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Yield and Profitability of Carrot (*Daucus carrota* L.) as Affected by Plant Spacing and Sowing Time

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Abstract: A field trial was carried out at the Horticulture Farm of Sher-e-Bangla Agricultural University, Dhaka to determine the growth and yield of carrot as influenced by different sowing dates and spacing. The study was conducted with four sowing times of carrot viz. 28 November (T_1), 8 December (T_2), 18 December (T_3) and 28 December (T_4) having three spacings viz. 20cm x 10cm (S_1), 25cm x 15cm (S_2) and 30cm x 20cm (S_3). All the yield contributing characters were the highest to the plants grown on 28 November at the spacing of 30cm x 20cm and the lowest on 28 December at the spacing of 20cm x 10cm. maximum gross yield (38.17 t ha^{-1}) was found in T_1S_1 and the minimum (6.65 t ha^{-1}) was in T_4S_3. The maximum (34.33 t ha^{-1}) and the minimum (3.135 t ha^{-1}) marketable yield were also found in the treatment of T_1S_1 and T_4S_3. The highest (2.95) Benefit Cost Ratio (BCR) was observed in T_1S_1 and the lowest (-0.03) was in T_4S_2. The yield and yield contributing characters were increased with the closest spacing but growth parameters were increased with the widest spacing. Gross yield and marketable yield were increased in early sowing and decreased in delay sowing. In twelve treatments of combination of four sowing times and three spacings, the maximum yield and marketable yield were in T_1S_1.

Key words: *Daucus carrota* · Yield · Productivity · Profitability · Plant polulation

INTRODUCTION

Carrot (*Daucus carota* L.), herbaceous biennial plants, belongs to the member of Apiaceae family [1]. It is said to be originated in Mediterranean region [2]. It produces an enlarged fleshy tap root that is edible and possesses high nutritive value [3].

Vegetables are one of the most important components of human food, which provides proteins, carbohydrates, fats, vitamins and minerals. Per capita vegetable production in Bangladesh is much less than its requirement. It contains high amount of carotene (10 mg/100 g), thiamin (0.04 mg/ 100 g), riboflavin (0.05mg/100 g) and also serves as a source of carbohydrate, protein, fat, minerals, vitamin-C and calories [4]. Sugar and volatile terpenoids are the two major components of carrot flavor; glucose, fructose and sucrose which make up more than 95% of the free sugars and 40% to 60% of the stored carbohydrates in the carrot root. The ratio of sucrose to reducing sugar increases with root maturity but decreases following harvest and during cold storage [5]. Blindness in children for the severe Vitamin-A deficiency is a problem of public health in some countries, particularly in the rice dependent countries of Asia [6]. So, carrot (rich in Vitamin-A) may contribute a lot of Vitamin-A to overcome this situation in Bangladesh,

The popularity of carrot is increasing day by day in Bangladesh especially among the urban people because of its high nutritive value and possible diversified use in making different palatable foods. Carrot can be eaten either row or by making halua, a preparation of sweets in Bangladesh. Carrot root is being used as vegetable for soups and curries and grated roots are used as salad. It can be canned [7]. But large-scale production of carrot is yet not started to meet up the demand. The area under carrot cultivation was 899 thousand hectares with total production of 193740 thousand tones in the world [8].

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In Bangladesh the production statistics of carrot is not available. Rashid [9] mentioned an average yield of carrot 25 tonnes per hectare. The production is relatively low compared to other carrot producing countries, Switzerland, Denmark, Sweden, UK, Australia and Israel, where the average per hectare yield are reported to be 40.88-42.67, 51.88, 54.88, 56.70 and 64.20 tonnes, respectively[8].

Plant spacing is one of the important factors for the increased production of carrot. Pavlek [10]; Lipari [11] and McCollum *et al*. [12] reported that there is a positive correlation between the number of plants and yield of carrot. But many workers reported that different plant densities of spacing have different effect for the marketable yield of carrot [13,14].

