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Effects of cowdung and potassium on growth and yield of Kohlrabi

J. Sultana, M. A. Siddique and M. H. A. Rashid
Department of Horticulture, Bangladesh Agricultural University, Mymensingh- 2202, Bangladesh
E-mail: mharashids@yahoo.com

Abstract

An experiment was carried out at the Horticulture Farm of the Bangladesh Agricultural University, Mymensingh during the period from November 2010 to January 2011 to study the effects of cowdung and potassium on growth and yield of Kohlrabi. The experiment consisted of three levels of cowdung (0, 20 and 40 t/ha) and four levels of potassium (0, 20, 50, 80 kg /ha). The experiment was laid out in randomized complete block design with three replications. All the parameters were significantly influenced by application of cowdung and potassium. The highest plant height (44.65 cm), number of leaves per plant (12.11), length of largest leaf (37.54 cm), and breadth of largest leaf (18.66 cm) were obtained from the highest dose of cowdung and potassium applied (40 t cowdung + 80 kg K/ha) while the lowest plant height (33.64 cm), number of leaves (9.01), length of largest leaf (27.94 cm), and breadth of largest leaf (11.00 cm) were obtained from control treatment combination. The highest fresh weight of leaves (49.33 g), fresh weight of knob (328.66 g) and fresh weight of roots (66.55 g) per plant were also recorded under the treatment combination of 40 t cowdung + 80 kg K/ha, while the lowest fresh weight of leaves (22.11 g), fresh weight of knob (136.00 g) and fresh weight of roots (23.33 g) were obtained from control treatment combination. Similarly, the dry weight of leaves (19.34%), knob (15.19%) and roots (32.75%) were highest under the same treatment combination of 40 t cowdung + 80 kg K/ha and the lowest dry weight of leaves (11.71%), dry weight of knob (7.38%) and dry weight of roots (15.29%) were obtained from control treatment combination C_0K_0. The marketable yields of knob per plot (7.86 kg) and per hectare (39.58 tons) were also the highest under the treatment combination 40 t cowdung/ha and 80 kg potassium per hectare.

Keywords: Kohlrabi, Cowdung, Potassium, Growth, Yield

Introduction

Kohlrabi (*Brassica oleracea* var*. gongylodes*), a member of the cole crops, is also known as Knolkhol and Ol-kapi. It belongs to the family Cruciferae and is of north-European origin. The stem, which is the edible part is generally enlarged immediately above ground (Nieuwhof, 1996). Production of Kohlrabi depends on many factors such as quality of seed, variety, plant spacing, fertilizer and proper management practices. The production of Kohlrabi has not been extended much beyond the agricultural farms in Bangladesh (BBS, 2009). Kohlrabi responds greatly to major essential nutrients, like, N, P, K and organic fertilizer in respect of growth and yield. In 2009-2010, Bangladesh produces 35 thousand tones of Kohlrabi per year from 7.29 thousand hectares of land with an average yield of 4.80 t ha^{-1} which is very low against the potential yield (BBS, 2010). Potassium is considered essential in photosynthesis, sugar translocation, nitrogen metabolism, enzyme activation, stomatal opening, water relation and growth of meristematic tissue. It acts as chemical traffic policeman, root booster, stalk strengtheners, protein builder and breathing regulator and retards diseases. But potassium is not fully effective without its co-efficients such as N and P (Chandra, 1989). Deficiency of potassium may hamper various physiological processes such as, respiration, photosynthesis, chlorophyll development, and may reduce water content of leaves which is directly related to plant growth and yield. The cost of inorganic fertilizers is very high and sometimes it is not available in the market. Consequently, the farmers fail to apply inorganic fertilizer to the crop field in the optimum dose. On the other hand, the organic fertilizer is easily available to the farmers, and its cost is relatively low than the inorganic fertilizers. The crop production cost is more or less similar to organic and inorganic fertilizer (Haque, 2000). The readily available organic sources of nutrients should, therefore, be used to maximize the economic return. Therefore, the present study was undertaken to study the effect of cowdung and potassium on growth and yield for obtaining high economic return of Kohlrabi.

