University of Thi-Qar Journal of agricultural research

Thi-Qar Journal of agricultural research

ISSN Onlin:2708-9347, ISSN Print: 2708-9339 Volume 13, Issue 1 (2024) PP 212-216

https://jam.utq.edu.iq/index.php/main *https://doi.org/10.54174/utjagr.v13i1.307*

A Study of Phenotypic Characteristics of Eggplant Grown via the Sandponic Technique

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Abstract

Sandponic is a developed technology working for the prosperity of food security. It means growing plants and fish together in a recycling environmental system which uses natural bacterial cycles to use fish waste as plant nutrition. Eggplant is regarded as the most important Solanaceae crops because their nutritional benefits. This plant is a major crop in both temperate and tropical regions in this world. Eggplant – French Flomorin varity- was planted in sandponic boards and natural ground. Five plants were selected randomly from each experimental unit in the green-growth phase and the indicators of the green-growth were recorded. The results showed that there are significant differences in the height of the plant regarding the water quality, temporal period and the interaction between them. The quality of water without fish recorded the highest mean of plant height, whereas the period 140 days after growing recorded the highest mean of the plant length in comparison with the period 70 days from the growing time. In addition, the study results indicated significant differences in the number of the plant leaves for each the water quality, temporal period and the interaction between them. That is, the number of leaves in plants irrigated with water without fish was the highest in comparison with the number of leaves of the plants irrigated with fish water. Concerning the temporal period, the period of 140 days from the growing recorded the highest mean of leaves number in comparison with the period of 70 days since the time of growing. Regarding flowers number, the results showed significant differences in the mean of water quality and no significant differences in the temporal period and the interaction between them. The results recorded the highest number of flowers after 70 days from growing in comparison with their number after 140 days from growing. Also, it appeared that the highest number of flowers in plants irrigated with water without fish compared with those irrigated with water having fish. The results showed that there were significant differences between water quality, temporal period and interaction between them concerning the plant height and leaves number. Regarding to the number of flowers, the study results indicated that there significant differences of water quality only, whereas -in regard to temporal period and interaction between them, no significant differences were shown by the results.

Keywords: Sandponic, Eggplant, Phenotypic Characteristics

I. INTRODUCTION

Eggplant (Solanum melongena L.) is one of the Solanaceae family. It is a self-pollinating plant. Eggplant growing is spread in different countries because it is a light-neutral plant [1,2]. Eggplant is one of the important vegetable crops in Iraq; This is because it is used as food, besides its good economical incomes for the farmers and its many medical benefits [3,4]. In Iraq, irrigated growing depends mainly on surface irrigation method that is one of the traditional methods. The ratio of lands irrigated depending on this method is 60% [5]. Sandponic systems are considered an advanced technology working on the prosperity of food security, environmental luxury and economic advantages [6]. It is defined as growing plants and fish together in a recycled environmental system using natural bacterial cycles to use fish waste as nutrition for plants [7,8]. A study about Arabidopsis thaliana found out that the growth of leaves area determines the light-intercepting capacity of the crops. Mostly it is used as an alternative for plant growth in apparent pattern that is distinctive with highly productive and quality. The leaf surface area is a crucial indicator of forming the leaf apparatus that is responsible for photosynthesis, transpiration and the absorption of nutrient elements [9]. The importance of plant height lies in measuring the average of the plant growth. The plant height above the ground is considered as an indicator of the crop's productivity

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and growth in the suitable environmental conditions and the absorption of required nutrient elements [10]. The flowers number in the grown plant represents one of the important characteristics affecting crop productivity. Flowers are the reproductive apparatus of the plant. Later, they are transformed to be fruits. Consequently, the increase of flowers number reflects the increase of the crop fruits [11]. The appropriate pollination of flowers is regarded as one of the general determinants of getting good quality fruits and seeds. The heterogeneity phenomenon presenting in eggplant flowers lessens the productive capacity of vegetables [12].

Using sandponic technique as a means for producing organic plants free of chemical fertilizers. Also, it can be a solution to water scarcity which many countries suffer from and knowing the impact of sandponic technique for producing vegetables and fish at the one cycle and with the lowest financial cost.

II. MATERIALS AND METHODS

Experimental Location

For studying the use of sandponic technique in growing vegetables and solving water scarcity, this field experiment was conducted in a plastic greenhouse in Baladruz-Imam Asker district located east of Diyala governorate- Iraq, 33º49, 28.25''N4504,48.20''E in winter 2023.

