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LEAVES AND FRUITS CONTENT OF N, P, AND K AS WELL AS FRUIT QUALITY OF SWEET PEPPER PLANT AS AFFECTED BY IRRIGATION LEVELS AND SOIL AMENDMENTS UNDER EL-ARISH REGION CONDITIONS

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ABSTRACT

This study was carried out during summer season of 2017 and 2018 at the Experimental Farm, Faculty of Environmental Agricultural Sciences, Arish University, Egypt to investigate the effects of water irrigation levels and soil amendments on content of N, P and K in leaves and fruits as well as fruit quality of sweet pepper plant. Sweet pepper cv. "Top star" was subjected to three irrigation levels (100,80 and 60% of irrigation requirements) and three soil amendments; *i.e.,* control (without amendment), gypsum and pressed olive cake and their interactions in a factorial experiment using the randomized complete block design with three replications. Drip irrigation system was used and soil texture was sandy loam. The obtained results indicated that the highest contents of N, P and Kin leaves and fruit were recorded with applying 100% irrigation level + pressed olive cake as soil amendment followed by 80% irrigation levels + pressed olive cake in both seasons. All fruit quality studied traits; *viz*., fruit length, fruit diameter, fruit wall thickness, hardness, TSS%, and vitamin C content had their highest values with applying 100% of irrigation water + pressed olive cake as a soil amendment in both seasons, except length/diameter (L/D) ratio and pH values, where the highest values of fruit L/D ratio were recorded with applying 80% of irrigation water level + pressed olive cake in both seasons, while the highest values of fruit pH were recorded with applying 80% of irrigation water + pressed olive cake without significant difference than the same treatment of soil amendment with 100% or 60% irrigation water level in both seasons.

INTRODUCTION

Sweet pepper is a high value crop and rich in vitamins, particularly provitamin A, vitamin B, vitamin C and minerals such as Ca, P, K and Fe **(Malik *et al.,* 2011)**. It also contains thiamine, vitamin B_6, beta carotene, and folic acid.

Pepper plant is sensitive to drought stress and it is moderately sensitive to salt stress **(Rhoades *et al.,* 1992).** Irrigation is essential for pepper production because pepper is considered one of the most susceptible crops to water stress in horticulture **Jaimez *et al.* (2000). Nahar and Gretzmacher (2002)** studied the influence of three water stresses (100%, 70% and 40% of the field capacity, FC) on tomato plants and they found that the highest amount of nitrogen and potassium were found at 100% and the lowest was recoded at 40% of field moisture capacity, while moisture stress treatments did not influence significantly the uptake of phosphorous, calcium, magnesium and sulphur, where

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their concentrations showed a slight decrease from 100% to 40% of F.C.

Bell pepper (*Capsicum annum* L.) plants have a high demand for water and nutrients and are particularly sensitive to water stress during the establishment period and fruit setting. High levels of irrigation are often applied in order to maximize yields **Diaz-Perez (2009).** On the other hand, **Kirnak *et al.* (2001)** determined the effects of irrigation levels on paprika pepper, drip irrigation system was created by applying 125% of cumulative Class-A Pan evaporation (CAP125), 100% (CAP100), 75% (CAP75) and 50% (CAP50) of cumulative class-A-pan and they found that, content of vitamin C and capsaicin were not affected significantly by the irrigation levels.