Materials and Methods

The present study was carried out at the Horticultural Farm of the Bangladesh Agricultural University, Mymensingh during the period from October 2010 to January 2011. The soil of the experimental plot was silty loam in texture and medium high in nature belonging to the Old Brahmaputra Floodplain Alluvium under the Agro-Ecological Zone 9 (UNDP and FAO, 1988). The variety of Kohlrabi selected for the experiment was Winter queen F-1. It is a hybrid variety and originated from Japan. Seeds were sown on 12 October 2010. The experiment consisted of 3 levels of cowdung manure (0, 20 and 40 t ha^{-1}) and 4 levels of potassium (0, 20, 50, 80 kg K ha^{-1}). The two factor experiment comprised 12 treatment combinations, and was laid out in randomized complete block design with three replications. The total number of plots was 36. The size of each unit plot was 1.6m × 1.2m. The crop was fertilized with urea, TSP, Borax @ of 200, 150 and 10 kg per hectare, respectively (Haque, 1985). Entire amount of cowdung and TSP, half of MoP and one third of urea were applied in respective plots as per treatment during the final land preparation. The rest of urea and MoP were applied in 3 equal installments. Data on plant height, number of leaves, length of largest leaf and breadth of largest leaf were collected 20 days after transplanting (DAT). All other parameters were recorded during harvest and after harvest. The collected data were analyzed statistically and analysis of variance was done with the help of MSTAT computer programme. The mean differences among the treatments were tested with least significant difference (LSD) at 5 and 1% levels of probability (Gomez and Gomez, 1984).

Results and Discussion

Effects of cowdung

Cowdung significantly influenced the plant height, number of leaves, number of lateral roots per plants, fresh weight of leaves and knob, dry weight of leaves and knob per plant and marketable yield per plot and per hectare of kohlrabi. The highest plant height (40.38 cm) was obtained from the C_2 (40 t cowdung ha^{-1}) treatment while the lowest plant height (37.05 cm) was obtained from C_0 (0 t cowdung ha^{-1}) treatment (Table 1). Cowdung showed highly significant effect on the number of leaves per plant. The maximum number of leaves per plant (10.59) was obtained from C_2 (40 t cowdung ha^{-1}) treatment while the minimum number of leaves (9.55) was found from the treatment of C_0 (0 t cowdung ha^{-1}) at harvest (Table 1). Similar results were also observed by Subhan (1988). He observed that application of organic manure increased the average number of leaves per plant. The number of lateral roots per plant showed significant response to different doses of cowdung. Cowdung at 40 t ha^{-1} gave the highest number of lateral roots per plant (15.60) while the minimum (11.71) was recorded with control (0 t cowdung ha^{-1} treatment (Table 1). From the above results it was noted that cowdung kept the soil loose, porous, increased moisture content, microbial activities and provided proper aeration and as a result plant nutrients became more available for better growth and development of roots which ultimately increased the number of lateral roots (Azad, 2000). The maximum fresh weight of leaves (44.08 g) per plant was obtained when the plants received C_2 (40 t cowdung ha^{-1}) treatment while the minimum fresh weight (33.31 g) was found from the treatment K_0 (control) (Table 1). The maximum fresh weight of knob per plant (258.99 g) was obtained when the plants received C_2 (40 t cowdung ha^{-1}) treatment while the minimum fresh weight (171.16 g) was recorded from C_0 (control). The highest dry weight of leaves (15.68%) was recorded from the C_2 (40 t cowdung ha^{-1}) treatment while the minimum dry weight (12.62%) was found from control (0 t cowdung ha^{-1}) treatment at harvest The highest dry weight of knob (13.13%) was recorded with the C_2 (40 t cowdung ha^{-1}) treatment and the minimum dry weight of knob (8.22%) was found from control (0 t cowdung ha^{-1}) treatment. The highest marketable yield per plot (6.52 kg) and per hectare (34.14 t ha^{-1}) were found from C_2 (40 t cowdung ha^{-1}) treatment while the minimum marketable yield per plot (4.60 kg) and per hectare (24.00 t ha^{-1}) were obtained from control (0 t cowdung ha^{-1}) treatment (Table 1 and Fig. 1).

