Effect of Nitrogen Fretilizer 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 nitrogen on the growth and yield of carrot. The experiment was laid out in a Randomized Complete Block Design with three replications. The five doses of nitrogen were 0, 50, 100, 150, 200 kg ha^{-1}. Root yield increased progressively and significantly with the increased application of nitrogen. Application of nitrogen 150 kg ha^{-1} increased the root diameter (5.14 cm), fresh weight (200.1 g) and yield (53.37 t ha^{-1}) and when the dose was increased upto 200 kg/ha it decreased the yield (50.17 t ha^{-1}), fresh weight (189.2 g ha^{-1}) and root diameter 5.01 cm). High dose of nitrogen also increased cracked and branched root which reduced the marketable yield.

Keywords: Nitrogen, carrot, growth, yield, increase.

Introduction

Carrot (*Daucus carota* L.) is a winter crop and is one of the important root vegetable crops cultivated throughout the world. It produces an enlarged fleshy tap root that is edible and high nutritive value. Carrot is rich in beta-carotene and is an excellent source of iron, calcium, phosphorus, and folic acid and vitamin [1].The fleshy roots are eaten as raw, boiled or steamed in vegetable dishes and also cooked with other vegetables [2]. In Bangladesh carrot is cultivated on an area of 13 thousand hectares with an annual production of 15021 metric tons of carrot roots, with an average yield of 10.84 t ha^{-1} [3]. Comparatively, the yield of carrot in our country is very low. There are several factors which influence the yield and quality of seed. Among these optimum plant spacing, floral set, planting material, nutrition, health of mother plant, root size and root age, etc. are very important. In carrot cultivation nitrogen fertilizer is essential and necessary for its growth and development, particularly in early stages which leads to thicker and healthy root development [4]. Nitrogen increases the vegetative growth, and produces good quality foliage and promotes carbohydrate synthesis [5]. There is sufficient scope for increasing the yield of carrot by judicious application of nitrogen. An attempt was therefore made to study the effect of different levels of nitrogen on growth and yield of carrot.

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Materials and Methods

Experimental site and soil

The experiment was conducted at the Horticulture farm of the Bangladesh Agricultural University, Mymensing during the period from October 2005 to March 2006. 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 nitrogen viz., N_0 = 0 kg ^{N} ha^{-1} (Control), N_1= 50 kg ^{N} ha^{-1}, N_2= 100 kg ^{N} ha^{-1}, N_3 = 150 kg ^{N} ha^{-1} and N_4 = 200 Kg ^{N} ha^{-1}. 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^{-1} as narrated by Rashid (1993), consequently 20 g of seeds were used for the experimental 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 [6]. Seeds were sown on 15 November, 2005.

Manure and fertilizers, Irrigation and Intercultural operations

Well decomposed cow dung was applied to the plots at the rate of 10 t ha^{-1} and incorporated to the soil during land preparation. TSP was applied at the rate of 125 kg ha^{-1}/ha as a basal dose to provide 60 kg ha^{-1} [6]. 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.

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 and number of leaves per plant

Plant height was recorded at different days after planting and it differed significantly among different nitrogen treatments (Figure 1). Since nitrogen was applied at 30 DAP, plant height was recorded at 30 DAP and did not differ significantly. With the advent of time, plants were growing gradually and significantl variations in plant heights were observed at 45, 60 and 75 DAP due to different nitrogen levels. At each DAP, the minimum plant height was observed at control treatment. With the increase of nitrogen levels, plant height also gradually increased and the maximum plant height was observed at the highest level of nitrogen. Plant height was also recorded at harvest (Table 1). The minimum plant height was found at control treatment (0 Kg ^{N} ha^{-1}). With the increase of nitrogen dose, plant height was also found to increase and the maximum plant height was noticed at the highest dose of nitrogen (200 Kg ha^{-1}).

Plant height showed a general trend of increase with the increasing levels of nitrogen. The tallest plants at the highest dose of nitrogen were observed due to the fact that they received more nutrient (nitrogen) which might have encouraged more vegetative growth. Plant height was increasing slowly during the early stages of growth, rapidly between 30-60 days and later the plants grew rather slowly. The result in respect of plant height agrees to Deshi *et al*. [7] who reported significant increase in plant height due to increasing rate of nitrogen. Skrbic [8] also noticed slow growth at the beginning of the vegetative growth and quite intensive growth after the formation of 7- 8 leaves until the technological maturity was observed.

