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Effect of Nutrients on the Yield of Carrot

A.S.M.M. Uddin, [1]A.K.M.S. Hoque,
[2]M. Shahiduzzaman, P.C. Sarker, M.M.A. Patwary and [1]S.M.A. Shiblee
Regional Agricultural Research Station, Bangladesh Agricultural Research Institute,
Hathazari, Chittagong, Bangladesh
[1]Bangladesh Agricultural Research Institute, Joydebpur, Gazipur, Bangladesh
[2]Regional Agricultural Research Station, Bangladesh agricultural Research Institute, Jamalpur, Bangladesh

Abstract : In the present study, a 2 year field experiment was conducted at the Regional Agricultural Research Station, BARI, Hathazari, Bangladesh in the year 2000-2001 and 2001-2002 on the fertilizer requirement for carrot as influenced by different levels of NPKS and Cowdung. Six combinations of NPKS and Cowdung were used in this investigation. Different combinations of NPKS and Cowdung showed significance influence on yield of carrot. The combination of fertilizer 120-45-120-30 kg ha^{-1} of NPKS and 5 t ha^{-1} cowdung produced the highest root yield of 27.22 t ha^{-1} which was 303% higher over control treatment. The highest marginal rate of return (7633%) also obtained from the same treatment.

Key words: Carrot, nutrient management

INTRODUCTION

Carrot (*Daucus carrota* L.) is a cool season crop. It is grown all over the world in spring, summer and autumn in temperate countries and during winter under tropical and subtropical climate. The world wide consumption of carrot has increased over the years and it is one of the most ancient and valuable vegetables all over the world. Its roots are valued as food mainly for its high carotene content. Additionally it is an excellent source of iron and contains good qualities of vitamin B and C and rich in sugar[1]. Further it has some important medicinal values[2,3]. Since, carrot in usually grown on light soils of medium to low fertility, it responds well to the application of manure and fertilizers[4-7]. Information regarding fertilizer requirement of carrot is very scarce in Bangladesh. Hence, the present experiment was undertaken to study the yield response of carrot to different fertilizer nutrients.

MATERIALS AND METHODS

The experiment was conducted in Grey Piedmont soils of Regional Agricultural Research Station (RARS), BARI, Hathazari, Chittagong, Bangladesh during Rabi 2000-2001 and 2001-2002. Before setting the experiment the chemical properties of soil were analyzed. The soil analysis result were shown in Table 1. The soil status was nitrogen- very low, phosphorus- low, potassium- low and sulphur-medium[8]. Six fertilizer treatments were tested. The treatments were T_1 (120, 45, 120, 30 kg ha^{-1} NPKS and 5 t ha^{-1} cowdung), T_2 (120, 45, 90, 30 kg ha^{-1} NPKS and 5 t ha^{-1} cowdung), T_3 (120, 45, 90, 30 kg NPKS and 0 t ha^{-1} cowdung), T_4 (90, 30, 60, 20 kg NPKS and 5 t ha^{-1} cowdung), T_5 (60, 15, 30, 10 kg ha^{-1} NPKS and 5 t ha^{-1} cowdung) and T_6 (No fertilizer and manure i.e. control) were applied in the form of Urea, Triple super phosphate (TSP), Muriate of potash (MP) and Gypsum, respectively. All PKS, cowdung and half of N were applied during final land preparation and the remaining N was applied 30 days after sowing (DAS). The experiment was laid out in a Randomised Complete Block Design with

Table 1: Initial soil nutrient status of experimental plot of RARS, Hathazari, Chittagong

Soil properties	Soil test value	Critical level
pH	5.0	-
OM (%)	1.6	-
Ca (meq/100 g)	4.1	2.0
Mg (meq/ 100 g)	1.2	0.8
K (meq/ 100 g)	0.1	0.2
Total N (%)	0.08	0.12
P (μg g^{-1})	12.0	12.0
S (μg g^{-1})	18.0	12.0
B (μg g^{-1})	0.11	0.2
Fe (μg g^{-1})	74.0	10.0
Mn (μg g^{-1})	42.0	5.0
Zn (μg g^{-1})	3.5	2.0

