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EFFECT OF IRRIGATION TREATMENTS AND SOME SOIL AMENDMENTS ON SOIL PROPERTIES AND PRODUCTION OF WHEAT- PEANUT ROTATION IN SANDY SOIL

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ABSTRACT

The use of organic and synthetic soil amendments such as compost, farmyard manure and polyacrylamide can be considered as a specific management to improve the soil physical and chemicals properties of sandy soil along with decreased irrigation water consumptive use and water use efficiency. So, a field experiment was carried out at the Farm of El-Ismailia Agricultural Research Station, El-Ismailia Governorate Egypt in winter season 2014/2015 cultivated with wheat (*Triticum aestivum* L., cv Giza 168) under three water deficit at (100%, 75% and 50% of crop evapotranspiration, ETc) and soil amendments (none, compost, farm yard manure and polyacrylamide). Also, the effect of allowable soil moisture depletion (ASMD) at 25%, 50% and 75% of total soil available water was studied on peanut crop (*Arachis hypogaea* L. Giza 6) under the same previous soil amendments. Wheat and peanut water consumptive use, water use efficiency and both yields components along with physical and chemicals properties of studied sandy soil were also evaluated.

Results indicated that, the highest actual irrigation treatment was recorded at rate of 100% (ETc) treatment, for wheat crop, while the highest one was recorded under 25% (ASMD) for peanut crop as compared to other irrigation treatment. Also, the obtained results show a noticeable reduction in soil pH and salinity as a result of treating the soil with different soil amendments compared to control. The effect was more obvious in case of applying FYM and irrigation treatments 100% ETc for wheat and 25% ASMD for peanut crops as compared to other treatments and control. Also, OM and CEC values were increased in case of used FYM soil amendment as compared with other treatments and control for both studied crops under different irrigation treatments. However, the highest diameters of dry aggregates were positive affected by FYM and irrigation treatments 100% ETc for wheat and 25% ASMD for peanut crops as compared with other treatments and/or control. In addition, the values of soil bulk density of soil profiles treated by all treatments were relatively low compared to those of control, whereas the maximum

decrease exists in soil treated by FYM and irrigation treatments 100% ETc for wheat and 25% ASMD for peanut crops as compared with other treatments and control. The same trend was true in case of the soil total porosity values. It is clear that application of all treatments decreased soil hydraulic conductivity (cm h^{-1}) values when compared to the control. Moreover, the best treatment in decreasing soil hydraulic conductivity (cm h^{-1}) value of FYM and irrigation treatments 100% ETc for wheat and 25% ASMD for peanut crops as compared with other treatments and control. Whereas the highest values of field capacity and available water existed in case of the same treatments.

Finally, applying FYM and irrigation treatments 100% ETc for wheat and 25% ASMD for peanut crops as compared with other treatments and control increased significantly the yield and yield components of both wheat and peanut. The beneficial effects of the applied treatments on wheat and peanut yields could be arranged in the following order: FYM>compost > polyacrylamide>control under different irrigation treatments.

INTRODUCTION

It is of utmost importance to identify the crop production that can be achieved from the basic water unit relative to the cultivated area unit currently and in the future. This is needed because the world population increases especially in developing countries which consequently necessitate increasing food production. However, these increasing trends are not accompanied by similar increase in the fresh available water for everybody. So, the aim of this study is to show the effect of irrigation water deficit and irrigation water stress on wheat and peanut crops production in rotation, respectively.

Rizk and Sherif (2014), Taha et al. (2017) and Morsy et al. (2018) indicated that exposing durum wheat to deficit levels from 60% to 100% caused a decrease in all measured parameters in Toshka conditions, Egypt. **Ouda et al. (2010)** stated that the deficit irrigation till 70% of full irrigation produced 5% losses of wheat yield. **Zaman et al. (2017)** found that water deficit from 60% to 80% of field capacity decreased grain yield and water use efficiency of wheat by 15.66% and 38%, respectively. **Jongrungklang et al. (2008)** added that decreased the irrigation amount at levels of field capacity (100%, 25%, 40% and 60%) caused drop of peanut water use efficiency. **El-Boraie et al. (2009)** showed that irrigation quantity (983.73mm) produced the highest peanut pods in shalatien sandy soil along with **Abd El-Halim et al. (2016)** observed that peanut production was 1.32 kg/m^3 at irrigation depth 730 mm under sprinkler irrigation. **Tojo Soler et al. (2013) and Aly et al. (2016)** reported that medium water stress level gave the highest peanut water use efficiency.