The number of leaves per plant also showed significantl variation due to different level of nitrogen. The number of leaves per plant increased significantly with the increasing levels of nitrogen. The plant having received 200 Kg N ha^{-1}, which was statistically identical with 150 Kg ha^{-1} was, produced the highest leaf number per plant, and the lowest by the control plants (Table 1).

Root length and root diameter

Nitrogen markedly influenced the development of root. Significant variation in root length was found due to different nitrogen levels applied. The highest root length (16.61 cm) was produced by the plants having received 150 Kg ^{N} ha^{-1}, which was statistically identical with 100 and 200 Kg ^{N} ha^{-1}, and the lowest (13.87 cm) for the control plants (Table 1). The results of this experiment are in accordance with those of Deshi *et al*. [7] and Sein [9]. The root length gradually increased with increasing level of nitrogen. Sarker [10] also found similar results.

Root diameter increased with increasing nitrogen levels up to a certain level and then decreased (Table1). The highest diameter of root (5.14 cm) was found in plants having received 150 Kg ^{N} ha^{-1} and the lowest diameter of root (4.50cm) was found for the control plants. Sarker [10] and Batra and Kallo [11] also found similar result.

The percentage of cracked root varied significantly due to the application of different levels of nitrogen (Table 1). The maximum percentage of cracked root (19.57 %) was found in plants having received 200 Kg ^{N} ha^{-1} and the lowest cracked root (8.77 cm) was found in control plants. Percentage of cracked root increased significantly with the increase in the levels of nitrogen. The results of this experiment are in accordance with that of Goodman [12].

Significant variation in the percentage of branched root was found due to different nitrogen levels applied. The highest percentage of branched root was produced by those plants received 200 Kg ^{N} ha^{-1}, which was statistically identical with 150 Kg ^{N} ha^{-1}, and the lowest by the control plants. Branching of root increased progressively with the increase in the levels of nitrogen. The result showed conformity with the findings of Orphanos and Krentos [13] who reported that the highest dose (189 Kg ha^{-1}) of nitrogen reduced the exportable yield due to branching of roots .

Fresh weight and dry matter content of shoot

Significant variation was found with respect of weight of fresh leaves due to application of different levels of nitrogen (Table 1). The maximum fresh weight of shoot (59.76 g) per plant was obtained for 200 Kg ^{N} ha^{-1} and the minimum fresh shoot weight (23.26 g) per plant was obtained for control treatment. Skrbic [8] found that nitrogen had significant effect on the dynamics of the increase in the weight of shoot. The maximum dry weight per plant (8.64 g) was obtained at 200 Kg ^{N} ha^{-1}, while the minimum dry weight (4.0 g) was obtained for the control treatment. There was a trend of increase in dry weight of shoot when grown with higher dose of nitrogen (Table 1).

Fresh weight and dry matter content of root

Statistically significant variation due to different doses of nitrogen was found on fresh weight of carrot root. The maximum fresh root weight (200.1 g) was produced by the plants having received 150 Kg^{N} ha-1 and the minimum (137.79g) by the control treatment. There was significant increase in fresh root weight with the increase of nitrogen levels upto 150 kg ha^{-1} and thereafter, fresh root weight was declined. Sarker [10] observed that nitrogen application on the soil at 120 Kg ha^{-1} showed significant effect on fresh root weight per plant.

The variation in the dry weight of carrot root per plant due to the application of different levels of nitrogen was statistically significant. The dry weight of root per plant varied from 29.41 to 47.74 g. The maximum dry root weight was produced by those plant received 150 Kg ^{N} ha^{-1} and the minimum by the control treatment (Table 1). Information regarding the effect of nitrogen on this parameter is scanty.

Root yield per plot

Statistically significant variation due to different levels of nitrogen was found in root yield per plot. The maximum root weight (6.00 t ha^{-1}) was produced by those plant received 150 Kg^{N} ha^{-1} and the minimum (5.65 t ha^{-1}) in control treatment. It was clear that yield increased with the increasing levels of nitrogen upto 150 kg ha^{-1} and thereafter it decreased with excessive level of nitrogen. Burleson [14] reported that carrots had strong response to nitrogen. Polach [15] reported that nitrogen at 180 kg/ ha gave the best yield and quality carrots.