Corresponding Author: Parimal Chandra Sarker, Scientific Officer, Regional Agricultural Research Station, Bangladesh Agricultural Research Institute, Hathazari, Chittagong-4330, Bangladesh
E-mail: ies@globalctg.net

four replications. The unit plot size was 3x3 m with a spacing of 30 cm apart from row to row and 15 cm from plant to plant. The variety of carrot was SB–Kuruda. The seeds were sown on the 8th December in both the years. Irrigation, plant protection measures and other intercultural operations were done as and when necessary. The yield attributes were collected from randomly selected 10 plants of each plot and the root yield data were collected from whole plot basis. Carrot was harvested in the last week of April in both the years. The data on yield and yield components were analysed statistically and differences among treatment means were adjusted by Duncan's Multiple Range Test[8]. Cost and return analysis including marginal rate of return (MRR) was ascertained to select the suitable treatment. The marginal rate of return was calculated by dividing the marginal gross margin by the marginal variable cost, expressed as a percentage[10,11]. Pooled yield data were used to determine the partial budget and marginal analysis of undominated fertilizer responses by the methods of Perrin *et al.*[12]. Gross margin and cost of fertilizer were calculated considering the prevailing market price. Price of inputs and outputs were; Seed-3000 Tk kg^{-1}, Urea– 6 Tk kg^{-1}, TSP-14 Tk kg^{-1}, MP-10 Tk kg^{-1}, Cowdung 500 Tk kg^{-1} and price of carrot was 10 Tk kg^{-1}. The temperature, rainfall and humidity during the experimental period at Hathazari site were shown in Table 2.

RESULTS AND DISCUSSION

Application of fertilizer had no significant influence on plant height in both the years. The root yield and yield contributing characters viz., root length, root diameter and individual root weight were found to be significantly influenced by the treatments over the control in both the years (Table 3) as the soil was NPK deficient. The results are in agreement with the findings of Saparov[13] and Balooch *et al.*[14]. The highest root length (14.66 and 16.00 cm) were observed from the treatment T_1 (120, 45, 120, 30 kg ha^{-1} of NPKS with 5 ton ha^{-1} cowdung) followed by T_2 (13.42 and 15.13 cm), T_3 (13.00 and 14.80 cm) and the lowest root length (6.60 and 6.31 cm) were recorded from the treatment T_6 i.e., control in the year 2000-2001 and 2001-2002, respectively. The highest root diameter (3.49 and 3.90 cm) were also noticed in the treatment T_1 in both the years and it was at par with the treatment T_2 (3.46 cm) and T_3 (3.32 cm) in 2000-2001 and T_2 (3.72 cm) in 2001-2002. The lowest root diameter (2.29 and 3.02 cm) were also recorded from the treatment T_6 i.e., control in both the years. In relation to individual root weight of carrot, it was noticed that the highest individual root weight (96.35 and 104.50 g) were recorded from the treatment T_1 which was statistically similar to treatment T_2 (88.51 g) in 2000-2001 and treatment T_2 (95.75 g) and T_3 (87.75 g) in 2001-2002. The treatment T_6 showed the lowest (41.26 and 59.00 g) individual root weight in both

Table 2: Weather data of RARS, Hathazari, Chittagong during 2000-2001 and 2001-2002

	Temperature (°C)							
	Maximum		Minimum		Relative humidity (%)		Rainfall (mm)	
Months	2000-2001	2001-2002	2000-2001	2001-2002	2000-2001	2001-2002	2000-2001	2001-2002
November	27.50	29.90	21.50	22.70	90.96	92.00	26.00	54.00
December	26.80	28.80	14.80	17.50	83.80	92.90	-	-
January	26.30	29.60	12.60	22.60	89.37	92.90	-	-
February	26.23	28.30	14.70	15.20	85.90	91.90	35.00	50.00
March	31.30	30.30	19.30	19.90	90.10	91.70	-	50.00
April	33.26	30.10	24.15	024.8	87.70	91.60	51.00	143.00

Table 3: Effect of different fertilizer combination levels on the yield and yield components of carrot during 2000-2001 and 2001-2002

