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EFFECT OF IRRIGATION WATER DEFICIT ON BACTERIAL DIVERSITY, WATER USE EFFICIENCY AND PRODUCTIVITY OF CALCAREOUS SOIL

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ABSTRACT

Two experiments were carried out in calcareous sandy loam soil of Experimental Farm of the Faculty of Environmental Agricultural Science, El-Arish Suez Canal University, North Sinai Governorate, Egypt. The first experiment (pot experiment) aimed to study the effect of deficit irrigation water on enumeration of microorganisms associated with roots of wheat (*Triticum aestivum vulgare cv.* Sakha 93) and bacterial diversity. The obtained data indicated that there is no obvious effect of deficit irrigation water on the enumeration of total bacterial and actinomycetes count. Bacterial strains were classified into 14 clusters according to morphological characteristics, gram staining and growth curves. The bacterial strains were grouped into ten clusters when soils were irrigated by 100 and 75% ETm whereas fourteen clusters were obtained when soils were irrigated by 50 and 25% ETm causing an appearance of new strains having the ability to survive in water stress conditions.

The second experiment (field experiment) aimed to investigate the effect of deficit irrigation water under drip irrigation system on water relations, yield and growth parameters of wheat crop. The actual evapotranspiration (ETa) of wheat crop was decreased with increasing applied deficit irrigation water. The highest ETa value of wheat crop was found at applied deficit irrigation water of 100% ETm followed by 75, 50 and 25% ETm. The highest water use efficiency was found at deficit irrigation water level of 25% ETm followed by100, 50, 75% ETm. The deficit of irrigation water of 100 % ETm had the highest values for plant height and number of tillers per m^2, while the deficit irrigation water of 25 % ETm had the lowest ones. The deficit of irrigation water of 100 % ETm had the highest values of grains, straw yields and weight of 1000 grain, while the deficit irrigation water of 25 % ETP had the lowest ones.

Keywords: water irrigation deficiency, water relations, microorganisms enumeration, bacterial diversity, wheat plants, calcareous soil.

INTRODUCTION

Irrigated agriculture is still practiced in many areas in the world with complete disregard to basic principles of resource conservation and sustainability. Therefore, irrigation water management in an era of water scarcity will have to be carried out most efficiently, aiming at saving water and at maximizing its productivity. Insufficient water supply for irrigation will be the norm rather than the exception, and irrigation management will shift from emphasizing production per unit area towards maximizing the production per unit of water consumed, the other productivity, Fereres and Soriano (2007). The environmental stresses such as drought, temperature, salinity, air pollution, heavy metals, pesticides and soil pH are major limiting factors in crop production because, they affects almost all plant functions, Shao *et al.*, (2007).

Growth of wheat plants affected by water stress during vegetative and fruiting stages was studied by Farahat (1978). She reported that increasing the depletion of available soil moisture caused a significant decrease in height of the main stem, number of tillers per plant, number of plant spikes, wheat grain, straw yield and weight of 1000 seeds. Choudhury and Kumar (1980) in their study on the response of dwarf wheat to different levels of water stress (at sowing to maximum tillering, maximum tillering to flowering and flowering to maturity growth stages) concluded that moderate and severe water stress treatments for all growth stages decreased plant length. The same trend was observed in recent studies, Zhang *et al*., (2004); El-Kassas (2008) and Ibrahim *et al*. (2010).

Plant adaptations to water stress may cause changes in below ground C input through higher root production and turnover. This may in turn influence the functional structure and activity of the microbial community in the rhizosphere (Bolton *et al*., 1992; Grayston *et al*., 1998). Drought also directly affects the soil microorganisms by creating osmotic stress, which leads to microbial death and cell lysis (Turner *et al*., 2003). The mechanism of plant drought tolerance may involve promotion of root extension, allowing efficient water up take as illustrated by Bethlenfalvay and Linderman (1992) and Ruíz-Lozano *et al*., (1995). Thus, an alternate plant strategy for coping with water deficiencies is the interaction with beneficial soil microorganism. Plants can interact with several soil microorganisms including bacteria having plant growth promoting (PGP) abilities and/or mycorrhizal fungi that enhance plant water uptake and nutrition status, improving plant stress tolerance (Glick, 1995; Barea *et al*., 2002; Marulanda *et al*., 2007 ; Marulanda *et al*., 2009 and Azcon and Barea, 2010).

