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Effect of Potassium Fretilization to Increase the Yield of Carrot (*Daucus carota* L.)

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Abstract

A study was conducted at the Horticulture farm of Bangladesh Agricultural University, Mymensingh to evaluate the effect of five levels of applied potassium on the growth and yield of carrot. The experiment was laid out in a RCB (randomized complete block) design with three replications with five treatments *viz*. 0, 30, 60, 90, 120 kg Potassium per hectare. Root yield increased progressively and significantly with the increased application of potassium. Application of potassium 120 kg/ha increased the Leaf number per plant (11.93), root length (16.11 cm), root diameter (5.04 cm), fresh weight (184.8 g) and yield (49.29 t/ha). High dose of potassium also increased cracked and branched root which reduced the marketable quality of yield.

Keywords: Potassium, carrot, growth, yield

Carrot (*Daucas carota* L.) is an important vegetable crop, belonging to the family Umbelliferae. It is grown in spring, summer and autumn in temperate countries, and during winter in tropical and sub-tropical countries[1]. In the recent years, the crop has gained much popularity in Bangladesh especially among the urban people because of its high nutritive value and possible diversified use in making different palatable foods. The popularity of carrot is increasing day by day in our country, but large scale production of carrot has not yet been started to meet up its demand. Rashid[2] reported that the yield of carrot under Bangladesh conditions about 25 tons per hectare. The yield is very low, compared to the same of some countries like USA, UK, Canada and Denmark where, per heater yield is much high. The yield of any crops can be increased upto substantial level by using improved variety and following improved technology in cultivation. Hipp[3] reported that, the yield of carrot could be increased by judicious management of fertilizers. Potassium application is very important for carrot plants. Hochmuth *et al*.[4] indicated that potassium (K) is required for successful carrot production in sandy soils. Moreover, several studies revealed the importance of potassium to achieve high carrot yield[5, 6]. Ivanov[7] discussed the role of potassium in maintaining soil fertility and emphasized the necessity of continuous use of potassium fertilizer for carrot production. Foliar application of potassium increased the yield

of carrot plants[8]. Kadar[9] described that carrot is a potassium-demanding plant. Therefore, additional foliar application of potassium could be beneficial for improving carrot productivity. The aim of the present study was to examine the effectiveness of application of potassium on carrot growth, yield and quality of roots.

MATERIALS AND METHODS

Experimental site and soil

The experiment was conducted at the Horticulture farm of the Bangladesh Agricultural University, Mymensing during the winter season. The soil of the experimental plot belongs to the Old Brahmaputra flood plain area. The texture of the soil was silt loam and pH of the soil was 6.8. The selected land was medium high.

Layout, treatments and design of the experiment

The single factor experiment was laid out in a Randomized Complete Block Design with three replications. The whole experimental area was 20.30 m × 8.85 m, which was divided into three blocks. Each block was again divided into 25 plots and hence there were (5×5) unit plots. The size of unit plot was 1.25 m × 10 m. The distance between the blocks was 0.60 m and between the plots was 0.40 m. The experiment consisted of five levels of potassium *viz*., K_0 = 0 kg K_2O/ha (Control), K_1= 30 kg K_2O/ha, K_2= 60 kg K_2O/ha, K_3 = 90 kg K_2O/ha and K_4= 120 Kg K_2O/ha. The treatments were assigned randomly in each block separately.

Seed rate, sowing and treatment

Carrot seeds of the variety 'New Kuroda' were soaked into water for 12 hours and then wrapped with a piece of thin cloth prior to sowing. Then they were spread over polythene sheet for two hours to dry. The seeds were treated with Vitavex-200 @ 3 g/100 g seed. Seeds were used at a rate of 3 Kg/ha as narrated by Rashid (1993)[2], consequently 20 g of seeds were used for theexperimental area. Seven, six and five shallow furrows were made for spacing of 25 cm × 15 cm with 1 cm depth in each plot for sowing seeds. Seeds were sown on mid-November.

Manure and fertilizers, Irrigation and Intercultural operations

Well decomposed cow dung was applied to the plots at the rate of 10 ton per hectare and incorporated to the soil during land preparation. TSP was applied at the rate of 125 kg/ha as a basal dose to provide 60 kg P_2O_5/ha . Total amount of TSP was applied to the plots during final land preparation. Nitrogen and potassium (K_2O) in the form of urea and MP, respectively as per treatment schedule were top-dressed at 30 days after sowing the seeds. The field was irrigated 3 times during the whole period of plant growth following flood method. Intercultural operations like thinning,weeding, irrigation, insects and pest management were done as and when necessary to facilitate optimum crop growth.

Harvesting

The crop was harvesting when the foliage turned pale yellow. The soil adhering to the roots was cleaned with cloth.