El-Arish area is considered as sandy soil poor in the nutrients and its low ability to maintain water and mineral nutrients. Additionally, it had severe problems; *i.e.* scarcity of water, so several management practices were reported by the scientists to overcome this problem. They used both soil amendments (organic and chemical soil additives). **Economou *et al.* (1980); Chouliaras *et al.* (1998) and Gougoulias *et al.* (2010)** reported that Olive-mill solid wastes (OMSW) contain high levels of organic matter and mineral nutrients mainly nitrogen, phosphorous, potassium and magnesium. Profitable use of these organic materials as soil amendments are beneficial both to soil improvement and environmental protection as reported by inorganic matter; *i.e.* gypsum or calcium sulfate dihydrate ($(CaSO_4.)_2H_2O$). It is a direct source of macronutrients (calcium and sulfur) for plants, and improves soil physical and chemical properties that promote nutrient uptake from soil minerals into plants. Gypsum application has been found to reduce the amount of phosphorus in runoff. By enhancing soil composition and improving water infiltration, gypsum can contribute to enhanced crop growth, improve water conservation, and reduce the loss of soil and nutrients into area waterways. These are in agreement with **Bhumbla and Abrol (1975)** who found that the application of saline water with gypsum appreciably decreased the soil pH, improved the water infiltration rate and raised the crop yield so, promoted the removal of Na from the soil profile. Also, **Naeem *et al.* (I987)** claimed that salinity and sodic alkalinity of soil could be corrected by the use of various soil amendments of which gypsum was considered to be very effective. Gypsum has received renewed attention in recent years as a potential soil amendment, so its effects on soil physical properties then lead to higher yields and profits. **Elrashidi *et al.* (2007)** reported that the potential productivity of gypsiferous soils is related to the fact that gypsum mineral surfaces have no charges that attract exchangeable cation. Furthermore, the mineral supports high concentration of calcium (Ca) and sulfate ions in soil solution. Moreover, the high salinity in soil may have physiological effects on reducing nutrient uptake and plant growth.

Gypsum has long been used as a soil conditioner and fertilizer but it is only, recently, reported that gypsum potential for reducing agricultural emissions to waterways has been researched that gypsum can improve soil aggregation through calcium induced flocculation of particles and sulfate induced leaching of excess sodium. Such effects can reduce surface runoff volume by improving water infiltration into soil, improving stability of aggregates, reduces the potential loss of soil particles to waterways both over and through soil. The calcium ions can also increase precipitation of phosphate ions either directly as calcium phosphate or indirectly by increasing availability of aluminum ions. Increased ionic strength of soil solutions due to dissolution of gypsum may also increase adsorption of phosphate ions and organic matter to soil particles **(Mc Farland *et al.*, 2003; O'Connor *et al.*, 2005; Uusitalo *et al.*, 2012).**

The aim of this study was studying the effect of irrigation water levels and some soil amendments on N. P and K contents in leaves and fruits as well as quality of sweet pepper fruits under El-Arish region conditions.

MATERIALS AND METHODS

Two experiments were carried out during the summer seasons of 2017 and 2018 at the Experimental Farm, Faculty of Environmental Agricultural Sciences, Arish University. The experiments aimed to study the effect of irrigation levels (100, 80 and 60% of irrigation water requirements) and soil amendments; *i.e.,* control (without amendment), gypsum and pressed olive cake and their interaction on leaves and fruits content of N, P, and K as well as fruit quality of sweet pepper plants. Analyses of soil and irrigation water are presented in Tables 1 and 2.The experiment design was randomized complete block in a factorial trial in three replications. Seeds of "Top Star" cv. were sowed on seedling trays on 14th March and transplanting was carried out on 23th April in both seasons. Plants were irrigated using drip irrigation system, the distance between dripper lines centers was 1.2m., while the distance between plants in the same row was 50 cm. The plot area was 14.4m^2. Total content of nitrogen, phosphorus and potassium were determined in dry matter of leaves at 60 days after transplanting and in fruits from the second harvest (80 ays after transplanting) according to **Bremner and Mulvaney (1982), Piper (1950) and Brown and Lilliand (1946),** respectively, Total soluble solids was determined using a hand refractometer and Vitamin C content was determined in fruit juice as mg/100g using 2,6 dichlorophenolindophenol according to **AOAC (1990).** Soil parameters determined before conducting the experiments were particles size distribution **Piper, (1950),** total carbonate **Jackson, (1967)** and soil pH value was determined in 1:2.5 soil water suspension. The soil water extract for the 1:5 soil water ratio was chemically analyzed for electrical conductivity (EC) according to **Richard (1954)** and **Jackson (1967).**

