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WAYS OF INCREASING THE EFFICIENCY OF CARROT GROWING TECHNOLOGY

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Abstract

In the article, the results of the field research on carrot cultivation in Bostonliq district of the Republic of Uzbekistan, Tashkent region, as well as statistical data are given. The optimal planting scheme and planting dates used in the cultivation of carrots are given. The best time to harvest spring carrots is at the end of May and the first ten days of June, the mid-term carrot varieties should be harvested at the end of August and the first ten days of September, and the late-season carrots should be harvested between November 5-20. In addition, it has been proven that 30% of irrigation water can be saved and the carrot yield could be increased by using the methods of furrow and sprinkler irrigation.

Key words. Carrots, technology, planting scheme, planting period, irrigation, surface irrigation, sprinkler irrigation, irrigation rate, productivity.

INTRODUCTION

In addition to having a negative impact on the environment, population growth increases the demand for food and water resources, as well as the number of environmental problems. At the same time, the global population is expected to rise from 7.8 billion to 10.9 billion by 2050, owing to significant growth in population and economic activity in the second half of the twenty-first century. According to data, the population's demand for water will increase by 160% by 2065. This leads to a number of problems, including climate change, an increase in average weather temperature, a decrease in crop yields, and an increase in the global demand for

agricultural products, including food. Modernization of irrigation systems is important for sufficient production of agricultural products and to fully meet the water needs of agricultural crops. Improvement of irrigation water management and use of water-saving technologies will help to alleviate the above problems [1,2,3,4,5,6].

In the world, including the Republic of Uzbekistan, where water scarcity is increasing year after year, effective and rational use of irrigated land, as well as economical use of existing water resources, is and will remain one of the most important priorities in agricultural reform. Morever, climate change has a significant impact on agriculture, which is one of the most dependent on the weather sectors of the economy. Taking into account all these current problems, water saving technologies are applying in all over the world including in Uzbekistan [7,8,9,10].

It is known that the efficiency of agricultural production, ensuring the economic and food security of our country, improving the material well-being not only of rural workers, but also of the population of Uzbekistan, is inextricably linked with the productivity of irrigated land, which is our priceless wealth, and regular improvement of its quality [11].

There are a number of decisions and decrees of the President of the Republic of Uzbekistan on measures to accelerate the introduction of water-saving technologies in agriculture. In order to increase the effectiveness of the mechanisms for promoting the introduction of water-saving technologies in agriculture, to achieve a stable supply of water to irrigated areas, it is important to grow vegetable crops, including carrots, using sprinkler irrigation technology within the framework of the implementation of the decision on the wide introduction of water-saving irrigation technologies in the cultivation of agricultural crops [12] .

To support the implementation of water-saving irrigation technologies, the Ministry of Economy and Finance of the Republic of Uzbekistan, the Ministry of Investments, Industry and Trade of the Republic of Uzbekistan, the Ministry of Agriculture of the Republic of Uzbekistan, training in new technologies for the production of fruit and vegetable products, the production of fruit and vegetable products produced by members of agricultural associations a number of tasks on the procedure for providing subsidies to cover 50% of the costs associated with conducting marketing research in foreign markets have been defined[13].

In recent years, in the Republic of Uzbekistan, comprehensive measures have been implemented in order to fully satisfy the population's needs for food and other agricultural products, in particular, vegetables. In the cultivation of vegetable crops, including carrots, new innovative technologies are used to produce products on an industrial basis.

1.The main part

Carrot is one of the most important root vegetables of the "Apiaceae" family, cultivated worldwide. According to the characteristics of carrot roots, it is divided into two types in agriculture: eastern and western carrots. Nikolay Vavilov noted that the centers of origin of cultured carrots are mainly Asian regions. In addition, the main centers of carrot cultivation in Asia are Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan. According to the research of Stolarczyk and Janickan, Afghanistan was the first center of carrot diversity, and Turkey was the second [14].

Vegetables have been consumed as food and medicine since ancient times. Natural food is the basis of most people's diet. It was found that proper selection and growing methods of vegetables not only provide the body with carbohydrates, lipids, vitamins and minerals, but also proteins containing amino acids important for health [15,16].

There are many varieties of carrot types, white, orange, red and purple varieties are common. Carrots have biologically active substances, including carotenoids, anthocyanins and other phenolic substances. When this vegetable is included in the human diet, it becomes an adequate source of nutritional antioxidants. Carrots contain the highest levels of antioxidant chemicals, including carotene, vitamin E, and anthocyanin. Surprisingly, the amount of this antioxidant root property found in different varieties is responsible for the carrot's color. Due to its nutritional and antioxidant capacity, carrots have the ability to prevent certain diseases, including cardiovascular diseases and certain types of cancer [17].

