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## Effect of growing conditions and sowing months on growth and yield of carrot (*Daucus carota* L.) cv. New Kuroda

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**Abstract**

An investigation was carried out at Vegetable Research Station, Rajendranagar, Sri Konda Laxman Telangana State Horticultural University, Mulugu (V & M), Siddipet Dist., Telangana State during the period of 2017-18 and 2018-19 to determine the growth and yield of carrot as influenced by different sowing dates and conditions. The study was conducted with six sowing times of carrot viz., M<sub>1</sub> Sept 2<sup>nd</sup> week, M<sub>2</sub> Oct 2<sup>nd</sup> week, M<sub>3</sub> Nov 2<sup>nd</sup> week, M<sub>4</sub> Dec 2<sup>nd</sup> week, M<sub>5</sub> Jan 2<sup>nd</sup> week, M<sub>6</sub> Feb 2<sup>nd</sup> week having two conditions viz., C<sub>1</sub> open condition, C<sub>2</sub> shadenet condition (35% shade). All the parameters interms of number of leaves, length of tap root, root diameter, root yield per plant, root yield per plot, root yield per hectare were significantly differed among the sowing times at different conditions. The maximum length of taproot (16.54cm), root diameter (3.83cm), root yield per plant (80.33gm), root yield per plot (17.66kg) and root yield per hectare (28.26t/ha) were found in M<sub>2</sub>C<sub>1</sub> and the minimum of these parameters were found in M<sub>6</sub>C<sub>1</sub> whereas maximum number of leaves (11.14) were found in M<sub>4</sub>C<sub>1</sub> and the minimum of leaves per plant was recorded in M<sub>6</sub>C<sub>1</sub>.

**Keywords:** Carrot, growth, root length, diameter

**Introduction**

Carrot is a cool season crop grown under wider range of climatic conditions. It is grown during the autumn in temperate countries and winter in tropical and subtropical countries. The ideal temperature for its growth and development is 15.6°C to 21.1°C. Higher and lower temperature reduce the rate of growth and adversely effect the quality of the roots and the best time is from mid October to mid November for its cultivation to get satisfactory yield. It is one of the most important root crops in the country, which is cultivated in an area of 82,000 ha with an annual production of 13.38 lakh MT.

Carrot (*Daucus carota* L.) a root vegetable primarily grown for its fleshy roots used as vegetable of the family Umbelliferae. It is one of the best sources of β- carotene and provides 17 per cent of the total β- carotene in human nutrition (Alasalvar *et al.*, 2001) [2]. β-carotene is the principle precursor of vitamin A, which is involved in vision, cell differentiation, synthesis of glycoprotein and overall growth and development of bones. Carrot also contain a wide spectrum of other antioxidants, vitamins, carbohydrates, crude fiber and nutrients like Ca, P, Fe and Mg (Sharma *et al.*, 2011) [9]. Carrot intake enhances the immune system, protect against cancer, high blood pressure, osteoporosis, cataracts, atherosclerosis, heart diseases and many others (Brandt *et al.* 2004) [3].

To extend the availability of carrot during the early and late period of growing season and sowing time and different growing conditions may play a critical role. Also quality of the roots depends on the harvesting time under Telangana conditions.

Manipulation of environmental conditions for extending the growing season to force for off season production of carrot which not only generates higher returns to the farmers but also fresh quality produce without loss of quality can be sold to the consumers Forcing can be done through protected cultivation of vegetables which can be used to improve yield and quality.

Protected cultivation has the potential to reduce biotic and abiotic stresses, further extends the growing season, in addition it is an efficient alternative for land use and other resources (Sanwal *et al.*, 2004) [8]. There is also a significant interaction between growing conditions and sowing time.

Therefore, the present investigation was taken find out optimum sowing time and growing conditions for better growth of carrot.

### Material and Methods

The present investigation entitled “Studies on the effect of growing conditions, sowing months on growth and yield of carrot (*Daucus carota* L.) cv. New Kuroda” was carried out during Rabi and Summer (2017-18 and 2018-19), at Vegetable Research Station, Rajendranagar, Hyderabad. The experimental site comes under sub-tropical zone and is situated at latitude of 17° 19' N and longitude of 79° 23' E. The altitude of the place is 542.3 m above the mean sea level. The soil was black sandy loam with good drainage and moderate water holding capacity with a pH value of 8.00. Soil samples were collected randomly to a depth upto 30cm of experimental plot and analysis were done and showed Available Nitrogen 450 kg ha<sup>-1</sup>, Available Phosphorus 51 kg ha<sup>-1</sup>, Available Potassium 575 kg ha<sup>-1</sup>, Organic Carbon 0.34% and Electrical conductivity 0.69 dS m<sup>-1</sup>.

New Kuroda variety of carrot was used for the experiment, the seeds of this variety were collected from local market.

