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Effect of Nitrogen Levels on Yield and Yield Contributing Characters of Three Varieties of Carrot

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Abstract: The study was carried out on the effects of different level of nitrogen on yield and yield contributing characters of three varieties of carrot. Two different factors were considered in the study. They were A. nitrogen level: 0, 50, 100 and 150 kg N ha⁻¹ and B. three variety: Sufola, SB Kuroda and New Kuroda. The experiment comprised twelve treatments combination. The 2 factor experiment was laid out in randomized complete block design with three replications. The size of a unit plot was 1.5×1.0 m. The crop was fertilized as per treatments of the experiment. Seeds of three carrot varieties were sown on 15, October 2003 with a spacing 10×20 cm and harvesting was down on 25 January, 2004. Data were collected from 5 randomly selected plant of each plot at harvest. The collected data were statistically analyzed. Nitrogen level showed significant effects on growth and yield of carrots. On the other hand, maximum number of leaves, plant height, root length, root diameter, fresh and dry weight of shoot, fresh and dry weight of root and root yield were obtained by the 150 kg N ha⁻¹ applied, the variety SB Kuroda showed the best response in all parameters except leaves per plant, plant height and root length. The results of the study revealed that number of leaves and plant height were significantly influenced by different nitrogen nutrients. The highest number of leaves per plant (9.59) was produced by the treatment 150 kg N ha⁻¹ and the variety Sufola produced maximum number of leaves when applied 150 kg N ha⁻¹ and the lowest number of leaves in control. The tallest plant (28.95 cm) was produced by 150 kg N ha⁻¹ and the lowest plant height in control. The variety Sufola fertilized with 50 kg N ha⁻¹ gave the highest plant height (29.33 cm). Fresh and dry weight of shoot were significantly influenced by nitrogen nutrition. When fertilized with 150 kg N ha⁻¹ the crop produced the highest fresh weight, whereas percent of dry matter higher. Significantly different results were found in case of root length and diameter by nitrogen application. The highest root length and diameter was recorded when applied 150 kg N ha⁻¹. The variety SB Kuroda fertilized with 150 kg N ha⁻¹ and 100 kg N ha⁻¹ produced the highest root length and diameter. The fresh and dry weight of root were also significant influenced by nitrogen dose and variety. 150 kg N ha⁻¹ fertilizing produced the highest fresh and dry weight of root and the variety SB Kuroda gave the best result in fresh and dry weight of root. There were no significant variation among three varieties in respect of leaves per plant, plant height, shoot fresh and dry weight, root length and root diameter. The root yield was significantly influenced by applied nitrogen nutrition. The highest root yield (27.82 t ha⁻¹) was obtained from treatment 150 kg N ha⁻¹ and the lowest yield (18.04 t ha⁻¹) was found when no application of nitrogen. The variety SB Kuroda gave the highest yield of 26.03 t ha⁻¹ while the lowest yield of 19.00 t ha⁻¹ by variety Sufola. The combined effect of nitrogen and variety performed significantly in respect of all parameters. On the other hand, application of nitrogen 150 Kg ha⁻¹ and three varieties showed good response in respect of yield and yield contributing characters. When applied 150 Kg N ha⁻¹, SB Kuroda was the best in all parameters except leaf number, plant height, shoot fresh and dry weight. The highest yield of 31.06 t ha⁻¹ by SB Kuroda while the lowest yield of 14.57 t ha⁻¹ by the variety Sufola in control plot.