Table 1. Main effect of cowdung and potassium on the growth and yield components of Kohlrabi

Treatments	Plant height (cm)	No. of leaves/plant	No. of lateral roots / plant	Fresh wt. of leaves /plant (g)	Fresh wt. of knob/ plant (g)	Dry wt. of leaves/ plant (%)	Dry wt. of knob/ plant (%)	Marketable yield/plot (kg)
C_0	37.05	9.55	11.71	33.31	171.16	12.62	8.22	4.60
C_1	38.87	9.89	13.38	37.73	209.14	12.97	9.68	5.36
C_2	40.38	10.59	15.60	44.08	258.99	15.68	13.13	6.52
$LSD_{(0.05)}$	0.545	0.340	0.356	0.551	5.872	0.496	0.519	0.116
$LSD_{(0.01)}$	0.764	0.477	0.499	0.773	8.232	0.696	0.727	0.163
K_0	34.74	9.59	11.44	31.44	179.70	12.80	9.46	4.63
K_1	38.94	9.74	12.65	36.43	207.40	13.30	10.75	5.23
K_2	39.12	9.79	13.62	40.60	206.29	13.50	9.62	5.92
K_3	42.26	10.92	16.55	45.02	259.00	15.43	11.55	6.18
$LSD_{(0.05)}$	0.653	0.407	0.427	0.661	7.039	0.595	0.622	0.139
$LSD_{(0.01)}$	0.938	0.585	0.613	0.949	10.113	0.854	0.893	0.200
Level of significance	**	**	**	**	**	**	**	**

(**= Significant at 1% level of probability, DAT= Days after transplanting, C_0= 0 t cowdung/ha, C_1= 20 t cowdung/ha, C_2= 40 t cowdung/ha, K_0= 0 kg potash/ha, K_1= 20 kg potash/ha, K_2= 50 kg potash/ha, K_3= 80 kg potash/ha)

Effects of potassium

Potassium showed significant effect on plant height, number of leaves, number of lateral roots per plant, fresh weight of leaves and knobs per plant, dry weight of leaves and knob per plant, marketable yield per plot and per hectare. The longest plant height (42.26 cm) at harvest was recorded from K_3 (80 kg K ha^{-1}) treatment while the shortest plant height (34.74 cm) was observed from K_0 (0 kg K ha^{-1}) (Table 1). The plant height increased with the increased doses of K fertilizer. This result is partially supported by Farooque and Mondal (1987). The maximum number of leaves per plant (10.92) was found from the K_3 (80 kg K ha^{-1}) treatment while the minimum (9.59) was found from control (K_0) treatment (Table 1). The maximum number of lateral roots (16.55) per plant was found from K_3 (80 kg K ha^{-1}) treatment while the minimum number of lateral roots (11.44) was recorded from K_0 (control) (Table 1). The maximum fresh weight of leaves per plant (43.71 g) was found from the K_3 (80 kg K ha^{-1}) treatment and the minimum (3.24g) was found from control (K_0) treatment (Table 1). The present results are in full agreement with the report of Lawande *et al*. (1988). The maximum fresh weight of knob (259.00g) was found from the K_3 (80 kg K ha^{-1}) treatment while the minimum (179.70g) was found from control (K_0) treatment (Table 1). This result is in conformity with that of Lawande *et al*. (1988). The maximum dry weight of leaves (15.43%) was recorded from the K_3 (80 kg K ha^{-1}) while the minimum dry weight of leaves (12.80%) was found from K_0 (control) treatment (Table 1). The maximum dry weight of knob (11.55%) was recorded from the K_3 (80 kg K ha^{-1}) while the minimum dry weight of knob (9.46%) was found from K_0 (control) treatment (Table 1). Fischer (1992) found similar results in kohlrabi. The maximum marketable yield per plot (6.18 kg) was observed from the K_3 (80 kg K ha^{-1}) treatment while the minimum marketable yield per plot (4.63 kg) was found from K_0 (control) treatment (Table 1). Gianquinto and Borin (1995) reported that marketable yield were greatest when kohlrabi received medium and high level NPK fertilizers. It might be due to the synergistic relation of nutrient elements for better uptake by plants. The maximum marketable yield per hectare (31.77 t) was observed from the K_3 (80 kg K ha^{-1}) treatment while the minimum marketable yield per hectare (25.82 t) was found from K_0 (control) treatment (Fig. 2).

