Original Research Article

Understanding the Relationship Between Macronutrients, Harvest Time, and Carrot Yield

ABSTRACT

The growth and production of carrots influenced by macronutrients and harvesting time were the subjects of a field experiment conducted in the Horticultural Research Field of Sher-e-Bangla Agricultural University, Dhaka, between December 2020 and March 2021 during the Rabi season. The experiment consisted of two factors, and followed Randomized Complete Block Design (RCBD) with three replications. Factor A: Different levels of macronutrients (4) *e.i.*F_0= Control, F_1= $N_{160}P_{50}K_{120}S_{30}$ kg $ha^{-1,}$ F_2 = $N_{185}P_{70}K_{140}S_{40}$ kg $ha^{-1,}$ F_3 = $N_{210}P_{90}K_{160}S_{50}$ kg ha^{-1} and Factor B: A Harvesting time (3) *e.i.*H_1 = 90 days after sowing, H_2 = 100 days after sowing and H_3 = 110 days after sowing. Experimental results revealed that different levels of macronutrients and harvesting time significantly influenced the growth and yield of carrot. In case of different levels of macronutrients application the highest brix percentage of carrot root (7.77 %), marketable root yield per plot (6.13 kg) and marketable root yield per hectare (25.56 t) of carrot were observed in F_2 treatment ($N_{185}P_{70}K_{140}S_{40}$ kg ha^{-1}). Among different time of harvesting, the highest brix percentage of carrot root (7.20 %), marketable root yield per plot (6.10 kg) and marketable root yield per hectare (25.42 t) of carrot were observed in H_2 (harvesting at 100 days after sowing) treatment. In case of combination treatment the highest brix percentage of carrot root (8.20 %), marketable root yield per plot of carrot (6.40 kg) and marketable root yield of carrots per hectare (26.67 t) were observed in the F_2H_2 treatment combination comparable to others treatment combinations.Therefore, it was suggested that cultivation of carrot through application of fertilizer @ $N_{185}P_{70}K_{140}S_{40}$ kg ha^{-1} (F_2) and harvesting at 100 days after sowing (H_2),appeared to be best for achieving higher growth, yield and quality root of carrot.

Keywords: Carrot, Macronutrients, harvesting time, brix percentage and marketable root yield.

I. INTRODUCTION

The root vegetable known as the carrot (*Daucus carota* L.), a member of the Apiaceae family, is said to have originated in the Mediterranean region, where it was also first cultivated as a crop. It is a significant vegetable crop worldwide [1]. It is usually orange in color, though purple, black, red, white, and yellow cultivars exist. Carrot is a popular root crop from the nutritional point of view. It contains appreciable amount of carotene (10 mg/100 g), thiamine (0.04 mg/100 g), riboflavin (0.02 mg/100 g), carbohydrates (10.6%), protein (0.9 g/100 g), fat (0.2 g/100 g) and vitamin C (3mg/100 g) [2].Carrot roots have endogenous sugar levels that are 10 times higher in sucrose than in glucose and fructose. It has some significant medical benefits [3]. Eating carrots is thought to enhance night vision. It can be prepared as a salad, a cooked vegetable for recipes including soups, stews, and curries, as well as pickles, preserves, and desserts.[4].In spite of the crop's many virtues, growing consumer demand, and the fact that it is a profitable crop, carrot production in Bangladesh is currently limited in scale and efficiency.

In order to sustain a greater yield and soil fertility, nutrient management is one of the most important factors affecting carrot production[5].Nutrients play a vital role in functioning of normal physiological processes during the period of growth and development of plants. However, for obtaining higher economic yield, balanced supply of nutrients is one of the key factors [6]. Too low or high fertilizers levels can reduce the growth and development process of plants which may affect the crop yield.

Nitrogen is a crucial macronutrient for plant growth and development, but a lack of it results in interveinal yellowing, the production of the anthocyanin color, leaf rolling, chlorosis, and necrosis[7]. Nitrogen (N) has the great effect on plant physiology and is probably the most important limiting nutrient for crop growth. Nitrogen strongly stimulates growth expansion of the plant canopy, yield and yield contributing characters and gross yield [21].Phosphorus is a crucial component of phospholipids, enzymes, and nucleic acids. It

participates in a number of the plant's metabolic processes and is necessary for the transfer of energy within the system of the plant. [8]. Potassium facilitates protein and starch synthesis and improves plant immunity to weather changes, diseases and nematodes in plants. Application of inorganic S is very essential for better growth and biosynthesis of protein and chlorophyll in plants [9].

