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Influence of Planting Date Upon Growth and Objective Component of Two Carrot Cultivars Grown in Riyadh Region of Saudi Arabia

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Abstract. The demand of fresh vegetables, such as carrot have been increased in Saudi Arabia in recent years. Thus, field studies were undertaken to investigate the effect of planting dates, 14th October and 4th November on the growth and the objective component of two carrot cultivars (Chantenay and Nantes). The experiments were conducted during 1992/93 and 1994/95 seasons at Deirab Agricultural and Research Experimental Station, near Riyadh. Treatments were replicated four times and arranged in split-plot design. In general, the results showed that planting dates did not affect the leaf number, shoot length, carotenoids, total sugar and non reducing sugar for both seasons. However, the later planting date (4th Nov.) significantly reduce the total yield. Shoot fresh weight was also affected by the difference in planting dates. Analysis of variance showed no significant difference on the growth and yield between the two cultivars tested. No significant interaction was observed between cultivars and planting dates on the carrot growth and objective component.

Introduction

Carrot (*Daucus carota*) L. is one of the popular vegetables in many countries and had very important nutritional value. The total carrot production in Saudi Arabia has increased from 18084 tons in 1988 to 23881 tons in 1992 [1]. Almost 65% of the total production in Saudi Arabia is produced in Riyadh region. Carrot is a cool season crop, the optimum temperature range is 16-18°C. Temperature higher than 28 °C was reported to reduce top growth and also the root becomes strong flavored [2, pp. 320-334]. Changes in environmental condition including the day and night temperature associated with planting date can affect carrot yield and its quality. Monthly mean of climatic data recorded during the two growing seasons is presented in Table 1. Carrot growth and root development were best at root temperature of 23 -28 °C and day / night temperature of 18/13°C [3]. Quagliotti [4] reported an increase in carrot vegetative growth at 20 and 26°C but the ultimate plant size was smaller than that at 14°C. The root : top ratio is

usually higher at low root temperature [3]. Stanhill [5] reported that the ratio of relative growth rate of the root to that of leaves reached its maximum when root and leaf temperatures were both near 18 °C.

Table 1. Monthly mean of climatic data recorded during 1992-93 and 1994-95 growing seasons at Dirab Agricultural and Research Experimental Station

Month	October	November	December	January	February	March
	1992			1993		
	Mean	Mean	Mean	Mean	Mean	Mean
Max. T.	36.0	30.5	21.9	23.8	25.0	27.1
Min. T.	16.3	14.8	6.6	4.3	9.3	12.1
Av. T	26.0	23.3	14.4	13.5	17.5	19.8
Av. RH	17.8	23.1	32.3	35.3	31.4	35.7
Soil T.	30.9	26.1	18.2	16.0	20.2	23.0
Rain	0	0	0	0	0	2.4
	1994			1995		
	Mean	Mean	Mean	Mean	Mean	Mean
Max. T.	35.4	28.0	22.0	19.1	22.8	35.4
Min. T.	12.9	10.7	8.8	6.5	8.6	12.9
Av. T	24.3	19.6	15.3	12.4	15.8	24.3
Av. RH	14.3	30.8	51.8	60.5	40.0	14.3
Soil T.	28.2	22.9	18.2	14.0	18.3	28.2
Rain	0	0	0.03	1.75	1.4	0

Carrot flavor attributes are influenced by genotype and environmental condition [6,7]. Color of the carrot root was related to the temperature effect in three to six weeks before harvest as reported by Bnadley & Smittle [8]. This study was carried out to evaluate the growth of carrot cultivars, Chantenay and Nantes, and to study the influence of the planting date on the growth and some objective component.

Material and Methods

Two field experiments were conducted in 1992/93 and 1994/95 growing seasons, at the Agricultural Research and Experiment Station (King Saud University, College of Agriculture) in Deirab (24°N and 46°E) near Riyadh. Growth and yield of two carrot cultivars, Chantenay and Nantes, were evaluated in two planting dates, 14th October and 4th November for both 1992/93 and 1994/95 seasons. Treatments were replicated

four times and arranged in a split-plot design. Cultivars represented the main plot and planting dates were assigned to sub-plot.

The experiment consisted of 8 main plots and 16 sub-plots. The sub-plot area was 8.4 m^2 and consisted of four rows, 3m long with 0.7 m between the rows. The growing seedlings were thinned out at about 5 cm, and other agricultural practices including, irrigation, fertilization, pests and weed control were uniform among cultivars and planting dates during both seasons. It was carried out as recommended for carrot production [2, pp. 320-334].

The plants were harvested on 21st of February and 13th March for the first and second planting date, respectively. Vegetative growth was determined as a leaf number, fresh and dry weight of the shoot. Yield component measurement including root fresh and dry weight, root length and diameter and root : top ratio were determined.