Key words: Carrot, *Daucus carota*, variety, yield, nitrogen level

INTRODUCTION

Carrot (*Daucus carota* L.) belongs to the family Apiaceae (Previously Umbelliferae). Its root is valued as food mainly for its high carotene content. INFS (1992)

reported the nutritive content of the carrot per 100 g edible portion as: Water (85%), energy (57 calories), protein (1.2 g), calcium (27 mg), vitamin A (10520 I.U), vitamin C (6 mg), thiamin (0.04 mg), riboflavin (0.05 mg), total mineral (0.9 g). It is well known that smoking is

hazardous to health, particularly by increasing the risk of cancer. But recent studies in medical science reported that smoker who consumes carrots daily have little risk of cancer (Anonymous, 1994). Carrot is an important vegetable for its high nutritive values and possible diversified use in making different palatable dishes and long storage life. Moreover, it has some important medicinal values (Bose and Som, 1990). Carrot roots play an important role to protect the blindness in children providing vitamin A.) The popularity of carrot is increasing day by day in Bangladesh. But large scale production of carrot has not yet been started to meet up its demand. It can be eaten either raw or in processed forms. It is grown in spring, summer and autumn in temperate countries and during winter in tropical and sub-tropical countries (Bose and Som, 1990). Carrot is grown successfully in Bangladesh during the Rabi season and mid November to early December is the best sowing time for its satisfactory yield (Rashid, 1999). In Bangladesh, the production statistics of carrot is not available. Rashid (1993) mentioned an average yield of 25 t ha⁻¹ of carrot. The area under carrot cultivation was 899 thousand hectares with total production of 19374 thousand tones in the world (FAO, 2000). This production is relatively low compared to other carrot producing countries, like, Switzerland, Denmark, UK, Sweden, Austria and Israel, where the average per hectare yields are reported to be 40.88, 42.67, 51.88, 54.35, 56.7 and 64.2 tones, respectively (FAO, 2000). The growth and yield of carrot largely depend on the soil, climatic condition and different production practices. Both manures and fertilizers have a potential role on growth and development of carrot. The present study was undertaken with the aim of investigating the effects of different doses of nitrogen fertilizer to increase the yield and yield contributing characters of three varieties of carrot. It is hoped that the information gathered from the results of the present experiment would be helpful for the grower to increase the production and quality of carrot by applying judicious amount of nitrogen fertilizer to the soils.

MATERIALS AND METHODS

The field experiment was conducted at the Horticulture Farm of Narikelbaria Campus, Rajshahi University, Bangladesh during October, 2003 to April, 2004 and the laboratory work was done both at the Horticulture laboratory and the SRDI, Rajshahi Laboratory. The soil sample of experimental field was analyzed following ASI method (Hunter, 1984). The soil was silty clay loam in texture with pH 8.2, organic matter 1.12%, total N 0.06, Ca 8.6 me, Mg 6.2 me, K 1.05 me, P 7.7 ppm, S 9.5, Zn 0.55 and B 0.35 ppm. The soil was medium

fertile and very low content of N. Two different factors were considered in the study. They were (A) Nitrogen level: 0, 50, 100, 150 kg ha⁻¹. (B) Variety: Sufola (BRAC), SB Kuroda (Japan) and New Kuroda (Japan). The standard dose of cowdung, P and K was followed by the Fertilizer Recommendation Guide (BARC, 1997). The 2 factorial experiments were laid out following a Randomized Complete Block Design with three replications. The land was ploughed and cross ploughed several times by a power tiller to obtain a good tilth. The whole amount of cowdung and Triple Super phosphate, Muriate of Potash and one-third of the whole amount of urea were applied two days before seed sowing. The rest of urea (2/3) was applied in tow equal splits in ring method at 30 and 60 days after sowing. The whole experimental area 15.0×8.5 m² which was divided into 3 blocks, each was subdivided into 12 plots and hence there were in total 36 unit plots. Five shallow furrows per plot at a distance of 20 cm with 1.5 cm depth were made in each plot. Seeds mixed with sand were sown in lines continuously by hand and covered with loose soil. Initially light irrigation was done with watering can. Seventy five plants/plot were allowed to grow ultimately. Plant spacing of 10 cm was adjusted by thinning at two stage, 20 and 30 days after sowing. Weeding was done as and when necessary. The field was irrigated by flood method. Savin 85 WP at the rate of 2 kg ha⁻¹ was spread around each unit plot as precautionary measures against ants and worms infestation. Precautionary measures against Fusarium rot were taken by spraying Dithane M-45 at the rate of 2 g L⁻¹ water. Harvest was done when most of the roots of carrot showed the sign of maturity i.e., after 100 days of sowing. The data pertaining to growth and yield (e.g., no. of leaves, plant height, length and diameter of root, fresh and dry weight of root and shoot, yield of root) characteristics were recorded at harvest. Diameter of roots was measured by slide calipers. The data for the characters under study were statistically analyzed and differences among treatment means were adjusted by Least Significant Difference test (LSD) (Gomez and Gomez, 1994).