Moreover, sandy soil has poor physical and chemical properties including water holding capacity, loose structure, high bulk density and water conductivity, low cation exchange capacity and organic matter. These soils were the main reclaim land in Egypt. Hence, this investigation was carried out on sandy soil, which needs to improve its properties by adding amendments, which was the second goal of this study. **Gopinath et al. (2008)** found that the organic amendments in sequence, farm yard manure was better than vermicomposting in terms to wheat growth and yield and improved soil properties. **Ghosh et al. (2006) and Zayton et al. (2014)** showed that straw mulching decreased peanut water consumptive use. **Bulluck et al. (2001), El-Hady et al. (2012) and Allam (2017)** observed that organic compost and hydrogel conditioners have a good effect on the sandy soil moisture characteristic and crops yield. **Singh et al. (2019)** stated that water deficit and soil amendment were considered saving water techniques to overcome the water shortage that can be used in agriculture and this was similarly noted by **Shenglan et al. (2020)**.

From the earlier detailed information, the aim of this experiment is to evaluated the consequence of irrigation treatments (100%, 75% and 50%) of wheat crop evapotranspiration ($ET_{c)}$ and 25%, 50 % and 75% from available soil moisture depletion (ASMD) irrigation regime for peanut crop in sandy soil treated with some organic and synthetic soil amendments. Water consumptive use, water use efficiency, yields production along with soil physical and chemical properties was taken in consideration.

MATERIALS AND METHODS

The existing investigation was carried out at the farm of Ismailia Agricultural Research Station in Ismailia Governorate, Egypt, during the winter season (2014/2015) cultivated with wheat (*Triticum aestivum* L., cv Giza 168) and peanut crop (*Arachis hypogaea* L. Giza 6) in summer season (2015). The research farm is located at 30 35, 41.9" N latitude and 32 16 45.8" E longitude. Some soil physical and chemical properties have been performed according to **Klute (1986)** and **Pansu and Gautheyrou (2006).** These results were presented in Table (1 -2).

The main objective of this study was to determine the effect of irrigation deficit levels on wheat crop and available soil moisture depletion to peanut crop with applied soil amendments (none, compost, farm yard manure and poly acrylamide) on water consumptive use, yield of both crops, water use efficiency and some other soil properties.

Table(1). Physical analysis and moisture constants of the investigated soil.

Soil depth cm	Particle size distribution				Texture	Bulk density g cm^{-3}	Retained moisture at field capacity, v /v		Retained moisture at permanent wilting point ,v/v		Available moisture mm/soil depth
	Coarse sand %	Fine sand %	Silt %	Clay %			%	mm/15 cm	%	mm/15 cm	
0-15	67.50	26.86	3.77	1.87	Sandy	1.60	12.80	19.20	3.00	4.50	14.70
15-30	70.66	24.01	3.94	1.39	Sandy	1.62	12.20	18.30	2.80	4.20	14.10
30-45	73.55	21.12	3.87	1.46	Sandy	1.65	7.92	11.88	2.60	3.90	7.98
45-60	85.47	10.87	2.65	1.01	Sandy	1.66	6.80	10.20	2.60	3.90	6.30
Total											43.08

Table (2). Chemical analysis of the investigated soil.

Parameters	Values	Parameters	Values
pH(1.2.5 soil water susp.	8.12	OM %	0.23
EC dS m^{-1}	0.50	$CaCO_3$ %	0.53
Soluble anions in soil paste extract (meq L^{-1})		Soluble cations in soil paste extract (meq L^{-1})	
CO_3^{-2}	-	Ca^{+2}	1.20
HCO^-_3	1.50	Mg^{+2}	0.50
Cl^-	2.01	Na^+	2.80
SO^{--}_4	1.20	K^+	0.21
Macronutrients in soil			
Total N %	0.06	Total P %	0.04
Available N (meg Kg^{-1})	21.6	Available P meg kg-[1]	2.85

Climatic condition:

The meteorological data ,air temperature (C^o), relative humidity (%), actual and possible sunshine (hour), solar and extraterrestrial radiation (MJm^{-2} day^{-1}) and wind speed (m/sec) had been daily recorded (Table 3) at Ismailia Station , Egypt and their general monthly mean values were calculated.