The experiment was conducted to study the effect of six levels of sowing times and two levels of conditions. Different levels of two factors were as follows,

**Factor: 1:** Growing condition, carrot seeds were sown at two different growing conditions denoted as,

C<sub>1</sub>: Open condition

C<sub>2</sub>: Shade net

**Factor: 2:** Carrot seeds were sown at six different sowing times denoted as,

M<sub>1</sub>: September 2<sup>nd</sup> week

M<sub>2</sub>: October 2<sup>nd</sup> week

M<sub>3</sub>: November 2<sup>nd</sup> week

M<sub>4</sub>: December 2<sup>nd</sup> week

M<sub>5</sub>: January 2<sup>nd</sup> week

M<sub>6</sub>: February 2<sup>nd</sup> week

The two factors experiment was laid out in a FRBD with three replications. The whole experimental area was 90×90m, 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 2.5×2.5m. The distance between two adjacent blocks and plots were 1.0m and 0.5m respectively. Land preparation, manuring and intercultural operations were done properly.

Growth parameters were recorded at the time of harvest. The recorded data on different growth and yield parameters were calculated for statistical analysis. Analysis 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

#### Number of leaves per plant

A significant difference was observed on leaves per plant in six sowing times. The highest (11.14) number of leaves per plant was obtained from the seeds sown in December which was on par with the October sowing (10.99), while the minimum no. of leaves per plant was recorded from seeds

sown in February month. The present results agreed with the results obtained by Bussell, 1976. Leaves per plant were found significant due to different growing conditions. The maximum number of leaves per plant (10.74) was recorded under open conditions. The interaction effect of sowing time and growing condition showed significant variation on leaves per plant (Table 1). The highest (11.89) number of leaves per plant was recorded in October sowing and open field condition which was on par with the September sowing (11.47) in openfield condition while the minimum number of leaves per plant (9.14) was obtained from February sowing in openfield condition. The variation of leaves number per plant as affected by time of sowing might be due to the variation in the environmental conditions during growing period.

Approximate and proper time of sowing is one of the basic requirements for obtaining maximum growth in any crop. Early sown crop get more time for growth and development, whereas for late sown crop environmental conditions may not be favourable. Further, approximate sowing time leads to highest number of leaves and leaf length due to maximum photosynthesis with longer growth period than very early and late sown crop. These results are in accordance with Rubatzky *et al.* (1999)<sup>[7]</sup>, and Lee and Kader (2000)<sup>[5]</sup>.

#### Length of taproot (cm)

The root length of carrot was significantly influenced by sowing times. The longest root length (16.54cm) was observed in October sowing whereas the shortest root (11.33cm) was observed in the February sowing month. There was a significant difference among the different growing conditions in respect of root length. The longest root (14.76cm) was recorded under open condition than the shadenet condition. A significant interaction was found between sowing time and growing conditions on root length of carrot. The maximum root length (17.11cm) was recorded in October sowing and open field condition which was on par with September sowing (16.65cm) under open field condition whereas the minimum root length (10.92cm) was recorded in February sowing (Table 1) under open field condition. This result showed that the root length progressively increased with the planting of September sowing but decreased with the planting of December to February. The present results agreed with Rashid and Shakur, 1986<sup>[6]</sup>.

#### Root diameter (cm)

Root diameter exhibited significant variation among the six sowing times. The root diameter was progressively decreased after October sowing. The maximum root diameter (3.83cm) was found from the crop sown in October whereas the minimum root diameter (2.61cm) was obtained from crop sown in February month. Significant difference was observed among the growing conditions of carrot production in respect of root diameter. The maximum root diameter (3.31cm) was found under shadenet condition. The interaction effect of sowing time and growing conditions statistically influenced the root diameter of carrot. The highest root diameter (4.10cm) was received from treatment combination of October sowing (Table 1) in open field condition whereas the lowest root diameter was (2.39cm) was received from treatment combination of February sowing in open field condition.

From the present study the root length, diameter of roots were progressively increased up to October, November sowing months and lowest in February sowing month. This shows that root parameters were significantly influenced by different

months of sowing. The increased values in root parameters during early sowing might be due to vigorous growth and sufficient period to develop roots compared to late sowing. During late sowing months gradual increase in temperature in late part of season, might influenced early transition of plants from vegetative to root productive phase leading to poor root growth. Similar finding was reported by Ahmed Oabidul Azad (2002)<sup>[1]</sup>.

#### Fresh root weight per plant (gm)

Weight of fresh roots was significantly differed by the sowing times. The highest fresh root weight (80.33gm) was recorded in October sowing crop which was on par with September sowing (77.93gm), while the lowest fresh roots weight per plant (64.04gm) was recorded in the February sowing crop (Table 2). The results were in agreement with the findings of Rashid and Shaker, 1986. They reported that carrot is a photosensitive and thermosensitive crop. Growth of root was developed under a sustainable environmental condition. Late sowing could not provide their suitable environmental conditions to grow up properly. So early sowing was the best for higher fresh weight of root. Different growing conditions for carrot production was found to have significant effect on fresh roots weight per plant. The maximum fresh root weight (73.52gm) was obtained from the plants grown under open conditions. The interaction effect of different sowing times and growing conditions was statistically significant in respect of weight of fresh root. The maximum fresh root weight per plant (83.79gm) was observed from the crop sown in October month in open field conditions which was on par with September sowing (79.99gm) in openfield condition whereas the lowest fresh root weight (62.06gm) was recorded from crop sown in February in open field condition.