Statistical Analysis

Statistical analysis of the obtained data was carried out according to statistical analysis of variance according to **Snedecor and Cochran (1980)**. Duncan's multiple range tests was used for comparison among means **(Duncan, 1958).**

RESULTS AND DISCUSSION

Effect of Irrigation levels

Leaves and fruit content of N, P and K

Results in Table 3 illustrate significant effect for irrigation levels on N, P and K content in leaves and fruits of sweet pepper plant in both seasons. The highest values of all traits; *viz.,* Total N, P and K in leaves and fruit were recorded with applying the highest irrigation water level (100%), while the lowest values were recorded with applying 60% irrigation water level in both seasons.

These results may be due to that, increasing levels of irrigation increased soil moisture content that makes minerals more available to the plant, which led to enhance mineral concentrations and their uptake by plant. **Kirnak *et al.* (2001)** came to similar results, where they reported that water deficit inhibited the uptake of nitrogen, phosphorus and potassium within the eggplant plant, but the well-watered plants showed higher nutrient concentrations, that was probably due to less availability of these elements to the plant and disturbing the electrolyte balance under water stress condition, resulting in deficiency of some nutrients.

Fruit quality

Results presented in Table 4 show significant effect for irrigation water levels on all studies traits; *viz.,* fruit length, fruit diameter, fruit L/D ratio, fruit wall thickness, hardness, fruit pH, TSS (%), and vitamin C content. The highest values were recorded of applying 100%irrigation level for all studied traits, in both seasons, except fruit L/D ratio and pH, where the highest values were recorded with applying 60% irrigation water level in both seasons.

Table 1. Chemical analyses of irrigation water

pH	EC (dSm^{-1})	Soluble ions(ml $eq.l^{-1}$)							
		Cations				Anions			
		Ca^{++}	Mg^{++}	Na^{+}	K^{+}	Cl^{-}	HCO_3^{-}	CO_3^{--}	SO_4^{--}
First season (2017)									
7.55	5.56	19.50	17.36	18.50	0.24	45.92	2.90	-	6.78
Second season (2018)									
7.60	5.71	21.00	17.05	18.80	0.25	46.77	2.99	-	7.34

Table 2. The initial physical and chemical analyses of the experimental soil site

Physical property	First season (2017)	Second season (2018)
Coarse sand (%)	58.3	59.5
Fine sand (%)	19.8	19.3
Silt (%)	11.9	11.1
Clay (%)	10.0	10.1
Soil texture	Sandy loam	Sandy loam
Bulk density (Mg^{-3})	1662	1661
Chemical properties (Soluble ions (in 1:5 soil water extract)		
Ca^{++} ($meq.^{L-1}$)	3.90	3.90
Mg^{++} ($meq.^{L-1}$)	3.42	3.43
Na^{+} ($meq.^{L-1}$)	2.74	2.55
K^{+} ($meq.^{L-1}$)	0.34	0.32
CO_3^{-} ($meq.^{L-1}$)	-	-
HCO_3^{-} ($meq.^{L-1}$)	4.50	4.40
Cl^{-} ($meq.^{L-1}$)	4.40	4.35
SO_4 ($meq.^{L-1}$)	1.50	1.45
EC (dSm^{-1}) in 1:5 water extract)	1.04	1.02
pH (in1:2.5 Soil water suspension extract)	8.10	8.13
Organic matter (%)	0.153	0.160
$CaCO_3$ (%)	22.43	22.48

Table 3. Effect of soil irrigation water levels on N, P and K content in leaves and fruits of sweet pepper plants at 60 days after transplanting in 2017 and 2018 seasons

Parameter	Leaves			Fruits		
Irrigation water level (%)	N (%)	P (%)	K (%)	N (%)	P (%)	K (%)
			First season (2017)			
100	2.63a	0.290a	4.37a	1.87a	0.203a	3.53a
80	2.52b	0.270b	4.22b	1.77b	0.197b	3.40b
60	1.78c	0.196c	3.29c	1.42c	0.172c	2.91c
			Second season (2018)			
100	2.89a	0.264a	4.67a	2.06a	0.220a	3.82a
80	2.77b	0.245b	4.51b	1.95b	0.208b	3.68b
60	1.83c	0.179c	3.35c	1.42c	0.167c	2.96c

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance, according to **Duncan's** multiple range test.

