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THE EFFECT OF IRRIGATION PERIODS AND SPRAYING OF HUMIC ACIDS ON THE GROWTH AND PRODUCTION OF OKRA UNDER PROTECTED AGRICULTURE CONDITIONS

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Abstract

The study was conducted in the green houses of Faculty of Agriculture, University of Wasit under protected agriculture conditions during the winter season 2016-2017, due to the environmental conditions of Wasit to know the possibility of cultivating and producing okra, studying perfect irrigation periods using drip irrigation technology. The period between an irrigation and another was 3-5-7 days, and studying the effect of spraying humic acids with three different concentration ;(0, 2.5, 5) ml/l, and the Interaction in growth and the produced okra which is locally known as batra. The research was conducted as a practical result using Randomized Complete Block Design RCBD with three replicates. The results showed the possibility of cultivating okra with a commercial production and economic income ranging between 5-9.67 tons/h for different factors with an average of 7 tons/h. The results showed the significance of spraying humic acids in all vegetative qualities which positively affected the product. The results also showed the importance of irrigation each 7 days which gave the highest increase in the product. The results also showed the Interaction between watering and spraying humic acids F_2I_2 which gave the highest increase in all qualities.

Key words: Humic, okra, irrigation periods, spraying

Introduction

Okra *Abelmoschus esculentus* L. belongs to bambrian family Malvaceae. It is one of the important summer vegetables in Iraq for its nutrition and commercial value. It is composed of 16.17 proteins, 60.90% carbohydrate, beside other important nutrition elements; iron 371 ppm, calcium 107 ppm, (Matloob *et al.,* 1989).

Acids play a role in improving soil properties and absorbing its degradation products by the plant beside effecting the plant metabolism for they are involved in the synthesis of many effective compounds that affect the cell membrane which increases the number of cells, division, and elongation. Also, when acid is sprayed on the vegetative aggregate, it increases the permeability of the cell membrane, (Alsahaf, 1989). Many researchers confirmed that the increase in vegetative qualities of the product increased when it was treated with liquid humic acids through their study of okra, (Jaafar *et al*., 2012) and (Alqaisi *et al.,* 2012).

Alsaadi (2012) indicated that spraying with 20ml/l of humic acids increased the vegetative qualities of tomato. Yassir *et al.,* (2009) found out that spraying pepper with humic acids increased the total product. Ertan (2007) confirmed that spraying tomato with 20ml/l humic acids increased the plant hight and the dry weight as well as the quantity of the product.

The increase of world population and the water scarcity need to be considered to find ways to regulate the use of water and choose plants that tolerate spacing irrigation periods. Water is a good medium to dissolve and transport metabolites and growth regulators. The amount of ingredients mRNA responsible for the synthesis of proteins (El-Sahookie, 2009). It is necessary for growth and production when it is added with optimal levels in the root area to be ready for absorption by the plant. Low soil moisture content causes water stress for plants, resulting in reduction in photosynthesis because of the little plant size and low CO_2 permeability. It also results in small leaf area (Ackerson *et al.,* 1997). Abdul_ Rahman (2006) explained that the values of the okra plant increased gradually with the stages of growth progress until it reaches its maximum value at flowering and then begin to decline at the end of the crop. As the growth

season progresses, the vegetative size of the plant will increase as well as its water needs in its physiological processes and building of its tissues. The study of water consumption is particularly important to add new lands to irrigational agriculture. Modern management recommends rationing water consumption to control water scarcity. Therefore, crops water consumption is important for irrigation management and scheduling program (Nameer and Hassan, 2013). (Abdulaal *et al.*, 2012) found that watering tomato to 100% gave good vegetative qualities of the plant. The experiment aims at knowing the effect of watering and humic acids and the Interaction between them on the growth and the product of okra.

