INFLUENCE OF IRRIGATION, FERTILIZATION AND CULTIVAR ON THE CARROT PRODUCTION FROM 2016 TO 2018

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Abstract. The aim of the study was to identify some healthy technological solutions for carrot production in the agricultural area Aiton, Cluj County, for three carrot varieties: Royal Chantenay, Atomic Red and Purple Haze F_1, especially in the actual conditions of climate worming and aridity (risk situations and areas strongly affecting the carrot production potential). The experiments were taken in Aiton locality (46° 31' and 46° 31' North latitude; 23°40' and 23°48 ' East longitude) from 2016 to 2018, containing 3 repetitions, 18 analyzed samples and 54 experimental plots. The crops were clustered into a complete randomly multifactorial system with plots of lands. It has been observed that after irrigation there was a 10% increase of the production (2.73 t/ha), compared to the crops that were not irrigated; also, fertilization by zeolite increased the carrot production by 27.1%, while the chemical fertilization increased the harvest only with 14.9%.

Keywords: carrots, irrigation, fertilization, zeolites

INTRODUCTION

The carrot (*Daucus carota*) is a vegetable, medicinal herb, biennial, having a developing time of 90-140 days (Bundinienė et al., 2009; http://www.fao.org). It prefers dry or salty regions, mostly sandy-loamy soils; the Mediterranean area is the homeland of carrots. The light, the silicic acid, the heat and the humus offer good developing possibilities. Carrots are one of the most perfect vegetables offered for humans, from the Umbelliferae family. The carrots leaves contain between 6-12% sugars; pectin, lecithin, glutamine and phosphatide are found in the roots; the yellow color is given by the carotene content. Carrots contain important amounts of vitamins B_1, B_2, C, D, and E. Those vitamins reduce the free radicals from the human body and feed the skin (Suman and Kumari, 2002; http://www.fao.org). Globally, China is the leader of the carrot production. Recordings of the Food and Agriculture Organization indicated that between 1994 and 2014, China had an annual carrot production of one million tons (http://www.fao.org).

Regarding the vegetables harvesting, the adaptability at local conditions implies, first of all, a detailed study regarding the natural conditions, especially the climate and pedological ones (Welch et al., 2016). Thus, the sustainable agriculture was developed, indicating a fair and just use of the natural resources and vegetation. For a successfully implementation of the sustainable agriculture some conditions for the agriculture producers must be fulfilled, namely crops rotation, fertilization, weed and pests' control, reducing the energy consumption (Suman and Kumari, 2002).

Obtaining a superior harvesting (quantitative and qualitative) with low production costs, implies a rational use of water and a fair use of irrigated lands by choosing the most proper method for spraying and calculating the water supply (Nagaz et al., 2012).

Certain study has proposed to analyze the influence of irrigation, fertilization and biologic material on carrot crops during 2016 and 2018, from a local agricultural area in Aiton locality, Cluj County.

MATERIALS AND METHODS

The factors used in this experimental study were: the irrigation regime – with two alternatives graduations (irrigation/no irrigation), fertilization with three graduations (basic fertilization/ chemical fertilization/ fertilization by using zeolites) and the biological material with three graduations (Royal Chantenay, Atomic Red and Purple Haze F_1). There were three (3) replicas of experiments (n =3), the number of the analyzed samples were 18 (v = 2 x 3 x 3), the total number of the plain plots were 54 (18 x 3). Test plain plots had a rectangular shape (90x60cm). The comparable crops were clustered in a randomized multifactorial system with plain plots.

The analyzed soil (source- plain plots of the carrot crop) is a cernosiom soil, Faeziom argic type; formed on clay deposits, it has a bioaccumulation orison rich in humus. Due to the physico-chemical characteristics, soils from certain class have the highest natural fertility, sustaining diverse crops (40%), grass lands (34.2%) and cattle run (12.5%). Sampling of soil was done at 30 cm depth. The land preparations started in autumn with disking, differential excavation, chemical fertilization with 200 kg/ha potassium chloride and 300 kg/ha superphosphate, and ended with a deep tilth (20-30 cm). For the basic fertilization 400 kg/ha Qrop Complex Top K (12-6-24) fertilizer was used, given in three stages: first before seeding, second when the plants had 3-4 leaves, and the last, after 15-20 days after the second stage; 350 kg/ha Doctor Zeolit® Fertilizator Eco zeolite was used as well. Dripping irrigation method was used, in order to use a rational and useful amount of water, which was a reduced water consumption compared to other irrigation systems characterized by a water consume of 3500-4200 m^3/ha. For statistics results, POLIFACT statistical software (analysis of the variant for complete random multifactorial experiments) was used.

EXPERIMENTAL CONDITIONS

Experiments were done in Aiton locality, situated in the central-east part of the Cluj County, between 46° 31' and 46° 31' North latitude and 23°40' and 23°48 ' East longitude; on a private property at 28 km from Cluj-Napoca and 17 km from Turda. Implications of certain localization are diverse, observing the spatial and temporal distribution of hydroclimatic and biopedological elements.

RESULTS

Influence of the three technological factors on the carrot harvest was indicated in Table 1. Table 1 showed the study results regarding the influence of A factor (irrigation) on the carrot production, 2016-2018, Aiton. Analyzing the obtained results and comparing the recorded values of the mean observations for both alternatives of experimental A factor, *irrigation regime*, in samples that were not irrigated, (graduation a_1) and irrigated ones (graduation a_2), it was observed that irrigation, independence from the fertilized or biological materials, had positive effects on the carrot production.