Table 4. Effect of irrigation water levels on fruit quality of sweet pepper fruit in 2017 and 2018 season

Parameter / Irrigation water levels (%)	Fruit length (mm)	Fruit diameter (mm)	Fruit L/D ratio	Fruit thickness (mm)	Fruit pH	Fruit TSS (%)	Fruit hardness (kg cm^{-1})	Vitamin. C (mg/100g) (FW)
				First season (2017)				
100	63.43 a	54.38 a	1.28 a	2.08 a	5.14 b	8.33a	1.28a	219.61a
80	60.02 b	50.68 b	1.19 b	2.00 a	5.28ab	8.03ab	1.16b	211.05b
60	62.07 ab	50.09 b	1.24 a	1.68 b	5.37 a	7.96b	1.02c	192.05c
				Second season (2018)				
100	64.61a	54.29a	1.23a	2.06a	5.20b	8.41a	1.20a	222.16a
80	60.61b	49.39b	1.19b	1.99a	5.29ab	8.03b	1.09b	201.88b
60	63.38a	48.43b	1.31a	1.72b	5.38a	8.02b	1.06b	186.50c

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance, according to **Duncan's** multiple range test.

These results are in agreement with **El-Banna *et al.* (2006)** on potato crop, **Shammout *et al.* (2018)** on bell pepper crop, and **Abd El-Rheem (2003)** who previously mentioned that, increasing levels of irrigation to the soil increased the moisture content that makes minerals more available to the plant, that led to enhance mineral concentration and their uptake by plant then reflect on fruit quality for pepper plant.

These results may be due to increasing levels of water (quantity) applied led to save higher moisture content in the soil and this in turn might favor the plant metabolism that leads to increase the plant growth characters, on the other hand, water stress led to reduction in the uptake of nutritional elements that might causes a disturbance in the physiological processes for plant growth as reported by **Salter and Goode (1967)** which was reflected on good photothyinthetic process that enhanced flowering and fruiting.

Effect of Soil Amendments

Leaves and fruit content of N, P and K

Results in Table 5 show significant effects for soil amendments on content of leaves and fruits of sweet pepper plant from N, P and K in both seasons. The highest values of N, P and K were recorded with applying pressed olive cake followed by applying gypsum soil amendments, while the lowest values were recorded with control treatment (soil without amendment) in both seasons.

Alburquerque *et al.* (2006) suggested that pressed olive cake (POC) composition content lignocelluloses materials (32.6–56.0% lignin; 27.3–41.6% hemicellulose and 14.0–24.9% cellulose), so it makes the soil a container for constant source for supplying plants with water and nutrients without need for external additions. In addition, it is rich in organic matter and had a high potassium and organic nitrogen content but had low content of phosphorus and micronutrients.

Gypsum (calcium sulfate dehydrate $(CaSO_4)_2H_2O$) increases the productivity due to the improvement of sandy soil characteristics because it is a direct source of macronutrients (calcium and sulfur) for plants, and improves soil physical and chemical properties that promote nutrient uptake from soil minerals into plants.

Fruit quality

Results in Table 6 show significant effect for soil amendments on all studies traits; *viz*., fruit length, fruit diameter, fruit L/D ratio, fruit thickness, hardness, fruit pH, TSS (%), and vitamin C content. The highest values of all studied traits were recorded with applying pressed olive cake amendment in both seasons, except fruit pH, where the highest values were recorded with applying gypsum in both seasons.