Materials and methods

The experiment was conducted in the green houses of the faculty of agriculture, university of wassit during the winter season, 2013-2014. The dimensions of the plastic house are; 50×9m. The plastic house was divided into 6 plates. The width of each plate was 75cm. The distance between a plate and another was 1m. The local type, batra, was used. The seeds were planted at the beginning of January in corky dishes placed at a plastic chamber inside the green house to maintain a temperature level that allows the germination of the seeds. A month later, the seedlings were transferred to the plastic house and planted with 30cm distance between a plant and another. A drip irrigation system was used to water the crop. (The drip irrigation system... was used). Soil samples were randomly collected from several locations in the plastic house. The soil was dried, grinded, and sifted by a 2mm sieve. The soil 1:1 was prepared for testing. The soil texture was estimated by the pipette of virtual density through paraffin wax method according to Singh, 1980. The pH was measured by the pH meter device. Salt concentricity was measured using by ECE device. Calcium, Magnesium, Sodium, and potassium were measured by Flame Photometer device. Carbonates and bicarbonates were estimated through Corrosion with Sulfuric acid. Chloride A was measured through corrosion with silver nitrate. Sulfur was measured by precipitation in the form of barium sulphate.

Table 1: Shows that. The tip was measured by a dual cylinder device.

Value	Qualities
0.155 mm/m	Major tip rate
2.5 g/cm^3	Real density
1.28 g/cm^3	Virtual density
50.04%	Porosity
34%	Field capacity rate

Table 2: Physical and chemical qualities of the soil.

Dissolved ions (meq/l)				P	TotalN	ECMl	PH	texture	Real	Virtual	Soil details%			
Na	Mg	Ca	K			Moz.Cm			Density	Density	Sand%	Silt%	Mud%	Quality
16.7	12.8	24.3	0.815	1.19	0.33	4.3	6.7	Muddysilt	2.55	1.29	2	36.4	61.6	Value

The experiment was carried out as a practical experiment using Randomized Complete Block Design R.C.B.D. with three replicates including two factors; the first was the spraying with humic acids (contains 12% humic acids and Micro elements) in three levels; the first level, without spraying which is symbolized F0. The second level, spraying with 2.5ml/l which is symbolized F1. The third level, spraying with 5ml/l concentration which is symbolized F2. After a month of planting inside the plastic house, the plants were sprayed and the period between each spraying was two weeks.

The second factor was irrigation, which was on three levels; the first, watering each 3days which is symbolized I_0. The second level, watering each 5days which is symbolized I_1. The third level, watering each 7days which is symbolized I_2. The number of factors inside the experimental unit was 9. Each experimental unit contained 20 plants. The experiment was analyzed and differences were examined due to less difference test L.S.D. under probability level of 0.05. The following qualities were studied.

1- Plant height (cm). Plant height was measured by using the metric tape from the area of contact of shank with soil to the growing top of the plant. 10 plants were chosen randomly.

2- The leaf area (m^2/plant). It was measured due to the dry weight by taking a leafy disk for which dimensions are known, drying it and then measuring the leafy area of each plant.

3- The dry weight (gm). It was measured at the end of the season by taking five plants with their roots, drying them at 70c for two days and then the sensitive scale, (Al-Sahaf, 1989).

4- Plant crop weight average (gm). It was measured through the result of the experimental unit divided by the number of its plants.

5- The total yield (ton/h). It was measured through the

Table 3: Chemical qualities of irrigation water.

Ds/m	PH	Dissolved ions (meq/l)					
EC		CO	HCO	CL	Ca	Mg	Na
1.4	8.05	0	26.6	8.5	6.4	5.6	6.1

accumulative crop for all seeds since the beginning of growth season, 22-3-2014 to 17-4-2014.

Fruits number. It was calculated through dividing the fruits number by the plants number.

Results

Table 4 indicates that there is a moral effect between the irrigation periods and the concentration of the humic acid and interaction between it on height of the okra plant. Drip irrigation every 7 days is recorded, the highest height of the plant more than irrigation periods is 5 days and 3 days. Concentration of 2.5 and 5 ml/L to humic acid registered a plant height of 133.00 and 135.67 cm superior to the comparison treatment (F0). The Interaction between workers (humic acid and irrigation periods) notes that the addition of humic acid to the okra is a better benefit than irrigation water and increase in altitude, with 5 ml/L in the irrigation period of 7 days (143.00 cm), while the lowest plant height was observed in the comparison treatment and when A irrigation is done every three days. This gives a good indication of improved water investment and improved growth.

Table 4: The effect of irrigation, humic acids, and the Interaction between them on the height of okra plant (cm).