When produced as a winter crop, carrots need three to five months from seeding to harvest. When it reaches the proper size for the grade and market demand, it should be harvested. The harvesting period has a significant impact on carrot yield. The most crucial elements influencing carrot storage are temperature and root yield, which are determined by harvesting time. [10]. [11] suggested that carrot should be harvested at proper stage of maturity; otherwise, it will become fluffy and unfit for consumption. This study will help farmers become more knowledgeable about managing fertilizer and carrot harvesting times, resulting in increased productivity and benefits to farmers' revenue. The purpose of this study is to find out the appropriate application of macronutrient levels and suitable harvesting time for maximum growth and yield of carrot. It also helps to determine the best combination of macronutrient levels and harvesting time for maximum growth and yield of carrot.

II. MATERIAL AND METHODS

1. Description of the site

Between December 2020 and March 2021, the research was carried out at the Horticulture Farm of the Sher-e-Bangla Agricultural University in Sher-e-Bangla Nagar, Dhaka. The site was at a latitude and longitude of 23°77′ N and 90°35′ E, and it was 8.6 meters above sea level. The experimental site was located in a subtropical region with three distinct seasons: winter (November to February), the hot pre-monsoon season (March to April), and monsoon season (May to October). The research site experiences a cold winter and a scorching summer. The monsoon season accounts for the majority of the year's average precipitation, which is 490 mm over a 30-year period. The mean maximum and lowest temperatures were 28 and 19°C, respectively, for the entire year.

2. Soil sampling and analysis

Soil samples were collected in order to assess the physical and chemical characteristics prior to the experiment. The experimental field's soil has a silty loam texture. The soil in the test location is from AEZ No. 28's Modhupur Tract and is a portion of it. The Soil Resources Development Institute (SRDI), Soil Testing Laboratory, Kamarhati, Dhaka, evaluated the soil sample from the experimental plot, which was taken from a depth of 0 to 30 cm and had a pH of 7.1. It underwent physical and chemical testing after being air dried and crushed.

3. Statistical Analysis

Statistic 10 software was used to statistically examine the acquired data for the various parameters. At a 5% level of probability, the least significant difference test (LSD) was used to determine the significance of the differences between the treatment means.

4. Field preparation and Treatment allocation

The plot selected for the experiment was opened with a power tiller in the 14th December, 2020 and left exposed to the sun for 10 days. To achieve good tilth, the land was harrowed, ploughed, and cross-ploughed several times, followed by laddering. The experiment was laid out in a Randomized Complete Block Design (RCBD) having double factor with three replications. The experiment comprised as two factors. Factor A: Different levels of macronutrients (4) *e.i.*F_0= Control, F_1= $N_{160}P_{50}K_{120}S_{30}$ kg ha$^{-1,}$ F_2 = $N_{185}P_{70}K_{140}S_{40}$ kg ha$^{-1,}$ F_3 = $N_{210}P_{90}K_{160}S_{50}$ kg ha^{-1} and Factor B: A Harvesting time (3) *e.i.*H_1 = 90 days after sowing, H_2 = 100 days after sowing and H_3 = 110 days after sowing. Each block was divided into 12 plots where 12 treatments combination were distributed randomly and 36-unit plots altogether in the experiment. The size of each plot was 2.5 m × 1.5 m. The distance maintained between two blocks were 1.00 m and two plots were 0.50 m. The plots were raised up to 10 cm.

5. Planting Materials

The seeds of carrot cv. New Kuroda (a Japanese Varity) was used as planting material for this experiment. The seeds of this variety was collected from Nadim Seed Store, Siddique Bazar, Dhaka.

6. Manuring and Fertilization

In the experimental plots total amount of cowdung (10 ton /ha) and Urea, TSP, MoP, gypsum as a source of nitrogen, phosphorus, potassium and sulphur were applied as par treatment requirement. Urea was applied in two splits, the first dose as basal application and another dose at 30 days after sowing. The recommended doses of fertilizer of carrot was given below

Table 1. The following doses of organic and inorganic fertilizers were applied in the experimental plots

Organic and Inorganic Fertilizer	Dose /ha	Dose for F_1 Treatment	Dose for F_2 Treatment	Dose for F_3 Treatment
Urea	200 kg	130.13 g	150.75 g	171 g
Triple super phosphate (TSP)	150 kg	40.5 g	57 g	73.13 g
Muriate of Potash (MP)	200 kg	75 g	87.38 g	99.75 g
Gypsum	220 kg	62.25 g	83.25 g	103.88 g

III. RESULT AND DISCUSSIONS

1. Effect of different levels of macronutrients

Significant differences were observed in the different parameters of plant due to different levels of macronutrients.The maximum plant height (55.40 cm) was measured at harvest from F_3 followed by F_2 treatment (Fig.1). The highest number of leaves (15.97) per plant of carrot at harvest was recorded from F_3 treatment (Fig.2). The treatment F_3 recorded the maximum fresh weight of leaves per plant of carrot (86.53 g), dry matter (%) of leaves (8.73 %), root length (19.71 cm), fresh weight of root per plant of carrot (174.74 g), root diameter (4.70 cm), core diameter of root (1.69 cm), dry matter (%) of roots (12.43 %), cracked root (9.53 %), rotten root (8.20 %), root yield per plot (6.83 kg) of carrot and highest root yield per hectare (28.47 t) of carrot were observed in F_3treatment (Table 2). However the highest brix percentage of carrot root (7.77 %), marketable root yield per plot (6.13 kg) and marketable root yield per hectare (25.56 t) of carrot were observed in F_2 treatment (Table 2).

