J. Sher-e-Bangla Agric. Univ., 5(2): 17-22, July 2011 ISSN 1997-6038

EFFECT OF SPACING ON GROWTH AND YIELD OF DIFFERENT VARIETIES OF KNOL-KHOL

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ABSTRACT

The experiment was conducted at Horticulture Farm, Sher-e-Bangla Agricultural University, Dhaka, during October 2010 to January 2011. The experiment was consisted of two factors, viz. four varieties of Knol-khol (White Vienna, Big Ball, UFO and Early 005) and three spacing (30 cm × 15 cm, 30 cm × 20 cm, 30 cm × 25 cm). Result revealed that different varieties significantly influenced on growth parameter and yield of knoll-khol. The maximum gross yield (74.93 t/ha) was recorded from the variety White Vienna. The maximum marketable yield (55.38 t/ha) of Knol-khol was also obtained from the variety White Vienna. Different spacing also influenced significantly on most of the parameters under study. The spacing 30 cm × 20 cm showed better performances and the highest gross yield (66.28 t/ha) as well as the highest marketable yield (48.32 t/ha) were obtained from this spacing. Interaction effect of different varieties and spacing had a significant variation on yield contributing characters and yield of Knol-khol. White Vienna and spacing 30 cm × 20 cm gave the maximum gross yield (80.26 t/ha) and also the maximum marketable yield (59.90 t/ha). So the treatment combination White Vienna with 30 cm × 20 cm spacing is suitable for the maximum yield of Knol-khol.

Keywords: knol-khol, variety, spacing, yield

INTRODUCTION

Knol-khol (*Brassica oleracea* var. *gongylodes*), is one of the important winter vegetables of Bangladesh belongs to the family Cruciferae. It is also known as Kohlrabi, originated in North-Europe. Knol-khol is a member of cole crops and closely related to cabbage. It has high nutritive value, contains substantial amount of moisture (92.7 g), protein (1.1 g), fat (0.2 g), mineral (0.7 g), vitamin A (38 IU) and vitamin C (85 mg) per 100 g of edible portion (Chowdhury, 1967). The actual yield of knol-khol is very low against the potential yield and has not been cultivated commercially at a large scale in Bangladesh. But the production of this crop can be intensified and popularized by adopting proper agronomic practices. Growth and yield of knol-khol in Bangladesh is not up to the mark. Main reason for such poor growth and yield might be due to lack of high yielding variety and proper cultural management practices. Variety itself is a genetic factor which contributes a lot in producing yield and yield components of a particular crop. Crop yield varies from variety to variety due to internal and external factors of the plant. Most of the seed companies collect crop varieties from different countries and sale to growers without adaptability test. Therefore, it is necessary to find out a suitable variety for higher yield and economic return as well. Optimal plant spacing is very important for crop production through efficient utilization of light, nutrient and water by the plants. 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 knol-khol increase yield per hectare but the quality is decreased. Considering these facts the present study was undertaken to find out suitable variety and optimum spacing for higher growth and yield of knol-khol.

MATERIALS AND METHODS

The field experiment was carried out at the Horticulture Farm, Sher-e-Bangla Agricultural University (SAU), Dhaka during the period from October, 2010 to January, 2011. The experiment was consisted of 12 treatment combinations of four varieties e.g. V_1: White Vienna, V_2: Big Ball, V_3: UFO, V_4: Early 005 and

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three spacing, viz. S_1 (30 cm × 15 cm), S_2 (30 cm × 20 cm), S_3 (30 cm × 25 cm). Seedlings were raised at Horticulture Farm, SAU, Dhaka under special care. Four seedbeds were made for four varieties of 3 m × 1 m size under the polythene tunnel. Two factor experiments were laid out in the Randomized Complete Block Design (RCBD) with three replications. The experimental area (20.9 m × 5.6 m) was first divided into three blocks. Then each block was divided into 12 unit plots. The treatments were assigned randomly in each block. The size of unit plot was 1.2 m ×1.2 m. The distance between two adjacent blocks and plots was 0.5 m. Healthy and vigorous seedlings were transplanted in the plot. Data were recorded on different parameters to assess plant growth and yield as affected by different treatment of the experiment. Data on height of the plant and number of leaves were recorded at different days after transplanting (DAT). All other parameters were recorded during harvest and after harvest. Collected data in respect of different 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 treatment according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Main effect of variety