Sowing time is also an important factor for increasing yield of carrot [15]. The different sowing time of carrot have a significant effect on growth and yield due to environmental factor like temperature and light intensity [16] suggested that carrot should be harvested at proper stage of maturity. Otherwise, it will become fluffy and unfit for consumption. Moreover, the percent of root splitting, firmness, the contents of dry matter, carotene and sucrose are increased during the growth of carrot, whereas the contents of glucose and fructose and respiration quotient are decreased. The contents of total sugar remained almost constant from the beginning of the harvesting period but increased at low temperature.

To extend the availability of carrot during the early and late period of growing season and sowing time may play a critical role. Also quality of the roots depends on the harvesting time under Bangladesh condition. There is also a significant interaction between plant spacing and sowing date [17]. Therefore the present investigation was taken to find out optimum sowing time and spacing for better yield of carrot and to assess their profitability.

MATERIALS AND METHODS

The experiment was conducted at the Horticulture Farm of the Sher-e-Bangla Agricultural University, Dhaka during November 2005 to April 2006. Laboratory works were done both at Horticulture Laboratory and Soil Science Laboratory in Sher-e-Bangla Agricultural University, Dhaka-1207. The experiment area was belonged to the Modhupur Tract and AEZ 28. The soil was sandy loam with a pH value 6.6. Soil samples were collected randomly from a depth up to 30 cm of the experimental plot and analyses were done and showed nitrogen 0.075%, phosphorus 13 ppm, exchangeable potassium 0.20 me/100g soil and organic carbon 0.82%.

New Caroda, variety of carrot, was used for the experiment. The seeds of this variety were collected from "Hamid Seed Store", Siddique Bazar, Dhaka. The experiment was conducted to study the effect of four levels of sowing times and three levels of spacing. Different levels of two factors were as follows:

Factor A:
Sowing time: Carrot seeds were sown at four different times denoted as T_1, T_2, T_3 and T_4:
T_1= 1st sowing, November 28, 2005
T_2= 2nd sowing, December 08, 2005
T_3= 3rd sowing, December 18, 2005
T_4= 4th sowing, December 28, 2005

Factor B:
Spacing: Three different spacing were used denoted as S_1, S_2 and S_3
S_1= 20 cm × 10 cm
S_2= 25 cm × 15 cm
S_3= 30 cm × 20 cm

The two factors experiment was laid out in a RCB Design with three replications. The whole experimental area was 24.5m × 8.0m, which was divided into three blocks. Each block was again divided into 12 plots and hence there were 36 (12×3) unit plots. The treatments were assigned randomly in each block separately. The size of unit plot was 2.0m ×1.5m. The distance between two adjacent blocks and plots were 1.0 m and 0.5 m respectively. Land preparation, manuring and intercultural operations were done properly.

The crop was harvested periodically for data collection. Randomly selected ten plants were harvested each time from each unit plot at 10 days interval. The harvesting was started after 105 days from each date of sowing. Final harvest was done when most of the roots of carrot showed the sign of maturity i.e. after 105 days of sowing. Yield parameters were calculated as follows:

$$\text{Gross yield (kg plot}^{-1}) = \frac{\text{Area of single plot (mxm) x Average yield per plant (g) x 10000}}{\text{Spacing (cmxcm)x1000}}$$

Gross yield of roots per hectare was calculated by using the following formula-

$$\text{Gross yield (t ha}^{-1}) = \frac{\text{Area (ha) x Average yield per plant (g) x 10000}}{\text{Spacing (cmxcm) x 1000 x 1000}}$$

Marketable yield = Gross yield - Non marketable yield (No. of cracked root and branched root)

Marketable yield of roots per hectare was calculated by conversion of the marketable root weight per plot and recorded in ton.

The recorded data on different growth and yield parameters were calculated for statistical analysis. Analyses of variances (ANOVA) for most of the characters under consideration were performed with the help of MSTAT program. Treatment means were separated by Duncane's Multiple Range Test (DMRT) at 5% level of significance for interpretation of the results.

