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EFFECT OF FERTILIZERS AND IRRIGATION ON GROWTH AND YIELD OF KOHLRABI

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ABSTRACT

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An experiment was carried out at the Horticulture Farm, Bangladesh Agricultural University, Mymensingh, during the period from November, 2005 to February, 2006 to investigate the effects of irrigation and fertilizer on growth and yield of Kohlrabi. The experiment consisted of three levels of irrigation at an interval of 7, 14 and 21 days and six fertilizer treatments namely (i) cowdung @ 15 t/ha, (ii) poultry manure @ 9.4 t/ha, (iii) Urea-TSP-MOP @ 326-218-201 kg/ha, (iv) Urea-TSP-MOP-Gypsum @ 326-218-201-55.6 kg/ha, (v) Urea-TSP-MOP-Gypsum-Borax @ 326-218-201-55.6-9.52 kg/ha and (vi) Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha and was laid down in split plot design with three replications. The plants irrigated at 7-day intervals produced the highest (43.59 t/ha) marketable yield while the lowest (16.80 t/ha) yield was recorded in the treatment of irrigation at 21- day intervals. The highest yield of kohlrabi (35.43 t/ha) was obtained from treatment of Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha and minimum yield (21.20 t) were found when cowdung @ 15 t/ha was applied. The highest yield per hectare (51.48 t) was obtained from irrigation at 7-day intervals with Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6- 9.52-20 kg/ha fertilizers.

Key words: *effects, irrigation, fertilizer, growth, yield, kohlrabi*

INTRODUCTION

Kohlrabi (*Brassica oleracea* var. *gongylodes*) is known as Knolkhol. Kohlrabi is one of the winter vegetable of Bangladesh under the family of Cruciferae and it is also a member of the cole crops. Kohlrabi is also a short duration vegetable crop. It has high nutritive value. It 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 (Choudhury 1967). Due to lack of awareness regarding its nutritive value and method of production, the kohlrabi cultivation has not been much extended. Kohlrabi responds greatly to major essential elemental nutrient like N, P and K in respect to its growth and yield (Thomson and Kelly, 1957). In tropical to subtropical regions, the soils are seriously impoverished in plant nutrients due to intensive weathering and leaching. Plants require food for growth and development in the form of proper doses of NPKSBZn. Judicious application of fertilizer and proper cultural management are related to get proper growth and high yield of kohlrabi. Adequate supply of nitrogen favors the transformation of carbohydrates into proteins and promotes the good quality foliage (Rai 1981). Phosphorus plays a vital role in several key physiological processes, *viz*., photosynthesis, respiration, energy storage and transfer, cell division and cell enlargement, stimulates root growth, blooming, fruit setting and seed formation (Memon 1996). Potassium is considered essential in photosynthesis, sugar translocation, nitrogen metabolism, enzyme activation, stomatal opening, water relation and growth of meristematic tissue (Chandra 1989). Sulfur is also essential for growth and yield of plant. Zinc is responsible for many important physiological functions and is an essential nutrient for carbon metabolism in plant. Boron is also one of the important micronutrients having different functions in plant metabolism such as cell division, nitrogen and carbohydrate metabolism. Brassica crops in general have a high boron requirement (Mengel and Kirkby, 1987). Irrigation has profound effect on the yield of crops. In Bangladesh kohlrabi is grown during rabi season when the weather is usually dry. Since it is a tuber like turnip cabbage frequent irrigation is require in order to achieve higher yield.

Fertilizers and irrigation management are the two important variables in kohlrabi production. There is no enough information with conclusive evidence of optimum use of irrigation and fertilizer management for the production of kohlrabi under Bangladesh conditions. So, the present study was undertaken:

- To evaluate the fertilizers and irrigation as well as the combine effect on growth and yield of kohlrabi.

MATERIALS AND METHODS

A field experiment was conducted at the Horticulture Farm, Bangladesh Agricultural University (BAU), Mymensingh during the period from November, 2005 to February, 2006 to study the effect of fertilizers and irrigation on growth and yield of kohlrabi cv. Challenger. Light irrigation was given by a watering cane at every morning and afternoon following transplanting and it was continued for a week for rapid and well establishment. Then irrigation was applied as treatment which was started 10 days after transplanting. There were three treatments i.e., I_1= irrigation at 21-day interval, I_2= irrigation at 14-day interval and I_3= irrigation at 7-day interval. The experiment was also comprised of six fertilizers treatments as F_1 (cowdung @ 15 ton/ha), F_2 (poultry manure @ 9.4 ton/ha), F_3 (Urea-TSP-MOP @ 326-218-201 kg/ha), F_4 (Urea-TSP-MOP-Gypsum @ 326-218-20 1-55.6 kg/ha), F_5 (Urea-TSP-MOP-Gypsum-Borax @ 326-218-201-55.6-9.52 kg/ha) and F_6 (Urea-

TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha). The experiment was laid out in split plot design with three replications. The whole experimental area (16.8m x 12.5m) was first divided into three blocks. Then each block was divided into 3 main plots and each main plot was again subdivided into 6 subplots. There were 18 main plots and (3x6x3) 54 unit plots in total. The size of each unit plot was 1.5m x l.2m and 36 plants were accommodated in each plot following a spacing of 25cm x 20cm. The total area used for the experiment was 210 square meter. Seedlings were transplanted on 6 December, 2005 and the crop was harvested at 4 February, 2006. Data were taken on eighteen growth and yield parameters. The collected data were analyzed and the differences between the means were evaluated by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Effect of fertilizer on growth and yield of kohlrabi

Plant height (cm)

The significant effects on plant height was influenced by application of Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha fertilizers except at 22 DAT. The highest plant height was recorded (40.39 cm) at 57 DAT having treatment Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha and the lowest plant height was recorded (37.82 cm) at the same DAT heaving treatment cowdung @ 15 t/ha (Fig. 1).

Number of leaves per plant

The maximum (11.32) and the minimum (10.32) number of leaves were found at 57 DAT having Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha and cowdung @ 15 t/ha treatment, respectively (Fig. 2).

Length of largest leaf per plant (cm)

The length of the largest leaf was also significantly influenced by different treatments of fertilizer application. The treatment of fertilizers Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha gave the highest leaf length (32.12 cm) and the lowest leaf length (28.13 cm) was recorded from the treatment of cowdung @ 15 t/ha at 57 days after transplanting, respectively (Fig. 3).

Breadth of largest leaf per plant (cm)

The application of fertilizers showed significant variation in respect to breadth of leaf in kohlrabi. The maximum breadth of leaf (12.58 cm) was observed from treatment of Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha fertilizers at harvest and the minimum breadth of largest leaf (11.25 cm) was found in cowdung @ 15 t/ha treatment (Fig. 4).

Spread of plant (cm)

It was observed that the maximum spread of plant (44.32 cm) was obtained from treatment of Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha. The lowest spread of plant 42.09 cm was obtained from the treatment of cowdung @ 15 t/ha (Fig. 5). The more positive effect of application of fertilizers treatment of Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha might be due to ensuring of optimum nutrient as provided by such fertilizer.

Days required for knob initiation

The treatments of Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha and Urea-TSP-MOP-Gypsum-Borax @ 326-218-201-55.6-9.52 kg/ha required shortest possible time (22.34 and 22.52 days) for knob initiation. Whereas the treatment of cowdung @ 15 t/ha and poultry manure @ 9.4 t/ha required the maximum time (24.32 and 24.02) for knob initiation followed by treatments of Urea-TSP-MOP @ 326-218-201 kg/ha and Urea-TSP-MOP-Gypsum @ 326-218-201-55.6 kg/ha requiring time 23.62 days and 23.26 days, respectively (Fig. 6).