Data on plant height were recorded periodically at 15, 25, 35, 45 and 55 days after transplanting (DAT). The plant height and number of leaves per plant were significantly influenced due to the different varieties at different days after transplanting. The tallest plant (21.84, 32.93, 38.98, 40.53 and 41.33 cm at 15, 25, 35, 45, and 55 DAT, respectively) was obtained from 'White Vienna' and the shortest plant (20.44, 28.04, 31.48, 31.72 and 32.28 cm at 15, 25, 35, 45, and 55 DAT, respectively) was obtained from 'Early 005' (Fig. 1). The highest number of leaves (7.16, 7.99, 10.10, 10.96 and 11.53 at 15, 25, 35, 45, and 55 DAT, respectively) was obtained from White Vienna and the lowest number of leaves (6.44, 7.71, 8.90, 9.29 and 8.78 at15, 25, 35, 45, and 55 DAT, respectively) was obtained from Early 005 (Fig 3). Due to the effect of different varieties of Knol-khol, a significant

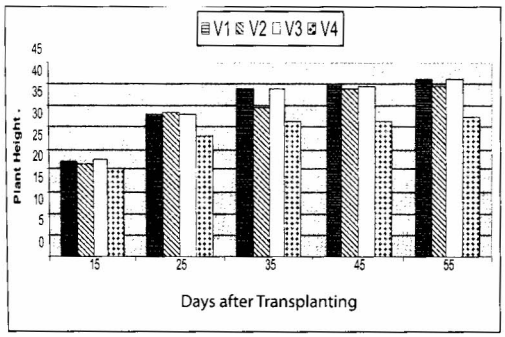

Fig 1. Effect of varieties on plant height at different days after transplanting

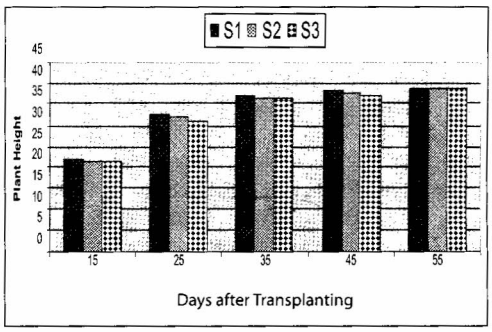

Fig 2. Effect of spacing on plant height at different days after transplanting

variation was observed in respect of fresh weight of knob per plant, diameter of knob per plant, thickness of knob per plant, average length of root per plant, dry weight of knob, gross yield per hectare and marketable yield per hectare. It was observed that the maximum fresh weight of knob (330 g), diameter of knob (8.96 cm), thickness of knob (7.74 cm), average length of root per plant (11.97 cm), and dry weight of knob (9.12 %) were produced from the variety 'White Vienna' and the minimum fresh weight of knob (174.10 g), diameter of knob (7.60 cm), thickness of knob (5.25 cm), average length of root per plant (6.23 cm), and dry weight of knob (5.38 %) were obtained from the variety 'Early 005' (Table 2). The highest gross yield (74.93 t/ha) was recorded from the variety 'White Vienna', while the lowest gross yield (43.50 t/ha) was observed from the variety 'Early 005'. The marketable yield of Knol-khol per hectare was remarkably

varied among varieties which was statistically significant. The maximum (55.38 t/ha) and the minimum (29.47 t/ha) marketable yield of Knol-knol were obtained from the variety 'White Vienna' and 'Early 005', respectively (Table 2). Arin *et al.* (2003) worked with three varieties of kholrabi cultivars and reported that cultivar 'Express Forcer' is more suitable in autumn. Haupt (1986) also reported that 'Express Forcer' yielded best and earliest.

Main effect of spacing

The plant height and number of leaves were not significantly affected due to the different spacing at different days after transplanting. The tallest plant (21.91, 32.71, 36.97, 37.88 and 38.94 cm at 15, 25, 35, 45, and 55 DAT, respectively) was obtained from S_1 (30 cm × 15 cm spacing) and the shortest plant (21.28, 30.90, 34.53, 36.84 and 38.54 cm at 15, 25, 35, 45, and 55 DAT, respectively) was obtained in S_3 (30 cm × 25 cm spacing) (Fig 2). The maximum number of leaves (7.00, 8.25, 9.85, 10.25 and 10.57 at 15, 25, 35, 45, and 55 DAT, respectively) was obtained from S_2 and the minimum number of leaves (6.47, 6.99, 8.88, 9.78 and 9.83 at15, 25, 35, 45, and 55 DAT, respectively) was obtained from S_1 (Fig. 4).