RESULTS AND DISCUSSION

Gross Yield of Root per Plot and Hectare: Gross yield of carrot per plot was statistically significant in respect of different sowing times (Fig. 1). The maximum yield (28.65 t ha^{-1} or 8.38 kg $plot^{-1}$) was found from the treatment T_1 (28 November) which was statistically similar to the treatment T_2 (8 December). The minimum yield (3.23 kg $plot^{-1}$ or 10.48 t ha^{-1}) was found from the treatment of T_4 (28 December). The result showed that early sowing gave the highest yield than other three sowing times. The yield of root was gradually decreased from T_1 (28 November) to T_4 (28 December). The result was agreed with Pariari and Maity [18]. Significant variation was found in respect of yield by different spacing (Fig. 2). It ranged from 27.02 t ha^{-1} to 12.70 t ha^{-1}. (8.46 kg $plot^{-1}$ to 3.7 kg $plot^{-1}$). The maximum yield (27.02 t ha^{-1} or 8.46 kg $plot^{-1}$) was found from the treatment of S_1 (20cm x 10cm) while the minimum in S_3 (30cm x 20cm). The highest yield was found under the spacing of S_1 (20cm x 10cm) due to be set up more number of plants than other two spacing in the same size of plot. The result was agreed with [19]. He obtained the highest yield from the highest densities used in the experiments. In association of different sowing times and spacing in respect of gross yield of root was not varied significantly (Table 1). However, the maximum (38.17 t ha^{-1} or 11.17 kg $plot^{-1}$) and the minimum yield (6.67 t ha^{-1} or 2 kg $plot^{-1}$) were obtained from the treatment combination of T_1S_1 and T_4S_3 respectively. Where as the maximum and minimum results were observed statistically similar with the combined treatment of T_2S_1 and T_4S_2 respectively. Similarly, treatment combination of T_1S_3 and T_3S_2 performed statistically same yield of carrot root that was 18.03 t ha^{-1} and 17.7 t ha^{-1}, respectively.

Marketable Yield per Plot and Hectare: Marketable yield was calculated by subtracting non-marketable yield from gross yield of carrot. Marketable yield also varied significantly due to different sowing times (Fig. 3).

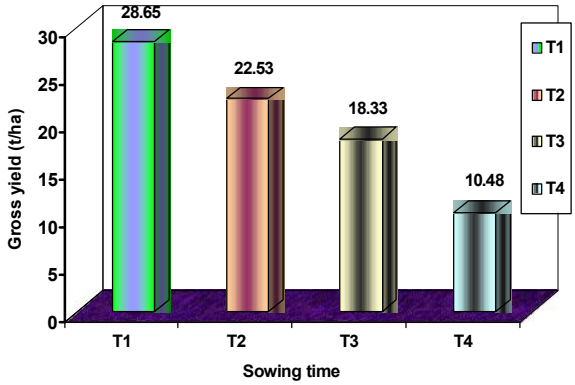

Fig. 1: Effect of sowing time on gross yield (t ha^{-1}) of carrot.

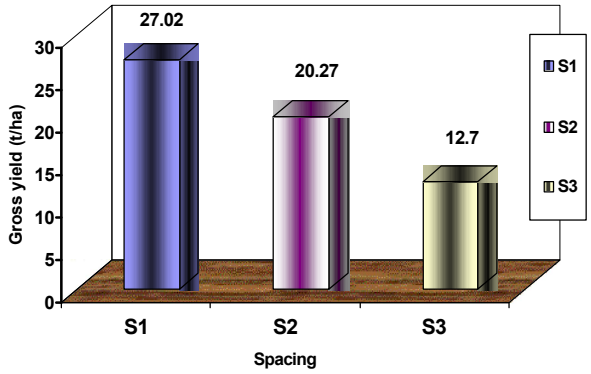

Fig. 2: Effect of spacing on gross yield (t ha^{-1}) of carrot.

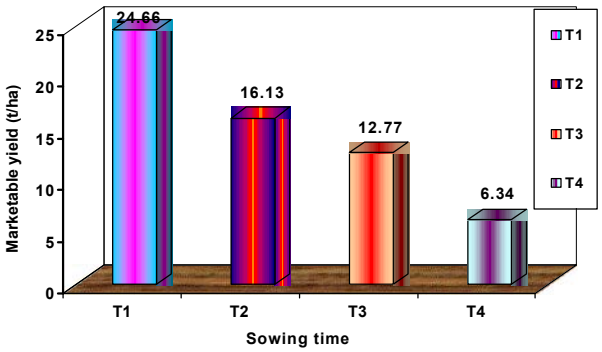

Fig. 3: Effect of sowing times on marketable yield (t ha^{-1}t) of carrot.