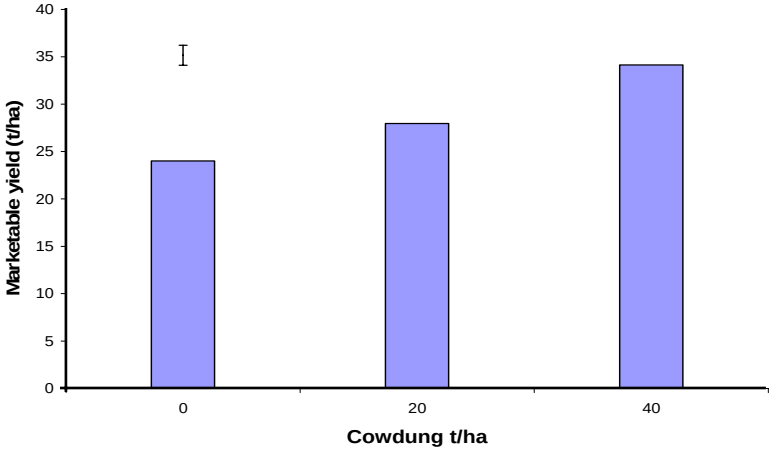

Fig. 1. Main effect of cowdung on marketable yield of Kohlrabi. Vertical bar represents LSD at 1% level of probability

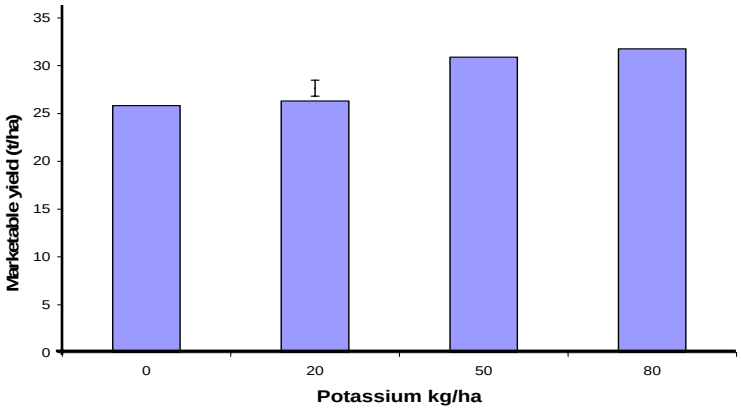

Fig. 2. Main effect of potassium on marketable yield of Kohlrabi. Vertical bar represents LSD at 1% level of probability

Combined effects of cowdung and potassium

The combined effect of cowdung and potassium was statistically significant on plant height, number of leaves, number of lateral roots per plant, fresh weight of leaves and knobs per plant, dry weight of leaves and knob per plant, marketable yield per plot and per hectare. The longest plant height (44.65 cm) was recorded from the treatment combination of C_2K_3 (40 t cowdung ha^{-1} and 80 kg K ha^{-1}) while the shortest plant height (33.64 cm) was found in the treatment combination of C_0K_0 (0 t cowdung ha^{-1} and 0 kg K ha^{-1}) (Table 2). Azad (2000) found that combination of organic manures and inorganic fertilizers gave the highest plant height. The present findings also partially support the results of Busayong (1996) and Roe (1998). The maximum number of leaves (12.11) recorded from the treatment combination of C_2K_3 (40 t cowdung/ha and 80 kg K ha^{-1}) and the minimum (9.01) was found in the treatment combination of C_0K_0 (0 t cowdung ha^{-1} and 0 kg K ha^{-1}) (Table 2). Number of leaves per plant increased with combined application of cowdung and potash which is in agreement with that of Kabir (1998). The highest number of lateral roots (20.18) was recorded when plants were produced with C_2K_3 (40 t cowdung ha^{-1} and 80 kg K ha^{-1}) treatment combination while the lowest number of lateral roots (9.21) was obtained from C_0K_0 (control) (Table 2). The maximum fresh weight of leaves per plant (49.33 g) was obtained from the treatment combination of C_2K_3 (40 t cowdung ha^{-1} and 80 kg K ha^{-1}) at harvest (Table 2) while the