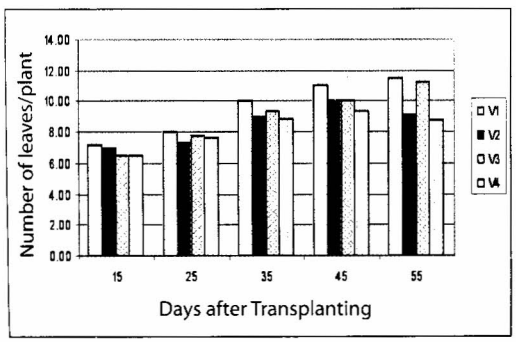

Fig. 3. Effect of varieties on number of leaves per leaves per plant

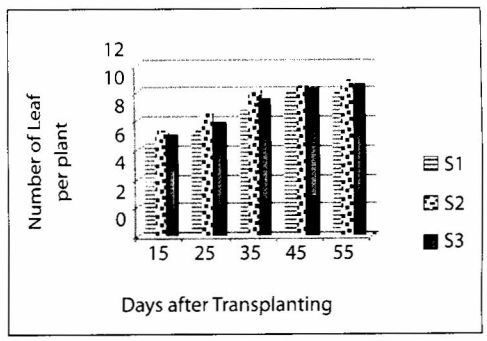

Fig. 4. Effect of spacing on number of plant

The diameter of knob was significantly influenced by spacing. Treatment S_3 produced maximum diameter of knob (8.67 cm) and the minimum (8.25 cm) diameter of knob were recorded in S_1 treatment. Fresh weight knob, average length of root per plant was maximum from S_3 treatment and minimum from S_1 treatment. (Table 2). This variation might be due to the more competition for nutrients, moisture and light among the plants. The thickness of knob was significantly influenced by spacing. Similar result was also reported by Bose and Som (1986). Treatment S_3 produced the maximum thickness of knob (6.61 cm) and dry matter content of knob (8.49 %) and the minimum (6.38 cm) thickness of knob and dry matter content of knob (7.3 %) were recorded in S_1 treatment (Table 2). Variation in gross yield of Knol-khol was found to be significant due to different spacing. The maximum gross yield of Knol-khol (66.28 t/ha) was obtained from the treatment S_2 (30 cm ×20 cm spacing) and the minimum gross yield of Knol-khol (60.81 t/ha) was found from the treatment S_1 (Table 2). It indicates that closer spacing accumudate more plant in definite area and produce higher yield but more closer spacing hamper the proper growth of individual plant resulting poor yield. The marketable yield of Knol-khol was also significantly influenced due to the different spacing. The maximum marketable yield of Knol-khol (48.32 t/ha) was obtained from S_2 (30 cm × 20 cm spacing) and the minimum marketable yield of Knol-khol (42.91 t/ha) was obtained from S_1 (30 cm × 15 cm spacing). (Table 2). Similar result was reported by Hartrath and Haber (1977). Orlowski and Slodkowski (1993) reported that highest seed yield of kholrabi was obtained from closer spacing.

Interaction effect of variety and spacing

Significant effect of interaction of variety and spacing on plant height was observed from the experiment. The tallest plant (23.67, 35.67, 41.03, 41.43 and 43.60 cm at 15, 25, 35, 45, and 55 DAT, respectively) was obtained from treatment combination V_1S_1 (White Vienna with 30 cm × 15 cm spacing) while the shortest

(20.10, 27.33, 26.10, 30.40 and 29.83 cm at 15, 25, 35, 45, and 55 DAT, respectively) was found from V_4S_3 (Early 005 with 30 cm × 25 cm spacing) (Fig 3). The maximum number of leaves (7.47, 8.53, 10.53, 11.00 and 12.00 at 15, 25, 35, 45, and 55 DAT, respectively) was obtained from V_1S_2 and the minimum number of leaves (5.93, 6.77, 8.07, 8.60 and 7.93 at 15, 25, 35, 45, and 55 DAT, respectively) was obtained from V_4S_1 (Table 1).