Among the vegetables, it is distinguished by the easy cultivation and usefulness of vegetables. That is why it was planted in different places of the republic and produced abundantly. In particular, in 2022, a total of 149,100 hectares of vegetables were planted in all farm categories, of which 78,100 hectares were the harvest of farmers and peasant farms (23,000 hectares were planted, 11,200 34 hectares of

orchards and vineyards) opened the door to an area of 9,000 hectares. In these geographical areas, 3.1 million tons of green cultivation is projected. Carrots have increased by 32,000 hectares over the past two years. This year's harvest, in November-December 2021, vegetables were planted on an area of 30,900 hectares in all types of fields. In view of the above, it is necessary to increase the water demand of green vegetables based on the technology of rainwater irrigation at the time of water shortage [18].

Today, several types of carrots are grown in the republic. In particular, as early varieties of carrots, it is recommended to plant: Mshak-95, Nurli-70, mid-early Mirzoi yellow-304, Red Mirzoi-228, Nantskaya-4, Shantane-2461, Zynatli varieties.

In the central regions of Uzbekistan, carrots are planted in spring, summer and before autumn. In these regions, carrots are planted in spring from March 1-15, in summer from June 10 to July 10, before autumn from November 10 to December 10 [19].

It is important to prepare the field for planting, before planting carrot seeds, the residues of the previous crops are crushed with RM-1.4, SI-3.6 plows and spread on the field surface with BDM-1.8, BDM-2.7 disc or BZSS - It is necessary to work at a depth of 6-8 cm with light toothed harrows of the 1.0 model. Light irrigation was carried out at the rate of 400-600 m^3 per hectare in the areas where soil moisture is not enough or dry.

2. Research methodology

Field studies and observations of carrot irrigation with sprinkler irrigation were carried out on the basis of methods developed by "Scientific research institute of vegetable growing", "Scientific research institute of agrotechnologies of cotton selection, seeding and growing", "Tashkent Institute of Irrigation and Agricultural Mechanization Engineers" National Research University and other research institutes [20].

The hydrological data of the area where the field research was carried out was obtained from the hydrogeological expedition of Tashkent region, and the mechanical composition of the soil according to the scientific research carried out in the field in genetic layers 0-100 cm. It was determined by the method of N.A. Kachinsky based on the samples taken from the soil shear in the depth to the layer.

The amount of radiation and evapotranspiration was determined using the CropWat program based on the indicators of the hydrometeorological station.

Based on the mechanical composition of the soil, 220 kg per hectare in pure form, taking into account the gray soil of the research area. nitrogen, 160 kg. phosphorus, 100 kg. potassium was given. Fertilizers were given according to the norms based on the recommendations given by scientists, in accordance with the region [21,22].

75% of the annual amount of phosphorus fertilizer, all of potassium was given to the irrigated area during the main tillage period, and the remaining 25% was given by fertilizing the land. Nitrogen fertilizers were given in two split feedings during the growing season. The first feeding was carried out after the number of plants was thinned, and the second when 2-3 leaves appeared. Fertilizers were applied closer to the plants between rows with fertilizer spreaders.

3. Results and discussion

Field research was conducted in Soylik region, Bostonliq district, Tashkent region, Republic of Uzbekistan. In the course of this research, the application of sprinkler irrigation technology in the growth and development of carrots consisted of improving the technical elements of irrigation and developing the irrigation procedure, as well as determining and analyzing the growth, development, productivity and total water consumption of carrots.

The mechanical composition of the soil is important in the cultivation of carrots, therefore, before planting carrots, the nutrients in the soil and soil moisture were monitored, and based on the results, the required amount of nutrients was given to the root during the growth process (Figure 1) and sprinkler irrigation was carried out on the soil taking into account the humidity.