The present study aims to determine the effect of deficit of water irrigation on microbial enumeration, diversity and water relations. Another main objective is to determine to which extent the deficit of water irrigation can influence wheat growth and production.

MATERIALS AND METHODS

Two experiments were carried out for the calcareous sandy loam soil of Experimental Farm of the Faculty of Environmental Agricultural Science, El-Arish Suez Canal University, North Sinai Governorate, Egypt, during two successive seasons 2008/2009 and 2009/2010. The first experiment (pot experiment) aimed to study the effect of deficit of irrigation water on enumeration of microorganisms in soil, especially those associated with roots of wheat (*Triticum aestivum vulgare cv.* Sakha 93) and bacterial diversity. The second experiment (field experiment) aimed to study the effect of deficit of irrigation water under drip irrigation system with irrigation efficiency of 85 % on water relations, yield and growth parameters of wheat crop.

Experiment 1

A surface calcareous sandy soil sample (0-15cm) from the Experimental Farm of the Faculty of Environmental Agricultural Sciences, El-Arish, Suez Canal University, North Sinai Governorate, Egypt, was air dried, sieved through a 2 mm sieve mich. The soil studied was a sandy loam (sand 67.48%, silt 27.17% and clay 5.35%; 16% $CaCO_3$, pH 8.1). The source of irrigation water was well water which collected from the Experimental Farm of the Faculty of Environmental Agricultural Science with total salinity of 5.5 dSm^{-1} and pH of 7.4.

The first experiment was assigned for wheat cultivation in pots. Four seeds were sown in each pot containing 2Kg soil and irrigated with 100, 75, 50 and 25 % of maximum evapotranspiration (ETm) in a completely randomized design with three replications. Nutritive solution contains salts illustrated by Mohamed and El Tantawy, 2009, was used as fertilization. Soil was manured by 1% organic material. Sixty days after planting, roots were lifted out of soils and root system was then transferred to a 1 liter Erlenmeyer flask containing 100 ml sterilized distilled water. The samples were shaken for 15 min on a rotary shaker and the 100 ml soil suspension was considered as rhizosphere soil suspension. Serial dilutions were plated on 1/10 TSA (Tryptone Soybean Agar) medium. The weights of rhizospheric soil were determined in a sample of the 100 ml soil suspension. After 5 days of incubation, bacterial and actinomycetes colony forming unites (CFU) were recorded. Weights of fresh and dry roots were determined.

Comparison of bacterial strains isolated under studied deficit of irrigation water:

Fifty-eight colonies of each treatment were isolated from plates of the same dilution and grown in microplates in 1/10 tryptone soybean broth (TSB). Each well contains 150 µl 1/10 TSB. Growth curves for the isolated strains were compared by inoculating each strain in a sterilized 95 well microplate. This was achieved by adjusting the optical density, OD, at 600 nm by a microplate reader, Model Stat Fax-2100, Awareness Technology Inc. USA. Optical densities were measured at 0, 9, 15, 21, 33, 39, 45, 57, 63, 69, 81, 87, 93, 105, 111, 117 and 129 hours after inoculation and initial OD was subtracted from the subsequent readings. Growth curves were achieved between the obtained OD and the time of measurement, Mohamed (2004). Based on different morphological colonies on TSA medium, the selected isolates were classified by cultural, morphological characteristics and gram staining according to the scheme of identification of Bergey's Manual of Systematic Bacteriology, (1976).

According to the similarity between isolated strains from studied deficit irrigation water, strains were regrouped in clusters. The distribution of strains at 100, 75, 50 and 25% from ETm in classes were compared by the Stat X act program (version 3). The test was used to compare the distribution of strains in their classes for the four populations, Mohamed (2009).

Experiment 2

The initial of some physical and chemical properties of the studied soil in the field experiment (second experiment) are given in Table (1).

Table (1): Some physical and chemical properties of the initial soil for the field experiment.