Collection of data and statistical analysis

Data on plant height, number of leaves per plant, length of root, diameter of root and yield contributing characters were recorded from ten selected plants. The recorded data on different parameters were statistically analyzed by Duncun's Multiple Rang Test (DMRT). The treatments mean were separated by Least Significant Difference (LSD) at 1% and 5% level of significance for interpretation of the result.

RESULTS AND DISCUSSION

Plant height

Plant height was recorded at different days after planting and it differed significantly among different potassium treatments (Fig. 1). Since potassium as muriate of potash was applied at 30 DAP, the plant height recorded at 30 DAP did not differ significantly. With the passing of time, plant were

growing gradually and significant variations in plant height were observed at 45, 60 and 75 DAP due to different potassium levels. At each DAP, the minimum plant height was revealed at control treatment. With the increase of potassium level, plant height also gradually increased and the maximum plant height was observed at the highest level of potassium. Plant height also recorded at harvest (Table 1). The minimum plant height was found at control treatment (0 kg K_2O/ha). With the increase of potassium dose, plant height was also found to increase and the maximum plant height was noticed at the highest dose of potassium (120 kg K_2O/ha). Plant height showed a general trend of increase with the increasing levels of potassium. The tallest plant at the highest dose of potassium was obtained due to the fact that plant received more potassium which along with nitrogen might have encouraged more vegetative growth. Plant height was increasing slowly during the early stage of growth, rapidly between 30- 60 days and later the plants grew rather slowly. The result in respect of plant height showed in accordance with those of Deshi *et al.*[10] who reported significant increase in plant height due to increase in the rate of potassium.

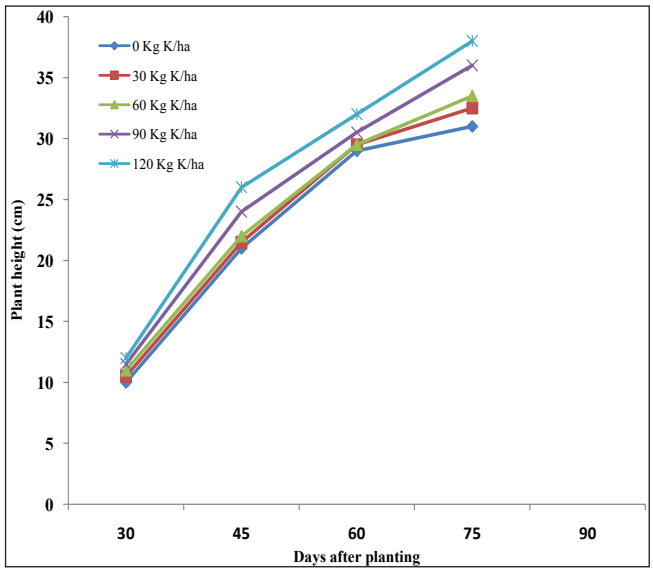

Fig. 1: Effect of Potassium on the plant height of carrot at different days after planting

Number of leaves per plant

Significant variation in the number of leaves per plant was found due to different potassium levels applied. The highest leaf number per plant was produced by the plants having received 120 kg potassium per hectare, which was statistically identical with 90 kg K_2O/ha, and the lowest by the control plants. The number of leaves per plant increased significantly with increase in the levels of potassium. The results of this experiment were in accordance with those of Deshi *et al.*[10] who noticed significant effect of potassium on leaf number per plant (Table 1).

Root length

Significant variation in the root length per plant was found due to different potassium levels applied. The highest root length was produced by the plants having received 120 kg K_2O/ha, which was statistically identical with 60 and 90 kg K_2O/ha, and the lowest by the control plants. The root length per plant increased significantly with increase in the levels of potassium. Sarker[11] and Farazi[12] obtained no significant effect of potassium on root length (Table 1).

Root diameter

No statistically significant variation in the root diameter of carrot was found due to different potassium levels applied. The highest root diameter of carrot was produced by the plants having received 120 kg/ha, and the lowest by the control plants. The root diameter of carrot increased with the increase in the levels of potassium. Farazi[12] and Sarker[11] also reported that potassium had significant effect on the root diameter (Table 1).

Percentage of cracked root

Significant variation in the percentage of cracked root was found due to different potassium levels applied. The highest percentage of cracked root was produced by the plants having received 120 kg K_2O/ha which was statistically identical with 90 kg K_2O/ha, and the lowest by the control plants. Number of cracked roots increased with the increasing of potassium (Table 1).