The plant height increased with increasing fertilizer dose, possibly as a result of its beneficial influence on plant height in conjunction with other crucial components. [12].[13]who said that the number of leaves was recorded maximum with increasing levels of fertilizer doses.[14] who reported that the root length of radish increased with increased application of inorganic fertilizer.[15]claimed that greater macronutrient levels result in a higher percentage of carrot roots that crack. The cracking percentage is reduced by application of optimum dose of fertilizer in the soil. [16]reported that the application of NPK fertilizers at 140 kg, 40 kg, and 80 kg ha-1, respectively, produced the highest marketable yield.

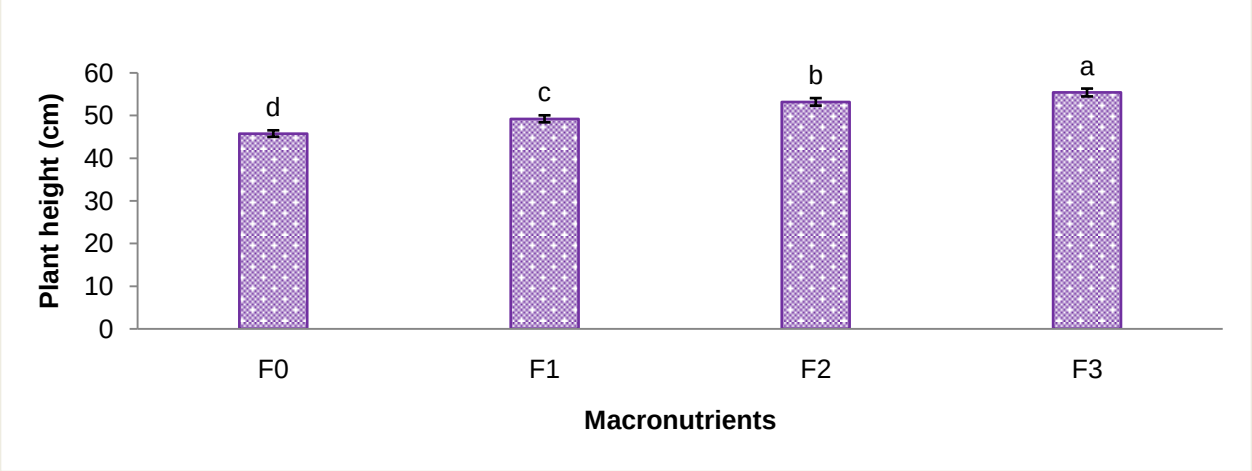

Fig. 1. Effect of macronutrients on plant height of carrot
Here, F_0:Control, F_1 : $N_{160}P_{50}K_{120}S_{30}$ kg ha^{-1}, F_2 : $N_{185}P_{70}K_{140}S_{40}$ kg ha^{-1} and F_3 : $N_{210}P_{90}K_{160}S_{50}$ kg ha^{-1}.