Soil properties	Season 2009-2010				
	Soil depth, cm				
	0-15	15-30	30-45	45-60	60-75
Sand %	69.20	78.20	55.20	65.20	55.20
Silt %	15.00	10.00	25.00	15.00	34.00
Clay %	15.80	11.80	19.80	19.80	10.80
Soil texture class	Sandy loam				
Soil moisture constants at tension					
Bulk density mg m^{-3}	1650	1660	1470	1460	1330
Organic matter %	0.19	0.15	0.14	0.12	0.12
Saturation percentage(0kPa)	29.77	30.22	36.46	28.75	26.43
Soil water content of field capacity, (-10 kPa),%	11.90	11.89	13.67	11.18	10.88
Soil water content of wilting point, (-1500 kPa),%	5.17	5.06	5.14	5.84	5.68
Chemical properties (soluble ions in 1:5 soil water extract)					
Ca^{++} me l^{-1}	4.45	2.90	1.92	2.40	3.60
Mg^{++} me l^{-1}	3.55	2.45	2.28	2.61	2.90
Na^{+} me l^{-1}	7.95	6.63	6.85	7.05	7.53
K^{+} me l^{-1}	2.55	1.02	0.45	0.94	0.97
CO_3^{--} me l^{-1}	-	-	-	-	-
HCO_3^{-} me l^{-1}	3.00	2.00	1.63	1.65	3.25
Cl^{-} me l^{-1}	13.0	9.25	8.50	9.55	9.50
SO_4^{--} me l^{-1}	2.50	1.75	1.37	1.80	2.25
EC(dS m^{-1}) in 1:5 soil water extract	1.85	1.30	1.15	1.30	1.50
pH in 1:2.5 soil water suspension extract	7.94	8.12	8.26	7.93	8.09
$CaCo_3$%	14.39	22.58	22.65	22.60	21.85

The source of irrigation water of the experiment 2 was well water from Experimental Farm of the Faculty of Environmental Agricultural Science. The chemical composition of the irrigation water is given in **Table (2).**

Table (2):Some chemical composition of irrigation water for the field experiment.

EC, dSm^{-1}	pH	Soluble cations, me l^{-1}				Soluble anions, me l^{-1}			
	(1:2.5)	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	CO_3^{--}	HCO_3^{-}	Cl^{-}	SO_4^{--}
7.73	8.31	11	24	40	2.25	-	4.25	55	18

Different soil and water parameters were analysed according to (Piper, 1950; Richards, 1954; Jackson, 1967). Air temperature and relative humidity were recorded from the meterological station at El-Arish, North Sinai Governorate (Table 3).

The second experiment was assigned for cultivating wheat. It included 4 treatments for the deficit irrigation water of 100, 75, 50 and 25% as amount of applied water from the ETP. One plant row was considered as a plot with a 10 m long. Each plot area was 2 m^2. Seeds were sown for successive season, 2009/2010, at a rate of 50 kg/fed on 20/11. After 34 days pretreatment period, irrigated every 2 days, irrigation treatments started for all plots on 24/12. The 100% ETm deficit irrigation water ended on 28/3. Its last irrigation occurred on 21/3. The 75% ETm deficit irrigation water ended on 25/3. Its last irrigation took place on 18/3. The 50% ETm deficit irrigation water, ended on 20/3. Its last irrigation occurred on13/3. The 25% ETm deficit irrigation water, ended on 12/3. Its last irrigation occurred on 5/3. The experimental design was completely randomized design with four replications.

Table (3): Monthly minimum, maximum and average values for temperatures,

Parameters		Month				
		November	December	January	February	March
Temperat-ure (C^O)	Maximum	30.56	27.71	26.52	28.04	32.95
	Minimum	12.91	10.02	8.78	8.84	10.14
	Average	21.74	18.87	17.65	18.44	21.55
Relative Humidity (%)	Maximum	78.60	79.30	80.60	78.90	80.00
	Minimum	23.60	24.60	26.20	27.90	24.40
	Average	51.10	51.95	53.40	53.40	52.20
Wind speed (m/s)		1.86	1.74	1.96	2.13	2.17
Rain rates (mm)		7.03	12.45	19.45	14.05	10.35

Recorded Data

Soil-Water Relations

Consumptive Use of Water (CU)

Consumptive use of water (CU) was calculated using the equation given by **Israelsin and Hansen (1962)** as follows:

$$CU = D * AD * \frac{ez - ei}{100}$$

Where:

CU = Consumptive use in cm.