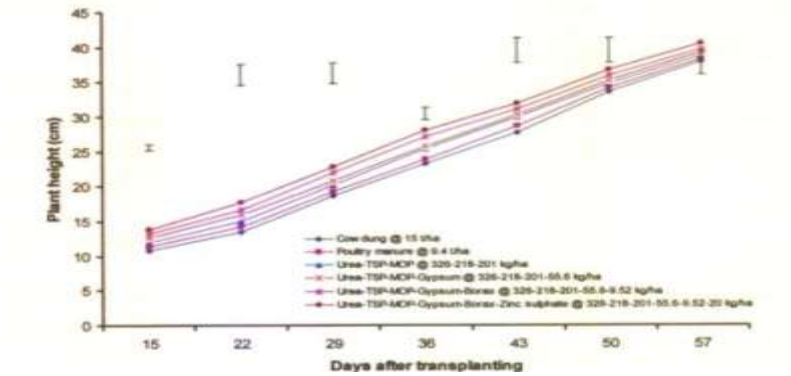

Fig. 1. Effect of fertilizers on plant height/plant of kohlrabi at different stages of growth. The vertical bars represent LSD at 0.05 level

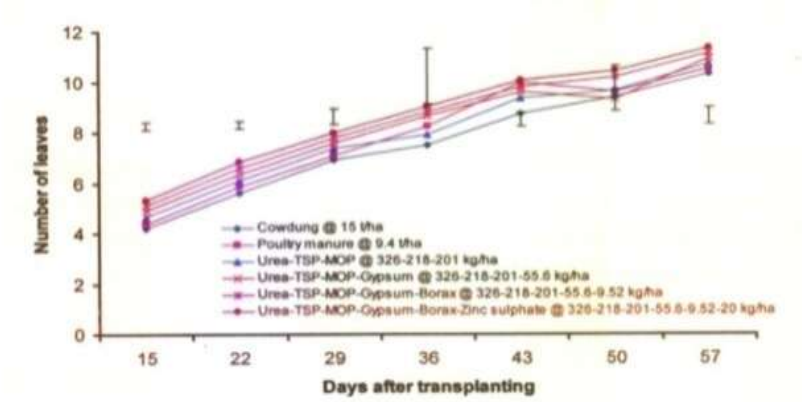

Fig. 2. Effect of fertilizers on number of leaves/plant of kohlrabi at different stages of growth. The vertical bars represent LSD at 0.05 level

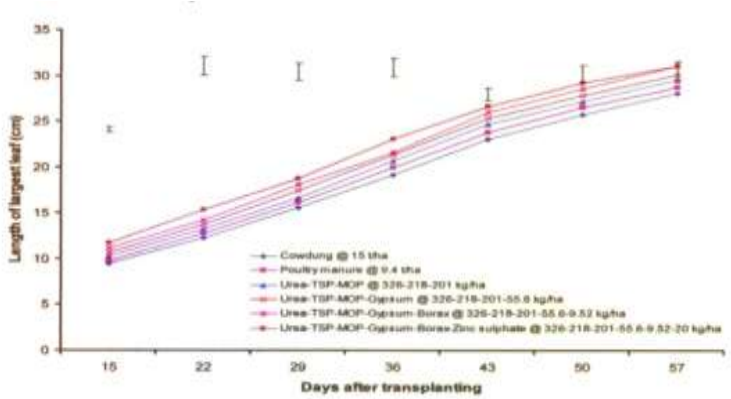

Fig. 3. Effect of fertilizers on length of largest leaf/plant of kohlrabi at different stages of growth. The vertical bars represent LSD at 0.05 level

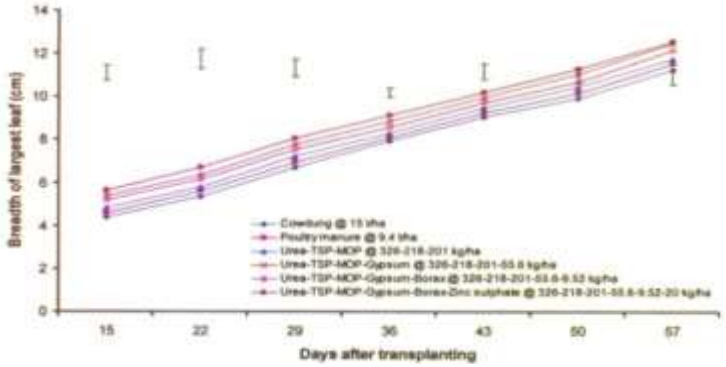

Fig. 4. Effect of fertilizers on breadth of largest leaf/plant of kohlrabi at different stages of growth. The vertical bars represent LSD at 0.05 level

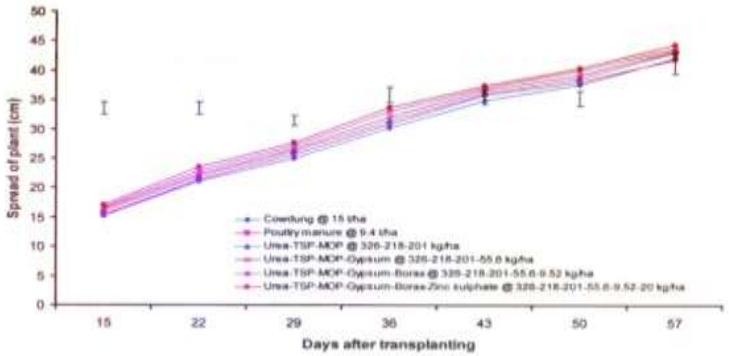

Fig. 5. Effect of fertilizers on spread of plant of kohlrabi at different stages of growth. The vertical bars represent LSD at 0.05 level

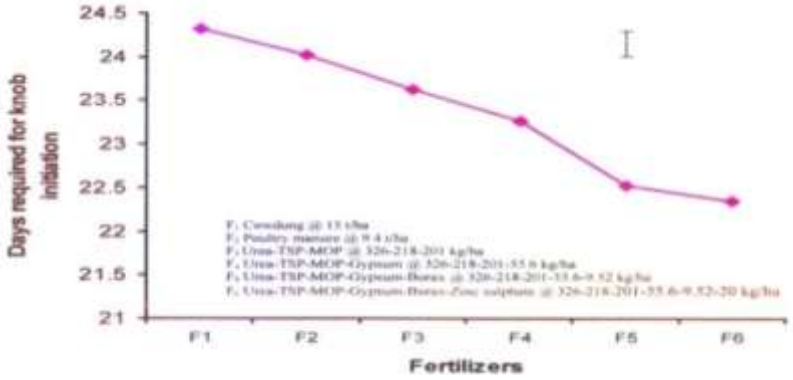

Fig. 6. Effect of fertilizers on days required for knob initiation of kohlrabi at different stages of growth. The vertical bars represent LSD at 0.05 level

Fresh weight of leaves per plant (g)

The highest fresh weight of leaves per plant (73.43 g) was recorded when the plants received Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha fertilizers and the lowest fresh weight of leaves (54.14 g) per plant was obtained from the treatment of cowdung @ 15 t/ha at harvest (Table 1). In the present study it was observed that the highest supply of nutrient produced highest fresh weight of leaves.

Fresh weight of knob per plant (g)

The highest fresh weight of knob per plant (193.29 g) was found from the treatment of Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha and the lowest (138.20 g) fresh weight of knob per plant was found from the treatment of cowdung @ 15 t/ha which was statistically similar with poultry manure @ 9.4 t/ha treatment at 57 DAT (Table 1).