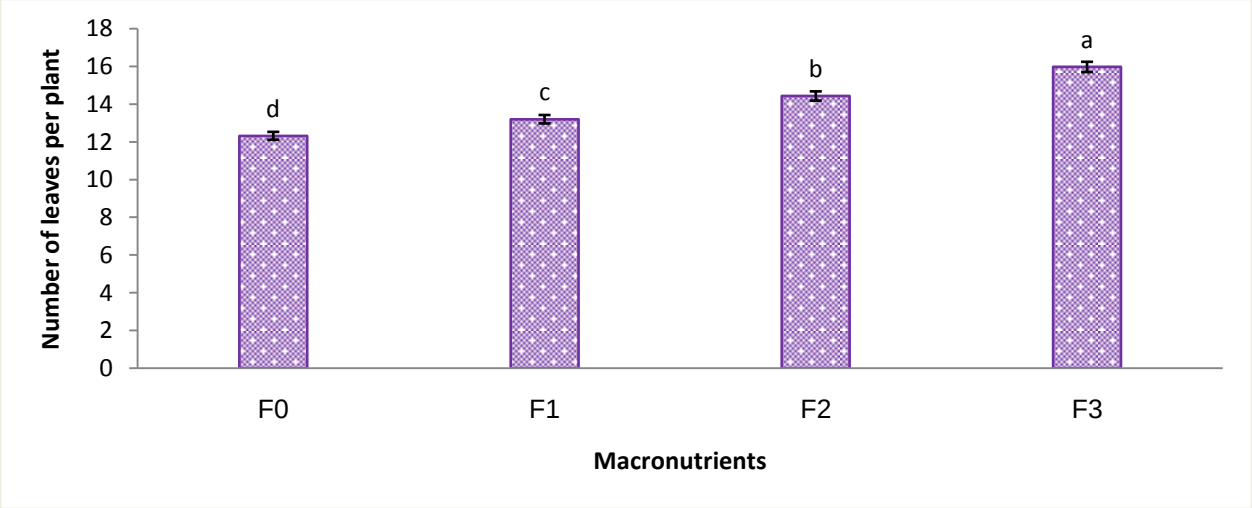

Fig. 2. Effect of macronutrients on number of leaves per plant of carrot
Here, F_0:Control, F_1 : $N_{160}P_{50}K_{120}S_{30}$ kg ha^{-1}, F_2 : $N_{185}P_{70}K_{140}S_{40}$ kg ha^{-1} and F_3 : $N_{210}P_{90}K_{160}S_{50}$ kg ha^{-1}.

2. Effect of harvesting time

Experimental data revealed that growth and yield of carrot significantly influenced due to harvesting time. Experimental result showed that the highest plant height (55.03 cm) was observed from H_3 treatment (Fig. 3). The highest number of leaves per plant (16.20) was observed from H_3 treatment (Fig. 4).The treatment H_3 recorded the highest fresh weight of leaves per plant of carrot (87.63 g), dry matter (%) of leaves (8.63 %), root length of carrot (20.18 cm), fresh weight of root (202.33 g), root diameter (4.68 cm), core diameter of carrot roots (1.94 cm), dry matter (%) of roots (12.24 %), cracked root (9.30 %), rotten root (6.75 %), root yield per plot (6.85 kg) and root yield per hectare (28.54 t) of carrot (Table 3). However the highest brix percentage of carrot root (7.20 %), marketable root yield per plot (6.10 kg) and marketable root yield per hectare (25.42 t) of carrot were observed in H_2 (100 days after sowing) treatment (Table 3).

It was discovered that throughout the early stages of growth, the plant's height increased quickly. The plant height was found to be decreased at the very end of harvest. This might be due to the senescence of the longer leaves at the later stages of plant growth. But [17]reported that plant height increased until

harvested at 135 days after sowing. [18]observed that the highest number of leaves per plant was found in last harvest (at 135th day) comparable to 1st harvest (75th day). [19]reported that the fresh weight of sugar beet leaves rose considerably by postponing harvesting dates from 180 to 210 days after sowing. [20]reported that the time of harvesting, which was inversely proportionate to the delay in planting date, had a substantial impact on total soluble solids, sucrose content, and sugar yields in sugar beet.

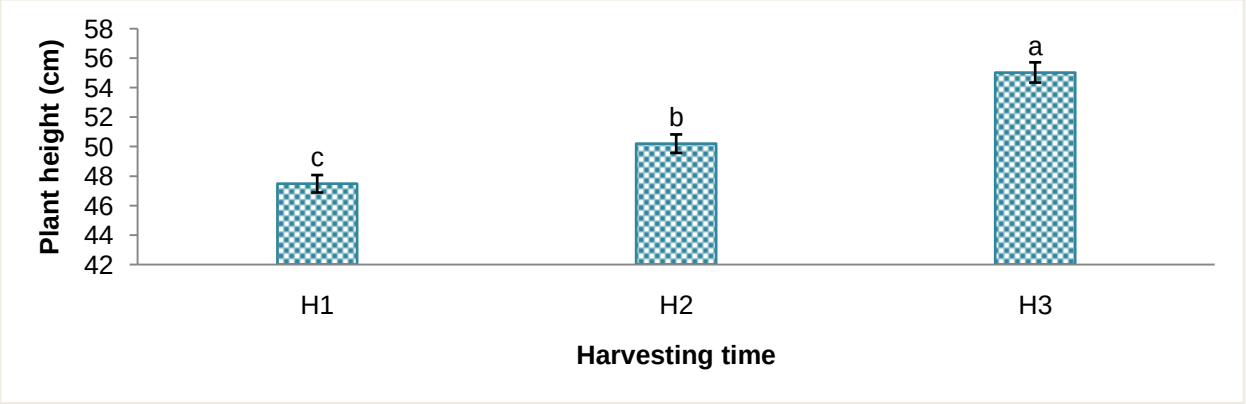

Fig. 3. Effect of different harvesting time on plant height of carrot
Here, H_1 : Harvest at 90 days after sowing, H_2 : Harvest at 100 days after sowing and H_3 : Harvest at 110 days after sowing.