Irrigation system:

The experiment was irrigated by a solid set triangle sprinkler system. The laterals were spaced 12 m apart. The sprinklers were spaced 10 meters lateral. Each two laterals and sprinklers have a control valve to adjust the quantity of applied water. The rate of water application was 45.5 m^3 fed^{-1}/hr (sprinkler discharge 1.3 m^3/ hr at 2.5 bars). The quantity of applied water was exactly controlled with excellent uniform distribution of water. The number of sprinklers per fed. were 35. The application rate (A) is calculated as follows:-

$$A = K \frac{Qs}{LS}$$

Where: A= Application rate [mm/hr], Qs = Discharge of sprinkler [L/min],

L= The distance between lateral [m], S= The distance between sprinklers on lateral [m], K= Fraction equal 60

Table (3). The meteorological general monthly mean values data of Ismailia Station in the year (2014/2015).

Month	Parameters										
	$T_{max.}$ °C	$T_{min.}$ °C	T_{mean} °C	$RH_{max.}$ %	$RH_{min.}$ %	RH_{mean} %	W.S m/sec	N hour	N hour	Rs MJm^{-2} day^{-1}	Ra MJm^{-2} day^{-1}
Jan.	19.8	8.0	13.9	79.5	21.50	50.50	2.57	7.6	10.23	12.86	20.7
Feb.	20.8	8.5	14.65	78.9	18.50	48.55	2.91	8.3	10.97	16.02	25.5
Mar.	23.7	10.5	17.1	73.0	22.50	47.75	3.24	9.1	11.8	19.83	31.2
Apr.	28.4	13.4	20.9	71.50	19.50	45.50	3.08	10.2	12.73	23.88	36.7
May	32.5	17.3	24.9	70.5	21.00	45.75	3.03	11.5	13.53	26.99	40
Jun.	35.1	20.5	27.8	71.80	23.60	47.70	2.93	13.1	13.97	29.67	41.27
Jul.	36.4	22.5	29.45	75.50	26.20	50.85	2.93	12.6	13.83	28.66	40.63
Aug.	36.5	23.2	29.85	76.80	27.50	52.15	2.47	12.2	13.13	27.13	37.97
Sep.	33.2	21.2	27.2	76.50	30.00	53.25	2.47	10.8	12.12	22.39	32.2
Oct.	30.9	18.1	24.5	77.50	21.70	49.60	2.17	10.2	11.27	19.16	27.27
Nov.	26.3	13.6	19.95	78.90	22.50	50.70	2.37	8.8	10.43	14.66	21.83
Dec.	21.8	9.8	15.8	79.50	23.30	51.40	2.31	7.3	10.03	11.89	19.37

The layout of first experiment:

The experiment was carried out in split plot design with three replicates. Wheat seeds (*Triticum aestivum* L., cv Giza 168) were sown in rows 300 cm long and 15 cm apart on December 3, (2014). The field was divided into main plot; 72 $m^{2.}$ The dimension of each plot was 3.0 m in length and 2 m in width. Each plot includes 13 rows. The main plots consisted of three irrigation treatments, viz. 100, 75, 50% of wheat crop evapotranspiration, $ET_{c,}$ respectively. The sub main plots include also three soil amendments (compost at rate of 5 ton fed^{-1}, FYM at rate of 10 m^3 fed^{-1} and polyacrylamide 0.2%) along with control treatment. All soil amendments were analyzed and results were presented in Table (4 - 5).These soil amendments were applied on the soil before cultivation. Normal cultural practices were used including: adding 30kg P_2O_5 $fed.^{-1}$ in form of calcium superphosphate (15% P_2O_5) before sowing and 48 Kg K_2O $fed.^{-1}$ in form of potassium sulfate. Nitrogen fertilizer was added as ammonium nitrate (33%) at rate of 300kg fed^{-1} divided at six equal doses; after sowing in 20 day and after that added every 15 days. The irrigation treatments (100, 75 and 50% of ETc) were applied at end of initial stage. The harvest date of wheat was 30/4/2015.