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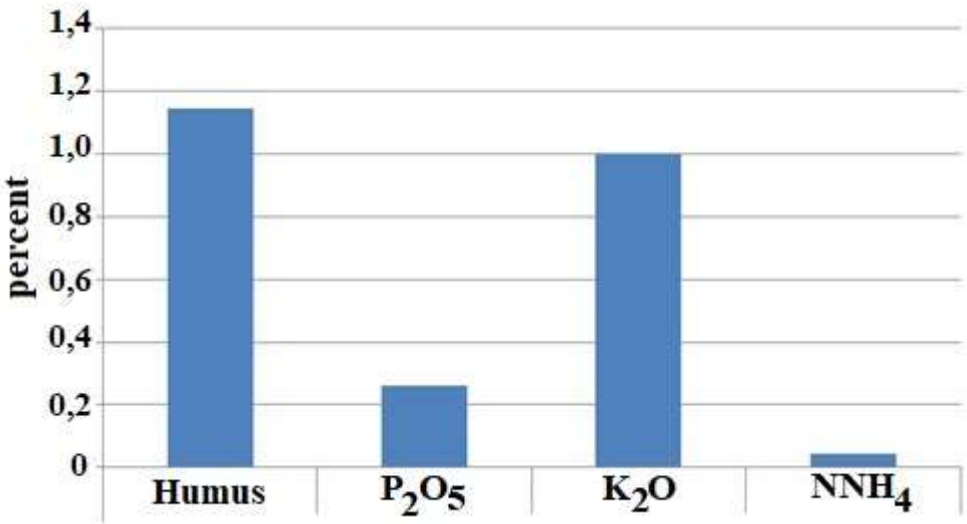


Figure 1. Substances in soil in the study field

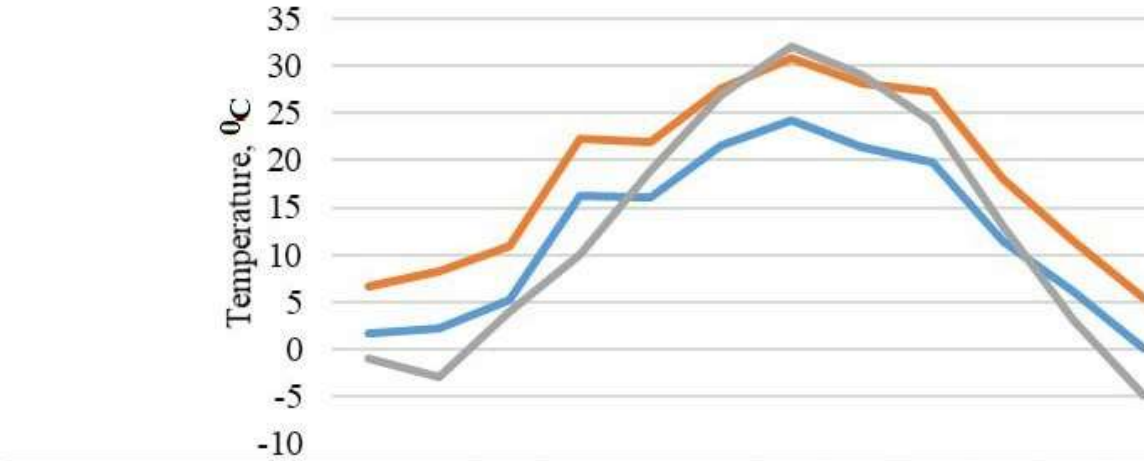
In the experiment, samples were taken from three different places of the research land to know the condition of the soil. Each sample is 30 cm. taken from the soil, the reason is 30 cm above the ground for the root to grow sufficiently. The soil composition at depth is important. Soil composition was determined using the method of N. Kachinsky. Average soil moisture in the study area was 9.45% and humus content was 1.146 (Figure 1). It was determined in laboratory conditions that the average content of phosphoric anhydride is 0.26%, potassium oxide is 1.004% and variable nitrate content is 0.044%.

Carrot seeds were sown with SKON-4.2, SMM-4 seeders at a depth of 1.5-2 cm, in a scheme of 52 x 8, 62 x 8 cm. Seed consumption is 5-6 kg per hectare. One of the most important issues in the process of caring for carrots is to get the seed straight from the ground. Carrot sprouts appeared in 5-7 days and germinated in 10 days when soil moisture was properly managed.

A number of agrotechnical measures were implemented in the cultivation of carrots, including weed control measures immediately after carrot germination. Carrots are passed 2 times. The first transplant was carried out when the carrot produced one leaf, and the next one when it produced 3-4 leaves. The only one was made during the transition. Herbicides were used to control weeds. Weed control was carried out in the autumn against perennial weeds. In this case, 1-2 kg of "Fuzilad Super" 12.5% drug per hectare. 1.5 kg

of "Super Zemek" was prepared and sprayed in 750 liters of water at the time of weed seed development of 2-4 leaves.

Rainfall and weather conditions were taken into account in field work. As shown in the given graph, temperature is high in June, July and August, with a maximum temperature of 30 degrees in July (based on 2022 data). Under such weather conditions, the soil temperature also increased accordingly, and this did not affect the irrigation rate (Figure 2).