In Table 2, results regarding the influence of B factor (fertilization) on the carrot production, 2016-2018, from Aiton were indicated.

Table 1

Influence of A factor (irrigation) on the carrot production, 2016-2018, Aiton

Experimental condition	Carrot production (t/ha)	Relative production (%)	Difference (t/ha)	Significance
Not irrigated	26.15	100.0	0.00	Mt.
Irrigated	28.88	110.4	2.73	*

DL (p 5%) 1.36 DL (p 1%) 3.15 DL (p 0.1%) 10.02

Table 2

The influence of B factor (fertilization) on the carrot production, 2016-2018, Aiton

Experimental condition	Carrot production (t/ha)	Relative production (%)	Difference (t/ha)	Significance
Basic fertilization	24.13	100.0	0.00	Mt.
Chemical fertilization	27.74	115.0	3.62	***
Fertilization with zeolite	30.67	127.1	6.54	***

DL (p 5%) 0.50 DL (p 1%) 0.73 DL (p 0.1%) 1.09

Analyzing the results showed in Table 2, it can be seen that the chemical fertilization, respectively fertilization with zeolite had a very significant effect compared to the blank (basic fertilization); differences were recorded as 3.62 t/ha (chemical fertilization) and 6.54 t/ha (natural- zeolite fertilization) in obtaining natural products. Furthermore, analyzing the influence of C factor (carrot variety) on the carrot crop by choosing the most profitable solution cost/benefits was an important objective as well. Results were presented in Table 3.

Table 3

The influence of C factor (carrot variety) on the carrot production, 2016-2018, Aiton

Experimental condition	Carrot production (t/ha)	Relative production (%)	Difference (t/ha)	Significance
Royal Chantenay	30.21	100.0	0.00	Mt.
Atomic Red	24.58	81.4	-5.62	000
Purple Haze F1	27.76	91.9	-2.45	000

DL (p 5%) 0.43 DL (p 1%) 0.59 DL (p 0.1%) 0.79

Analyzing the C factor, cultivar – biological material with three graduations highlighted the existence of an important difference between the recorded average production, thus the blank Royal Chantenay variety had the best behavior compared to the rest of the two varieties, which recorded a low production with 5.62 t/ha (Atomic Red) and 2.45 t/ha for Purple Haze F1, in the same environmental conditions.

Table 4 showed the synthetic effect of the interactions between the three technological factors on the carrot production, 2016-2018, Aiton considering to identity the best solutions.

Table 4

The effect of the interaction between the three technological factors on the carrot production, 2016-2018, Aiton

Experimental condition	Carrot production (t/ha)	Relative production (%)	Difference (t/ha)	Significance
a_1 x b_1 x c_1	25.97	100.0	0.00	Mt.
a_2 x b_1 x c_1	28.67	110.4	2.70	*
a_1 x b_1 x c_2	20.00	100.0	0.00	Mt.
a_2 x b_1 x c_2	21.67	108.3	1.67	-
a_1 x b_1 x c_3	23.37	100.0	0.00	Mt.
a_2 x b_1 x c_3	25.10	107.4	1.73	-
a_1 x b_2 x c_1	29.09	100.0	0.00	Mt.
a_2 x b_2 x c_1	32.47	111.8	3.43	*
a_1 x b_2 x c_2	23.73	100.0	0.00	Mt.
a_2 x b_2 x c_2	25.33	106.7	1.60	-
a_1 x b_2 x c_3	26.80	100.0	0.00	Mt.
a_2 x b_2 x c_3	29.10	108.6	2.30	*
a_1 x b_3 x c_1	30.67	100.0	0.00	Mt.
a_2 x b_3x c_1	34.43	112.3	3.77	**
a_1 x b_3 x c_2	26.37	100.0	0.00	Mt.
a_2 x b_3 x c_2	30.40	115.3	4.03	**
a_1 x b_3 x c_3	29.43	100.0	0.00	Mt.
a_2 x b_3 x c_3	32.73	111.2	3.30	*

DL (p 5%) 1.93 DL (p 1%) 3.72 DL (p 0.1%) 9.86

The results analysis from Table 4 regarding the influence of the interactions between A x B x C factors, irrigation regime x fertilization x cultivar on the carrot harvest, in the environmental conditions from Aiton – Cluj, between 2016 and 2018, indicated that the irrigation regime and the applied fertilizer in the growing period had a significative influence on the recorded production of the experimental fields of the cultivar, which implies a recommendation for applying irrigation and fertilization for obtaining a successful production.

CONCLUSION

Through the certain study it has been found that irrigation had an increased effect on the production, of 2.73 t/ha, compared to the blank production, which means 10%, related to the crop that was not irrigated. Zeolite fertilization influenced as well the production in a positive way, increasing it at 27.1% compared to the production obtained (14.9%) after applying the chemical fertilization; those values could present interest for the farmers who want to grow this vegetable in the necessary conditions for obtaining natural products. The analysis of the effect of biological material during the entire experimental study indicated that quantitatively, the Royal Chantenay was the most productive variety, being the most

recommended variety for Aiton, by under a *not irrigated x not fertilized* technology grow. Regarding the effects of the three technological factors on the carrot production, the best results were obtained by applying *irrigation x zeolite fertilization – Atomic Red* technique, recording an increase of production of 4.03 t/ha (15.3 %), comparing with the black experiment (no irrigation and no fertilization). Thus, for the soils and climatic conditions similar to the Aiton area it is highly recommended to apply the irrigation – zeolite fertilization – Atomic Red procedure, to obtain productions with a high degree of quality and quantity, and also to recover the financial effort.

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