minimum fresh weight of leaves per plant (22.11g) was found with the treatment combination of C_0K_0 (0 t cowdung ha^{-1} and 0 kg K ha^{-1}) (Table 2). The maximum fresh weight of knob (328.66 g) was obtained from the treatment combination of C_2K_3 (40 t cowdung ha^{-1} and 80 kg K ha^{-1}) at harvest while the minimum fresh weight of knob (136.00 g) was found with the treatment combination of C_0K_0 (0 t cowdung ha^{-1} and 0 kg K ha^{-1}). The maximum dry weight of leaves per plant (19.34%) was obtained from the treatment combination of C_2K_3 (40 t cowdung ha^{-1} and 80 kg K ha^{-1}) while the lowest dry weight of leaves (11.71%) was recorded from control treatment (C_0K_0) (Table 2). The maximum dry weight of knob (15.19%) was obtained from the treatment combination of C_2K_3 (40 t cowdung ha^{-1} and 80 kg K ha^{-1}) while control the lowest dry weight of knob (7.38%) was recorded from the control treatment (C_0K_0) (Table 2). The maximum marketable yield (7.86 kg) per plot was recorded from the treatment combination of C_2K_3 (40 t cowdung ha^{-1} and 80 kg K ha^{-1}) while the minimum (3.90 kg) yield was obtained from the treatment combination of C_0K_0 (control) (Table 2). The maximum marketable yield (39.58 t) per hectare was recorded from the treatment combination of C_2K_3 (40 t cowdung ha^{-1} and 80 kg K ha^{-1}) while the minimum marketable yield per hectare (20.51 t) was obtained from the treatment combination of C_0K_0 (control) (Table 2).

Table 2. Combined effects of cowdung and potassium on the growth and yield components of Kohlrabi

Treatment combinations	Plant height (cm)	No. of leaves/ plant	No. of lateral roots /plant	Fresh wt. of leaves/ plant (g)	Fresh wt. of knob/ plant (g)	Dry wt. of leaves/plant (%)	Dry wt. of knob/plant (%)	Marketable yield/plot (kg)	Marketable yield (t/ha)
C_0K_0	33.64	9.01	9.21	136.00	15.76	7.38	15.29	3.90	20.51
C_0K_1	36.96	9.52	10.90	195.55	18.36	8.30	16.30	4.70	24.48
C_0K_2	38.00	9.33	13.11	170.00	17.69	8.11	16.33	4.80	25.00
C_0K_3	39.61	10.34	13.61	183.11	17.22	9.10	16.80	5.00	26.04
C_1K_0	34.26	9.76	11.47	171.37	16.86	8.64	16.54	4.80	24.80
C_1K_1	39.55	9.66	12.98	211.11	17.03	11.46	16.49	5.00	26.07
C_1K_2	39.16	9.83	13.23	188.89	17.89	8.29	17.21	5.97	31.25
C_1K_3	42.53	10.31	15.87	265.22	18.55	10.36	19.00	5.70	29.69
C_2K_0	36.33	10.00	13.66	231.75	18.43	12.37	18.62	5.21	32.16
C_2K_1	40.32	10.06	14.07	215.55	19.14	12.51	22.95	6.00	28.36
C_2K_2	40.22	10.22	14.52	260.00	18.22	12.47	23.82	7.00	36.46
C_2K_3	44.65	12.11	20.18	328.66	21.28	15.19	32.75	7.86	39.58
$LSD_{(0.05)}$	0.292	0.182	0.191	0.295	3.144	0.266	0.278	0.062	0.423
$LSD_{(0.01)}$	0.390	0.244	0.255	0.395	4.207	0.355	0.372	0.083	0.566
Level of significance	**	**	**	**	**	**	**	**	**

(**= Significant at 1% level of probability, DAT= Days after transplanting, C_0= 0 t cowdung/ha, C_1= 20 t cowdung/ha, C_2= 40 t cowdung/ha, K_0= 0 kg potash/ha, K_1= 20 kg potash/ha, K_2= 50 kg potash/ha, K_3= 80 kg potash/ha)

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