Effect of Interaction Between Irrigation Levels and Soil Amendments

Leaves and fruit content of N, P and K

Results in Table7 show significant effect for interaction between irrigation levels and soil amendments on leaves and fruit content of N, P and K. The height contents were recorded with applying 100% irrigation water level+pressed olive cake amendment followed by 80% irrigation water level +olive pressed cake in both seasons.

These results are due to the effect of pressed olive cake and gypsum that improve physicochemical, chemical and biological properties of sandy soil, so increased cation exchange capacity and available mineral nutrients and this in turn stimulates chemical contents and fruit quality.

Fruit Quality

Results presented in Table 8 show significant effects for interaction between irrigation water levels and soil amendments on all studies traits; *viz*, fruit length, fruit diameter, fruit L/D ratio, fruit wall thickness, hardness, fruit pH, TSS (%), and vitamin C content. The highest values were

Table 5. Effect of soil amendments on N, P and K content in leaves and fruits of sweet pepper plant at 60 days after transplanting in 2017 and 2018 seasons

Parameter	Leaves			Fruits		
Soil amendment	N (%)	P (%)	K (%)	N (%)	P (%)	K (%)
			First season (2017)			
Control (without amendment)	1.85c	0.202c	3.35c	1.44c	0.173c	2.92c
Agricultural gypsum	2.19b	0.248b	3.85b	1.67b	0.189b	3.28b
Pressed olive cake	2.89a	0.307a	4.68a	1.95a	0.210a	3.65a
			Second season (2018)			
Control (without amendment)	1.97c	0.184c	3.53c	1.53c	0.169c	3.09c
Agricultural gypsum	2.35b	0.225b	4.05b	1.78b	0.195b	3.47b
Pressed olive cake	3.18a	0.279a	4.94a	2.12a	0.230a	3.90a

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance, according to **Duncan's** multiple range test.

Table 6. Effect of soil amendments on fruit quality of sweet pepper fruits in 2017 and 2018 season

Parameter	Fruit length (mm)	Fruit diameter (mm)	Fruit L/D ratio	Fruit thickness (mm)	Fruit pH	Fruit TSS (%)	Fruit hardness (kg cm^2)	Vitamin. C (mg/100g) (FW)
Soil amendment								
				First season (2017)				
Control (without amendment)	61.45b	50.45 b	1.22 a	1.89 b	5.23ab	7.95b	1.08b	202.16c
Agricultural gypsum	59.67 b	50.04 b	1.19 a	1.81 b	5.40 a	7.75b	1.01b	206.94b
Pressed olive cake	64.40a	54.66 a	1.19 a	2.08 a	5.17 b	8.63a	1.38a	213.61a
				Second season (2018)				
Control (without amendment)	62.37b	49.38b	1.26a	1.85b	5.21b	8.10ab	1.08b	197.00c
Agricultural gypsum	59.58c	49.08b	1.25a	1.88b	5.54a	7.70b	0.99b	202.61b
Pressed olive cake	66.65a	53.64a	1.22a	2.03a	5.13b	8.66a	1.29a	210.94a

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance, according to **Duncan's** multiple range test.

Table 7. Effect of interaction between irrigation water levels and soil amendments on N, P and K content in leaves and fruits of sweet pepper plant at 60 days after transplanting in 2017 and 2018 seasons.