Table 1. Interaction effect of varieties and spacing on number of leaves at days after transplanting of Knol-khol

Treatment	Number of leaves per plant				
	15 DAT	25 DAT	35 DAT	45 DAT	55 DAT
V_1S_1	6.93 abc	7.30 abcd	9.60 abc	10.93 a	11.20 ab
V_1S_2	7.47 a	8.53 a	10.53 a	11.00 a	12.00 a
V_1S_3	6.80 abcd	8.17 abc	10.07 ab	10.93 a	11.67 a
V_2S_1	6.13 de	6.90 cd	8.53 cd	9.87 abc	8.60 de
V_2S_2	6.73 abcd	7.97 abcd	9.73 abc	10.27 ab	9.00 cde
V_2S_3	6.47 cde	7.00 bcd	8.73 bcd	9.87 abc	9.67 bcd
V_3S_1	6.87 abcd	7.00 bcd	9.33 abcd	9.67 abc	10.40 abc
V_3S_2	6.87 abcd	8.50 a	9.87 abc	9.80 abc	11.73 a
V_3S_3	6.60 bcde	7.77 abcd	8.73 bcd	9.47 bc	11.47 a
V_4S_1	5.93 e	6.77 d	8.07 d	8.60 c	7.93 e
V_4S_2	7.27 ab	8.23 ab	9.47 abc	10.30 ab	8.93 cde
V_4S_3	7.13 abc	8.00 abcd	9.27 abcd	10.13 ab	9.47 cde
CV	5.79	8.54	7.72	6.86	8.49
LSD	0.67	1.11	1.22	1.16	1.46

Table 2. Effect of varieties on different growth and yield parameters of knol-khol

Treatment	Fresh weight of nob/plant (g)	Diameter of knob per plant (cm)	Thickness of knob per plant (cm)	Average length of root per plant (cm)	Dry matter content of knob (%)	Gross yield (t/ha)	Marketable yield (t/ha)
Variety							
V_1	330.0 a	8.96 a	7.74 a	11.97 a	9.12 a	74.93 a	55.38 a
V_2	290.10 b	8.81 a	6.53 ab	11.42 ab	9.00 a	66.66 b	48.89 b
V_3	290.40 b	8.54 a	6.33 bc	8.48 bc	8.31 b	67.52 b	49.06 b
V_4	174.10 c	7.60 b	5.25 c	6.23 c	5.38 c	43.50 c	29.47 c
CV(%)	5.12	6.62	7.46	12.73	10.94	10.83	11.76
$LSD_{(0.05)}$	29.06	0.88	1.25	3.15	0.34	5.98	5.00
Spacing							
S_1	193.10 c	8.25 b	6.38 b	9.36 b	7.30 b	60.81 b	42.91 b
S_2	289.90 b	8.52 a	6.39 b	9.45 ab	8.07 b	66.28 a	48.32 a
S_3	330.40 a	8.67 a	6.61 a	9.76 a	8.49 a	62.32 b	45.88 b
CV(%)	5.12	6.62	7.46	12.73	10.94	10.83	11.76
$LSD_{(0.05)}$	39.28	0.24	0.19	0.35	1.09	3.99	4.59

A significant difference was found in respect of interaction effects of different varieties and spacing on the fresh weight of knob and diameter of the knob. The maximum fresh weight of knob (406 g) and diameter of knob (9.48 cm) were observed from V_1S_3. The minimum fresh weight of knob (130 g) and diameter of knob (7.21 cm) was observed from V_4S_1 (Table 3). The diameter of the knob was increased with wider spacing probably due to the availability of more nutrients, light and moisture to the plants. Interaction effects of different varieties and spacing revealed that this interaction induced a significant difference on the thickness of the knob. The maximum thickness of knob (8.39 cm), average length of root per plant (12.78 cm), and

dry weight of knob (9.5 %) were observed from V_1S_3 while the minimum thickness of knob (5.18 cm), average length of root per plant (5.83 cm), and dry weight of knob (5.2 %) were observed from V_4S_1 Treatment (Table 3). It was found that V_1S_2 (White Vienna with 30 cm × 20 cm spacing) treatment combination produced the maximum gross yield (80.26 t/ha). On the other hand minimum gross yield (42.94 t/ha) was obtained from the V_4S_1 (Early 005 with 30 cm × 15 cm spacing) treatment combination (Table 15). It was observed that the combined effect of different

Table 3. Interaction effect of varieties and spacing on different parameters of Knol-khol