Table (4):- Chemical composition of the soil conditioners used in the experiment

Parameters	Compost	FYM	Parameters	Compost	FYM
pH(1:10)	8.00	8.70	C/N ratio	25.1:1	19.8:1
EC dSm^{-1}	4.10	4.30	Total- N %	0.59	0.24
OC %	14.8	11.7	Total- P %	0.44	0.20
OM %	25.5	20.1	Total- K %	0.67	0.15

Table (5):- Some characteristics of anionic polyacrylamide used in the experiment

Item	Index
Molecular formula	(C_3H_5NO) n
Appearance	White granular powder
Purity	> 92
Moisture %	< 9
pH value(1% water solution)	7.5 – 9
Molecular weight(million)	16 – 18
Charge density	High
Approx. bulk density	0.80
Dissolving time(min.)	< 60
Ionic character	Anionic
Chemical formula for polyacrylamide	
O OOO || || || C- NH_2 C- NH_2 C - NH |||| -CH_2 –CH- CH_2- CH – CH_2-CH –CH_2-CH-	

Wheat evapotranspiration (ET_C) calculated by multiplying the Potential evapotranspiration (ET_o) and adjusted wheat crop coefficient (Kc) according to the Penman Monteith daily (PM_d) equation **(Allen et al., 1998).**

$ET_c = K_c \times ET_O$

Where:

K_c : Crop coefficient.

ETc : The measured (estimate) evapotranspiration of a considered period (mm/day)

ET_o : reference evapotranspiration (mm/day) referring to the same period, calculated as average value of formulae.

The duration of wheat crop growth stages were 20, 50, 60 and 23 days for the initial, development, mid-season and late-season, respectively. The adjusted wheat was 0.7 and 0.985 for the initial stage and developmental stages, respectively. While the adjusted wheat crop coefficient K_c calculated by the next equation were 1.27 and 0.52 for mid-season and late-season a corroding **Allen et al. (1998),** respectively.

$K_{c\ mid} = K_{c\ mid\ (Tab)} + [0.04(u_2 - 2) - 0.004(RH_{min} - 45)]\ (h/3)^{0.3}$

$K_{c\ end} = K_{c\ end\ (Tab)} + [0.04(u_2 - 2) - 0.004(RH_{min} - 45)]\ (h/3)^{0.3}$

Where: h= plant height, m

The water irrigation management was required at 50% of the soil water-holding capacity, and also considering the root depth.

The layout of second experiment:

Peanut (*Arachis hypogaea* L., cv Giza 6) was planted on 1/6/2015. The seeds were placed in holes 25 cm apart on rows 300 cm long and 60 cm between the rows. The experiment was carried out in split plot design with three replicates. The main plot was assigned to irrigation treatments while the sub plot was assigned to soil amendments. The irrigation treatments (25%, 50% and 75% of available soil moisture depletion, ASMD) were applied at the end of initial stage. As well as, the same previous mentioned soil amendments with first experiment were applied as sub main plots. Normal cultural practices were used including: adding superphosphate (15 % P_2O_5) at rate of 200 kg fed^{-1} and potassium sulfate (48 % K_2O) was applied at rate of 100 Kg $fed.^{-1}$ divided to equal doses; first one before cultivation and second dose was added to soil after 35 day of sowing date. Nitrogen fertilizer as ammonium nitrate (33%) at rate of 100kg fed^{-1} .The harvest date of peanut was 8/10/2015.

The irrigation intervals were planned considering the ET_c and duration for every peanut irrigation treatments. The duration of growth stages for peanut crop are 25, 45, 35 and 25 days for the initial, development, mid-season and late-season, respectively. The adjusted peanut coefficients were 0.45, 0.75, 1.15 and 0.60 for the initial, developmental mid-season and late-season stages, respectively.

The following characters were included in the study:

1- Water relations:

1.1. Calculation of water consumptive use (Cu) or actual evapotranspiration (ET_a):

Water consumptive use (Cu) was determined according to the equation given by **Israelsen and Hansen (1962)** as follow:

$$WCU = \sum_{i=1}^{n=4} \frac{(\theta_2 - \theta_1)}{100} X\, Bd\, X\, D$$

Where:
WCU = Water consumptive use [mm],
D = depth of soil layer (15mm each) [mm],
Bd = Soil bulk density [g /cm^3],
e_1= Soil moisture content before irrigation, [w/w],
e_2 = soil moisture content after irrigation, [w/w].
n = number of soil layer.