#### Root yield per plot (Kg)

Root yield per plot was significantly differed by the sowing times. The highest root yield per plot (17.66kg) was recorded in October sowing crop which was on par with September sowing (16.05kg), while the lowest root yield per plot (8.51kg) was recorded in the February sowing crop (Table 2). The results were in agreement with the findings of Rashid and

Shakur, 1986<sup>[6]</sup>. Different growing conditions for carrot production was found to have significant effect on fresh roots weight per plant. The maximum root yield per plot (13.63kg) was obtained from the plants grown under open conditions. The interaction effect of different sowing times and growing conditions was statistically significant in respect of weight of fresh root. The maximum root yield per plot (19.43kg) was recorded from the crop sown in October month in open field conditions which was on par with September sowing (17.17kg) in open field condition whereas the lowest root yield per plot (7.27kg) was recorded from crop sown in February in open field condition.

#### Root yield per hectare (t)

Root yield per hectare was significantly affected by different dates of sowing considering the month of October sowing gave the highest root yield per hectare (28.26t/ha). The lowest root yield per hectare (13.61t/ha) was obtained from the February sowing. Between different growing conditions the significant difference was observed. The maximum root yield/ha (21.81t/ha) was observed from the crop sown under open field conditions (Table 2). The interaction effect of different sowing times and growing conditions was found to be significant. The treatment combination of October sowing and under open field conditions recorded highest root yield/ha (31.09t/ha) which was on par with September sowing (27.47 t/ha) in open field condition whereas the lowest root yield/ha (11.63t/ha) was recorded from crop sown in February sowing in open field condition.

Yield is the end product of various physiological processes, starting from germination to root development. The greatest accumulation of carbohydrates in the plants helps in giving highest yields. From the results it can be concluded that the highest root yield was obtained from October sowing month and the lowest yield was recorded in February sown month under open condition. increase in plant height, number of leaves and dry matter have attributed in increasing the root weight during October sowing, which might be due to favorable environmental conditions during that period. These results are in conformity with Rubatzky *et al.* (1999)<sup>[7]</sup> in carrot.

**Table 1:** Effect of growing condition and sowing months on growth and yield of carrot

Treatments	No. of leaves per plant			Length of the tap root (cm)			Diameter of root (cm)		
	C1	C2	Mean	C1	C2	Mean	C1	C2	Mean
T1	11.47	9.78	10.62	16.65	13.65	15.15	3.71	3.36	3.53
T2	11.89	10.09	10.99	17.11	15.97	16.54	4.10	3.57	3.83
T3	11.20	10.65	10.92	16.34	15.67	16.00	3.60	3.48	3.54
T4	11.04	11.24	11.14	14.85	15.4	15.12	3.19	3.51	3.35
T5	9.72	10.24	9.98	12.70	13.3	13.00	2.55	3.11	2.83
T6	9.14	9.92	9.53	10.92	11.74	11.33	2.39	2.84	2.61
Mean	10.74	10.32		14.76	14.28		3.25	3.31	
Factors	SE (m)+_		C.D. at 5%	SE (m)+_		C.D. at 5%	SE (m)+_		C.D. at 5%
Sowing month (S)	0.24		0.71	0.4		1.18	0.05		0.15
Growing condition (G)	0.14		0.41	0.23		NS	0.03		NS
S X G	0.34		1.00	0.56		1.67	0.07		0.22

**Table 2:** The results were in agreement with the findings of Rashid and Shakur

Treatments	Root fresh weight (g)			Root yield per plot (Kg)			Root yield per hectare (t)		
	C1	C2	Mean	C1	C2	Mean	C1	C2	Mean
T1	79.99	75.87	77.93	17.17	14.94	16.05	27.47	23.90	25.68
T2	83.79	76.88	80.33	19.43	15.90	17.66	31.09	25.44	28.26
T3	76.39	75.00	75.69	16.13	15.10	15.61	25.80	24.17	24.98
T4	75.34	77.21	76.27	13.23	15.20	14.21	21.16	24.31	22.73

T5	63.60	69.46	66.53	8.60	10.66	9.63	13.76	17.05	15.40
T6	62.06	66.02	64.04	7.27	9.75	8.51	11.63	15.60	13.61
Mean	73.52	73.40		13.63	13.59		21.81	21.74	
Factors	SE (m)+_		C.D. at 5%	SE (m)+_		C.D. at 5%	SE (m)+_		C.D. at 5%
Sowing month (S)	1.11		3.28	0.61		1.81	0.99		2.91
Growing condition (G)	0.64		NS	0.35		NS	0.57		NS
S X G	1.57		4.65	0.87		2.57	1.40		4.12

### Conclusion

From this investigation it can be concluded that the highest root yield per hectare (31.09t/ha) was recorded in the treatment combination of October sowing under open field conditions.

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