	Plant height (cm)		Root length (cm)		Root diameter (cm)		Individual root weight (g)		Root yield (tha^{-1})	
Treatments	2000-2001	2001-2002	2000-2001	2001-2002	2000-2001	2001-2002	2000-2001	2001-2002	2000-2001	2001-2002
T_1	56.02	58.13	14.66a	16.00a	3.49a	3.90a	96.35a	104.50a	24.50a	29.93a
T_2	56.64	58.60	13.42b	15.13b	3.46a	3.72ab	88.51a	95.75ab	22.15a	23.00b
T_3	55.79	57.45	13.00bc	14.80b	3.32ab	3.54b	77.26b	87.75ab	17.82b	20.82c
T_4	54.28	55.30	12.39cd	14.73b	2.99bc	3.43bc	70.20bc	81.25b	16.35bc	17.91d
T_5	52.50	54.73	11.95d	13.30c	2.77c	3.39c	62.63c	78.75b	14.21c	15.62e
T_6	50.92	50.25	10.62e	11.60d	2.29d	3.02c	41.26d	59.00c	8.80d	9.14f
CV%	12.04	9.39	6.60	6.31	4.96	6.33	7.90	14.92	5.20	6.45

Means separation by a common letter(s) are not significantly different at the 5% level by DMRT.

The treatments were:

T_1 = 120- 45- 120- 30 kg ha^{-1} NPKS and 5 t ha^{-1} cowdung

T_2 = 120- 45- 90- 30 kg ha^{-1} NPKS and 5 t ha^{-1} cowdung

T_3 = 120- 45- 90-30 kg NPKS and 0 t ha^{-1} cowdung

T_4 = 90-30- 60- 20 kg NPKS and 5 t ha^{-1} cowdung

T_5 = 60-15-30-10 kg ha^{-1} NPKS and 5 t ha^{-1} cowdung and

T_6 = No fertilizer and manure (I. e., control)

Table 4: Average root yield, percent increase over control and cost and return analysis of carrot as affected by different fertilizer combination levels

Treatments	Average root yield (t ha^{-1})	Per cent increase over control	Gross return (Tk ha^{-1})	Total variable cost (Tk ha^{-1})	Gross margin (Tk ha^{-1})	Marginal gross margin (Tk ha^{-1})	Marginal variable cost (Tk ha^{-1})	Marginal rate of return (%)
T_1	27.22	303.45	272200	10163	262037	172337	10163	7633
T_2	22.58	251.72	225800	9563	216237	126537	9563	1204
T_3	19.32	215.38	193200	7063	186137	96437	7063	2159
T_4	17.13	190.97	171300	7339	163961	74261	7339	-
T_5	14.92	166.33	149200	5115	144085	54385	5115	1063
T_6	8.97	-	89700	0	89700	-	0	-

the years, respectively. Regarding root yield, it was observed that the highest root yield (24.50 and 29.93 t ha^{-1}) were recorded from the treatment T_1 which was statistically similar with the treatment T_2 (22.15 t ha^{-1}) in 2000–2001 but the lowest root yield (8.80 and 9.14 t ha^{-1}) were recorded from the treatment T_6 i.e., in the control as usual in both the years, respectively. From the above discussed results, it was found that in all the parameters viz., root length, root diameter, individual root weight and finally the root yield were higher in 2001-2002 in comparison to the year 2000- 2001 in all the treatments may be due to higher rainfall during the growth period (Table 2). The parameters were also showed a decreasing trend from the treatment T_1 to T_6 in both the years (Table 3). Regarding the average root yield of both the years it was found that the highest root yield was recorded from the treatment T_1 (27.22 t ha^{-1}) which was followed by 22.58, 19.32 and 17.13 t ha^{-1} in the treatment T_2, T_3 and T_4, respectively and it was the lowest (8.97 t ha^{-1}) in the control treatment i.e., T_6 as usual (Table 4). The treatment T_1 contained the highest amount of fertilizer especially K (120 kg ha^{-1}) which might be resulted the longest root, the widest root diameter, maximum individual root weight and finally the maximum root yield. In relation to per cent increase over control, treatment T_1 and T_2 resulted 303 and 251% higher root yield. Economics analysis revealed that the highest marginal rate of return (MRR) was obtained from the treatment T_1 (7633%) which was followed by 2159% from the treatment T_3 and it was the lowest (1063%) in the treatment T_5 (Table 4). Though carrot yield was higher in T_2 in comparison to T_3 yet marginal rate of return was obtained higher in T_3 due to lower fertilizer cost.

From the study it is concluded that fertilizer dose 120-45-120-30 kg ha^{-1} of NPKS along with 5 t cowdung ha^{-1} may be applied for the production of carrot considering higher yield and marginal rate of return.

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