Parameter		Leaves		Fruits			
Irrigation water level (%)	Soil amendment	N (%)	P (%)	N (%)	P (%)	N (%)	P (%)
				First season 2017			
100	Control (Without amendment)	2.10f	0.241f	3.72f	1.65c	0.184d	3.22e
	Agricultural gypsum	2.50c	0.294c	4.35c	1.88b	0.205b	3.56b
	Pressed olive cake	3.29a	0.335a	5.00a	2.08a	0.221a	3.83a
80	Control (Without amendment)	2.01g	0.207g	3.28g	1.49d	0.176e	2.99f
	Agricultural gypsum	2.37d	0.273d	4.11d	1.79b	0.196b	3.42c
	Pressed olive cake	3.19b	0.330b	4.94b	2.05a	0.219a	3.8a
60	Control (Without amendment)	1.44i	0.158i	2.40i	1.18f	0.160g	2.57h
	Agricultural gypsum	1.72h	0.176h	2.85h	1.35e	0.168f	2.86g
	Pressed olive cake	2.19e	0.255e	3.89e	1.72c	0.190c	3.31d
				Second season 2018			
100	Control (Without amendment)	2.31f	0.219d	4.02f	1.82c	0.196c	3.48d
	Agricultural gypsum	2.75c	0.268b	4.70c	2.06b	0.219b	3.84b
	Pressed olive cake	3.62a	0.305a	5.40a	2.29a	0.237a	4.13a
80	Control (Without amendment)	2.21g	0.188e	3.54g	1.64d	0.188d	3.23e
	Agricultural gypsum	2.61d	0.248b	4.43d	1.97b	0.210c	3.70c
	Pressed olive cake	3.51b	0.300a	5.33b	2.25a	0.235a	4.11a
60	Control (Without amendment)	1.39i	0.144g	2.59i	1.14f	0.171e	2.56g
	Agricultural gypsum	1.69h	0.161f	3.08h	1.33e	0.180d	2.86f
	Pressed olive cake	2.41e	0.232c	4.20e	1.81c	0.203c	3.47d

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance, according to **Duncan's** multiple range test.

Table 8. Effect of interaction between irrigation water levels and soil amendments on fruit quality on pepper plant in 2017 and 2018 seasons.

Parameter		Fruit length (mm)	Fruit diameter (mm)	Fruit L/D ratio	Fruit thickness (mm)	Fruit pH	Fruit TSS (%)	Fruit hardness (kg/cm ^{2})	Vitamin. C (mg/100g) (FW)
Irrigation water level (%)	Soil amendment								
					First season 2017				
100	Control (Without amendment)	62.10 ab	53.94 b	1.15 abc	1.96ab	4.99b	8.26bcd	1.13b	220.50ab
	Agricultural gypsum	63.59 ab	49.67 bc	1.28 ab	2.06ab	5.23ab	7.81cde	1.13b	217.16c
	Pressed olive cake	64.61 a	59.54 a	1.10 bc	2.23a	5.21ab	8.93a	1.60a	221.16a
80	Control (Without amendment)	61.23 b	47.70 c	1.19 abc	2.05ab	5.28ab	7.93cde	1.09b	202.16e
	Agricultural gypsum	54.10 c	50.02 bc	1.07 c	1.77bc	5.48a	7.61e	0.97b	211.16d
	Pressed olive cake	64.74 a	54.32 b	1.30 a	2.18a	5.09ab	8.55ab	1.41a	219.83b
60	Control (Without amendment)	61.02 b	49.71 bc	1.22 abc	1.67c	5.43a	7.66de	1.02b	183.83h
	Agricultural gypsum	61.33 b	50.42 bc	1.21 abc	1.58c	5.48a	7.81cde	0.92b	192.50g
	Pressed olive cake	63.87 a	50.13 bc	1.28 ab	1.8bc	5.20ab	8.41abc	1.13b	199.83f
					Second season 2018				
100	Control (Without amendment)	63.69ab	51.38b	1.24abc	1.93bcd	5.08b	8.45ab	1.16bc	220.33a
	Agricultural gypsum	63.15ab	52.22b	1.21bc	2.04abc	5.51a	7.78ab	1.03cd	222.16a
	Pressed olive cake	67.00a	59.27a	1.14c	2.21a	5.01b	9.00a	1.41a	224.00a
80	Control (Without amendment)	60.53b	49.35bcd	1.22abc	1.91cd	5.23ab	7.88ab	1.07bcd	193.00cd
	Agricultural gypsum	54.30c	47.98cd	1.14c	1.94bcd	5.56a	7.56b	0.95d	200.00c
	Pressed olive cake	67.00a	50.84bc	1.32a	2.13ab	5.08b	8.63ab	51.2b	212.66b
60	Control (Without amendment)	62.9ab	47.41d	1.32a	1.72de	5.31ab	7.96ab	1.00cd	177.66e
	Agricultural gypsum	61.30b	47.05d	1.30ab	1.68e	5.56a	7.76ab	0.97d	185.66d
	Pressed olive cake	65.94a	50.82bc	1.29ab	1.76de	5.29ab	8.36ab	1.21b	196.16c