It ranged from 24.66 t ha^{-1} to 6.34 t ha^{-1} (7.35kg $plot^{-1}$ to 2.12kg $plot^{-1}$). The highest marketable yield (24.66 t ha^{-1} or 7.35 kg $plot^{-1}$) was found from the treatment of T_1 (28 November). The second highest marketable yield (5.64 kg $plot^{-1}$ or 16.13 t ha^{-1}) was found from the treatment of T_2 (8 December) and the lowest marketable yield (2.12 kg $plot^{-1}$ or 6.345 t ha^{-1}) was obtained from the treatment of T_4 (28 December). The result showed that early sowing on 28 November performed the highest marketable yield and

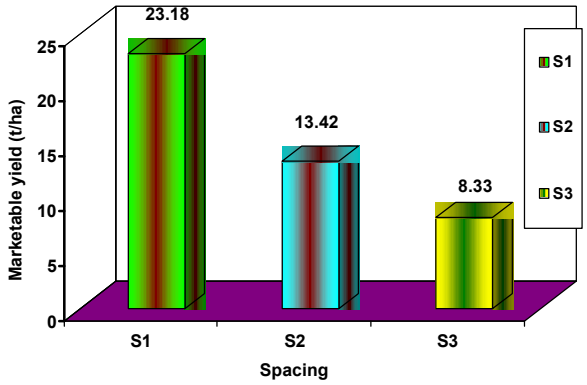

Fig. 4: Effect of spacing on marketable yield (t ha^{-1}) of carrot.

it was gradually decreased from the treatment of T_1 (28 November) to T_4 (28 December) (Fig. 3). Significant variation was observed among the different spacing of carrot production in respect of marketable yield (Fig. 4). It ranged from 23.18 t ha^{-1} to 8.33 t ha^{-1} (6.92 kg plot^{-1} to 2.50 kg plot^{-1}). The maximum (23.18 t ha^{-1} or 6.92 kg plot^{-1}) marketable yield was obtained from the treatment of S_1 (20cm x 10cm) while the minimum (8.33 t ha^{-1} or 2.50 kg plot^{-1}) in S_3 (30cm x 20cm). The highest marketable yield was observed under the treatment S_1 due to the highest amount of seedlings to be set up than other two treatments. The combined effect of different sowing times and spacing was significantly differed in respect of marketable yield (Table 1). The marketable yield ranged from 34.33 t ha^{-1} to 3.13 t ha^{-1} (10.32 kg plot^{-1} to 2.77 kg plot^{-1}). The highest marketable yield (34.33 t ha^{-1} or 10.32 kg ha^{-1}) was obtained from the treatment of T_1S_1 while the lowest (3.135 t ha^{-1} or 2.77 kg ha^{-1}) in T_4S_3. The lowest marketable yield under the treatment of T_4S_3 was statistically similar with T_1S_3.

Cost and Return Analysis: Material, non-material and overhead costs were recorded for all the treatment for unit plots and calculated per hectare basis (marketable yield). The price of carrot roots at the local market was also noted (Table 2 and 3). The total cost of production ranged between TK 52266 to TK 47709 among the treatments combination. The cost of variation was found for different amount of seed to be required in several treatments combination due to different spacings. The highest cost of production (TK 52266) was involved in the treatment combinations of T_1S_1, T_2S_1, T_3S_1 and T_4S_1 while the lowest cost of production (TK 47709) was involved in the treatment combinations of T_1S_3, T_2S_3, T_3S_3 and T_4S_3. Number of plants was highest in the treatment S_1 (20cm×10cm) in the same area than other treatments like S_2 and S_3. So cost of production was higher than others. On the other hand number of plants was lower in the treatment of S_3 (30cm×20cm) in the same area than others. So cost of production was lower in spacing S_3 (30cm×20cm) than others. The gross return from different treatments combination ranged between TK 206400 to TK 24600 per hectare. Gross return was the total income through sale proceeds of marketable yield of carrot root @ TK 6000/t. The benefit cost Ratio (BCR) was found to be the highest (2.95) in the treatment combination of T_1S_1 and the lowest BCR (-0.03) was recorded with T_4S_2. In the treatment combination of T_1S_1, marketable yield was higher than others and cost of production was more or less to other treatments combination. It was found that combination treatments from T_1S_1 to T_3S_2 were profitable for carrot production but combined treatments from T_3S_3 to T_4T_3 were non-profitable when production cost is higher than gross yield. Results revealed that marketable yield might be better in the treatment combination of T_1S_2 to be considered net-return respectively.