D = Irrigated soil depth in cm.

AD = Bulk density, g $cm.^{-3}$, of the chosen irrigated soil depth.

ez = Soil moisture content percent after irrigation.

ei = Soil moisture content percent before irrigation.

Water Use Efficiency (WUE)

The consumed water by wheat was calculated according to Yaron *et al.*, (1973) as follows:

$$WUE = \frac{Y}{ETa}$$

Where:

WUE = water use efficiency, kgm^{-3}.

Y = Crop yield in kg fed^{-1}.

ETa = Actual Evapotranspiration in m^3 fed^{-1}.

The actual evapotranspiration, ETa, is assumed to be synonymous to the calculated consumptive use of water (CU). Consequently, daily and monthly consumptive use of water was calculated for specified soil depths for all treatments.

Plant Growth parameters

Random samples of wheat plants were taken from each plot at the end of the season in order to determine plant height, number of tillers per m^2, weight of grains, ton fed^{-1}, weight of straw, ton fed^{-1} and weight of 1000 grains, grams. Analysis of variance was used to test the degree of variability among the obtained data. Duncan's Multiple rang test was used for the comparison among treatment means, Duncan, (1955). MSTATC program was used for the statistical analysis.

RESULTS AND DISCUSSION

First experiment was carried out to examine the effect of deficit OF irrigation water on bacterial and actinomycetes enumeration and diversity.

Effect of deficit OF irrigation water on bacterial and Actinomycetes counts

Results of the total rhizospheric bacterial, actinomycetes counts values are given in Table (4). The numbers of total bacterial recovered from the rhizospheric soil ranged between $5.2*10^9$ to $2.22*10^{10}$ CFU g^{-1} dry soil. These results are in agreement with those obtained by Mohamed (2004) and Söderberg *et al.,* (2004), who found that the rhizosphere has a high microbial activity since the counts of total rhizospheric bacteria were more than 10^9 CFU g^{-1} dry soil.

Table (4): Effect of deficit OF irrigation water on bacterial and actinomycetes colony forming unit (CFU) counts in the rhizosphere of wheat plants cultivated in calcareous sandy loam soil.

	CFU g^{-1} dry soil, at deficit irrigation water	
	100 % ETm treatment	
	Bacterial counts	**Actinomycetes counts**
Rhizospheric soil	$5.2X10^9$	$6.04X10^7$
Fresh root	$2.8X10^9$	$3.2X10^7$
Dry root	$1.9X10^{10}$	$2.2X10^8$
	75 % ETm treatment	
	Bacteria	**Actinomycetes**
Rhizospheric soil	$9.5X10^9$	$5.3X10^7$
Fresh root	$5.2X10^9$	$3.5X10^7$
Dry root	$3.9X10^{10}$	$2.4X10^8$
	50 % ETm treatment	
	Bacteria	**Actinomycetes**
Rhizospheric soil	$1.51X10^{10}$	$1.39X10^8$
Fresh root	$1.77X10^{10}$	$1.4X10^8$
Dry root	$1.4X10^{11}$	$1.01X10^9$
	25 % ETm treatment	
	Bacteria	**Actinomycetes**
Rhizospheric soil	$2.22X10^{10}$	$4.3X10^8$
Fresh root	$2.41X10^{10}$	$4.4X10^8$
Dry root	$2.4X10^{11}$	$4.7X10^9$

The numbers of total actinomycetes recovered from the rhizospheric soils ranged between $6.04*10^7$ to $4.3*10^8$ CFU g^{-1} dry soil. The obtained data indicated that there is no obvious effect of deficit water on the enumeration of total bacterial and actinomycetes count. The composition and counts of microorganisms in the rhizosphere of different plants may differ due to variations in the quantity and quality of compounds exuded by the different plants (Duah *et al.*, 1998; Aldén *et al.*, 2001). The rhizodeposition of easily available carbon makes the rhizosphere an area of high microbial activity (Ramos *et al.*, 2000; Söderberg *et al.*, 2004). Root exudates selectively influence the growth of bacteria that colonize the rhizosphere by altering the chemistry of soil in the vicinity of the plant roots and by serving as selective growth substrates for soil microorganisms. Consequently, different rhizosphere microbial communities are associated with different plants (Kremer *et al.*, 1990).