Fresh weight of root per plant (g)

The highest fresh weight (21.20 g) of roots was observed from the treatment of Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha and the minimum fresh weight (16.40 g) of roots was found in the treatment of cowdung @ 15 t/ha treatment (Table 1).

Diameter of knob (cm)

The maximum diameter of knob (8.54 cm) was produced by the plants receiving Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha fertilizers which was statistically identical to the treatment of Urea-TSP-MOP-Gypsum-Borax @ 326-218-201-55.6-9.52 kg/ha and the minimum diameter of knob (6.87 cm) was observed from cowdung @ 15 t/ha treatment (Table 1).

Thickness of knob (cm)

The maximum thickness (6.75 cm) of knob was found from the application of Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha fertilizers which was statistically similar with the treatment of Urea-TSP-MOP-Gypsum-Borax @ 326-218-201-55.6-9.52 kg/ha. The minimum thickness of knob (5.42 cm) was found from the treatment of cowdung @ 15 t/ha (Table 1).

Length of root per plant

The maximum length of root (17.81 cm) was recorded in plant receiving Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha fertilizers. The minimum length of root (15.08 cm) was observed from the treatment of cowdung @ 15 t/ha (F_1). This result revealed thatroot length increased with the increasing supply of fertilizers (Table 1).

Number of lateral roots per plant

A significant variation in number of lateral roots per plant at harvest was observed due to application of different treatments of Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha fertilizers. The highest number of lateral roots (24.17) was obtained when the fertilizer treatment of Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20kg/ha was used. On the other hand the lowest number (19.94) of roots per plant was obtained when the plants received cowdung @ 15 t/ha (Table 1).

Dry weight of leaves (%)

The significant variation in the per cent dry matter of leaves was observed due to the effect of Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha fertilizers. The highest percentage (16.43) of dry matter was accumulated in leaves when the plants received Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha fertilizers. The lowest percentage (13.98) was produced by the application of cowdung @ 15 t/ha treatment (Table 1).

Dry weight of knob (%)

The maximum dry weight of knob (8.70%) was produced by the plants receiving Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha fertilizers which was identically similar with the treatment of Urea-TSP-MOP-Gypsum-Borax @ 326-218-201-55.6-9.52 kg/ha, while the minimum (7.39%) dry weight of knob was found from treatment of cowdung @ 15 t/ha (Table 1).

Dry weight of root (%)

The maximum percent dry weight (28.00) of roots was recorded in the treatment of Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha and the minimum dry weight of roots (20.78%) was recorded in the treatment of cowdung @ 15 t/ha, respectively (Table 1).

Table 1. Effect of irrigation and fertilizers on yield and yield components of kohlrabi

Treatments	Fresh weight of leaves per plant (g)	Fresh weight of knob per plant (g)	Fresh weight of roots per plant (g)	Diameter of knob per plant (cm)	Thickness of knob per plant (cm)	Length of root per plant (cm)	Number of lateral roots per plant	Dry weight of leaves (%)	Dry weight of knob (%)	Dry weight of roots (%)	Marketable yield per plot (kg)	Marketable yield per hectare (t)
Factor A: Irrigation												
I_1	34.26c	90.12c	12.56c	5.53c	4.84c	11.61c	16.34c	11.64c	7.08c	17.78c	3.03c	16.80c
I_2	68.46b	159.14b	18.45b	7.97b	6.27b	16.45b	21.44b	15.60b	7.90b	21.73b	4.77b	26.48b
I_3	89.88ca	252.17a	25.73a	9.63a	7.11a	20.98a	28.21a	18.29a	9.26a	32.78a	7.86a	43.59a
Factor B: Fertilizer												
F_1	54.14f	138.20d	16.40f	6.87e	5.42e	15.08f	19.94e	13.98d	7.39d	20.78f	3.82f	21.20f
F_2	58.97e	144.43d	17.41e	7.15d	5.64d	15.47e	20.50e	14.41d	7.69c	21.93e	4.66e	25.92e
F_3	52.65d	163.07c	18.65d	7.59c	5.90c	16.03d	21.48d	15.00c	7.92c	23.04d	5.12d	28.48d
F_4	66.22c	178.78b	19.51c	7.80b	6.21b	16.56c	22.38c	15.33c	8.28b	24.63c	5.38c	29.88c
F_5	69.79b	185.08b	20.33b	8.31a	6.52a	17.13b	23.52b	15.92b	8.50ab	26.19b	5.94b	32.84b
F_6	73.43a	193.29a	21.20a	8.54a	6.75a	17.81a	24.17a	16.43a	8.70a	28.00a	6.38a	35.43a

Irrigation
I_1 = Irrigation at 21-day intervals
I_2 = Irrigation at 14-day intervals
I_3 = Irrigation at 7-day intervals

Fertilizer
F_1: Cowdung @ 15 t/ha
F_2: Poultry manure @ 9.4 t/ha
F_3: Urea-TSP-MOP@ 326-218-201 kg/ha
F_4: Urea-TSP-MOP-Gypsum @ 326-218-20 1-55. 6 kg/ha
F_5: Urea-TSP-MOP-Gypsum-Borax @ 326-218-201-55.6-9.52 kg/ha
F_6: Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha

Marketable yield per plot (kg)

The variation in yield of kohlrabi was found to be significant due to the application of fertilizers. The treatment with Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha fertilizers gave the highest yield per plot (6.38 kg) and the lowest yield (3.82 kg) per plot was found from the treatment of cowdung @ 15 t/ha (Table 1).

Marketable yield per hectare (ton)

The maximum (35.43 t/ha) marketable yield of kohlrabi was recorded from the treatment of Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha and the minimum (21.20 t/ha) marketable yield of kohlrabi was recorded from the treatment of cowdung @ 15 t/ha (Table 1).

Effect of irrigation on growth and yield of Kohlrabi

Plant height (cm)

The plant height was significantly influenced by different irrigation treatment except at 22 DAT. The maximum plant height was recorded with irrigation at 7-day intervals was 46.81 cm at 57 DAT. The minimum plant height (31.49 cm) was found with irrigation at 21-day intervals at same DAT. The height of the plant was increased with the higher irrigation levels. The height of the plant was increased with the higher irrigation levels possibly due to the increased number and expansion of plant cells. The results on effects of irrigation on plant height have been presented in Fig. 7.

Number of leaves per plant

The number of leaves per plant was significantly influenced by different irrigation treatment expect at 15 DAT & 36 DAT. The maximum number of leaves was recorded from the treatment of irrigation at 7-day intervals having 12.36 at 57 DAT respectively followed by irrigation at 14-day intervals and irrigation at 21-day intervals while it was the minimum with irrigation at 21-day intervals plants that was 9.48 at 57 DAT. The result on the number of leaves per plant has been presented in Fig. 8.

Breadth of largest leaf per plant (cm)

Maximum breadth of largest leaf per plant (14.04 cm) was found by the application of irrigation at 7-day intervals at 57 DAT whereas the minimum (9.88 cm) breadth of largest leaf per plant was found in the application of irrigation at 21-day intervals at 57 days after transplanting. The result on effects of irrigation on the breadth of largest leaf per plant has been presented in Fig. 9.

Length of largest leaf per plant (cm)

Different time of application of irrigation played a significant role on length of largest leaf at 15, 22, 29, 36, 43, 50 & 57 days after transplanting. The maximum significant response in the parameter was observed with treatment irrigation after 7-days' interval having 35.72 cm of length of largest leaf at 57 days after transplanting. The minimum (24.62 cm) of length of largest leaf was found from the treatment of irrigation at 21-day intervals at 57 DAT (Fig. 10).