Water use efficiency:

Water use efficiency (WUE) in kg/m^3 was calculated for the deferent treatments, using the following formulae of **Zhao et al., 2014):**

$$W.U.E = \frac{Y}{ET}$$

Where: Y is yields (dry weight, kg fed^{-1}) of a crop
ET is crop water consumption

2- Yield

a. **Wheat:** straw yield and grain yield kg fed.$^{-1}$
b. **Peanut:** straw, pods and seeds yield kg fed.$^{-1}$

3- Soil samples:

Before planting, soil samples from the surface layer (0-30) have been taken from the experiment site, air-dried, sieved through a 2 mm sieve and analyzed for some physical and chemical properties. After harvest, undisturbed and disturbed soil samples have been collected from the surface layers (0-30) from all plots for two seasons, air- dried and analyzed for soil pH, organic matter and cation exchange capacity according to the methods described by **Page et al. (1982)**. Particle size distribution was carried out by the pipette method described by **Gee and Bauder (1986).** The total soluble salts (EC) were determined using electrical conductivity meter at 25°C in soil paste extract as dSm^{-1} **(Jackson, 1973).** Soil bulk density, total soil porosity and dry aggregates were determined according to **Richards (1954).** Hydraulic conductivity was determined using the undisturbed soil samples according to the method of **Richards (1954)**. Soil moisture equilibrium values were determined according to the methods described by **Richards and Weaver (1944) and Richards (1947).** Wilting point was determined according to **Stakman and Vanderhast (1962),** while field capacity was determined as described by **Richards (1954).**

4. Statistical analysis:

All the data collected for the yield and water use efficiency were subjected to the statistical analysis according to **Snedecor and Cochran (1980)** and the mean values were compared by LSD.

RESULTS AND DISCUSSION

Water relations of two crops:

Wheat actual evaopotranspiration (ET_a) affected by different water treatments and soil amendments.

Results in (Table 6) demonstrate that mean values of wheat ET_a were 592.75 mm, 440.43 mm and 339.86 mm at irrigation treatments; 100%, 75 and 50% of ET_c , respectively. Whereas, the percent 38.45, 36.48 and 36.88 % of wheat water consumptive use occurred at March for the mentioned irrigation treatments, respectively. This behavior is due to the plant growth stage and weather conditions. Similar results were identified by **Rizk and Sherif (2014), Taha et al. (2017) and Morsy et al. (2018). Oweis et al. (2000)** added that the seasonal water consumptive use and grain yield varied from 304 mm to 485mm and 170 g m^{-2} to500 g m^{-2} for wheat in Syria northeast, respectively.

On the other hand, the effect of be relevant different soil amendment; none, compost, farm yard manure (FYM) and polyacrylamide on total mean actual wheat (ET_a) results were explained in (Table 6). Mean values of total ET_a were 489.45, 449.27, 425.71 and 470.04 mm, respectively. The saving water was 8.94%, 14.94% and 4.13% with utilizing compost, FYM and polyacrylamide, respectively. These results were in agreement with those obtained by **Ghosh et al. (2006) and Zayton et al. (2014).**

Peanut evaopotranspiration (ET_a) affected by different water treatments and soil amendments.

Results in (Table 7) revealed that peanut Eta was 764.13mm at 25% ASMD. Besides, it was 649.195 mm and 480.61mm at 50 and 75% ASMD, respectively. The highest monthly peanut water consumptive use was achieved at August under different irrigation treatments. The values in percent were 40.99, 35.64 and 29.53 at 25 %, 50% and 75% ASMD, respectively. These results were in agreement with those obtained by **El-Boraie et al. (2009) and Abd El-Halim et al. (2016).**

Table (6). Wheat daily, monthly and total actual evapotranspiration (ET_c) as affected by water deficit and soil amendments.