Root yield per hectare

Significant variation in root yield of carrot per hectare was found due to the application of different levels of nitrogen (Figure 2). The highest root yield of 55.37 t ha^{-1} was achieved from 150 Kg^{N} ha^{-1}, followed by 50.17, 48.26 and 44.09 t ha^{-1} produced from 200, 100 and 50 Kg^{N} ha^{-1}, respectively, while the minimum yield per hectare (36.77 ton) was found from control treatment. It was clearly observed that yield increased with the increasing levels of nitrogen upto150 Kg^{N} ha^{-1} and thereafter, it decreased with excessive level of nitrogen. Sein [9] noticed the trend of increasing yield with the application of increasing doses of nitrogen. Burleson [14] reported that carrots had strong response to nitrogen. Polach [15] reported that nitrogen at180 Kg^{N} ha^{-1} gave the best yield and quality carrots. Increasing the nitrogen supply upto 200 Kg^{N} ha^{-1} produced a relatively small increase in yields and nitrogen at 100 kg/ha gave the best yield [16]. Orphanos and Krentos [13] also reported average yield of 70 t ha^{-1} with sufficient nitrogen, where N was applied at the rate of 63- 126 kg $^{ha-1}$.

Conclusions

The overall results gathered from this study facilitated to draw the conclusion that nitrogen significantly influenced various growth components and increased the yield of carrot up to the level of nitrogen fertilizer 150 kg/ha beyond which the yield decreased considerably. So, use of nitrogen above 150 kg ha^{-1} will not be justified. Further study may be conducted in different agro-ecological zones of Bangladesh under variable field conditions to confirm the result of the present experiment before recommending it to the grower.

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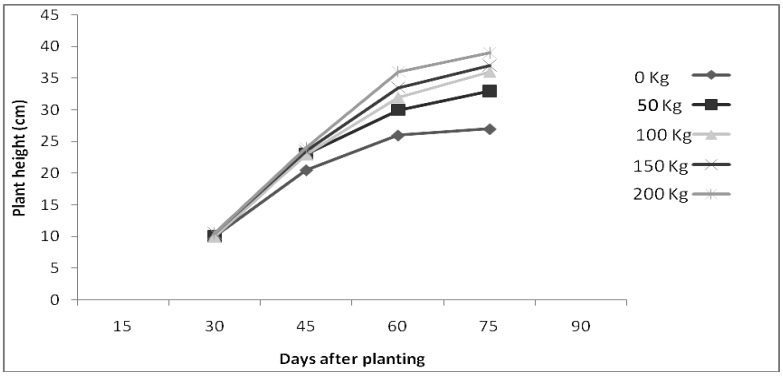

Fig. 1: *Effect of nitrogen on the plant height of carrot at different days after planting (LSD at 1% level)*

Table 1: *Effect of nitrogen on the growth and yield of carrot*

Level of nitrogen (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 (N_0)	26.98 e	9.87d	13.87c	4.50b	8.77 d	16.83 d	23.62 e	4.0 e	137.7 e	29.41e	4.15d
50 (N_1)	33.87d	10.89 c	15.38 b	4.84 a	12.83 c	19.19 c	33.36 d	5.26 d	164.9 d	37.19 d	4.96 c
100 (N_2)	36.55 c	11.65 b	16.10 ab	4.96 a	15.70 d	20.61 bc	44.30 c	6.33 c	182.2 c	42.57 c	5.45b
150 (N_3)	37.73 b	11.92 ab	16.61 a	5.14 a	14.48 bc	22.53 ab	53.64 b	7.49 b	200.1 a	47.74 a	6.00 a
200 (N_4)	39.17 a	12.64 a	16.05 ab	5.01 a	19.57 a	24.46 a	59.76 a	8.64 a	189.2 b	44.05 b	5.65 b

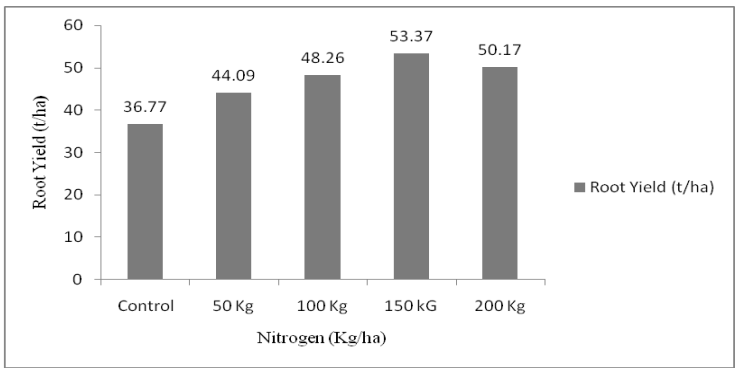

Fig. 2: *Effect of nitrogen on the yield of carrot (LSD at 5% level)*