Carotenoids determination was made by extraction of 0.1 g grated tissue in 10 ml hexane. Optical density of filtrate was determined at 440 nm using a LKB, Biochrom, Ultrospec - 4050 spectrophotometer. Concentration of carotenoid was determined from a β-carotene standard curve [9]. A representative sample of root was taken from each plot to determine total sugar, reducing and non-reducing sugar. The extraction was carried out for several times with 80% ethanol according to Loomis and Shull [10, pp. 250-255] and the determination was carried out colorimetrically as described by Dubois *et al* [11] using LKB, Biochrom, Ultrospec-4050 at 540 nm. Data was subjected to the statistical analysis using SAS program and treatments means were compared using LSD (5% level) according to Gomez and Gomez [12, pp. 188-207].

Results and discussion

The results of analysis of variance, presented in Table 2, showed the influence of planting date on carrot growth and yield. No significant interaction was observed between cultivars and planting date on the growth and major objective component of carrot.

Results of vegetative growth and yield component of the carrot cultivars are presented in Table 3. No significant difference was detected on the vegetative growth between the two cultivars studied, except that cv. Chantenay had a higher leaf number in the second season compared to cv. Nantes. The result also showed that cv.Nantes had a higher root length while Chantenay had a higher root diameter in both season. Similar result was reported by Doss and El-Adgham [13]. The average root fresh and dry weight

Table 2. Analysis of variance for growth, yield and objective variables of carrots

Source of variance		Variables: Total yield (kg/m2)	Shoot dry W (g/p)	Shoot dry W. (g/p)	Root fresh W (g/p)	Root dry W (g/p)	Carotenoids (mg/g)	Total sugar (%)
First season (1992/93)								
	df	F	F	F	F	F	F	F
Cultivar ©	1	ns	ns	ns	*	*	ns	ns
Planting date (D)	1	*	ns	ns	*	*	ns	ns
C*D	1	ns	*	*	ns	ns	ns	ns
Model R^2		0.733	0.784	0.744	0.876	0.879	0.820	0.772
Second season (1994/95)								
	df	F	F	F	F	F	F	F
Cultivar ©	1	ns	ns	ns	ns	ns	*	**
Planting date (D)	1	**	*	*	**	**	ns	ns
C*D	1	sn	ns	ns	ns	ns	ns	ns
Model R^2		0.910	0.776	0.805	0.856	0.879	0.545	0.702

ns,*,** Nonsignificant, significant at $P < 0.01$ respectively.

Table 3. Vegetative growth and yield of two carrot cultivars for the two seasons

Cultivar	Shoot fresh weight (g/p)	Shoot dry weight (g/p)	Leaf number (l/p)	Shoot length (cm)	Root length (cm)	Root diameter (cm)	Root fesh weight (cm)	Root dry weight (g/r)	Total yield G/p)	Root:Top Ratio (kg/m2)
First season (1992/93)										
Chanteny	17.31	2.68	11.8	22.93	13.11	3.38	66.58	7.96	1.95	3.87
Nantes	14.17	2.15	9.2	24.25	14.04	2.54	51.06	6.27	2.19	4.13
$LSD_{0\,05}$	ns	ns	ns	ns	0.59	10.2	10.2	1.55	ns	ns
Second Season (1994/95)										
Chanteny	37.95	5.95	12.71	37.81	14.97	3.98	122.2	16.23	6.37	3.34
Nantes	32.67	5.12	10.99	37.49	17.79	3.42	120.4	15.89	5.58	3.68
$LSD_{0\,05}$	ns	ns	1.42	ns	2.30	0.13	ns	ns	ns	ns

s: Nonsignificant

were significantly higher for cv. Chantenay compared to cv. Nantes in the first season while no difference was observed in the second season. Total yield and root : top ratio were almost similar for both cultivars in both season.

Results presented in Table 4 show the influence of planting date on carrot vegetative growth and yield. Vegetative growth was not affected by planting date in the first season. In the second season, the first planting date gave a significantly higher shoot fresh and dry weight while the leaf number and shoot length was not affected. Root length was significantly higher for the first sowing date plants in the second season, while the difference was not significant in the first season. Plants grown in 14th October had a significantly higher root diameter, fresh and dry weight and total yield compared to the plants grown in 4th November in both seasons. The reduction in the growth and yield of the second season plants could be attributed to the rapid decline in the maximum and minimum temperature during December and January (Table 1). According to Hori *et al* [3] root temperature of 23 - 28 °C and day and night temperature of 18 / 13 °C were the optimum for carrot growth and root development. Root : top ratio was significantly higher for the first planting date in the first season while the difference was not significant in the second season.