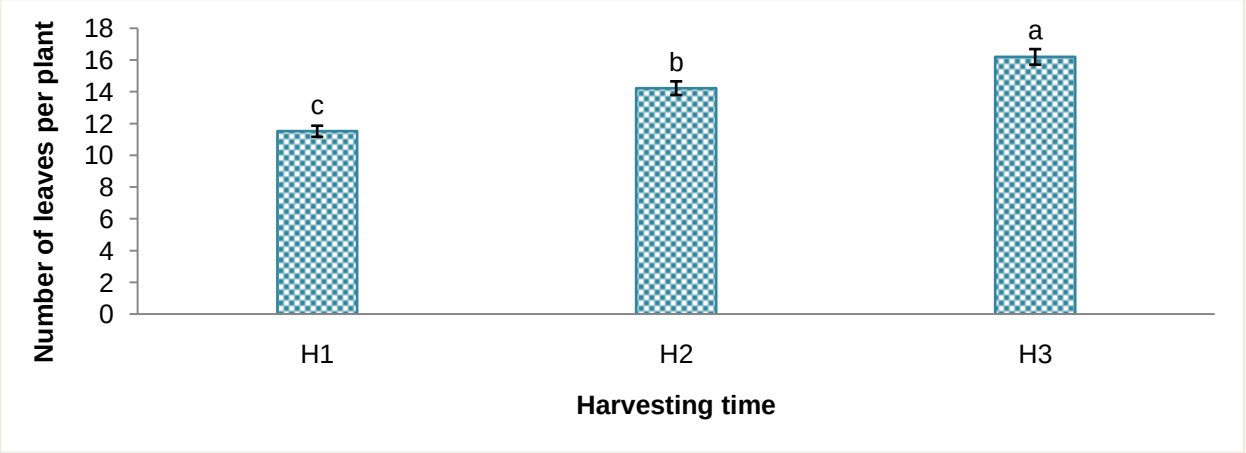

Fig. 4. Effect of different harvesting time on number of leaves per plant of carrot
Here, H_1 : Harvest at 90 days after sowing, H_2 : Harvest at 100 days after sowing and H_3 : Harvest at 110 days after sowing.

3. Combined effect of different levels of macronutrients and harvesting time
In case of combination, F_3H_3 treatment combination recorded the highest plant height (61.60 cm), number of leaves per plant (16.20), fresh weight of leaves per plant of carrot (93.30 g), dry matter (%) of leaves (9.60 %), root length (22.73 cm), fresh weight of root per plantof carrot (215.33 g), diameter of root (5.40 cm), core diameter of carrot roots (2.06 cm), dry matter content (14.00 %) of carrot roots (Table 4). However F_3H_3 treatment combination recorded the highest cracked root percentage of carrot root (11.00 %), rotten root percentage of carrot root (9.00 %), root yield per plot of carrot (7.10 kg) and root yield per hectare (29.58 t) of carrot (Table 5). However the highest brix percentage of carrot root (8.20 %), marketable root yield per plot of carrot (6.40 kg) and marketable root yield of carrots per hectare (26.67 t) were observed in the F_2H_2 treatment combination. While corresponding lowest value were found in F_0H_1 combination treatment (Table 5).

Table 2. Effect of macronutrients on fresh weight of leaves plant^{-1}, dry weight of leaves plant^{-1}, root length, fresh weight of root per plant, diameter of root, core diameter of root, dry matter (%) of roots, Brix^{0} percentage, cracked root percentage, Rotten root percentage, yield per plot, marketable yield per plot, yield per hectare and Marketable yield per hectare of carrot.

Treatments	Fresh weight of leaves plant^{-1} (g)	Dry weight of leaves plant^{-1} (g)	Root length (cm)	Fresh weight of root per plant (g)	Diameter of root (cm)	Core diameter of root (cm)	Dry matter (%) of roots	Brix^{0} (%)	Cracked root (%)	Rotten root (%)	Yield per plot (kg)	Marketable yield per plot (kg)	Yield per hectare (t)	Marketable yield per hectare (t)
F_0	75.50 c	7.07 c	14.67 d	145.10 d	3.73 c	1.43 d	10.17 c	5.87 d	4.97 d	2.97 d	6.07 d	5.43 c	25.28 d	22.64 d
F_1	81.32 b	8.17 b	15.73 c	152.20 c	4.15 b	1.50 c	10.50 bc	6.40 c	6.10 c	5.53 b	6.43 c	5.77 b	26.81 c	24.03 c
F_2	83.63 b	8.17 b	17.73 b	163.67 b	4.23 b	1.60 b	10.77 b	7.77 a	6.50 b	4.87 c	6.63 b	6.13 a	27.64 b	25.56 a
F_3	86.53 a	8.73 a	19.71 a	174.74 a	4.70 a	1.69 a	12.43 a	7.27 b	9.53 a	8.20 a	6.83 a	5.90 b	28.47 a	24.58 b
$LSD_{(0.05)}$	2.46	0.31	0.67	6.21	0.14	0.05	0.40	0.31	0.27	0.28	0.16	0.15	0.56	0.38
CV(%)	3.08	4.05	4.05	4.00	3.57	3.71	3.80	4.77	4.27	5.36	2.67	2.13	2.78	1.65

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability. Here, F_0:Control, F_1 : $N_{160}P_{50}K_{120}S_{30}$ kg ha^{-1}, F_2 : $N_{185}P_{70}K_{140}S_{40}$ kg ha^{-1}, F_3 : $N_{210}P_{90}K_{160}S_{50}$ kg ha^{-1}.

