

Research Application Summary

Influence of temperature on yield of carrots

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Abstract

This study evaluated the influence of temperature on yield and retinol content of two carrot cultivars. Both cultivars yielded higher at lower (10 °C) than higher temperature (18 °C), but retinol content was higher at 18 °C.

Key words: Carrots, retinol, temperature, yield

Résumé

Cette étude a évalué l'influence de la température sur le rendement et la teneur en rétinol de deux cultivars de carotte. Les deux cultivars ont rapporté plus à la température inférieure (10°C) qu'à la température supérieure (18°C), mais le contenu de rétinol était plus élevé à 18 °C.

Mots clés: Carottes, rétinol, température, rendement

Background

Carrot (*Daucus carota* var. *sativa*) belongs to the Umbelliferae (Apiaceae) family (Joubert *et al.*, 1994; Rubatzky *et al.*, 1999). It is a widely grown vegetable cultivated for the storage roots which have high nutritional value. The yield of any crop is the main indicator of productivity. Several factors such as temperature, light intensity, day length and soil moisture have a significant impact on the yield of carrots. Carrots are a cool season crop but can be sown throughout the year. However, high temperatures during warmer times of the year influence yield and quality of carrots negatively.

The aim of this study was to determine the influence of temperature on the yield and quality of two pre-pack carrot cultivars (Star 3002 and Nectar) at two different temperatures (10 and 18°C).

Literature Summary

Carrot is an important vegetable crop in South Africa. In Kwazulu Natal it is certainly one of the five most essential vegetable crops grown and it is also widely grown in the Free State particularly in the Bothaville area. For best yield and quality, carrot sowing times for the Free State are from August

to October and from the end of January to March (Joubert *et al.*, 1994).

Climate has the greatest overall influence on crop production, and temperature is one of its most important components (Rubatzky *et al.*, 1999). The influence of climatic conditions on carrot yield has been investigated in some detail. Important climatic factors for carrot production have been determined to be temperature, soil moisture, and to a lesser degree, day-length and light intensity (Nortjè and Henrico, 1986), with an optimal growth temperature between 10 and 25°C (Rubatzky *et al.*, 1999). Good quality roots (judged by length and diameter) develop at soil temperatures between 15.5 and 21.1°C (Petzoldt, 2008).

Yield is a quantitative character, resulting from the interactions of many components such as plant height, root diameter and fresh and dry mass (Ali *et al.*, 2003). Joubert *et al.* (1994) indicated that a yield of 30 to 40 tons/ha is regarded as a good average in South Africa, although 60 tons and more are often achieved by some farmers.

The nutritional value for carrots is predominantly for their β -carotene that gives them an orange colour (Alam *et al.*, 2004). This is largely genetically controlled, but it can be influenced by climatic conditions such as temperature and vary between the different stages of plant development (Kjellenberg, 2007).

Study Description

A glasshouse and growth chamber trial was conducted at the Department of Soil, Crop and Climate Sciences, on the Bloemfontein campus of the University of the Free State. The topsoil of a sandy loam Bainsvlei soil was collected in the field and dried, sieved through a 5 mm screen, mixed manually several times before filling the pots. Seed from two pre-pack carrot cultivars (Nectar and Star 3002) were sown in 0.34 m x 0.34 m x 0.35 m pots in four rows (4.8 cm apart) per pot and 8.5 cm in the rows. Pots were kept in the glasshouse at 20°C for four weeks to allow the seedlings to establish and reach the first true leaf stage whereupon they were moved to the controlled environment chambers. The trial was laid out as a factorial experiment replicated four times. Controlled environments were set to constant temperatures of either 10 °C or 18°C with a 12 hour photoperiod. The sown seeds were watered immediately after sowing and irrigation was done daily for four weeks in the glasshouse. In the growth chambers carrots were watered

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according to their water consumption, which varied with temperature until harvest. Carrots were manually harvested at twenty weeks after planting and yield parameters (root length and diameter, root mass) measured. Roots were then dried and sent for retinol analysis, following standard methods (Nelis and De Leenheer, 1983).

The root mass differed between the two cultivars, although not significantly. The highest mass for both cultivars was obtained at 10 °C and this was significantly higher than at 18°C (Table 1). Nectar had the highest root fresh mass of 34.26 g while that of Star 3002 was 39.12 g at 10°C.

Quality parameters such as root length and diameter differed significantly between both cultivars and temperatures (Table

Table 1. Influence of temperature on the yield and quality parameters of carrot cultivar Nectar and Star 3002.

Temperature(°C)	Cultivar		Mean
	Nectar	Star 3002	
Mass (g)			
10	34.26	39.12	36.69
18	11.62	9.11	10.37
Mean	22.94	24.11	
LSD _{T(0.05)}	T=4.14	C=ns	TxC=11.29
Root length (cm)			
10	14.21	16.16	15.19
18	7.49	6.57	7.03
Mean	10.85	11.36	
LSD _{T(0.05)}	T=1.10	C=ns	TxC=3.01
Root diameter (cm)			
10	22.63	20.87	21.75
18	16.86	14.65	15.75
Mean	19.74	17.76	
LSD _{T(0.05)}	T=1.56	C=1.56	TxC=4.25
Retinol content (mg kg⁻¹)			
10	475.54	253.80	364.67
18	774.44	591.88	683.16
Mean	624.99	422.84	
LSD _{T(0.05)}	T=ns	C=ns	TxC=ns

ns= Not significant.

1). Star 3002 exhibited the greatest root length (16.16 cm) at 10°C and showed the lowest root length (6.57 cm) at 18°C. Both Star 3002 and Nectar had significantly greater root diameter at 10 °C than at 18 °C (Table 1).

Retinol content of the roots showed no significant differences for any treatment (Table 1). This could have been due to too few replicates used to perform the analysis.

Recommendation

The results indicate that planting season plays an important role in yield and quality of carrots. Both cultivars should be cultivated during cooler periods (± 10 °C) in order to improve yield and external quality. However, it appeared as though temperature of 18 °C improved retinol content. This requires further investigation.

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