Spread of plant (cm)

Statistically significant differences were observed in case of spread area as influenced by different levels of irrigation. It was observed that the maximum spread of plant (49.28 cm) was observed from the irrigation at 7-day intervals at 57 DAT. The minimum spread of plant (36.21 cm) was recorded having irrigation treatment at 21-day intervals at 57 days after transplanting. The spread of plant is presented in Fig. 11.

Days required for knob initiation

The application of irrigation at different levels played a significant role on the time required for knob initiation. The maximum time required for knob initiation was found with the irrigation at 21-day intervals having 25.90 days and the minimum was required (20.56 days) at the application of irrigation at 7-day intervals. It is shown in Fig. 12.

Fresh weight of leaves per plant (g)

A significant variation due to the effect of irrigation was found on fresh weight of leaves per plant. The significant fresh weight (89.88 g) of leaves per plant was noted from the irrigation at 7-day intervals followed by the irrigation at 14-day intervals (68.46 g). The minimum fresh weight (34.26 g) of leaves per plant was recorded in the treatment of irrigation at 21-day intervals. It had been observed that the excess water increased the fresh weight of leaves per plant (Table 1).

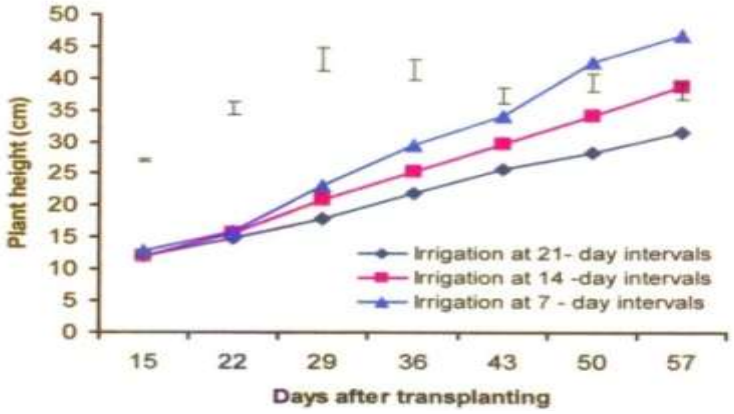

Fig. 7. Effect of irrigation on plant height/plant of kohlrabi at different stages of growth. The vertical bars represent LSD at 0.05 level

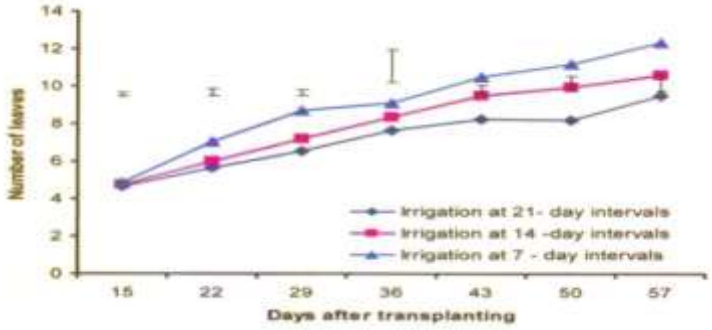

Fig. 8. Effect of irrigation on number of leaves/plant of kohlrabi at different stages of growth. The vertical bars represent LSD at 0.05 level

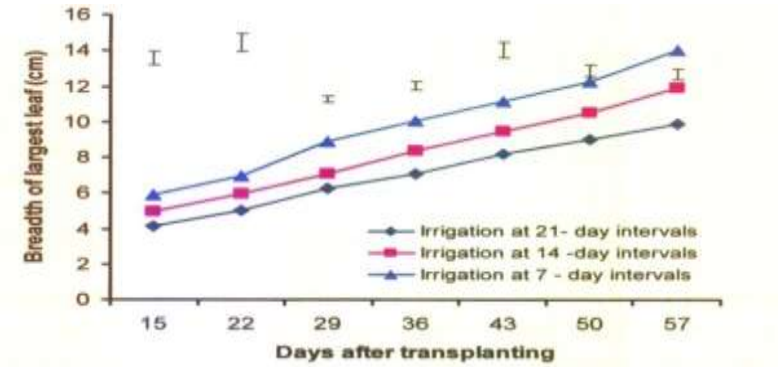

Fig. 9. Effect of irrigation on breadth of largest leaf/plant of kohlrabi at different stages of growth. The vertical bars represent LSD at 0.05 level

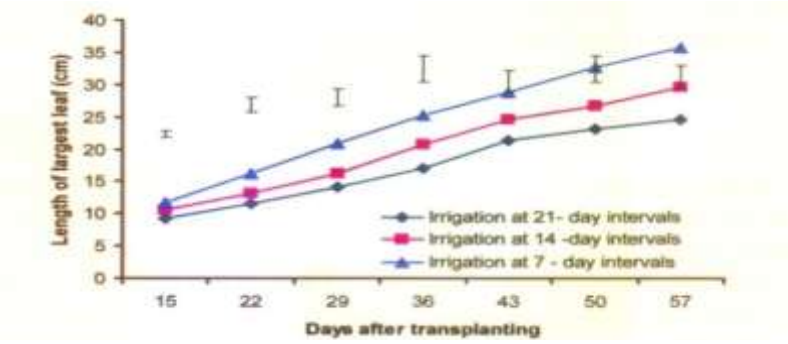

Fig. 10. Effect of irrigation on length of largest leaves/plant of kohlrabi at different stages of growth. The vertical bars represent LSD at 0.05 level

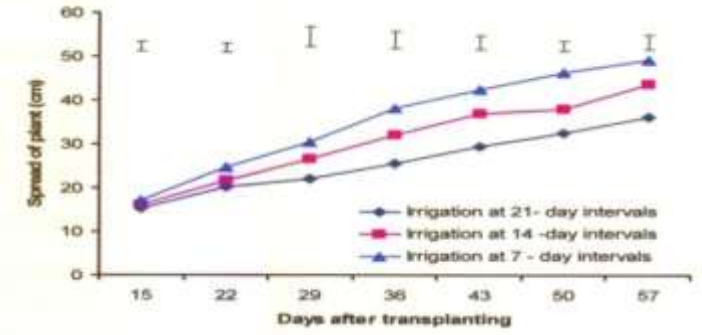

Fig. 11. Effect of irrigation on spread of plant of kohlrabi at different stages of growth. The vertical bars represent LSD at 0.05 level

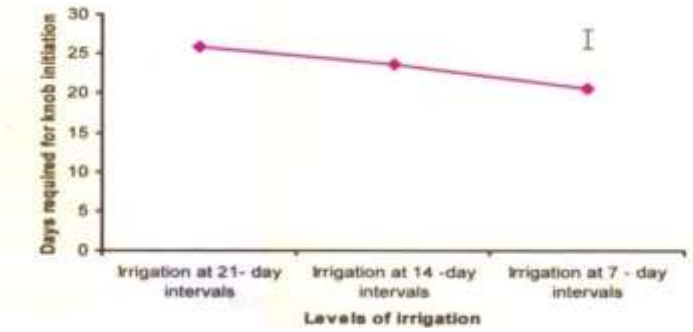

Fig. 12. Effect of irrigation on days required for knob initiation of kohlrabi at different stages of growth. The vertical bar represents LSD at 0.05 level

Fresh weight of knob per plant (g)

The highest fresh weight of knob per plant (252.17 g) was produced by the application of irrigation at 7-day intervals and the lowest (90.12 g) was found from the treatment where irrigation at 21-day intervals was applied at 57 DAT (Table 1). The increased weight of individual knob over irrigation at 7-day intervals was probably due to supply soil moisture through its conservation mechanism and plant nutrient which led to the production of higher fresh weight of knob.