Months		Dec.*		Jan		Feb		Mar.		Apr.**		Total	
Irrig. Treat.	Soil amendments	Daily mm	monthly mm	Daily mm	monthly mm	Daily mm	monthly mm	Daily mm	monthly mm	Daily mm	monthly mm	mm	m^3fed^{-1}
100% ET_c	None	2.69	75.36	3.49	108.36	4.57	128.08	7.93	245.88	2.55	76.44	634.12	2663.3
	Compost	2.5	70.16	3.34	103.43	4.29	120.11	7.12	220.62	2.29	68.68	583	2448.6
	FYM	2.48	69.38	3.00	93.03	3.91	109.41	6.86	212.79	2.17	65.05	549.66	2308.6
	polyacrylamide	2.58	72.12	3.37	104.38	4.35	121.81	7.5	232.5	2.45	73.4	604.21	2537.7
Mean		2.56	71.755	3.3	102.3	4.28	119.85	7.35	227.94	2.36	70.89	592.75	2489.54
75% ET_c	None	2.53	70.92	2.69	83.46	3.54	99.18	5.44	168.75	1.68	50.36	472.67	1985.2
	Compost	2.26	63.25	2.44	75.59	3.15	88.29	5.15	159.78	1.53	45.74	432.65	1817.1
	FYM	2.11	58.94	2.27	70.36	3.04	85.14	4.7	146.77	1.44	43.2	404.41	1698.5
	polyacrylamide	2.33	65.15	2.61	80.88	3.22	90.11	5.4	167.46	1.61	48.39	451.99	1898.4
Mean		2.3	64.565	2.5	77.57	3.24	90.68	5.18	160.69	1.56	46.92	440.43	1849.81
50% ET_c	None	2.15	60.14	2.21	68.48	2.61	73.11	4.19	130	0.99	29.83	361.56	1518.6
	Compost	1.97	55.14	1.95	60.43	2.3	64.42	4	124	0.94	28.17	332.16	1395.1
	FYM	1.97	55.14	1.94	60.02	2.13	59.58	3.89	120.72	0.92	27.61	323.07	1356.9
	Polyacrylamide	2.05	57.5	2.04	63.18	2.38	66.63	4.08	126.64	0.96	28.69	342.64	1439.1
Mean		2.03	56.98	2.03	63.03	2.35	65.935	4.04	125.34	0.95	28.575	339.86	1427.40
Mean overall of soil amendments	None	2.46	68.81	2.8	86.77	3.57	100.12	5.86	181.54	1.74	52.21	489.45	2055.7
	Compost	2.24	62.85	2.57	79.82	3.25	90.94	5.42	168.13	1.58	47.53	449.27	1886.9
	FYM	2.18	61.15	2.4	74.47	3.02	84.71	5.16	160.09	1.51	45.29	425.71	1788.0
	Polyacrylamide	2.32	64.92	2.79	86.58	3.316	92.85	5.66	175.53	1.67	50.16	470.04	1974.2

*Sowing date was 3/12/2014 ** Harvest date was 30/4/2015

Table (7). Peanut daily, monthly and total actual evapotranspiration (ET_a) affected different soil moisture depletion and soil amendments.

Months		June*		July		August		September		October**		Total	
Irrig. treat.	Soil amendments	daily mm	monthly mm	daily mm	monthly mm	daily mm	monthly mm	daily mm	monthly mm	daily mm	monthly mm	mm	$m^3 fed^{-1}$
25% ASMD	None	4.16	124.7	7.12	220.8	10.92	338.71	4.11	123.41	1.96	15.66	823.28	3457.8
	Compost	4.00	120.16	6.20	192.12	9.73	301.7	3.75	112.38	1.62	13	739.36	3105.3
	FYM	3.90	116.99	6.03	187.11	9.71	301.03	3.60	107.96	1.5	12	725.09	3045.4
	polyacrylamide	4.05	121.56	6.53	202.32	10.1	313.19	3.92	117.72	1.75	14	768.79	3228.9
Mean		4.02	120.85	6.47	200.59	10.12	313.66	3.84	115.37	1.71	13.66	764.13	3209.3
50% ASMD	None	3.93	117.9	6.31	195.51	8.17	253.25	3.31	99.37	2.77	22.13	688.16	2890.3
	Compost	3.89	116.72	5.86	181.8	6.93	215.02	3.13	93.98	2.13	17.02	624.54	2623.1
	FYM	3.84	115.3	5.6	176.16	6.94	215.09	3.08	92.61	2.19	17.52	616.68	2590.1
	polyacrylamide	30	117.02	6.15	190.7	7.81	242.25	3.29	98.61	2.35	18.82	667.4	2803.1
Mean		3.89	116.73	6.00	186.04	7.46	231.40	3.20	96.14	2.36	18.87	649.195	2726.6
75% ASMD	None	3.67	110.16	4.12	127.67	4.0	148.82	3.14	94.19	2.94	23.51	504.35	2118.3
	Compost	3.62	108.49	3.83	118.65	4.51	139.88	2.95	88.63	2.54	20.39	476.04	1999.4
	FYM	327	98.27	3.70	114.83	4.33	134.11	2.88	86.55	2.5	20	453.76	1905.8
	polyacrylamide	3.47	104.16	4.02	124.73	4.67	144.92	3.10	93.09	2.67	21.4	488.3	2050.9
Mean		3.51	105.27	3.92	121.47	4.58	141.93	3.02	90.615	2.66	21.32	480.61	2018.5
Mean overall of soil amendments	None	3.92	117.59	5.85	181.32	7.96	246.93	3.52	105.66	2.55	20.43	671.93	2822.1
	Compost	3.84	115.12	5.30	164.19	7.06	218.87	3.28	98.33	2.10	16.80	613.31	2575.9
	FYM	3.67	110.19	5.14	159.37	6.99	216.74	3.19	95.71	2.06	16.506	598.51	2513.7
	polyacrylamide	3.81	114.24	5.57	172.58	7.53	233.45	3.43	103.14	2.26	18.0	641.50	2694.3

