112.30 bc	314.90 c	5.62 c	11.56 c
K_2	249.70 b	112.70 b	347.40 b	6.19 b	12.74 b
K_3	253.00 a	116.20 a	400.10 a	7.15 a	14.70 a
LSD $_{(0.05)}$	0.336	0.463	22.860	0.362	0.391
			Interaction		
S_1K_0	244.80 e	108.10 f	288.40 d	6.05 de	12.45 de
S_1K_1	246.10 d	110.50 e	300.30 d	6.31 cd	12.98 cd
S_1K_2	247.40 c	111.80 de	324.60 cd	6.82 b	14.04 b
S_1K_3	247.70 c	112.20 c-e	384.30 b	8.07 a	16.61 a
S_2K_0	246.50 cd	109.30 ef	293.90 d	5.03 f	10.35 fg
S_2K_1	248.50 bc	111.30 d	295.00 d	5.31 f	10.93 f
S_2K_2	249.70 a-c	112.70 cd	328.10 cd	5.91 e	12.16 e
S_2K_3	250.10 ab	113.10 c	376.90 b	6.78 b	13.96 b
S_3K_0	249.30 b	113.20 c	313.60 cd	4.70 g	9.69 g
S_3K_1	249.80 ab	115.30 b	349.30 bc	5.24 f	10.78 f
S_3K_2	251.00 a	115.70 b	389.30b	5.84 e	12.02 e
S_3K_3	252.20 a	117.20 a	439.10 a	6.59 bc	13.54 bc
LSD $_{(0.05)}$	1.708	0.596	39.600	0.326	0.677
CV (%)	10.59	11.20	7.49	8.22	9.31

It seems that closer spacing along with higher dose of potassium fertilizer produced higher yield compared to other treatment combination. The higher dose of K_2O enhances plant growth and closer spacing provides more plant in unit area which might be ensured better yield. The lowest primary curd weight and the lowest secondary curd weight were recorded from the treatment combination S_1K_0 and S_2K_0, respectively and the lowest yield per plant (288.40 g), the lowest yield per unit plot (4.70 kg) and the lowest yield (9.69 t/ha) were found from the treatment combination of S_1K_0, S_3K_0 and S_3K_0, respectively (Table 2).

Considering all the results of the present experiment, it can be concluded that application of 120 kg K_2O/ha with 60 cm x 40 cm spacing is profitable for broccoli production. Investigation with other spacing and potassium fertilizer doses may be carried out to obtain more precise result concerning broccoli production.

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