Treatment	Fresh weight of knob/plant (g)	Diameter of knob per plant (cm)	Thickness of knob per plant (cm)	Average length of root per plant (cm)	Dry matter content of knob (%)	Gross yield (t/ha)	Marketable yield (t/ha)
V_1S_1	224.50 d	8.29 g	7.75 b	10.78 e	9.00 ab	70.14 cd	49.88 cde
V_1S_2	359.40 b	8.79 de	7.09 c	10.69 e	8.50 b	80.26 a	59.90 a
V_1S_3	406.00 a	9.48 a	8.39 a	12.78 a	9.50 a	74.40 b	56.38 b
V_2S_1	208.20 d	8.82 cd	6.09 g	12.43 b	8.50 b	64.99 e	46.25 f
V_2S_2	305.30 c	8.93 c	5.32 i	12.05 c	9.37 a	69.14 cde	50.89 cd
V_2S_3	356.70 b	8.69 e	5.25 ij	11.43 d	9.47 a	65.85 e	49.54 cdef
V_3S_1	209.90 d	8.16 h	5.93 h	8.00 h	6.50 c	65.17 e	46.65 ef
V_3S_2	313.60 c	8.53 f	6.59 e	8.45 g	9.43 a	71.29 bc	52.26 c
V_3S_3	347.70 b	9.25 b	6.46 f	8.99 f	8.93 b	66.09 de	48.28 def
V_4S_1	130.00 f	7.21 k	5.18 j	5.83 k	5.20 d	42.94 f	28.87 g
V_4S_2	181.30 e	7.62 j	6.59 e	6.26 f	5.60 d	44.43 f	30.22 g
V_4S_3	211.00 d	7.97 i	6.92 d	6.61 i	5.33 d	43.13 f	29.30 g
CV(%)	5.12	6.62	7.46	12.73	10.94	10.83	11.76
$LSD_{(0.05)}$	18.93	0.11	0.09	0.16	0.75	3.89	3.26

varieties and spacing on marketable yield was statistically significant. The treatment combination of V_1S_2 (White Vienna with 30 cm × 20 cm spacing) produced the maximum marketable yield (59.90 t/ha). The minimum marketable yield (28.87 t/ha) was found from V_4S_1 (Early 005 with 30 cm × 15 cm spacing) treatment combination (Table 3). Considering the results of the present experiment, it can be concluded that variety 'White Vienna' with 30 cm ×20 cm spacing is suitable for knol-khol production.

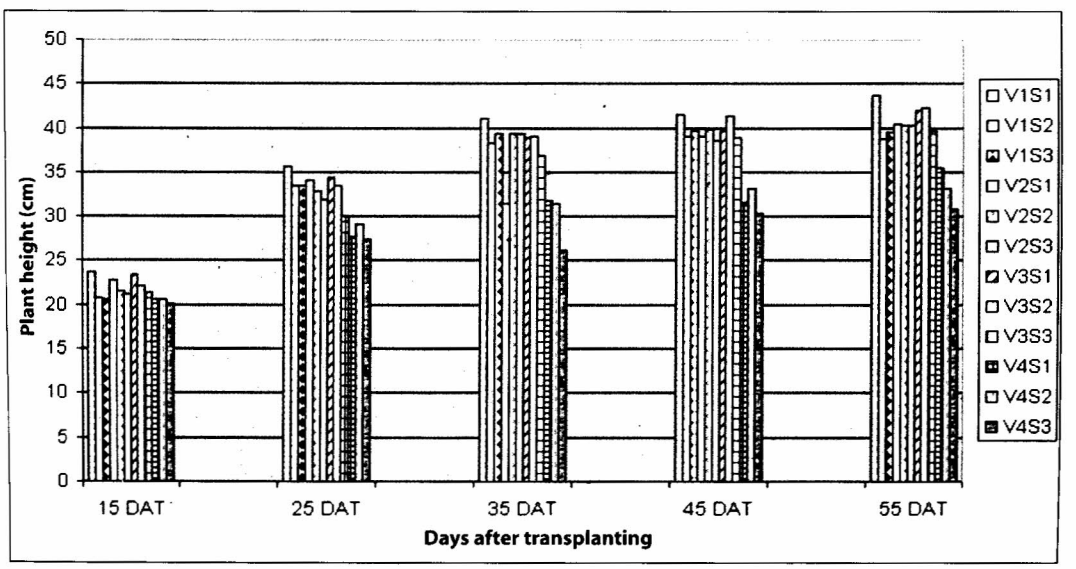

Fig. 5. Combined effect of varieties and spacing on plant height at days after transplanting of Knol-khol.

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