Table 3. Effect of harvesting time on fresh weight of leaves plant^{-1}, dry weight of leaves plant^{-1}, root length, fresh weight of root per plant, diameter of root, core diameter of root, dry matter (%) of roots, Brix^{0} percentage, cracked root percentage, Rotten root percentage, yield per plot, marketable yield per plot, yield per hectare and Marketable yield per hectare of carrot.

Treatments	Fresh weight of leaves plant^{-1} (g)	Dry weight of leaves plant^{-1} (g)	Root length (cm)	Fresh weight of root per plant (g)	Diameter of root (cm)	Core diameter of root (cm)	Dry matter (%) of roots	Brix^{0} (%)	Cracked root (%)	Rotten root (%)	Yield per plot (kg)	Marketable yield per plot (kg)	Yield per hectare (t)	Marketable yield per hectare (t)
F_0	75.50 c	7.07 c	14.67 d	145.10 d	3.73 c	1.43 d	10.17 c	5.87 d	4.97 d	2.97 d	6.07 d	5.43 c	25.28 d	22.64 d
F_1	81.32 b	8.17 b	15.73 c	152.20 c	4.15 b	1.50 c	10.50 bc	6.40 c	6.10 c	5.53 b	6.43 c	5.77 b	26.81 c	24.03 c
F_2	83.63 b	8.17 b	17.73 b	163.67 b	4.23 b	1.60 b	10.77 b	7.77 a	6.50 b	4.87 c	6.63 b	6.13 a	27.64 b	25.56 a
F_3	86.53 a	8.73 a	19.71 a	174.74 a	4.70 a	1.69 a	12.43 a	7.27 b	9.53 a	8.20 a	6.83 a	5.90 b	28.47 a	24.58 b
$LSD_{(0.05)}$	2.46	0.31	0.67	6.21	0.14	0.05	0.40	0.31	0.27	0.28	0.16	0.15	0.56	0.38
CV(%)	3.08	4.05	4.05	4.00	3.57	3.71	3.80	4.77	4.27	5.36	2.67	2.13	2.78	1.65

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability. Here, H_1 : Harvest at 90 days after sowing, H_2 : Harvest at 100 days after sowing and H_3 : Harvest at 110 days after sowing.

Table 4. Combined effect of macronutrients harvesting time on plant height, number of leaves per plant, fresh weight of leaves plant^{-1}, dry weight of leaves plant^{-1}, root length, fresh weight of root per plant, diameter of root, core diameter of root, dry matter (%) of rootsof carrot.

Treatments	Plant height (cm)	Number of leaves per plant	Fresh weight of leaves plant^{-1} (g)	Dry weight of leaves plant^{-1} (g)	Root length (cm)	Fresh weight of root per plant (g)	Diameter of root (cm)	Core diameter of root (cm)	Dry matter (%) of roots
F_0H_1	43.90 g	10.06 g	70.30 g	6.50 e	12.60 g	101.30 j	3.30 e	1.00 h	8.60 f
F_0H_2	45.30 g	12.30 de	75.60 f	7.00 e	13.60 g	142.00 fg	3.90 cd	1.40 e	10.60 cd
F_0H_3	48.10 ef	14.60 c	80.60 de	7.70 d	17.80 de	192.00 c	4.00 cd	1.90 b	11.30 bc
F_1H_1	46.10 fg	11.00 fg	74.67 f	7.60 d	13.10 g	113.30 i	3.80 d	1.20 g	9.60 e
F_1H_2	48.70 ef	13.30 d	82.30 d	8.30 bc	15.00 f	145.30 f	4.06 c	1.40 e	10.30 de
F_1H_3	52.90 c	15.30 bc	87.00 bc	8.60 b	19.10 c	198.00 bc	4.60 b	1.90 b	11.60 b
F_2H_1	49.80 de	12.00 ef	77.00 ef	7.60 d	15.20 f	125.00 h	3.90 cd	1.30 f	10.00 de
F_2H_2	52.30 cd	15.00 c	84.30 cd	8.30 bc	16.90 e	162.00 e	4.10 c	1.60 d	10.30 de
F_2H_3	57.50 b	16.30 b	89.60 ab	8.60 b	21.10 b	204.00 b	4.70 b	1.90 b	12.00 b
F_3H_1	50.10 de	13.00 de	82.30 d	8.00 cd	17.70 de	131.60 gh	4.10 c	1.30 f	11.30 bc
F_3H_2	54.50 c	16.30 b	84.00 cd	8.60 b	18.70 cd	177.30 d	4.60 b	1.70 c	12.00 b
F_3H_3	61.60 a	18.60 a	93.30 a	9.60 a	22.73 a	215.33 a	5.40 a	2.06 a	14.00 a
$LSD_{(0.05)}$	2.72	1.13	4.26	0.55	1.16	10.76	9.25	0.09	0.70
CV(%)	3.16	4.79	3.08	4.05	4.05	4.00	3.57	3.71	3.80