Table 1: Interaction effect of plant height (cm), gross yield (kg plot^{-1}), gross yield (t ha^{-1}), marketable yield (kg plot^{-1}), marketable yield (t ha^{-1}), % of cracking root and % of branched root of carrot

Treatment Combination	Gross yield (t ha^{-1})	Gross yield (kg plot^{-1})	Marketable yield (t ha^{-1})	Marketable yield (kg ha^{-1})
T_1S_1	38.17a	11.17a	34.33a	10.32a
T_1S_2	29.43b	8.557bc	24.14bc	7.220c
T_1S_3	18.36cd	5.410d	15.50de	4.510ef
T_2S_1	28.63b	10.00ab	28.63b	8.633b
T_2S_2	38.17a	7.213c	10.41ef	5.530de
T_2S_3	29.43b	4.567de	9.343fg	2.770gh
T_3S_1	18.36cd	8.233bc	20.48cd	6.000d
T_3S_2	28.63b	5.310d	12.49ef	3.727fg
T_3S_3	10.17ef	3.033ef	5.353gh	5.530de
T_4S_1	14.65de	4.457de	9.267fg	2.770gh
T_4S_2	10.15ef	3.233ef	6.633fg	6.000d
T_4S_3	6.65f	2.000f	3.135h	3.727fg
CV%	17.34%	16.65%	21.18%	15.24%

Means Followed by uncommon letter under the same factor are significantly differed at 5% level by DMRT.
T_1 = 28 November, T_2 = 8 November, T_3 = 18 December, T_4 = 28 December
S_1 = 20cm × 10cm, S_2 = 25cm × 15cm, S_3 = 30cm × 20cm

Table 2(A): Material cost (TK)

Treatment combination	Carrot seed (3 kg ha^{-1})	Manures and Fertilizers				Pesticide	Subtotal.1(A)
		Cow dung (12 t ha^{-1})	Urea (150 kg ha^{-1})	TSP (125kg ha^{-1})	MP (175 kg ha^{-1})		
T_1S_1	6000	4800	1050	2000	1575	2000	17425
T_1S_2	3340	4800	1050	2000	1575	2000	14765
T_1S_3	2140	4800	1050	2000	1575	2000	13565
T_2S_1	6000	4800	1050	2000	1575	2000	17425
T_2S_2	3340	4800	1050	2000	1575	2000	14765
T_2S_3	2140	4800	1050	2000	1575	2000	13565
T_3S_1	6000	4000	1050	2000	1575	2000	17425
T_3S_2	3340	8000	1050	2000	1575	2000	14765
T_3S_3	2140	4800	1050	2000	1575	2000	13565
T_4S_1	6000	4800	1050	2000	1575	2000	17425
T_4S_2	3340	4800	1050	2000	1575	2000	14765
T_4S_3	2140	4800	1050	2000	1575	2000	13565

Carrot seed @ TK 2000/Kg
Cow dung @ TK 0.40/Kg
Urea @ TK 7.00/Kg
TSP@ TK 16.00
MP @ TK 9.00
T_1 = 28 November, T_2 = 8 November, T_3 = 18 December, T_4 = 28 December
S_1 = 20cm × 10cm, S_2 = 25cm × 15cm, S_3 = 30cm × 20cm

Table 2(B): Non- Material cost (TK/ha)