RESULTS AND DISCUSSION

Number of leaves: The highest number of leaves at final harvest was obtained from 150 kg N ha⁻¹ and lowest from control (Table 1). Number of leaves increased gradually during the early stage of growth, rapidly between 60-80 days and later the plants produced small number of leaves. Skrbic (1987) noticed that nitrogen fertilization had significant effect on the dynamics of the increase in the number of leaves in carrot. The difference in number of leaves per plant as affected by nitrogen level.

Plant height: The nitrogen element individually showed significant effects on plant height of carrot at harvest. The tallest plant (28.04 cm) was recorded in the variety New Kuroda and lowest was recorded from the variety SB Kuroda. On the other hand the tallest plant height (28.95 cm) was recorded when apply 150 kg N ha⁻¹ and the lowest plant height (24.39 cm) was recorded with control (Table 1). Patil and Gill (1981) found that nitrogen and phosphorus application significantly increased height of tops in carrot. In the combined effect the plant height was significant and the highest value was recorded from variety Sufola when apply the 150 kg N ha⁻¹ in soil and lowest plant height was (23.33 cm) recorded without application of nitrogen.

Fresh weight of shoot: The fresh weight of shoot per plant was significantly influenced by different level of nitrogen on three variety of carrot. The maximum fresh weight of shoot per plant was recorded by the apply 150 kg N ha⁻¹. The variety Sufola produced the maximum fresh shoot weight per plant (Table 1).

Dry weight of shoot: Significant effect of nitrogen level was found on dry shoot weight per plant (Table 1). But there was no significant difference among the three varieties in this regard (Table 2). Considering the nitrogen level, 150 kg N ha⁻¹ gave the highest dry matter per plant (2.95 g). Although there was no significant variation on varietal aspect, SB Kuroda showed greater weight compared to New Kuroda and Sufola. In respect of combined effect, the variety New Kuroda was the best result when apply 150 kg N ha⁻¹ in the soil and lowest was found from control. Ali (1994) reported nitrogen and potassium in combination had no significant influence on individual shoot dry weight in carrot.

Root length: The length of root increased at different level of nitrogen application. The highest root was obtained from 150 kg N ha⁻¹ (Table 1) and the lowest root length obtained from control. There was no significant effect come form variety, but the combined effect significant. The variety SB Kuroda gave the highest root length (14.33cm) when apply 150 kg N ha⁻¹ and the lowest was obtained from control. The results are in agreement with findings of Saparov (1992) and Balooch *et al.* (1993) Sarker (1989) noted that the application of nitrogen significantly influence on the root length, root weight plant⁻¹ and had no significant effect on root diameter.

Root diameter: Root diameter exhibited significant variation with nitrogen level (Table 1). The biggest root diameter (3.70 cm) resulted from 150 Kg N ha⁻¹ which was significantly greater then those of the remaining dose of nitrogen. These results were in agreement with Parraga

et al. (1995). They reported that application of organic matter with NPK increased the diameter of root per plant. In general the treatments having produced taller plant height and higher number of leaves per plant had higher root diameter. It might be due to increased photosynthesis in those treatments which resulted in higher food production and storage of produced food in storage roots. The highest root diameter was obtained from SB Kuroda variety (Table 2). The combined effect of nitrogen and variety were significant. The highest root diameter was obtained from variety SB Kuroda when apply 150 Kg N ha⁻¹.