Fresh weight of root per plant (g)

Irrigation at 7-day intervals was found to produce maximum fresh weight of roots (25.73 g). The minimum fresh weight of roots (12.56 g) was produced by the plants irrigated at 21-day intervals. It was observed that the treatment of irrigation at 7-day intervals produced earlier and longest root having maximum fresh weight of root at harvest (Table 1).

Diameter of knob (cm)/ plant

Effects of different irrigation treatments under study revealed that variation was significant in respect of diameter of kohlrabi. Application of irrigation at 7-day intervals produced the highest diameter (9.63 cm) of kohlrabi. Application of irrigation at 21-day intervals produced the smallest (5.53 cm) knobs in terms of diameter (Table 1).

Thickness of knob (cm)/plant

Irrigation had significant effects of thickness of knob of kohlrabi. The highest thickness (7.11 cm) was found from the frequent application of irrigation at 7-day intervals. It might be due to the presence of optimum amount of moisture for better vegetative growth which increased the number and size of the leaves and subsequently helped in the formation of larger and comparatively thicker knob of kohlrabi. The application of irrigation at 21-day intervals produced the smallest (4.84 cm) knobs in terms of thickness (Table 1).

Length of root per plant (cm)

The effect of irrigation on the length of root was found significantly influenced by kohlrabi production. The longest root (20.98 cm) was obtained from the treatment of irrigation at 7-day intervals. The minimum length of root was noted from the plants irrigated at 21-day intervals (11.61 cm) (Table 1).

Number of lateral roots per plant

Significant effect was observed due to the variation among the different levels of irrigation in relation to number of lateral roots per plant in kohlrabi. The maximum number of lateral roots per plant (28.21) was found from the treatment of irrigation at 7-day intervals irrigated plots followed by 21.44 and 16.34 with irrigation at 14-day intervals and irrigation at 21-day intervals treatments, respectively (Table 1).

Dry weight of leaves (%)

Variation in the percentage of dry matter in leaves due to level of irrigation found to be significant on kohlrabi. The maximum dry matter (18.29%) was recorded from the treatment of irrigation at 7-day intervals, whereas the minimum (11.64%) was produced by the treatment of irrigation at 21-day intervals (Table 1).

Dry weight of knob (%)

The significant effects of different number of irrigation under study were also observed on dry weight of knob in kohlrabi. Knob dry weight was the highest (9.16%) in case of treatment of irrigation at 7-day intervals. On the other hand irrigation at 21-day intervals produced the lowest (7.08%). As the knob weight and diameter were maximum in case of irrigation at 7-day intervals for that the dry matter percentage was possibly also highest here (Table 1).

Dry weight of root (%)

The effects of irrigation were found significant in the respect of dry weight of roots of kohlrabi. The highest (32.78%) and lowest (17.78%) dry weight of roots were observed from the treatments of irrigation at 7-day intervals and irrigation at 21-day intervals, respectively (Table 1).

Marketable yield per plot (kg)

The yield variation of kohlrabi was found to be significant due to the application of frequent irrigation. The treatment of irrigation at 7-day intervals gave the height yield per plot (7.86 kg) and the lowest yield per plot (3.03 kg) was found in the plants irrigated at 21-day intervals (Table 1).

Marketable yield per hectare (ton)

In case of yield per hectare a similar trend was also observed where irrigation at 7-day intervals gave the maximum marketable yield (43.59 t/ha) and the minimum yield (16.80 t/ha) was observed in the treatment of irrigation at 21-day intervals (Table 1).

Combined effect of irrigation and fertilizers on growth and yield of kohlrabi

Plant height per plant

The combined effect of irrigation and application of fertilizers on plant height per plant was found significant at 15, 22, 29, 36, 43, 50 and 57 days after transplanting, while the interaction effect was significant at 29, 36 and 43 DAT. The maximum (48.44 cm) plant height from the treatment combination of irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha that was (47.50 cm) identically similar to the treatment combination of irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-

Borax @ 326-218-201-55.6-9.52 kg/ha (Table 2). The lowest plant height (30.38 cm) was observed from the treatment combination of irrigation at 21-day intervals and cowdung @ 15 t/ha at harvest.

Number of leaves per plant

The interaction effect of irrigation and fertilizer treatments were found significant at 43 DAT and the combined effect of irrigation and fertilizer was significant at 29, 43, 50 and 57 days after transplanting. The maximum number of leaves per plant (13.07) was recorded from the treatment combination of irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha which was statistically similar (12.76) to the treatment combination of irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax @ 326-218-201-55.6-9.52 kg/ha. The minimum (9.13) number of leaves per plant was recorded at harvesting time with irrigation at 7-day intervals combined with cowdung @ 15 t/ha (Table 2).

Length of largest leaf per plant

There was statistically significant interaction effect of irrigation and fertilizers on the length of largest leaf per plant at 15, 43 and 50 DAT and the combined effects of irrigation and fertilizers management were significant on growth and yield of kohlrabi. The maximum length of largest leaf (38.43 cm) was recorded with treatment combination of irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha fertilizers at 57 DAT. It was identically similar (37.32 cm) with the treatment of irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax @ 326-218-201-55.6-9.52 kg/ha treatment combination. The minimum length of largest leaf (23.31 cm) was recorded from the treatment combination of irrigation at 7-day intervals and cowdung @ 15 t/ha at the same time (Table 2).

Breadth of largest leaf (cm)

There was no significant interaction effect of irrigation and fertilizers on breadth of largest leaf (cm) and the combined effect of those factors were statistically significant except at 15 and 22 DAT in kohlrabi. The maximum breadth of largest leaf (14.72 cm) was found from the treatment combination of irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha at 57 DAT. The minimum (9.18 cm) breadth of largest leaf was recorded with irrigation at 7-day intervals and cowdung @ 15 t/ha treatment combination (Table 2).

Spread of plant (cm)

The combined effects of irrigation and fertilizer management were significant on spread of plant at 15, 22, 29, 36, 43, 50 and 57 DAT, while there was no significant interaction effect on the two variables on growth and yield of kohlrabi. The maximum spread of plant (50.30 cm) was found with the combination of irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha fertilizers which was identically similar (49.96 cm, 49.73 cm, 49.33 cm) to the treatment combination of irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax @ 326-218-201-55.6-9.52 kg/ha, irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum @ 326-218-201-55.6 kg/ha and irrigation at 7-day intervals and Urea-TSP-MOP @ 326-218-201 kg/ha. The minimum spread of plant (35.30 cm) was observed from the treatment combination of irrigation at 7-day intervals and cowdung @ 15 t/ha at 57 DAT (Table 2).

Days required for knob initiation

Both the combined and interaction effects of irrigation and fertilizers in respect of time required to knob initiation were found to be statistically significant. The maximum significant number of 26.42 days ware required for knob initiation by the treatment combination of irrigation at 7-day intervals and cowdung @ 15 t/ha which was statistically similar to 26.42 days and 26.02 days followed by the treatment combinations of irrigation at 21-day intervals with poultry manure @ 9.4 t/ha and irrigation at 21-day intervals with Urea-TSP-MOP @ 326-218-201 kg/ha respectively. On the other hand, the minimum time (20.08 days) was recorded from the treatment combination of irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha (Table 2).