Treatment combination	Land Preparation	Manures and fertilizers application	Seed sowing	Intercultural operation	Harvesting	Sub total II (B)	Total input cost (A+B)
T_1S_1	7000	1050	2660	2100	7700	20510	37935
T_1S_2	7000	1050	2660	2100	7700	20510	35275
T_1S_3	7000	1050	2660	2100	7700	20510	34075
T_2S_1	7000	1050	2660	2100	7700	20510	37935
T_2S_2	7000	1050	2660	2100	7700	20510	35275
T_2S_3	7000	1050	2660	2100	7700	20510	34075
T_3S_1	7000	1050	2660	2100	7700	20510	37935
T_3S_2	7000	1050	2660	2100	7700	20510	35275
T_3S_3	7000	1050	2660	2100	7700	20510	34075
T_4S_1	7000	1050	2660	2100	7700	20510	37935
T_4S_2	7000	1050	2660	2100	7700	20510	35275
T_4S_3	7000	1050	2660	2100	7700	20510	34075

Labour cost @ Tk. 70 per day
T_1 = 28 November, T_2 = 8 November, T_3 = 18 December, T_4 = 28 December
S_1 = 20cm × 10cm, S_2 = 25cm × 15cm, S_3 = 30cm × 20cm

Table 2(C): Overhead cost and total cost of production (TK)

Treatment combination	Overhead cost (TK)				
	Cost from leased land	Interest of rooming capital (13% of total input cost/year)	Miscellaneous cost (5% of total input cost)	Sub total (Overhead cost)	Total cost of production (Total input cost + Overhead cost)
T_1S_1	7500	4932	1899	14331	52266
T_1S_2	7500	4586	1764	13850	49125
T_1S_3	7500	4430	1704	13634	47709
T_2S_1	7500	4932	1899	14331	52266
T_2S_2	7500	4586	1764	13850	49125
T_2S_3	7500	4430	1704	13634	47709
T_3S_1	7500	4932	1899	14331	52266
T_3S_2	7500	4586	1764	13850	49125
T_3S_3	7500	4430	1704	13634	47709
T_4S_1	7500	4932	1899	14331	52266
T_4S_2	7500	4586	1764	13850	49125
T_4S_3	7500	4430	1704	13634	47709

T_1 = 28 November, T_2 = 8 November, T_3 = 18 December, T_4 = 28 December
S_1 = 20cm × 10cm, S_2 = 25cm × 15cm, S_3 = 30cm × 20cm

Table 3: Cost and return of carrot due to sowing time and spacing:

Treatment combination	Marketable yield of carrot (t ha^{-1})	Gross return (TK/ha)	Total cost of production (TK/ha)	Net return (TK/ha)	BCR
T_1S_1	34.40	206400	52266	154134	2.95
T_1S_2	24.06	144360	49125	95235	1.94
T_1S_3	15.03	90180	47709	42471	0.89
T_2S_1	28.76	172560	52266	120294	2.30
T_2S_2	18.43	110580	49125	61455	1.25
T_2S_3	9.23	56380	47709	8671	0.18
T_3S_1	20.0	120000	52266	67734	1.29
T_3S_2	12.03	72180	49125	23055	0.47
T_3S_3	5.06	30360	47709	-17349	-0.04
T_4S_1	9.13	54780	52266	2514	0.05
T_4S_2	5.71	34280	49125	-14845	-0.03
T_4S_3	4.1	24600	47709	-23109	-0.05