Table 1: Main effect of potassium on the growth and yield components of carrot

Level of Potassium (kg / ha)	Plant height (cm)	Leaf number/ plant	Root length (cm)	Root diameter (cm)	Cracked root (%)	Branched root (%)	Shoot fresh weight (g)	Shoot dry weight (g)	Root fresh weight (g)	Root dry weight (g)	Root yield (kg/ plot)
0 (K_0)	33.64 c	10.86 c	15.02 c	4.81 a	11.20 c	20.04 a	38.62 e	5.76 d	165.3 e	37.41 e	4.96 c
30 (K_1)	33.89 c	11.07 bc	15.34 bc	4.81 a	13.20 bc	19.96 a	41.12 d	6.20 c	170.3 d	38.79 d	5.09 c
60 (K_2)	34.26 c	11.42 ab	15.79 a	4.88 a	14.98 ab	20.80 a	43.33 c	6.36 bc	174.8 c	40.12 b	5.25 b
90 (K_3)	35.66 b	11.52 ab	15.77 ab	4.92 a	15.64 ab	21.24 a	45.11 b	6.57 ab	178.9 b	41.30 b	5.32 b
120 (K_4)	36.85	11.93 a	16.11 a	5.04 a	16.53 a	21.57 a	46.50 a	6.83 a	184.8 a	43.34 a	5.55 a

Percentage of branched root

Statistically significant variation in the percentage of branched root was not found by the different potassium levels applied. The highest percentage of branched root was produced by the plants having received 120 kg K_2O/ha which was statistically identical with 90 kg K_2O/ha, and the lowest by the control plants. Percentage of branched root increased with increasing levels of potassium. Information regarding the effect of potassium on branching of root are not available in literature.

Fresh shoot weight

The result showed that there was highly significant variation in fresh shoot weight due to different potassium dosed. Fresh shoot weight showed a general trend of increase with the increasing levels of potassium. The weight of fresh shoot ranged from 38.62 to 46.50 g. The maximum weight of fresh shoot was obtained at 120 kg K_2O per hectare and the minimum was obtained at the control treatment (Table 1). Farazi[12] reported that potassium had no effect on fresh weight of individual plant.

Dry weight of shoot

There was significant variation among different doses of potassium in respect of dry weight of shoot. The maximum dry weight of shoot (6.83 g) was obtained at 120 kg K_2O/ha, while the minimum dry weight of shoot (5.76 g) was obtained in control treatment (Table 1). There was a trend of increase in the weight of dry shoot when grown with higher doses of potassium. Information regarding the effect of potassium on this parameter is scanty in the literature.

Fresh weight of carrot root

Statistically significant variation due to different doses of potassium was found in fresh weight of carrot root. The maximum fresh root weight (184.8 g) was produced by the plant having received 120 kg K_2O/ha and the minimum (165.3 g) by the control treatment (Table 1). The results in respect of fresh weight of carrot root showed in accordance with those of Sarker[11] who reported that potassium significantly increased the fresh root weight.

Dry weight of carrot root

Significantly variation in the dry weight of carrot root was found due to application of different doses of potassium. The dry weight of root varied from 37.41 to 43.34 g. The maximum dry weight was produced by the plant having received 120 kg K_2O/ha, while the minimum was produced by control treatment (Table 1). The dry root weight increased with the increasing levels of potassium.

Root yield per plot

Statistically significant variation due to different doses of potassium was found in root yield/plot. The maximum weight (5.55 kg/plot) was produced by the plant having received 120 kg K_2O/ha and the minimum (4.96 kg/plot) by control treatment. It was clearly observed that yield increased with the increasing level of potassium (K_2O) (Table 1).

Polach[13] reported that application of potassium at 196 kg/ha gave the best yield and quality carrots.

Root yield per hectare

There was significant variation due to the application of different doses of potassium in root yield of carrot (Fig. 2). The highest root yield per hectare (49.29 t/ha) was obtained from 120 kg K_2O/ha, while the minimum yield per hectare (44.03 t/ha) was found from control treatment. It was clearly observed that the yield increased with increase in the levels of potassium. Different doses of potassium produced significantly different yields. Burleson[14] and Sein[15] reported that potassium did not show any significant effect on the yield of carrot roots. Polach[13] reported that application of potassium at 196 kg /ha gave the best yield and quality carrot. Szwonek[16] reported that root yield was depressed by high potassium rates.

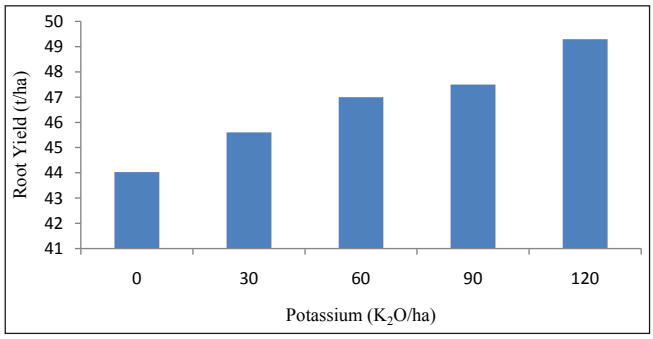

Fig. 2: Effect of potassium on the yield of carrot.

CONCLUSION

The overall results gathered from this study facilitated that potassium significantly influenced most of the parameters under study. Yield was found to be increased gradually with the increase of potassium levels upto 120 kg K_2O/ha. Further investigation is needed to be carried out to observe the effect of potassium levels above 120 kg K_2O/ha on root yield.

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