Table 2. Combined effects of irrigation and fertilizers on growth characters of kohlrabi

Treatment combination	Plant height (cm) at							Number of leaves at						
	15 DAT	22 DAT	29 DAT	36 DAT	43 DAT	50 DAT	57 DAT	15 DAT	22 DAT	29 DAT	36 DAT	43 DAT	50 DAT	57 DAT
I_1F_1	10.43j	13.31g	16.59j	20.561	22.53i	26.94h	30.38h	4.03j	5.13k	6.001	7.18f	7.87n	8.10i	9.13m
I_1F_2	11.12i	14.02efg	16.91 ij	20.87kl	25.17hi	27.63gh	30.68gh	4.20ij	5.30k	6.20kl	7.37ef	7.97m	8.20i	9.27Im
I_1F_3	11.50hi	14.51efg	17.48hij	21.52jk	25.84hi	28.26fgh	31.18fgh	4.53h	5.60J	6.50jk	7.57ef	8.171m	8.40hi	9.47klm
I_1F_4	12.26g	15.17de	17.98ghij	21.89ij	25.95hi	28.49fgh	31.64fgh	4.90fg	5.73ij	6.63ijk	7.70def	8.33kl	8.53j	9.53klm
I_1F_5	13.05de	15.61cde	18.54gh	22.59hi	26.17hi	29.24fg	32.18fg	5.10cde	6.00gh	6.87ij	7.93cdef	8.53jk	8.66ghi	9.70kl
I_1F_6	13.55bc	16.52bcd	19.24fg	23.45gh	26.85gh	29.89f	32.59f	5.27abc	6.23ef	7.03ij	8.20bcdef	8.73ij	8.83fghi	9.80jk
I_2F_1	10.57j	13.50g	18.37ghi	23.23gh	27.06gh	32.27e	37.58e	4.23i	5.30k	6.67hij	8.33abcdef	8.93hi	9.53egh	10.17ij
I_2F_2	11.13i	14.15efg	19.00fgh	23.73g	28.05fg	33.15de	37.99e	4.33i	5.60j	6.77hi	8.53abcdef	9.16gh	9.70defg	10.33hi
I_2F_3	11.74h	15.12def	20.23ef	25.17f	29.62ef	33.64de	38.50de	4.60h	5.83hi	7.10hi	7.17abcde	9.43fg	9.86cdef	10.50ghi
I_2F_4	12.50fg	16.29bcd	20.99e	25.50f	30.04e	34.15d	38.68de	4.87g	6.08fg	7.30gh	9.03abcde	9.60ef	9.96cdef	10.70fgh
I_2F_5	12.98de	16.91abc	22.63cd	26.65e	31.45de	34.80cd	39.09de	5.07def	6.43de	7.57fg	9.17abcde	9.86de	10.16cde	10.90fg
I_2F_6	13.57bc	18.30a	23.54bc	27.62d	32.43cd	36.29c	40.14d	5.30ab	6.63d	7.80ef	9.40abcd	10.10d	10.43bcde	11.10f
I_3F_1	11.20i	13.57fg	20.92e	25.99ef	31.37de	41.26b	45.49c	4.33i	6.40e	8.17de	8.67abcd	9.46fg	10.53bcde	11.63e
I_3F_2	11.87h	14.42efg	21.70de	26.83de	32.7lcd	41.60b	46.03bc	4.57h	6.63d	8.37cd	8.83abc	9.80def	10.87abcd	11.96de
I_3F_3	12.73ef	15.43cde	22.58cd	29.14c	34.11bc	42.32ab	46.47bc	4.80g	6.90c	8.60bcd	9.00abc	10.53c	11.03abc	12.20cd
I_3F_4	13.20cd	16.27cd	23.17bcd	29.78c	34.62ab	42.85ab	46.96abc	4.93efg	7.20b	8.80abc	9.23ab	10.87bc	11.16abc	12.53bc
I_3F_5	13.71b	17.33ab	24.56ab	31.92b	35.70ab	43 .5 la	47.50ab	5.20bcd	7.40b	8.97ab	9.33ab	11.10ab	11.70ab	12.76ab
I_3F_6	14.29a	18.29a	25.29a	32.94a	36.37a	43.96a	48.44a	5.40a	7.63a	9.23a	9.50a	11.33a	12.00a	13.07a

Irrigation

I_1 = Irrigation at 21 - day intervals
I_2 = Irrigation at 14 - day intervals
I_3 = Irrigation at 7 - day intervals

Fertilizer

F_1: Cowdung @ 15 t/ha
F_2: Poultry manure @ 9.4 t/ha
F_3: Urea-TSP-MOP @ 326-218-201 kg/ha
F_4: Urea-TSP-MOP-Gypsum @ 326-218-201-55.6 kg/ha
F_5: Urea-TSP-MOP-Gypsum-Borax @ 326-218-201-55.6-9.52 kg/ha
F_6: Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha

Table 2. (contd.) Combined effect of irrigation and fertilizers on growth characters of kohlrabi

Treatment combination	Length of largest leaf (cm) at							Breadth of largest leaf (cm) at						
	15 DAT	22 DAT	29 DAT	36 DAT	43 DAT	50 DAT	57 DAT	15 DAT	22 DAT	29 DAT	36 DAT	43 DAT	50 DAT	57 DAT
I_1F_1	8.271	10.40k	12.91k	15.49k	19.38o	21.33n	23.311	3.51h	4.52j	5.51k	6.46m	7.49n	8.401	9.181
I_1F_2	8.72k	10.79jk	13.35jk	16.18jk	20.39no	22.48m	23.68kl	3.73gh	4.7 lij	5.8 ijk	6.621m	7.75mn	8.541	9.46kl
I_1F_3	9.19j	11.29ijk	13.86ijk	16.66jk	21.31mn	22.91m	24.24jkl	4.06fg	4.89hij	6.09ij	6.851	8.031m	8.79kl	9.71jk
I_1F_4	9.42j	11.68hij	14.51hij	17.37jk	21.771m	23.451m	24.71 ijk	4.34ef	5.14ghij	6.37ghi	7.22k	8.38kl	9.13jk	10.03ij
I_1F_5	9.92ij	12.12hij	14.88hi	16.76j	22.46klm	24.24kl	25.4 lij	4.52ef	5.39ghij	6.63hi	7.52j	8.63jk	9.45ij	10.37hi
I_1F_6	10.26i	12.65ghi	15.35gh	19.27i	22.82jkl	24.87jk	26.40i	4.72ef	5.62ghi	6.88ghi	7.68j	8.83ijk	9.73hi	10.51h
I_2F_1	9.55i	11.70ghi	14.50hi	18.75hi	23.35ijk	25.56ij	27.65h	4.37ef	5.30gh	6.45gh	7.81j	9.05hij	9.92gh	11.19g
I_2F_2	9.82hi	12.23fgh	15.33hij	19.40hi	23.77hij	25.87hij	28.43gh	4.54ef	5.51fgh	6.69fgh	7.98hi	9.21ghi	10.26fg	11.44fg
I_2F_3	10.25gh	12.70fgh	15.53gh	20.37gh	24.34ghi	26.47ghi	29.43fg	4.79de	5.75efg	6.92fgh	8.13h	9.36fgh	10.53ef	11.73f
I_2F_4	10.72gh	13.20fg	16.41fg	21.42fg	24.76fgh	26.90fgh	29.84f	5.10de	6.11defg	7.18efg	8.43g	9.59efg	10.65ef	12.22e
I_2F_5	11.07fg	13.64ef	17.41ef	21.85f	25.30efg	27.35fg	30.54ef	5.3 lcd	6.35cdef	7.38ef	8.69g	9.75ef	10.90e	12.51e
I_2F_6	11.73ef	14.84de	18.29de	22.52ef	25.71 ef	27.87f	31.54e	5.56bc	6.54cde	7.64e	8.98f	9.92e	11.00e	12.52e
I_3F_1	10.81de	14.77de	19.33cd	23.33de	26.47de	30.22e	33.44d	5.30bc	6.23cd	8.17d	9.50e	10.60d	11.49d	13.37d
I_3F_2	10.11de	15.26cd	19.90c	24.30cd	27.24d	31.19de	34.23cd	5.44bc	6.50c	8.37d	9.72de	10.80cd	11.72cd	13.63d
I_3F_3	11.35d	15.6lcd	20.48bc	25.04bc	28.42c	32.29cd	34.96bc	5.63b	6.74c	8.63cd	9.88cd	11.05bcd	12.03bc	13.82cd
I_3F_4	11.88c	16.25bc	21.41ab	25.33bc	29.36bc	33.27bc	35.93b	6.14a	7.16bc	9.03bc	10.06bc	11.19bc	12.34b	14.20bc
I_3F_5	12.37b	16.95b	22.05a	26.20ab	30.30ab	34.2 lab	37.32a	6.29a	7.33ab	9.28ab	10.34b	11.50ab	12.83a	14.52ab
I_3F_6	13.03a	18.89a	22.62a	27.3 la	31.27a	34.93a	38.43a	6.59a	7.64a	9.61a	10.72a	11.92a	13.16a	14.72a