Average air temperature	1.7	2.2	5.2	16.3	16.1	21.5	24.2	21.4	19.8	11.5	6.1	
Maximum air temperature	6.6	8.2	10.9	22.3	21.9	27.7	30.8	28.2	27.3	18.1	11.5	5.
Soil temperature	-1	-3	4	10	19	27	32	29	24	13	3	-
Months	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X**	**XI**	**X**

Figure 2. Air and soil temperature at the research field

Irrigation was carried out in two different ways. Soil moisture management required for carrots was implemented, including furrow irrigation and sprinkler irrigation.

Since carrot is a water-demanding crop, it was tried to keep the moisture in the soil high. It was considered that if there is a lack of moisture in the soil, the core will become woody and not suitable for consumption.

In carrot cultivation, pre-irrigation soil moisture was required to be around 70-75 percent of the soil's marginal field moisture capacity and was managed accordingly.

There is critical evidence that ionizing radiation may stimulate plant growth at certain stages of development and may induce earlier flowering. It can also stimulate lateral development, presumably by auxin inactivation. Moreover, evapotranspiration also plays an important role in agriculture. It provides a relatively objective and reliable estimate of the water requirements of actively growing plants in a farm situation. Evapotranspiration information can be used to more accurately schedule irrigations to achieve top yields and improve water productivity. We calculated these data using CropWat model taking into account minimum and maximum temperature, humidity, wind and the sun hours in 2022 [Figure 3].

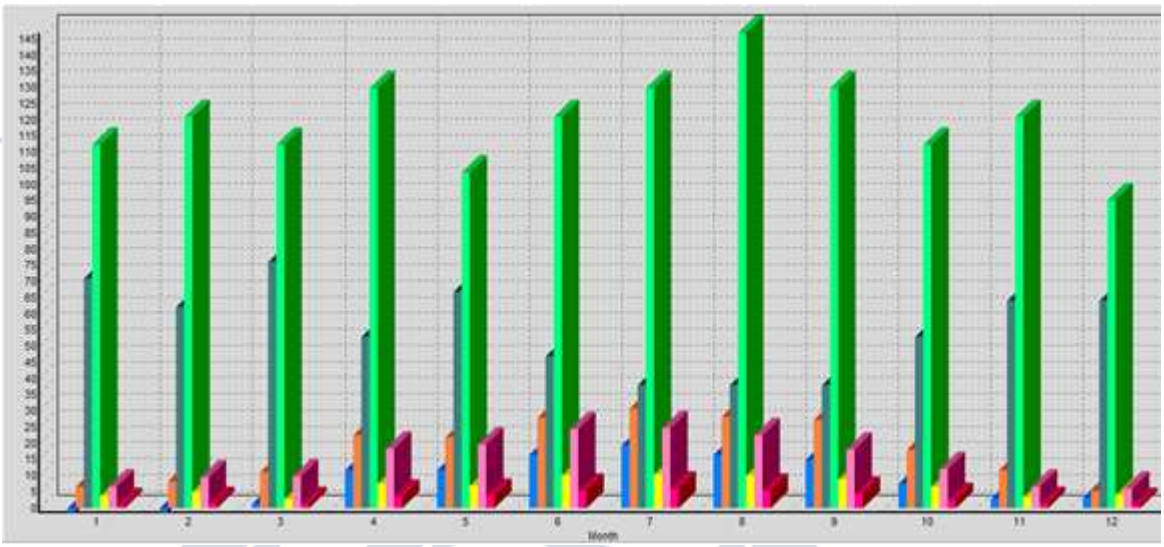


Figure 3. Changes in the amount of radiation and evapotranspiration in the research area by month

In the conditions of Uzbekistan, carrot seeds are mainly sown in autumn, winter and summer, and cultivation has been started on this basis. When it is sown in autumn and winter, the growth period of carrots is quite cool, but the time of rooting is in hot summer. When planted at this time, the seed germinates easily due to the accumulated moisture from the amount of rain that fell in winter and spring. Sometimes, only in dry years, seed water is given to accelerate seed germination.

Root vegetables planted in autumn and spring are watered from the second half of April. At the beginning, the crop is watered every half to two weeks, and from the second half of May, when it grows rapidly, every 7-8 days. Irrigation is stopped when it is established and harvest time is approaching.