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability. Here, F_0:Control, F_1 : $N_{160}P_{50}K_{120}S_{30}$ kg ha^{-1}, F_2 : $N_{185}P_{70}K_{140}S_{40}$ kg ha^{-1}, F_3 : $N_{210}P_{90}K_{160}S_{50}$ kg ha^{-1}, H_1 : Harvest at 90 days after sowing, H_2 : Harvest at 100 days after sowing and H_3: Harvest at 110 days after sowing.

Table 5. Combined effect of macronutrients harvesting time on Brix^0 percentage, cracked root percentage, Rotten root percentage, yield per plot, marketable yield per plot, yield per hectare and Marketable yield per hectare of carrot.

Treatments	Brix^0 (%)	Cracked root (%)	Rotten root (%)	Yield per plot (kg)	Marketable yield per plot (kg)	Yield per hectare (t)	Marketable yield per hectare (t)
F_0H_1	5.30 f	3.00 g	1.30 f	5.60 g	23.33 g	4.90 e	20.42 g
F_0H_2	6.20 e	4.30 ef	3.60 e	6.20 ef	25.83 ef	5.90 bc	24.58 cd
F_0H_3	6.10 e	7.60 c	4.00 e	6.40 de	26.67 de	5.50 d	22.92 e

F_1H_1	6.20 e	4.00 f	4.00 e	6.10 f	25.42 f	5.30 d	22.08 f
F_1H_2	6.80 d	6.30 d	5.60 d	6.30 d-f	26.25 d-f	6.10 b	25.42 b
F_1H_3	6.20 e	8.00 c	7.00 c	6.90 ab	28.75 ab	5.90 bc	24.58 cd
F_2H_1	7.10 cd	4.30 ef	3.60 e	6.20 ef	25.83 ef	5.90 bc	24.58 cd
F_2H_2	8.20 a	4.60 e	4.00 e	6.70 bc	27.92 bc	6.40 a	26.67 a
F_2H_3	8.00 ab	10.60 a	7.00 c	7.00 a	29.17 a	6.10 b	25.42 b
F_3H_1	7.00 d	8.00 c	7.60 b	6.50 cd	27.08 cd	5.80 c	24.17 d
F_3H_2	7.60 bc	9.60 b	8.00 b	6.90 ab	28.75 ab	6.00 bc	25.00 bc
F_3H_3	7.20 cd	11.00 a	9.00 a	7.10 a	29.58 a	5.90 bc	24.58 cd
$LSD_{(0.05)}$	0.55	0.48	0.49	0.29	0.97	0.27	0.67
CV(%)	4.77	4.27	5.36	2.67	2.13	2.78	1.65

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability. Here, F_0:Control, F_1 : $N_{160}P_{50}K_{120}S_{30}$ kg ha^{-1}, F_2 : $N_{185}P_{70}K_{140}S_{40}$ kg ha^{-1}, F_3 : $N_{210}P_{90}K_{160}S_{50}$ kg ha^{-1}, H_1 : Harvest at 90 days after sowing, H_2 : Harvest at 100 days after sowing and H_3: Harvest at 110 days after sowing.

IV. CONCLUSION

On the basis of present study, it is concluded that, among different levels of macronutrients application the highest brix percentage of carrot root (7.77 %), marketable root yield per plot (6.13 kg) and marketable root yield per hectare (25.56 t) of carrot were observed in F_2 treatment ($N_{185}P_{70}K_{140}S_{40}$ kg ha^{-1}). However in case of different time of harvesting, the highest brix percentage of carrot root (7.20 %), marketable root yield per plot (6.10 kg) and marketable root yield per hectare (25.42 t) of carrot were observed in H_2 (harvesting at 100 days after sowing) treatment. Therefore, it was suggested that cultivation of carrot through application of fertilizer @ $N_{185}P_{70}K_{140}S_{40}$ kg ha^{-1} (F_2) and harvesting at 100 days after sowing (H_2)and their combination (F_2H_2) seems promising for getting highest marketable yield and quality root of carrot.

REFERENCE

1. Bussmann, R., Batsatsashvili, K., Kikvidze, Z. (2020). Daucus carota L. Apiaceae. In book: Ethnobotany of the Mountain Regions of Central Asia and Altai., pp.259-266.

2. Jahan, I., Hossain, M.M. and Karim, M.R. (2019). Effect of salinity stress on plant growth and root yield of carrot. *Prog. Agric*.,30(3): 263-274.