Effect of deficit of irrigation water on bacterial diversity

The effect of deficit of irrigation water on bacterial clusters on rhizospheric calcareous sandy loam soil is represented in Table (5). Bacteria strains were classified into 14 clusters according to morphological characteristics, gram staining and growth curves. The bacterial strains were grouped into ten clusters when soils were irrigated by 100 and 75% ETm whereas bacterial strains were grouped into fourteen clusters when soils were irrigated by 50 and 25% ETm.

Table(5): Effect of deficit of irrigation water on bacterial diversity isolated from the rhizosphere of wheat plants cultivated in calcareous sandy loam soil.

Clusters	Percentages of bacterial strains grouped to different clusters at deficit of irrigation water			
	100% ETm	75% ETm	50% ETm	25% ETm
C1	26.7	26.7	6.60	40.0
C2	16.6	20.8	25.0	37.5
C3	25.0	37.5	37.5	-
C4	40.0	25.0	20.0	15.0
C5	30.4	30.4	26.1	13.1
C6	35.0	25.0	25.0	15.0
C7	13.6	36.4	27.3	22.7
C8	36.4	22.7	22.7	18.2
C9	35.0	35.0	15.0	15.0
C10	31.8	27.3	22.7	18.2
C11	-	-	57.1	42.9
C12	-	-	35.3	64.7
C13	-	-	71.5	28.5
C14	-	-	58.3	41.7
P<0.001				

This indicates that as deficit of water irrigation increased, new strains appeared causing an increase in number of clusters indicating that these strains have the ability to survive in water stress conditions. The percentages of strains grouped to C1, C2 tend to increase in deficit irrigation water of 50 and 25% ETm, indicating that the strains grouped to these clusters have the ability to growth and survive in water stress conditions. On the other hand, the percentages of strains grouped to cluster C3, C4, C5, C6, C7, C8, C9 and C10 decreased as water moister decreased. This may indicates that the strains of these clusters were less tolerant to water stress than strains of clusters C1, C2. Four new clusters appeared at deficit irrigation water of 50 and 25% ETm. The strains of these clusters may have special characteristics allow to their appearance in this water stress condition. The idea of strains classification into clusters when exposed to different conditions was used before by Delorme (2001) and Mohamed (2004).

Effect of deficit of irrigation water

The effect of deficit irrigation water levels on water relations, growth parameter, yield and component of wheat crop (*Triticum aestivum l.*) cultivated under drip irrigation system were investigated during the second experiment.

Actual evapotranspiration for wheat crop (ETa)

Actual daily and monthly evapotranspiration for wheat crop were calculated and presented in Table (6).

Table (6): Mean daily, monthly and total actual evapotranspiration of wheat crop (ETa, mm) as affected by deficit of irrigation water.

Month	ETa at Deficit of Irrigation Water, mm							
	100% ETm		75% ETm		50% ETm		25%ETm	
	Daily	Monthly	Daily	Monthly	Daily	Monthly	Daily	Monthly
November*	1.98	21.78	1.98	21.78	1.98	21.78	1.98	21.78
December	2.85	88.35	2.56	79.36	1.53	47.43	0.58	17.98
January	3.21	99.51	2.96	91.76	1.93	59.83	0.66	20.46
February	3.65	102.20	3.08	86.24	2.09	58.52	0.81	22.68
March**	4.04	109.08	3.20	76.8	2.66	50.54	1.27	13.97
Total		420.92		355.94		238.10		96.87

***11 days from November, **27 days from March for I_1,24 days from March for I_2, 19 days from March for I_3 and 11days from March for I_4**

Monthly rates were always high for the 100 % ETm and continued to decreases as percent permissible soil moisture increased. During wheat growth period, ETa value was the highest one during March for the 100% ETm of deficit irrigation water. This result may be related to the vary high evapotranspiration demand. The reason for the variation in maximum ETa during wheat growth periods might be related to the interrelation for the variation in the distinction between wheat growth periods and wheat crop requirement growth stage as reported by Doorenbos and Kassam (1979).