Fresh weight of root: There was significant effect of applied nitrogen dose on fresh weight of individual root. The maximum fresh weight of root per plant was resulted from the nitrogen 150 kg ha⁻¹ was applied. Inorganic fertilizer supplied readily available nutrients that helped in maximum fresh weight of root per plant. The variety SB Kuroda gave the highest root fresh weight per plant and significant with other variety. In the combined effect, when apply 150 kg N ha⁻¹, SB Kuroda gave the highest performance from the other variety Sufola and New Kuroda. Otani (1974) reported that fresh weight of root increased with the nitrogen supply. Such result gives an impression that nitrogen played a significant positive role on fresh weight of root.

Dry weight of root: The variation in root dry weight plant⁻¹ due to application of different nitrogen level and variety were statistically significant (Table 1 and 2). The highest dry matter was found from 150 kg N ha⁻¹ applying and the highest dry matter was produced by the variety SB Kuroda. The lowest dry matter of root was obtained from the control. In the combined effect, the variety SB Kuroda gave the maximum dry matter per plant when the 150 kg N ha⁻¹ apply. Best result from this combination was possibly due to more sufficient nutrient.

Root yield: The highest yield (27.82 t ha⁻¹) was obtained from 150 kg N ha⁻¹ applying which was significantly different from all other nitrogen level. The increase in yield of carrot root might be attributed to higher individual root weight, higher number of leaves per plant, higher dry matter content of root. Burleson (1957) reported that carrot had strong response to nitrogen. Polach (1982) reported that nitrogen at 180 kg ha⁻¹ gave the best yield and quality in carrots, which is in agreement with the present results. Sarker (1991) mentioned that maximum yield 35.9 t ha⁻¹ was obtained when NPK was applied at the ratio of 120:120:60 kg ha⁻¹.

In respect of variety SB Kuroda was the best result. Uddin *et al.* (2004) also found that combination of fertilizer 120-45-120-30 kg ha⁻¹ of NPKS and 5 t ha⁻¹ cowdung

Table 1: Effect of different levels of nitrogen on yield and yield contributing characters of carrot varieties

Nitrogen level (Kg/ha)	No. of leaves/ plant	Plant height/ plant (cm)	Fresh weight of shoot/ plant (g)	Dry weight of shoot/ plant (g)	Root length/ plant (cm)	Root diameter/ plant (cm)	Fresh weight of root/ plant (g)	Dry weight of root/ plant (g)	Root yield (t ha ⁻¹)
N 0	7.86	24.39	7.05	1.90	12.07	2.85	36.07	3.33	18.04
N 50	8.56	27.67	7.99	2.19	12.19	3.23	38.39	3.71	19.20
N 100	8.67	26.22	9.41	2.51	13.44	3.44	46.61	4.16	23.30
N 150	9.59	28.95	10.76	2.95	13.75	3.70	55.64	4.67	27.82
LSD 5%	09801	2.396	1.065	0.5399	1.244	0.4007	6.613	0.4878	3.311
1%	-	3.256	1.448	0.7338	-	0.5446	8.988	0.6631	4.500
Level of Significance	*	**	**	**	*	**	**	**	**

Unit plot size was 1.5×1 m

Table 2: Effects of different varieties of carrot

Variety	No. of leaves/ plant	Plant height/ plant (cm)	Fresh weight of shoot/ plant (g)	Dry weight of shoot/ plant (g)	Root length/ plant (cm)	Root diameter/ plant (cm)	Fresh weight of root/ plant (g)	Dry weight of root/ plant (g)	Root yield (t ha ⁻¹)
Sufola	8.83	26.92	9.48	2.35	12.73	3.23	37.99	3.68	19.00
SB Kuroda	8.92	25.46	8.64	2.41	12.58	3.46	52.06	4.26	26.03
New Kuroda	8.26	28.04	8.29	2.39	13.27	3.21	42.48	3.96	21.24
LSD 5%	-	-	0.9224	-	-	-	5.727	0.4225	2.867
1%	-	-	-	-	-	-	7.784	-	3.897
Level of Significance	NS	NS	*	NS	NS	NS	**	*	**