Average	Humic acids (ml/L)			Irrigation
	5 acids concentricity	2.5 acids concentricity	Control	
124.89	127.33	125.67	121.67	Once every 3days
132.89	136.67	132.67	129.33	Once every 5 days
140.67	143.00	140.67	138.33	Once every 7days
	135.67	133.00	129.78	Average
Humic acids	Interaction between irrigation and humic acids		Average	L.S.D 0.05%
0.805	1.394		0.805	

Table 5: The effect of irrigation, humic acids, and the Interaction between them on the leaf area of okra plant (m/plant).

Average	Humic acids			Irrigation
	5 acids concentricity	2.5 acids concentricity	Control	
0.983	1.117	1.033	0.800	Once every 3days
1.189	1.233	1.167	1.167	Once every 5 days
1.311	1.467	1.300	1.167	Once every 7days
	1.272	1.167	1.044	Average
Humic acids	Interaction between irrigation and humic acids		Average	L.S.D 0.05%
0.0689	0.1193		0.0689	

Table 6: The effect of irrigation, humic acids, and the Interaction between them on the dry weight of okra plant (gm).

Average	Humic acids (ml/L)			Irrigation
	5 acids concentricity	2.5 acids concentricity	Control	
32.5	35.13	34.07	30.77	Once every 3days
34.21	36.47	33.73	32.93	Once every 5 days
36.37	37.5	34.83	33.8	Once every 7days
	35.38	34.38	33.32	Average
Humic acids	Interaction between irrigation and humic acids		Average	L.S.D 0.05%
0.690	0.195		0.690	

Table 5 shown The effect of irrigation periods in the leaf area of the okra plant, with the treatment of irrigation every 7 days recorded above the rate of leaf area is 311 m², while the treatment of irrigation is related to every 5, 3 days of 189 and 0.983 m²/plant. The addition of the humic acid in the leaf area of the okra plant has improved the leaf area by 10.3 and 18.1% compared to the control treatment.

Interaction treatment between the irrigation periods and the humic acid workshop were morally different, the two treatments exceeded the irrigation every 7 days with the addition of acid with 2.5 and 5 ml/l water in the highest paper area of the plant on all other treatment , while the treatment of irrigation was given every three days without adding humic acid is the least leaf area of the plant. This gives a good indication of the improvement of the crop representative with the addition of humic acid and the spacing of the irrigation periods.

Dry weight of the plant represents the main product of photosynthesis in the vegetation, and the increase in dry weight means a reflection of an improvement in plant growth and an increase in the accumulation of dry matter. Results in table 6. Appeared to that treatment of irrigation is more than 7 days in the dry weight of the okra plant on the treatment of irrigation every 5 to 3 days. The concentration of humic acid also have a moral effect on the dry weight of the okra plant. The treatment of the addition of humic acid with a concentration of 5 and 2.5 ml/L was recorded as 35.38 and 34.38 g of the plant compared to the control treatment of 33.32g. Interaction between the humic acid and irrigation periods have shown a moral effect on the dry weight of the plant, if the coefficient of the addition of the humic is recorded at 5 ml/l increase in dry weight clearly

for all irrigation periods, the above are for irrigation every 7 days compared to irrigation transactions without adding humic acid. While the effect was less with the addition of humic acid with a concentration of 2.5 ml/L.

The results in tables 7, 8 and 9 shown a significant increase in the yield and its components of the okra due to the spacing of the irrigation periods. The treatment of irrigation every 7 days given increase on the number of fruits (42.36 friut/plant), one plant yield (566.6g) and total yield (8.11 t/ha) compared to the treatment of irrigation every 3 days and In which the number of fruits decreased (37.37 fruit/plant), one plant yield (290.7g) and total plant yield (4.01 t/ha).

Organo-fertilizer (Humic) coefficients have had a moral effect on the number of fruits, the plant yield, and total yield and the moral differences in control treatment (without spraying). Treating the addition of humic acid 5 ml/l increase in the number of fruits, the rate of the plant quotient, and the total crop yield; 40.92 century, 488.9g, 6.94 t/ha, respectively, compared to the control treatment in which the number of fruits has fallen to 39.18 fruit/ plant and the rate of one plant to 338.8g and total quotient to 5.23 t/ha.