Table 5 gives the main effect of cultivars and planting date on some selective objective variables. In the first season cv. Chantenay had a significantly lower non-reducing sugar and higher reducing sugar compared to cv.Nantes. No difference was observed on cartenoida and total sugar. In the second season cv. Chantenay had a significantly higher carotenoids, total sugar and non-reducing sugar compared to cv. Nantes. Difference in sugar accumulation between carrot cultivars occurred because of the ability of some cultivars to remain photosynthetically active late in growing season rather than producing more photosynthetic material [14]. Contradicting results were reported about the environmental effect on carotenoids synthesis [15]. Maximum pigment content in carrot root is generally achieved in an environmental temperature of 13-16°C [16, pp.143-188]. Our results showed that carotenoids, total sugar and non-reducing sugar were not affected by planting date. The only difference was observed for the reducing sugar in the first growing season.

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Table 4. Mean vegetative growth and yield of two carrot cultivars as influenced by planting date for the two seasons

Plantind date	Shoot fresh weight (g/p)	Shoot dry weight (g/p)	Leaf number (l/p)	Shoot length (cm)	Root length (cm)	Root diameter (cm)	Root fresh weight (g/r)	Root dry weight (g/r)	Total yield kg/m²	Root:top Ratio
First season (1992/93)										
14th October	14.49	2.41	10.08	23.35	13.9	3.26	66.93	7.78	2.36	4.95
4th November	16.89	2.42	10.94	23.83	13.23	2.65	50.71	6.25	1.78	3.05
$LSD_{0.05}$	ns	ns	ns	ns	ns	0.33	11.37	1.34	0.51	0.70
Second Season (1994/95)										
14th October	40.48	6.45	12	40.5	17.10	3.86	142.7	19.52	7.44	3.58
4th November	29.78	4.62	11.7	34.81	15.66	3.55	99.87	12.60	4.51	3.44
$LSD_{0.05}$	7.73	1.22	ns	ns	0.89	0.31	20.17	2.95	1.08	ns

ns: Nonsignificant

Table 5. Yield quality of two carrot cultivars and the influence of planting date

Cultivar	Carotenoids (mg/g)	Total sugar sugar (%)	Non-reducing sugar (%)	Reducing sugar (%)	Planting date	Carotenoids (mg/g)	Total sugar (%)	Non-reducing sugar (%)	Reducing sugar (%)
First season (1992/93)									
Chanteny	200.4	5.31	1.86	3.45	14th October	230.6	5.88	2.44	3.44
Nantes	233.5	6.04	3.60	2.44	4th Nov.	203.2	5.46	3.01	2.45
$LSD_{0.05}$	ns	ns	0.91	0.29	$LSD_{0.05}$	ns	ns	ns	0.37
Second season (1994/95)									
Chanteny	267.2	5.89	4.69	1.19	14th October	231.4	5.67	4.42	1.26
Nantes	242.2	5.36	4.17	1.83	4th Nov.	278.0	5.57	4.45	1.12
$LSD_{0.05}$	17.8	0.199	0.161	ns	$LSD_{0.05}$	ns	ns	ns	ns

ns: Nonsignificant

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تأثير موعد الزراعة على نمو وإنتاجية صنفين من الجزر المزروعة في منطقة الرياض في المملكة العربية السعودية.

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ملخص البحث: تزايد الطلب في السنوات الاخيرة على الخضروات الطازجة في المملكة العربيه السعوديه، ومن ضمن هذه الخضروات الجزر. اجريت تجارب حقلية لدراسة تأثير موعدى الزراعه (١٤ اكتوبر ، ٤ نوفمبر) على نمو وكمية و نوعية محصول صنفين من الجزر (Chantenay، Nantes). اجريت الدراسة خلال موسمى الزراعة ١٩٩٢/١٩٩٣ م و ١٩٩٤ / ١٩٩٥ م في محطة الأبحاث و التجارب الزراعية التابعه لكلية الزراعه في ديراب بالقرب من الرياض. نفذت التجربة في تصميم القطع المنشقة باستخدام اربع مكررات. وقد اظهرت النتائج عموما عدم وجود تأثير لموعد الزراعة على عدد الاوراق، طول المجموع الخضرى ، تركيز الكاروتينات في الجذور ، والمحتوى الكلى من السكريات و كذلك السكريات المختزلة خلال موسمى الزراعة. بينما تأثر وزن المجموع الخضرى و كذلك المحصول الكلى بتأخير موعد الزراعة. لم تظهر نتائج تحليل التباين فروق معنويه بين الصنفين المستخدمة في الدراسه من حيث النمو الخضرى و المحصول. كما لم تظهر النتائج و جود تداخل معنوى في التأثير بين مواعيد الزرعه و الاصناف المستخدمة.