Price of carrot @TK.6000/t

Gross Return = Market yield × Price of carrot (Tk/ha) Carrot

T_1 = 28 November, T_2 = 8 November, T_3 = 18 December, T_4 = 28 December

S_1 = 20cm × 10cm, S_2 = 25cm × 15cm, S_3 = 30cm × 20cm

CONCLUSION

Gross yield and marketable yield significantly influenced by different sowing times and spacings. The highest gross yield (38.17t ha^{-1}) was observed in treatment combination of T_1S_1 while the minimum (6.65 ha) in T_4S_3. The highest marketable yield (34.33 t ha^{-1}) was noticed under the combined treatment of T_1S_1 and the lowest (3.13 t ha^{-1}) in T_4S_3. The maximum gross yield (38.17 t ha^{-1}) was found in T_1S_1 and the minimum (6.65 t ha^{-1}) was in T_4S_3. The maximum (34.33 t ha^{-1}) and the minimum (3.135 t ha^{-1}) marketable yield were also found in the treatment of T_1S_1 and T_4S_3. The highest (2.95) Benefit Cost Ratio (BCR) was observed in T_1S_1 and the lowest (-0.03) was in T_4S_2. The yield and yield contributing characters were increased with the closest spacing but growth parameters were increased with the widest spacing. Gross yield and marketable yield were increased in early sowing and decreased in delay sowing. In twelve treatments of combination of four sowing dates and three spacing, the maximum yield and marketable yield were in T_1S_1.

REFERENCES

1. Peirce, L.C., 1987. Vegetable: Characteristics, production and marketing. John Wiley and Sons. Inc. New York, pp: 251-252.
2. Banga, O., 1976. In Evolution of Crop plants by N.W. Simmands (Ed.) London, London.
3. Shanmugavelu, K.G., 1989. Production technology of vegetable crops. Oxford and IBH publishing Co., Pvt. Ltd.,New Delhi, Calcutta, pp: 397-399.
4. Yawalker, K.S., 1985. Vegetable crops in India. Third edition. Mrs. K.K. Yawalker, Agri-Horticultural Publishing House, 52, Bajaj Nagar-440010, pp: 210-220.
5. Freman, R.E. and P.K. Simon, 1983. J. Amer. Soc. Hort. Sci., 108(1): 50-56.
6. Woolfe, J.A., 1989. Nutrition Aspects of Sweet potato Roots and Leaves. Improvement of sweet potato (Ipomea batatas) in Asia; CIP, pp: 167-182.
7. Chauhan, V.V.S., 1989. Cole crops, Vegetable Production in India. Agra, India, pp: 117-147.
8. FAO, 2000. FAO production year Book, Food and Agriculture Organization, Rom, Italy, 45: 146.
9. Rashid, M.M., 1993. Shabji Bijnan (Olericulture) (in Bangla). Published by Bangla Academy, Dhaka, Bangladesh, pp: 502-507.
10. Pavlek, P., 1977. Effect of plant density on carrot yield. Plojprivredna Znanstvena Smotra, 42: 67-73.
11. Lipari, V., 1975. Yield, growth pattern and morphological characteristics of carrot root in the autumn-winter spring cycle in relation to planting density and maturing. Rivista di Agronomia, 9(2/3): 240-245.
12. McCollum, T.G., S.J. Locascio and J.M. White, 1986. Plant density and row arrangement effects on carrot yields. J. Amer. Soc. Hort. Sci., 111(5): 648-651.
13. Dragland, S., 1986. Plant density and row spacing in carrots. Forskning of Forsiki Landbruket, 37(3): 139-145.

14. Nogueira, I.C.C., F.C. Nogueira and M.Z. de Negreiros, 1982. Effect of plant spacing on yield of carrot (*Daucus carota L.*) cv. *Kuroda Nocional.* Proc. Trop. Reg., Amer. Soc. Hort. Sci., 25: 125-127.
15. Rashid, M.M. and M.A. Shakur, 1986. Effect of date of planting and duration of growing period on the yield of carrot. Bangladesh Horticulture, 14(2): 28-32.
16. Mack, H.J., 1979. Effect of fertilizers, row spacing and harvest dates on table carrots. J. Amer. Soc. Hort. Sci., 104(5): 717-720.
17. Salter, P.J., L.E. Currah and J.R. Fellows, 1979. The effect of plant density, spatial arrangement and time of harvesting on yield and root size in carrots. J. Agric. Sci., 93(2): 431-440.
18. Pariari, A. and T.K. Maity, 1992. Growth and yield of carrot (*Daucus carota* L.) cultivars as influenced by sowing dates. Department of Horticulture, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur 741 252, West Bengal, India. Crop-Research-Hisar, 5: 158-162.
19. Bussell, W.T., 1978. Studies on baby carrot production. New Zealand Experimental Agriculture, 6(2): 131-137.