Values having the same alphabetical letter(s) did not significantly differ at 0.05 level of significance, according to **Duncan's** multiple range test.

recorded with applying 100% irrigation water level +olive pressed cake amendment for all studies traits in both seasons, except L/D ratio and pH, where the highest values of fruit L/D ratio were recorded with applying 80% of irrigation water level + pressed olive cake in both seasons, while the highest values of fruit pH were recorded with applying 80% of irrigation water + pressed olive cake without significant difference than the same treatment of soil amendment with 100% or 60% irrigation water level in both seasons.

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الملخص العربي

تأثر مستويات الري ومحسنات التربة على محتوى أوراق وثمار الفلفل الحلو من النيتروجين والفوسفور والبوتاسيوم وجودة الثمار تحت ظروف منطقة العريش

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أجريت تجربة حقلية خلال الموسم الصيفي لعامي ٢٠١٧ و٢٠١٨ في المزرعة التجريبية لكلية العلوم الزراعية البيئية، جامعة العريش لدراسة تأثير مستويات مختلفة من مياه الري ومحسنات التربة على محتوى الأوراق والثمار من النيتروجين والفوسفور والبوتاسيوم وكذلك جودة الثمار لنبات الفلفل الحلو. استخدمت ثلاث مستويات من مياه الري وهي ١٠٠% و٨٠% و٦٠% من الاحتياجات المائية للفلفل مع إضافة ثلاثة أنواع من محسنات التربة وهي معاملة كنترول (بدون استخدام أي محسن)، الجبس الزراعي، وتفلة الزيتون، بالإضافة إلى التداخل فيما بينهم وذلك في تجربة عمليّة استخدم فيها تصميم القطاعات العشوائية الكاملة بنظام القطع المشقة بثلاث مكررات وتم ري النباتات باستخدام نظام الري بالتنقيط. أظهرت النتائج أن أعلى محتويات النيتروجين، الفوسفور والبوتاسيوم بالأوراق والثمار تم الحصول عليها باستخدام مستوى الري ١٠٠% مع إضافة تفلة الزيتون كمحسن للتربة، ويليها استخدام مستوي الري ٨٠% مع إضافة تفلة الزيتون في الموسمين. كما بينت النتائج أن جميع الصفات الخاصة بجودة الثمار (طول وقطر الثمرة، وسمك جدار الثمار، والصلابة، ونسبة المواد الصلة الذائبة الكلية، وفيتامين (C) سجلت أعلى قيمه لها عند استخدام المستوى ١٠٠% من مياه الري مع إضافة تفلة الزيتون كمحسن للتربة في الموسمين، مع استثناء نسبة الأس الهيدروجيني، ونسبة طول الثمرة إلى قطرها، حيث تم تسجيل أعلى قيم نسبة طول الثمرة إلى قطرها، مع استخدام المستوى ٨٠% من مياه الري مع إضافة تفلة الزيتون في الموسمين، في حين تم تسجيل أعلى قيم لدرجة الأس الهيدروجيني في الثمار عند استخدام المستوى ٨٠% من مياه الري مع إضافة تفلة الزيتون مع عدم وجود فروق معنوية لنفس المعاملة لمحسنات التربة مع المستويين ١٠٠% أو ٦٠% من مياه الري في الموسمين.

الكلمات الاسترشادية: مستويات الري، محسنات التربة، الجبس الزراعي، تفلة الزيتون، الفلفل الحلو، جودة الثمار.