***Sowing date was 1/12/2014** ****Harvest date was 8/10/2015**

Moreover, results in (Table 7) show the effect of soil amendments on peanut ET_a. The values of peanut ET_a ordered from the highest to lowest were as follows: none (671.93mm), polyacrylamide (641.5mm), compost (613.31mm) and farm yard manure (598.51mm). Hence, the applied amendments saved water by 4.74 % for poly acrylamide, 9.56% for compost and 12.27% for farm yard manure. These results were analogous with **Bulluck et al. (2001), El-Hady et al. (2012) and Allam (2017).**

Crop yields and water use efficiency affected by irrigation treatments and soil amendments

1- Wheat crop:

Results presented in (Table 8) showed that straw and grains yields and water use efficiency of wheat crop decreased significantly when irrigation depth was decreased from 100% to 75% and also from 100% to 50% of ET_c, respectively. The reduction in straw, grains and WUE were 26.81%, 30.80% and 7.77% when irrigation depth dropped from 100% to 75%. Whereas, the reduction achieved was 58.67%, 65.07 and 39.43% when irrigation dropped from 100% to 50%, respectively. These results were in agreement with those reported by **Ouda et al. (2010) and Zaman et al. (2017).**

Table (8):- Effect irrigation treatments and some soil amendments on wheat crop production in sandy soil

Irrigation treatments	Type of amendments	Yield and water use efficiency of wheat		
		Straw yield kg fed^{-1}	Grain yield kg fed^{-1}	WUE Kg grain/m^3
100% ET_c	non	3100	2123	0.797
	compost	3450	2387	0.975
	FYM	3567	2543	1.122
	Poly acrylamide	3200	2373	0.935
Mean for irrigation (I1)		3329	2356	0.9575
75% ET_c	non	2283	1525	0.754
	compost	2483	1683	0.926
	FYM	2603	1697	0.999
	Poly acrylamide	2377	1618	0.852
Mean for irrigation (I2)		2437	1631	0.883
50% ET_c	non	1250	703	0.463
	compost	1417	897	0.641
	FYM	1487	907	0.668
	Poly acrylamide	1350	787	0.547
Mean for irrigation (I3)		1376	823	0.580
Mean for soil conditioners				
Non		2211	1451	0.671
Compost		2450	1656	0.847
Farmyard manure		2552	1716	0.930
Poly acrylamide		2309	1593	0.778
L.S.D. at 0.5% for				
irrigation (A)		32.28	17.03	0.011
Soil amendments (B)		35.65	14.05	0.009
A*B		61.74	24.33	0.017

Also, results in (Table 8) show that soil amendments; compost, farm yard manure had a significantly increased wheat yield (straw and grains) along with water use efficiency as compared to no applied amendments. These increments in straw yield, grains yield and water use efficiency for wheat crop was 10.8%, 14.13 and 26.21% when compost was applied. Similarly, increments of 15.43%, 18.27% and 38.49% and 4.4%, 9.81 and 15.89% were observed with the addition of farm yard manure and synthesis, respectively. Similar results were found by **Gopinath et al. (2008), Leu et al. (2010) and Singh et al. (2019).**