Unit plot size was 1.5×1 m

Table 3: Combined Effects of nitrogen level and variety on the yield and yield contributing characters of carrot varieties

Treatments		No. of leaves/ plant	Plant height/ plant (cm)	Fresh weight of shoot/ plant (g)	Dry weight of shoot/ plant (g)	Root length/ plant (cm)	Root diameter/ plant (cm)	Fresh weight of root/ plant (g)	Dry weight of root/ plant (g)	Root yield (t ha ⁻¹)
Nitrogen level (Kg ha ⁻¹)	Variety									
N0	Sufola	7.73	23.33	5.97	2.02	11.59	2.84	29.13	2.78	14.57
	SB Kuroda	7.83	23.00	7.19	1.99	11.67	2.88	44.08	3.81	22.04
	New Kuroda	8.00	26.83	6.99	1.68	12.92	2.83	35.02	3.42	17.51
N50	Sufola	9.00	29.33	8.49	2.20	12.42	3.16	34.57	3.84	17.29
	SB Kuroda	9.17	25.00	7.55	2.35	11.83	3.31	44.25	3.63	22.12
	NewKuroda	7.50	28.67	7.93	2.02	12.33	3.22	36.36	3.66	18.18
N100	Sufola	9.00	24.00	9.72	2.44	13.58	3.32	39.25	3.77	19.63
	SB Kuroda	9.00	26.17	9.75	2.36	12.50	3.85	57.83	4.54	28.90
	New Kuroda	8.00	28.50	8.77	2.73	14.25	3.14	42.75	4.17	21.38
N150	Sufola	9.60	31.00	12.76	2.73	13.33	3.61	49.03	4.35	24.51
	SB Kuroda	9.67	27.67	10.07	2.95	14.33	3.81	62.11	5.07	31.06
	New Kuroda	9.50	28.17	9.45	3.16	13.58	3.68	55.79	4.59	27.90
LSD5%		1.698	5.640	2.507	1.271	2.155	0.9433	11.45	1.148	5.735
1%		-	4.149	1.845	0.9352	-	0.9641	15.57	0.8450	7.794
Level of significance		*	**	**	**	*	**	**	**	**

Unit plot size was 1.5×1 m

produced the highest root yield of 27.22 t ha⁻¹ which is agreement with the present study. Considering the combined effect, among all the varieties and nitrogen level, SB Kuroda gave the highest yield (31.06 t ha⁻¹) of roots per hectare in 150 kg N ha⁻¹ (Table 3). Sagiv *et al.* (1994) reported that nitrogen fertilizer application had a significant effect on yield in the treatments without organic matter, the highest yield or their treatment were obtained with 200 kg N ha⁻¹. The variety Sufola produced the lowest yield when no application of nitrogen.

The results of this experiment therefore, indicate that nitrogen nutrition played an important role on growth, yield and yield contributing characters of carrot varieties. It was found that most of the characters that govern the

production of carrot were influenced and increase the yield by the higher doses of nitrogen. The variety SB Kuroda gave the best results in all characters among three varieties. The available information on the effects of plant nutrients particularly of nitrogen and three carrot varieties on yield and yield contributing characters under Bangladesh condition is not conclusive. Therefore to obtain the highest yield of carrot the nitrogen fertilizer treatment 150 kg N ha⁻¹ may be suggested to the carrot growers. The experiment may be repeated for on-farm trials at different agro-ecological region of Bangladesh to confirm the findings of the present experiment because continued over-application of fertilizers by growers may lead to an excessive accumulation of some nutrients

resulting in harmful effects on the yield and quality of carrots and may have an impact on the ecology and environment, contributing to ground and surface water pollution.