The Interaction between humic and irrigation periods is that the addition of humic acid from the growth of the crop in the spacing of irrigation periods. The treatment of the humic sprayed at 5 ml/l at irrigation every 7 days higher than the number of fruits 43.00 fruit/plant and the highest yield of plant (700g) and the highest total yield (9.67 t/ha), respectively, compared to the non-addition of humic and irrigation every 3 days that gave the lowest number of fruits (35.40 fruit/Plant), plant yield is 205.5g and the total quotient is 3.37 t/ha.

Table 7: The effect of irrigation, humic acids , and the Interaction between them on the number of okra plant fruits.

Average	Humic acids (ml/L)			Irrigation
	5 acids concentricity	2.5 acids concentricity	Control	
37.37	38.93	37.77	35.40	Once every 3days
40.26	40.38	40.47	39.47	Once every 5 days
42.36	43.00	41.40	42.67	Once every 7days
	40.92	39.88	39.18	Average
Humic acids	Interaction between irrigation and humic acids		Average	L.S.D 0.05%
0.882	1.527		0.882	

Table 8: The effect of irrigation, humic acids, and the Interaction between them in the average plant yield of okra plant (gm).

Average	Humic acids (ml/L)			Irrigation
	5 acids (F2) concentricity	2.5 acids (F1) concentricity	no acid (F0)	
290.7	455.5	355.5	205.5	Once every 3days
377.7	544.4	366.6	311.1	Once every 5 days
566.6	700	411.1	355.5	Once every 7days
	488.9	407.4	338.8	Average
Humic acids	Interaction between irrigation and humic acids		Average	L.S.D 0.05%
49.28	85.36		49.28	

Table 9: The effect of irrigation, humic acids , and the Interaction between them inthe total yield of okra plant (ton/h).

Average	Humic acids (ml/L)			Irrigation
	5 acids (F2) concentricity	2.5 acids (F1) concentricity	no acid (F0)	
4.01	6.67	5.67	3.37	Once every 3days
5.83	8	5.67	3.36	Once every 5 days
8.11	9.67	6.17	5	Once every 7days
	6.94	5.78	5.23	Average
Humic acids	Interaction between irrigation and humic acids		Average	L.S.D 0.05%
0.551	0.954		0.551	

Discussion

Irrigation and fertilization are the primary source of supplied plant mineral elements and the basic processor for the best performance of the crop, consisting of the construction of a good vegetative and fruit total. So the study came to see the critical period for irrigation of the okra crop to best produce with the best leaves fertilization. Many researchers have indicated that increased irrigation of the okra crop with a high nutrient or soil fertility supply may induce vegetation to increase the total vegetation significantly above of the total fruits (Jaafar *et al.*, 2012) and (Alqaisi *et al.*, 2012), as there is a hormone balance in the plant that may delay the flowering phase if the appropriate moisture is available to grow, and expose to the plant to a stress in a critical period stimulates the plant to early flowering. The results in this research were to confirm this fact, as it was observed that the extension of the irrigation period to 7 days stimulated the plant to increase the number of fruits formed and weighed in a single plant table 7 and 8 which clearly reflected the final yield table 9.

Fertilizer is an important factor for plant growth, as it contains the basic elements of the

photosynthesis process, but excessive fertilization with chemical fertilizers has poses a health risk to consumers of fresh vegetables, prompting researchers to use organic fertilizers, which are characterized as fertilizer Eco-friendly has a low adverse effect on consumer health. The results of the use of organic fertilizer showed that increasing the concentration of the humic acid to 5 ml/L increased the number of fruits in the okra plant and its weight per plant, which reflected increase in the area unit in measurement of control treatment that has not been sprayed with humic acid, and may be attributed to the role of manure in increasing growth Vegetative table 3 and 4 which leads to the transmission of processed nutrient from leaves to the fruity parts table 5, reflecting positively on the number Fruits table 6 thus increasing the total plant yield and these results correspond to what he found (2012-2011), (Ertan, 2007).

Choosing the right time for irrigation with good fertilization is very important to achieve a good product. The results show that the best verification of transactions that have received longer periods of irrigation with 5 ml/L from the compost, while the lowest recorded in transactions that were irrigated every 3 days and did not receive any proportion of compost. This confirms that the harmony between the amount of fertilizer and the irrigation period has an important role to play in achieving the highest quotient of the okra plant.

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