Data obtained for daily ETa values, for wheat crop presented in, Table (7) indicated that they vary from 20 November to 27 March and from deficit irrigation water level to another. All values were obtained for daily ETa high during March. The maximum daily ETa values for the deficit irrigation water of 100 and 75% ETm were 4.04, 3.20 mm/day during March, respectively.

Data given in Table (7) reveal that actual wheat crop evapotranspiration (ETa) according to growth stage affected by deficit irrigation water levels. This data indicated that actual evapotranspiration increased with increasing the amount of applied irrigation water from the initial stage to lat-season stage. The maximum ETa values were in the mid-season stage for all deficit irrigation water levels, while, the minimum ETa values were in the initial stage for the same levels.

A severe or slight soil water deficit significantly reduces ETa, which mainly depends on irrigation amounts. Thus, it is possible to reduce ETa somewhat without significantly decreasing green yield, **Zhang *et al* (2004).**

Table (7): Actual wheat crop evapotranspiration (ETa) according to growth stages as affected by deficit of irrigation water levels .

Deficit of irrigation water	ETa during growth stage, mm				
	Initial	Development	Mid-season	Lat-season	Total
100% ETm	36.03	77.31	180.25	127.33	420.92
75% ETm	34.58	66.56	156.44	98.36	355.94
50% ETm	29.43	38.25	101.07	69.35	238.10
25%ETm	24.68	13.34	33.54	25.31	96.87

Water use efficiency (WUE)

Data in Table (8) indicate that the average WUE values for the investigated season decreased from 1.96 and 1.79 kg m^{-3} at the applied deficit irrigation water of 100 and 75% ETm, respectively. Then the values increased at the applied deficit irrigation water of 50 and 25% ETm and by 1.92 and 3.49 kg m^{-3}, respectively. The average obtained values for grain production were 3.471, 2.672, 1.922 and 1.421 ton fed^{-1} at the applied deficit irrigation water of 100, 75, 50 and 25% ETm, respectively. For the consumed water, the obtained values were 1767.86, 1494.95, 1000.02 and 406.85 $m^3 fed^{-1}$ at the applied deficit irrigation water of 100, 75, 50 and 25% ETm, respectively. Finally, if the economic use of water during wheat production is more important, then the deficit irrigation water of 25% ETm is recommended. However, if increasing the wheat grain yield is more important, then deficit irrigation water 100% ETm is recommended. Such results are in harmony with those obtained by Zhang *et al*., (2004); Waraich *et al*., (2008) and El-kassas (2008).

Table (8): Water use efficiency, WUE, for wheat crop as affected by applied deficit irrigation water.

Deficit of irrigation water	Fresh yield, kg fed^{-1}	Total consumed water(ETa), $m^3 fed^{-1}$	Water use efficiency, kg m^{-3}
100% ETm	3471	1767.86	1.96
75% ETm	2672	1494.95	1.79
50% ETm	1922	1000.02	1.92
25%ETm	1421	406.85	3.49

Plant growth parameters

The results in Table (9) show that wheat height decreased significantly with decreasing irrigation water quantity. These results are related to the decrease in wheat water consumption. Average number of tillers per m^2 was affected significantly by deficit irrigation water, Table (9). The average numbers of tillers per square meter were 354, 321, 285 and 218, respectively. This trend as well as that obtained for plant height reflects the condition of straw production which is very useful. This result agrees with Alderfasi *et al* (1999).

Crop Yield

The effect of deficit of irrigation water on fresh grain, straw yields and 1000-grain weight for the investigated season is shown in Table (9). Data reveal that grains, straw yield and weight of 1000-grains, in general, significantly increased with decreasing deficit irrigation water level. These results are in agreement with those of Zhang *et al.*, (2004) and Ibrahim *et al.* (2010).