Late carrots are sown during the hottest time of summer, i.e. from the end of June to the beginning of July, the period of their formation coincides with the cool days of autumn. Therefore, water is applied for 2-3 days after sowing the late carrot seeds. After 2-3 days, water is given again. In this case, taking into account soil moisture, the duration of watering cannot be increased by one day. The seed water is applied until the grass turns green. After three or four waterings of carrots, the grass will be covered. After that, from September 8, it is necessary to irrigate every 10-12 days. If the carrot is watered in this order, it will be watered 11-12 times per season in areas with deep seepage water, and 6-8 times per season in areas with surface water seepage (the option using the surface irrigation method). In the variety using sprinkler irrigation technology, the number of irrigations is 1.8-2 times more than in the method of furow irrigation. It should also be noted that the amount of water supplied during the season was 1.5 times smaller than the option using the furrow irrigation method. High water productivity has been achieved in the variety using sprinkler irrigation technology.

The cultivated carrot variety requires water determined based on its biological characteristics, therefore, before the irrigation, the soil moisture before irrigation drops to 70-75% compared to the field moisture capacity of the soil, and the moisture is significantly reduced. At such times, carrots are irrigated at the rate of 550-600 m^3 per hectare, depending on the soil conditions.

Irrigation is a tool that strongly affects the soil and its fertility. Carrot yield increased and quality improved as a result of proper irrigation management. Therefore, proper organization of irrigation is the great importance in growing a consistently high and high-quality carrot crop. When irrigation is well organized, the productivity of carrots increases, the quality of the product improves and the cost decreases.

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Figure 4. Monitoring processes of growing carrots in the field

If we focus on the signs of carrot development, when the carrot germinates, the seed will raise its leaves. Its stems are very thin, purple in color, green in color, and true double true leaves appear after the seed stage leaves. Later, densely divided 3-5-fold leaves were formed. 10-15 leaves were formed with the leaf band cut and they were dark green in color. And in the second year of growth, it gave stems and produced flowers. The height of the stem is 70-100 cm high, it is hollow inside, white veins along the stem are clearly visible. Inside the stem is a white layer. The ball flower consists of a large number of complex, white florets, reminiscent of an umbrella. The flowers are pollinated by foreign insects. The seed or fruit is a double seed that can be divided into two parts. The back of the carrot seed has ribs or 3-4 rows of lines, which are filled with essential oils and small spines are visible on the seed. Before planting, the seed was sown without thorns by rubbing by hand and using special tools. The weight of 1000 seeds is 1.6-2 g.

Carrots are yellow and golden in color and have conical, cylindrical shapes. In most varieties, the flesh is golden in color.

Carrot seeds began to germinate at 2-3 C, for rapid seed germination was observed in 3-5 days. According to its biological characteristics, carrot is a cold-resistant plant. In early spring, its lawn can withstand temperatures as low as 5-6 degrees Celsius, and at the end of the growing season, it can withstand temperatures as low as 10-14 degrees Celsius. Even if there are no above-ground leaves, another set of leaves will form in early spring. The reason for this is that the root of the carrot is completely buried in the soil.

Carrot is the most demanding of moisture among root vegetables, it is certainly resistant to drought, but if there is insufficient moisture in the soil, the root fruit will crack and become dry and woody. The meat will not be juicy. It also grows in drought conditions, but yields less. Therefore, carrots were watered more often. Moisture is essential at the beginning of the growing season when the grass is forming and the roots are filling. If there is not enough moisture at this time, the grass may become dry or brittle.

Summary

Based on the conducted field research and the learned information, it is necessary to harvest carrots in the conditions of Uzbekistan within the specified calendar periods. The most optimal harvesting time for spring carrots is the end of May and the first ten days of June, the end of August and the first ten days of September for mid-term crops, and November 5-20 for late-term carrots. Failure to comply with these deadlines can result in significant crop losses. With a late harvest, the taste of carrots deteriorates. If it is not harvested in time, the carrot will be rough and juicy. The quality indicators are degraded and become unfit for consumption. When the harvest time is delayed, carrots begin to rot, and the yield loss can reach 5-10 percent. In addition, the formation of small additional rhizomes and severe cracking of rhizomes are observed. It is necessary to start harvesting evening carrots before the onset of permanent frost. Pre-harvesting results in huge losses. In the autumn months, the main formation of root crops rich in chemical composition takes place. It is during this period that 20-30% of the products of photosynthesis reach the roots from the leaves. During the harvesting of carrots, it is necessary to try to keep the tubers less in the open air, withered tubers lose their appearance and are unfit for storage. Depending on the size of the cultivated area, harvesting of carrots is done by hand or with self-propelled harvesters.

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