Irrigation
I_1 = Irrigation at 21 -day intervals
I_2 = Irrigation at 14- day intervals
I_3 = Irrigation at 7- day intervals

Fertilizer
F_1: Cowdung @ 15 t/ha
F_2: Poultry manure @ 9.4 t/ha
F_3: Urea-TSP-MOP @ 326-218-201 kg/ha
F_4: Urea-TSP-MOP-Gypsum @ 326-218-201-55.6 kg/ha
F_5: Urea-TSP-MOP-Gypsum-Borax @ 326-218-201-55.6-9.52 kg/ha
F_6: Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha

Table 2. (contd.) Combined effect of irrigation and fertilizers on growth characters of kohlrabi

Treatment combination	Spread of leaves (cm) at							Days required for knob initiation
	15DAT	22 DAT	29 DAT	36 DAT	43 DAT	50 DAT	57 DAT	
I_1F_1	14.40i	19.13h	20.67m	24.23j	28.13i	31.13i	35.30f	26.72a
I_1F_2	14.73hi	19.46gh	21.401m	24.80jj	28.63hi	31.66hi	35.70f	26.42ab
I_1F_3	15.l0ghi	20.03fgh	21.83kl	25.26ij	29.13ghi	32.00hi	36.06f	26.02abc
I_1F_4	15.37fghi	20.43fgh	22.23jkl	25.87ij	29.66ghi	32.47ghi	36.30f	25.70abcd
I_1F_5	15.67efghi	20.67fgh	22.63jk	26.23i	30.13gh	33.26gh	36.73f	25.40bcdf
I_1F_6	15.97efghi	21.33fg	23.13j	26.53i	30.46g	33.63g	37.13f	25.13cde
I_2F_1	15.23defghi	20.40fg	25.13i	30.03h	35.30f	36.40f	42.07e	24.65def
I_2F_2	15.56cdefgh	20.77ef	25.77hi	30.70gh	36.40ef	37.16ef	42.40e	24.37efg
I_2F_3	16.03cdefgh	21.26ef	26.33h	31.17gh	37.06de	37.57ef	43.60de	23.87fgh
I_2F_4	16.43cdefgh	21.46ef	26.66gh	32.23fg	37.40de	38.27de	44.07de	23.36ghi
I_2F_5	16.80bcdefg	22.20de	27.53fg	33.30ef	37.30de	39.30d	44.30de	22.88hi
I_2F_6	17.13bcdef	23.40cd	28.33ef	34.33e	38.26d	39.66d	45.53cd	22.35ij
I_3F_1	15.93abcde	23.67c	29.10de	36.23d	41.17c	45.03c	48.90bc	21.60jk
I_3F_2	16.67abcd	24.00bc	29.67cd	37.17cd	41.70bc	45.37bc	47.43ab	21.27jkl
I_3F_3	17.07abcd	24.63abc	30.26bc	37.70bcd	42.23abc	46.23abc	49.33ab	20.97kl
I_3F_4	17.40abc	25.10ab	30.86ab	38.33bc	42.63abc	46.76ab	49.73ab	20.72kl
I_3F_5	17.77ab	25.53a	31.30ab	39.33ab	43.10ab	47.23a	49.96a	20.401
I_3F_6	18.17a	25.73a	31.63a	40.10a	43.53a	47.63a	50.30a	20.08m

Irrigation
I_1 = Irrigation at 21- day intervals
I_2 = Irrigation at 14-day intervals
I_3 = Irrigation at 7- day intervals

Fertilizer
F_1: Cowdung @ 15 t/ha
F_2: Poultry manure @ 9.4 t/ha
F_3: Urea-TSP-MOP @ 326-218-201 kg/ha
F_4: Urea-TSP-MOP-Gypsum @ 326-218-201-55.6 kg/ha
F_5: Urea-TSP-MOP-Gypsum-Borax @ 326-218-201-55.6-9.52 kg/ha
F_6: Urea-TSP-MOP-Oypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20kg/ha

Fresh weight of leaves per plant (g)

The combined and interaction effects of irrigation and fertilizers treatment were significant on fresh weight of leaves at harvest. The highest (98.24 g) fresh weight of leaves per plant was found from the treatment combination of irrigation at 7-day intervals with Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha fertilizers and the lowest (19.32 g) fresh weight of leaves per plant was obtained from the treatment combination of irrigation at 21-day intervals and cowdung @ 15 t/ha (Table 3).

Fresh weight of knob per plant (g)

Both the combined and interaction effects of irrigation and fertilizers were recorded to be statistically significant. The maximum fresh weight of knob (278.34 g) was found from the treatment combination of irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha which was statistically similar (269.11 g) to the treatment combination of irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax @ 326-218-201-55.6-9.52 kg/ha. The minimum (71.27 g) fresh weight of knob per plant was recorded from the irrigation at 21-day intervals and cowdung @ 15 t/ha treatment combination (Table 3).

Fresh weight of roots per plant (g)

The both combined and interaction effects were recorded statistically significant on fresh weight of roots per plant of kohlrabi. The maximum fresh weight of roots was found (28.33 g) from the treatment combination of irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha and the minimum (9.43 g) fresh weight of roots per plant was found from the treatment combination of irrigation at 21-day intervals and cowdung @ 15 t/ha (Table 3).

Diameter of knob per plant (cm)

Statistical analysis showed that the interaction and combined effects of irrigation and fertilizers had significant effect on diameter of knob of kohlrabi. The maximum diameter of knob (10.60 cm) was observed from irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha treatment combination and the minimum diameter of knob (4.53 cm) was observed from irrigation at 21-day intervals and cowdung @ 15 t/ha treatment combination (Table 3).

Thickness of knob (cm) per plant

The combined and interaction effects of irrigation and fertilizer management were recorded statistically significant. The highest (8.03 cm) thickness of knob was recorded from irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha treatment combination and the lowest (4.33 cm) thickness of knob was recorded from irrigation at 21-day intervals and cowdung @ 15 t/ha treatment combination (Table 3).

Length of root per plant (cm)

The interaction effect of irrigation and fertilizers were observed to be statistically insignificant on the length of root per plant. However, the maximum (22.46 cm) length of root per plant was recorded from irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha treatment combination and it was statistically similar to irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax @ 326-218-201-55.6-9.52 kg/ha treatment combination. The minimum (10.22 cm) length of root per plant was found from irrigation at 21-day intervals with cowdung @ 15 t/ha treatment combination (Table 3).