Table(9): Plant height (cm), number of tillers per m^2 ,fresh grain yield (ton fed^{-1}) , Fresh straw yield (ton fed^{-1}) and weight of 1000 grain (g) for wheat crop as affected by deficit of irrigation water.

Deficit of irrigation water	Plant height (cm)	Average number of tillers m^{-2}	Fresh grain yield (ton fed^{-1})	Fresh straw yield (ton fed^{-1})	Weight of 1000 grain (g)
	2009-2010 season				
100% ETm	88.13 a	354 a	3.471 a	3.562a	56.25 a
75% ETm	84.75 ab	321 ab	2.672 b	2.738b	51.50 a
50% ETm	75.00 b	285 b	1.922 c	1.941c	39.63 b
25%ETm	58.50 c	218c	1.421 d	1.469d	27.38 c
Average	**76.595**	**294**	**2.366**	**2.427**	**43.69**

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تأثير النقص المائي على التنوع البكتيري وكفاءة استخدام المياه وإنتاجية الأراضي الجيرية

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أجريت تجربتين بالمزرعة التجريبية لكلية العلوم الزراعية البيئية بالعريش جامعة قناة السويس خلال الموسمين الشتوين لموسمي ٢٠٠٨/٢٠٠٩-٢٠٠٩/٢٠١٠. التجربة الأولى تناولت دراسة تأثير معاملات نقص مياه الري المختلفة على تعداد الاحياء الدقيقة الموجودة في تربة ريزوسفير نبات القمح "صنف سخا ٩٣"والتنوع البكتيرى. صممت التجربة لزراعة القمح في أصص. زرعت أربع بذور في كل أصيص يحتوى على ٢ كيلوجرام تربة تم ريها بمعاملات ري١٠٠ ,٧٥, ٥٠ و٢٥% من أقصي نتح بخر لمحصول القمح (ETm). تم استرجاع التربة الريزوسفيرية بعد٦٠ يوما من الزراعة وتم تقدير أعداد البكتريا الكلية المسترجعة من التربة الريزوسفيرية حيث وجد انها تتراوح بين ٥,٢ x $١٠^{٩}$ إلى ٢,٢٢ x $١٠^{١٠}$ وحدة مكونة للمستعمرة لكل جرام تربة جافة . بينما تراوحت الأعداد الكلية للاكتينوميسيتس من ٦,٠٤ x $١٠^{٧}$ إلى ٣,٤ x $١٠^{٨}$ جرام تربة جافة. أوضحت النتائج أنه لا يوجد تأثير ملوحظ على التعداد الكلي للبكتريا والأكتينوميسيتس لمعاملات نقص مياه الري. تم تقسيم السلالات البكتيرية الى ١٤ مجموعة طبقا الى كل من الشكل المورفولوجى, صبغة جرام ومنحنيات النمو. تم تقسيم السلالات البكتيرية الى ١٠ مجموعات عندما استخدمت معاملات ١٠٠ و٧٥% من اقصى نتح بخر لمحصول القمح بينما قسمت السلالات البكتيرية الى ١٤ مجموعة عند معاملات الرى ٥٠ و٢٥% من اقصى نتح بخرمما يؤكد ظهور سلالات جديدة لها القدرة على تحمل ظروف الإجهاد المائي.

أما التجربة الثانية تناولت تاثير معاملات الري المختلفة تحت نظام الري بالتنقيط على النتح بخر الفعلى وكفاءة استخدام المياه و محصول القمح. واحتوت التجربة على أربعة معاملات ري وهي ١٠٠ ,٧٥ ,٥٠ و٢٥% من أقصي نتح بخر لمحصول القمح. واظهرت النتائج تزايد النتح-بخر الفعلي مع زيادة كميات مياه الري للنباتات وكذلك ارتفاع النبات ، وعدد التفرعات للمتر المربع، المحصول الطازج لكل من الحبوب والقش، وكذلك وزن ١٠٠٠ حبة بينما كفاءة استخدام المياه انخفضت، وكانت أعلى كفاءة في استخدام المياه مع معاملة الري ٢٥% تبعها معاملة الري ١٠٠ ,٥٠ و ٧٥% من اقصى نتح-بخر للمحصول على التوالي.

قام بتحكيم البحث

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