Field Preparation

The preparation of the field which its area was 120 m^2 involved plowing, smoothing and leveling the soil. The sandponic area was designed in the form of panels built with blocks. There are three panels – T1, T2, and T3. The panel was 3m length, 1m width, and 40cm height. Each panel was covered with isolating nylon. At both sides of the panel, 2 irrigation plastic tubes (its diameter = 1.5 inch) were placed. The tubes were dissected and wrapped with gauze. Two pools were prepared and each one was 2m length, 1m width and 1m height. Each pool was filled with 1500 liters of water taken from Al-Rose springing from Hamrin Lake, Diyala governorate. Both pools had the same quantity of water used for irrigating the sandponic panels and the normal ground. Also, 3 boards of land (T1, T2, and T3); each one was 3m length and 1m width. Only 100 of carp fish brought from one of the private farms in the Nahrawan area, Baghdad governorate was put in the sandponic pool (i.e., aquarium) which was supplied with oxygen. A third pool (1m length, 1m width, and 50cm height) was prepared to collect irrigation water of the sandponic panels; then the water returned to the fish pool. In these panels was put fine sand was wished for several times before culturing. Eggplant plant (French Flomorin class) was cultured in 25th Dec. 2022 on the sandponic panels and normal ground. That is, 72 plants were in the sandponic panels, and the same number was cultured in the ground.

Only 5 plants were selected randomly from each experimental unit in the green-growth phase and the indicators of the green growth were recorded.

Plant Height (cm)

The plant height above the grown to the grown peak was measured for the selected 5 plants from each experimental unit.

Leaves Number in the Plant (leaf. plant^{-1})

The mean of this characteristic was assessed after numerating all the leaves of the selected plants from each experimental unit- from the first green leaf near the soil surface to the plant peak.

Flowers Number in the Plant (flower. plant^{-1})

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The number of flowers was assessed per plant in the flowering phase in all the 5 selected plants and the average was identified.

III. Results and Discussion

The Studied Features of the Plants

The Plant Height

The results appeared in Table (1) showed significant differences in the height of the plant regarding the water quality, temporal period and the interaction between them. Concerning water quality, water with no fish recorded the highest mean of plant height; it was 50.556 cm compared with water with fish that recorded the lowest mean 45.167cm. Regarding the temporal period, the period 140 days after planting recorded the highest mean of plant height; it was 74.722 cm in comparison with the period 70 days after planting; its plan height mean was 21.000 cm.

The increase in the height of plants irrigated with water without fish is attributed to the presence of potassium, phosphorus and organic material in the normal soil in comparison with the sandy soil.

Table (1): The impact of water quality, measuring appointment and the intersection between them on the height of the eggplant (cm).

Temporal period / Water Quality	Temporal period		Mean
	70 days from planting	140 days from planting	
Water with Fish	B 18.444	B 71.889	B 45.167
Water without fish	A 23.556	A 77.556	A 50.556
Mean	A 74.722	B 21.000	

Duncan Test: Water quality: significant Temporal period: significant Interaction: significant

Leaves Number in the Plant (leaf. plant^{-1})

The results of Table (2) showed significant differences in the number of plant leaves per water quality, temporal period, and interaction between them. The mean of leaves of plants irrigated with water without fish was 43.500 leaf. plant^{-1}, whereas the mean of leaves of plants irrigated with water with fish was 34.000 leaf. plant^{-1}. Concerning the temporal period, the period 140 days from planting time recorded the highest mean of leaves; it was 65.833 leaf. plant^{-1} · The results of this study were correspondent with Çekin's results [13]; the mean of leaves in sandponic system was lower than the normal irrigating system 22.86 leaf. plant^{-1}.

The number of leaves is considered one of the important factors that affect the plant productivity. The differences in leaves numbers are related to the nutrient content of irrigating water particularly nitrogen absorbed by the plant [14].

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Table (2): The impact of water quality, measuring appointment and the intersection between them on the leaves number in the eggplant.

Temporal period / Water Quality	Temporal period		Mean
	70 days from planting	140 days from planting	
Water with Fish	D 8.000	B 60.000	B 34.000
Water without fish	C 15.333	A 71.667	A 43.500
Mean	B 11.666	A 65.833	

Duncan Test: Water quality: significant Temporal period: significant Interaction: significant

Flowers Number in the Plant

The results of Table (3) showed there were significant differences in the mean of water quality and no significant differences in the temporal period and the interaction between them. The results recorded the highest number of flowers after 70 days from planting with a mean that was 3.278 in comparison with their number after 140 days from planting. Also, the results showed the highest number of flowers with water without fish with a mean that was 3.778 compared with the irrigation with water with fish in a mean that was 2.444.

The increase in the flowers number when irrigating with water without fish was attributed to the availability of nutrient elements in soil. These elements play an important role in producing plant hormones that in turn influence the plant flowers. Eggplant is considered one of the sensitive plants to nutrients and the increase in amounts of nitrogen, phosphorus and potassium leads to the increase of flowering speed and the deficiency of nitrogen and phosphorus leads to delaying flowering [15].

Table (2): The impact of water quality, measuring appointment and the intersection between them on the flowers number in the eggplant.

Temporal period / Water Quality	Temporal period		Mean
	70 days from planting	140 days from planting	
Water with Fish	2.556	2.333	B 2.444
Water without fish	4.000	3.556	A 3.778
Mean	3.278	2.944	

Duncan Test: Water quality: significant Temporal period: non- significant Interaction: significant

Conclusions:

The results showed significant differences among water quality, temporal period and the interaction between for plant height and leaves number. On the other hand, concerning flowers number, the results indicated significant differences of water quality only. In regard to the temporal period and interaction between them, the results did not show any significant differences.

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