3. Surbhi, S., Verma, R.C., Deepak, R., Jain, H.K. and Yadav, K.K. (2018). A review: Food, chemical composition and utilization of carrot (Daucus carota L.) pomace*. Int. J. Che. Stud*., 6(3): 2921-2926.

4. Ciza, A., Silungwe, F. and Kihupi, N.. (2022). Carrot Productivity under various levels of irrigation and fertilization. *Asian Res. J. Agric*., 1: 56-68.

5. Ahmad, T., Mazhar, M.S., Ali, H., Batool, A. and Ahmad, W. (2016). Efficacy of nutrient management on carrot productivity and quality: A review. *J. Environ. Agric. Sci.,* **7**: 62-67.

6. Goulding, K., Jarvis, S. and Whitmore, A. (2008). Optimizing nutrient management for farm systems. Philos. Trans. Roy. Soc. London. *Ser. Biol. Sci.* 363(1491): 667-680.

7. Del, B., Malajczuk, N., Xu, D. and Grove, T.S. (2016). Nutrient disorders in plantation eucalypts. 2nd edition. Canberra, ACIAR Monograph No. 74. pp.180-188.

8. Lovio-Fragoso, J.P., de Jesús-Campos, D., López-Elías, J.A., Medina-Juárez, L. Á., Fimbres-Olivarría, D. and Hayano-Kanashiro, C. (2021). Biochemical and molecular aspects of phosphorus limitation in diatoms and their relationship with biomolecule accumulation. *Bio.,* 10(7): 565.

9. Narayana, O.P., Kumara, P., Yadavb, B., Duab, M., and Johri, A.K. (2020). Sulfur nutrition and its role in plant growth and development. Plant Sig. Beha*.,* 1: 1-12.

10. Mohanta, H.C., Hossain, M.M., Islam, , M.S. and Saha, S.R. (2017). Effect of harvesting time on yield and quality of carrot. Ann. Bangladesh. Agric., 21: 79-87.

11. Fritz, D. and Habben, J. (1977). Influence of harvesting date on the quality of different Carrot cultivars. Gartenbauwissenschaft.,42(4): 185-190.

12. Nargave, K., Sharma, R.K., Kushwah, S.S. and Singh, O.P. (2018). Influence of varieties and fertility levels on growth, yield and quality of radish (*Raphanus sativus* L.) under malwa region of Madhya Pradesh. *Int. J. Agric. Sci*., 10(5): 5371-5374.

13. Verma, U.K., Kumar, R., Kumar, A., Kumar, S. and Prajapati, M.K. (2017). Integrated effect of organic manures and inorganic fertilizers on growth, yield and yield attributes of Radish CV. Kalyanpursafed. *J. Pharma. Phyto.,*6(6): 826-828.

14. Muhmood, A., Abdul, M., Abid, N., Javid, S., Shah, S.S.H. and Shah, A.H. (2015). Nutrients Uptake and the yield of okra and carrot in response to bioslurry and inorganic n fertilizers. *Int. J. Plant Soil Sci*.,7(5): 297-305.

15. Patwary, N.H., Rahman, M.A., Mondal, M.F., Ahmed, S and Shahidullah, S.M .(2015). Effects of cultivation method and fertilizer management on the growth and yield of carrot. *Int. J. Nat. Soc. Sci*.,2(1): 72-78.

16. Hossain, M. (2005). Effect of NPK fertilizers on growth and yield of carrot. M.Sc. Thesis,Department of Horticulture, BangladeshAgricultural University, Mymensingh., pp. 31-57.

17. Rashid, M.M. and Sarkar, M.A. (1986). Effect of date of planting and duration of growing period on the yield of carrot. *Bangladesh Hort*., 14(2): 28-32.

18. Kabir, A., Ali, A., Waliullah, M. H., Rahman, M. M. M. and Rashid, A. (2013). Effect of spacing and sowing time on growth and yield of carrot (*Daucus carota* L.). *Int. J. Sust. Agric*., 5(1): 29-36.

19. Shalaby, N.M.E., Osman, A.M.H. and EL-Labbody, A.H.S.A. (2011). Evaluation of some sugar beet varieties as affected by harvesting dates under newly reclaimed soil. Egypt. *J. Agric. Res.,* 89(2): 605.

20. Terouzi, W., Otmani, M., Abdelkhalek, O., Salmaoui, S. and Mbarki, M. (2020).Effect of sugar beet harvest date on its technological quality parameters by exploratory analysis.*J. Food Qual*., 1: 1-8.

21. Sarkar, M. I., Khatun, K., Mostarin, T., Alam, M. M., Siddika, M. J., Saddam, M. A. H., Banik, N. and Samad, M. A. (2022). Effect of Macronutrients Combination with Plant Spacing on the Growth and Yield of Black Cumin (*Nigella sativa* L.). *European Journal of Nutrition & Food Safety*. 14(8), pp. 15–27. doi: 10.9734/ejnfs/2022/v14i830517.