REFERENCES

- Ali, A., 1994. Interaction effects of nitrogen and Potassium on growth, yield and quality of carrot (*Daucus carota* L.). M.S. Thesis, Bangladesh Agril. Univ., Mymensingh, Bangladesh.
- Anonymous, 1994. Dhum Pie-Der Janna. The Daily Ittefaq, Ittefaq Group of Publications Ltd., Dhaka, pp: 1.
- BARC, 1997. Fertilizer Recommendation Guide. Bangladesh Agricultural Research Council, Farmgate, Dhaka, Bangladesh, pp: 83.
- Balooch, A.P., M.A. Balloch and S.M. Qayyum, 1993. Influence of phosphorus and potassium fertilizer combination levels with standard dose of nitrogen on the productivity of carrot (*Daucus carota* L.). Sindh Agric. Univ. Pak., 9: 21-25.
- Bose, T.K. and M.G. Som, 1990. Vegetable Crops in India. Naya Prakash, Calcutta, India, pp: 408-442.
- Burleson, C.A., 1957. The response of carrot to fertilizer applications. J. Rio-grande Valley Hortic. Soc., 11: 97-98.
- FAO., 2000. Production Yearbook. Food Agric. Organiz., Rome, Italy, 54: 160-161.
- Gomez, K.A. and A.A. Gomez, 1984. Statistical Procedures for Agricultural Research. 2nd Edn., John Wiley and Sons Inc., New York, USA., pp: 13-175.
- Hunter, A.H., 1984. Soil Fertility Analytical Services in Bangladesh: A Consultancy Report. Bangladesh Agricultural Research Council, Dhaka, Bangladesh.
- INFS., 1992. Deshiyo Khaddodrobber Pushtiman. [Nutritive Values of Local Food Items]. Institute of Nutrition and Food Sciences, University of Dhaka, Bangladesh, pp: 8-9.
- Otani, K., 1974. Effect of nitrogen fertilizer on carotenoid content in carrots. J. Agric. Sci., 18: 270-273.
- Parraga, M.S., 1995. Effect of organic matter on quantity and quality of roots in carrot (*Daucus carota* L.) harvested at three dates. Semira, 16: 80-85.
- Patil, B.D. and A.S. Gill, 1981. Response of fodder carrot to NPK fertilization. Ind. J. Agron., 26: 203-204.
- Polach, J., 1982. Effect of fertilization on carrot yield and quality. Bull. Vykumny Slechtitel'sky Ustav Zelinarsky Olomouc, 25: 119-127.
- Rashid, M.M., 1993. Sabjibijnan. Bangla Academy, Dhaka, Bangladesh, pp: 502-507.
- Rashid, M.M., 1999. Shabjee Biggan. 2nd Edn., Rashid Publishing House, Dhaka, Bangladesh, pp: 498-503.
- Sagiv, B., A. Hadas and B. Bar-Yosef, 1994. Influence of organic manure, composted refuse and nitrogen fertilization and their combination, on carrots (variety Nantes). Hassadeh, 74: 631-634.
- Saparov, U.B., 1992. Irrigation and fertilization of carrot crops on oasis sands. Prob. Desert Dev., 4: 67-70.
- Sarker, N.K., 1989. Effect of nitrogen, phosphorus and potash on the yield of carrot. M.S. Thesis, BAU, Mymensingh, Bangladesh, pp: 89.
- Sarker, N.K., 1991. Effect of NPK fertilizers on growth yield of carrot. Progressive Agric., 2: 29-34.
- Skrbic, K., 1987. Influence of nitrogen nutrition upon the growth dynamics and total nitrogen content in the roots and leaves of some carrot varieties. Agrohemija (Yugoslavia), 5: 349-358.
- Uddin, A.S.M.M., A.K.M.S. Hoque, M. Shahiduzzaman, P.C. Sarker, M.M.A. Patwary and S.M.A. Shiblee, 2004. Effect of nutrients on the yield of carrot. Pak. J. Biol. Sci., 7: 1407-1409.