Number of lateral roots per plant

Both the combined and interaction effects of irrigation and fertilizer on number of lateral roots per plant were found to be statistically significant (Table 3). Maximum number of lateral roots (31.57) was recorded from irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha treatment combination and the minimum (15.17) lateral roots per plant was recorded having treatment combination of irrigation at 21-day intervals with cowdung @ 15 t/ha.

Dry weight of leaves (%)

The combined & interaction effects of irrigation & fertilizer management were significant on the growth & yield of kohlrabi. The maximum (19.03%) dry weight of leaves was recorded from the treatment combination of irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha and it was statistically similar with the treatment combinations of irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax @ 326-218-201-55.6-9.52 kg/ha, irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum @ 326-218-201-55.6 kg/ha and irrigation at 7-day intervals and Urea-TSP-MOP @ 326-218-201 kg/ha. The minimum per cent dry weight of leaves (10.23) was recorded with the irrigation at 21-day intervals and cowdung @ 15 t/ha treatment combination which was statistically similar with irrigation at 21-day intervals with poultry manure @ 9.4 t/ha treatment combination (Table 3).

Dry weight of knob (%)

There was no interaction effect between the treatment combinations of irrigation and fertilizers on dry weight of knob (%) production. But the combined effect of the both treatment of irrigation and fertilizers was statistically significant. The maximum and minimum dry weight of knob were recorded (9.93% and 6.37%) from the treatment combinations of irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha and irrigation at 21-day intervals and cowdung @ 15 t/ha (Table 3).

Dry weight of root (%)

The interaction and combined effects of both treatments of irrigation and fertilizers were statistically significant. The maximum (38.30%) dry weight of roots was recorded from the treatment combination of irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha and the minimum (15.47%) dry weight of root was recorded from the treatment combination of irrigation at 21-day intervals with cowdung @ 15 t/ha (Table 3).

Marketable yield per plot

It was observed that both the combined and interaction effect of irrigation and fertilizers on yield per plot were statically significant. The treatment combination of irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha produced the highest yield per plot (9.27 kg). The lowest yield per plot (2.33 kg) was found from the treatment combination of irrigation at 21-day intervals with cowdung @ 15 t/ha (Table 3).

Marketable yield per hectare

The combined effect of irrigation and fertilizers management was recorded statistically significant on the marketable yield per hectare of kohlrabi (Table 3). The highest marketable yield (51.48 ton/ha) was found with the treatment combination of irrigation at 7-day intervals and Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20 kg/ha and minimum marketable yield (12.96 ton/ha) was recorded with the treatment combination of irrigation at 21-day intervals with cowdung @ 15 t/ha.

Table 3. Combined effect of irrigation and fertilizers on yield components and yield of kohlrabi

Treatment combination	Fresh weight of leaves per plant (g)	Fresh weight of knob per plant (g)	Fresh weight of roots per plant (g)	Diameter of knob per plant (cm)	Thickness of knob per plant (cm)	Length of root per plant (cm)	Number of lateral roots per plant	Dry weight of leaves (%)	Dry weight of knob(%)	Dry weight of roots(%)	Marketable yield per plot (kg)	Marketable yield (t/ha)
I_1F_1	19.32q	71.27m	9.43o	4.531	4.331	10.22n	15.17n	10.231	6.371	15.471	2.33o	12.96n
I_1F_2	26.25p	75.841m	11.39n	4.781	4.56k	10.78mn	15.53n	10.77kl	6.70kl	16.23kl	2.63no	14.63mn
I_1F_3	32.28o	85.39kl	12.20m	5.37k	4.77j	11.151m	16.031m	11.33k	6.93jk	17.13jk	2.92mn	16.201m
I_1F_4	37.19n	95.55jk	13.091	5.80j	4.89j	11.691	16.501	11.66jk	7.23ij	18.26ij	3.031k	16.85kl
I_1F_5	42.98m	103.05jk	14.31k	6.21i	5.15i	12.42k	17.23k	12.40j	7.50ij	19.20hi	3.50jk	19.44j
I_1F_6	47.511	109.61ij	14.93k	6.46i	5.31i	13.40j	17.60j	13.46i	7.73hi	20.3 7h	3.73j	20.74j
I_2F_1	61.38k	125.14i	16.56J	7.36h	5.55h	15.26i	19.30i	14.33hi	7.23hi	18.50ij	3.37kl	18.70jk
I_2F_2	65.50kl	128.71h	17.35i	7.65gh	5.88g	15.68hi	19.70hi	14.63gh	7.53gh	20.03h	4.23 i	23.52i
I_2F_3	67.73ij	149.82h	18.38h	7.84fg	6.17f	16.34gh	21.03gh	15.50fg	7.83fgh	20.59h	4.57hi	25.37hi
I_2F_4	69.77hi	176.14g	18.82gh	7.98f	6.41e	16.66fg	22.13fg	15.80ef	8.10efg	22.40g	4.83h	26.85h
I_2F_5	71.81h	183.09f	19.27g	8.45e	6.69d	17.18ef	23.17ef	16.53de	8.26def	23.53g	5.46h	30.37g
I_2F_6	74.55g	191.94ef	20.34f	8.55e	6.90ef	17.58e	23.33e	16.80d	8.43cde	25.30f	6.13g	34.07g
I_3F_1	81.70f	218.20d	23.21e	8.71e	6.37e	19.77d	25.36d	17.36cd	8.56bcd	28.37e	5.77f	31.95f
I_3F_2	85.15e	228.72d	23.48e	9.02d	6.48d	19.93cd	26.26cd	17.83bc	8.83bc	29.53e	7.11e	39.62e
I_3F_3	87.93d	254.02c	25.37d	9.55c	6.76c	20.58c	27.37c	18.16abc	9.00b	31.43d	7.90ed	43.84d
I_3F_4	91.70c	264.65bc	26.61c	9.62c	7.32b	21.32b	28.50b	18.53ab	9.50a	33.23c	8.27dc	45.93c
I_3F_5	94.58b	269.1 lab	27.40b	10.16b	7.72b	21.79ab	30.16ab	18.83a	9.70a	35.83b	8.87b	48.71b
I_3F_6	98.24a	278.34a	28.33a	10.60a	8.03a	22.46a	31.57a	19.03a	9.93a	38.30a	9.27a	51.48a

Irrigation

I_1 = Irrigation at 21-day intervals

I_2 = Irrigation at 14 -day intervals

I_3 = Irrigation at 7- day intervals

Fertilizer

F_1: Cowdung @ 15 t/ha

F_2: Poultry manure @ 9.4 t/ha

F_3: Urea-TSP-MOP @ 326-218-201 kg/ha

F_4: Urea-TSP-MOP-Gypsum @ 326-218-201-55.6 kg/ha

F_5: Urea-TSP-MOP-Gypsum-Borax @ 326-218-201-55.6-9.52 kg/ha

F_6: Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6-9.52-20kg/ha

CONCLUSION

From the above discussion, it may be concluded that maximum yield/ha (35.84 t/ha) was obtained from Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6- 9.52-20 kg/ha fertilizers and minimum yield/ha (21.20 t/ha) was found when cowdung @ 15 t/ha was applied. The results of the present study reveal that optimum supply of fertilizers helped to increase yield of kohlrabi. Different irrigation treatments played important role on yield of kohlrabi. The maximum yield/ha (43.59 t/ha) was obtained from the plants irrigation at 7-day intervals. While the lowest yield/ha (16.8 t/ha) was found in the treatment of irrigation at 21-day intervals. The highest yield per hectare (51.48 t/ha) was obtained from irrigation at 7-day intervals with Urea-TSP-MOP-Gypsum-Borax-Zinc Sulphate @ 326-218-201-55.6- 9.52-20 kg/ha fertilizers.

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