2- Peanut crop:

Peanut straw (kg fed^{-1}), pods (kg fed^{-1}), seeds (kg fed^{-1}) yield and WUE (Kg seed/m^3) were significantly influenced by water stress and the various soil amendments. The obtained values are presented in Table 9. The decreasing ASMD significantly increased peanut straw, pods and seeds production. Whereas, the peanut WUE was produced at medium ASMD. Similar results were found by **Tojo Soler et al. (2013), Aly et al. (2016) and Abd El-Halim et al. (2016).**

Table (9):- Effect irrigation treatments and some soil amendments on peanut crop production in sandy soil

Irrigation treatments	Type of amendments	Yield and water use efficiency of peanut			
		Straw yield kg fed^{-1}	pods yield kg fed^{-1}	seed yield kg fed^{-1}	WUE Kg seed/m^3
25% ASMD	Non	1700	1433	1103	0.323
	Compost	1927	1643	1260	0.406
	FYM	2203	1787	1373	0.451
	Poly acrylamide	1897	1648	1217	0.377
Mean for irrigation (I1)		1932	1628	1238	0.389
50% ASMD	Non	1450	1370	1003	0.347
	Compost	1597	1532	1193	0.455
	FYM	1810	1632	1277	0.493
	Poly acrylamide	1597	1533	1137	0.406
Mean for irrigation (I2)		1613	1517	1153	0.425
75% ASMD	Non	690	542	580	0.274
	Compost	850	683	654	0.327
	FYM	932	772	693	0.371
	Poly acrylamide	785	602	567	0.276
Mean for irrigation (I3)		814	650	623	312
Mean for soil conditioners					
none		1280	1115	896	0.315
Compost		1458	1286	1036	0.396
Farmyard manure		1648	1397	1114	0.438
Poly acrylamide		1426	1261	973	0.353
L.S.D. at 0.5% for					
irrigation (A)		33.22	41.67	30.21	0.011
Soil amendments (B)		30.56	21.41	12.92	0.009
A*B		52.93	37.08	22.38	0.017

The obtained data for the effect of soil amendments namely; none, compost, farm yard manure and poly acrylamide to peanut straw, pods, seeds and WUE are presented in Table 9. The results revealed that the best soil amendment to peanut production is farm yard manure followed by compost and synthesis, respectively. These results are in agreement with those obtained by **Allam (2017) and Shenglan et al. (2020)**.

Soil properties of the studied soil under wheat- peanut crops.

1. Soil chemical properties

Results in Table (10) revealed that soil chemical properties were substantially improved by all treatments. These soil chemical properties included:

1.1. Soil electrical conductivity:

Electrical conductivity was a soil parameter that indicates indirectly the total concentration of soluble salts and is a direct measurement of salinity. Soil salinity after harvested wheat and peanut crops as affected by different treatments was given in Table (10). Results showed that slightly increased in EC values as affected by applied irrigation treatments. Applied irrigation treatment 50% ETc for wheat crop and 75% ASMD for peanut crop were relatively high EC values as compared to other irrigation treatments for both crops in two successive seasons. In addition, it is clear that application of all treatments significantly decreased soil EC (dSm^{-1}) values when compared to control. **Shaban et al. (2012)** indicated that the decrease of EC soil as treated with applied organic amendments were due to the activity of microorganisms in reducing salinity and simultaneously improving characterization of soil structure; increasing drainable porosity and aggregate stability, and consequently enhanced leaching process through irrigation fractions. The treatment of applied FYM to both studied crops and irrigation treatments 100% ETc for wheat and 25% ASMD for peanut has the highest effect in lowering EC values compared with other treatments and control. These results are in agreement with those of **Aiad (2010)** and **Hassan and Abdel Wahab (2013).**

1.2. Soil pH:

Soil pH is an important consideration for farmers and graders for several reasons, including the fact that many plants and soil life forms prefer either alkaline or acidic conditions, that some diseases tend to thrive when the soil is alkaline or acidic, and that pH can affect the availability of nutrients in the soil **(Smith et al., 1994)**. Results of pH values in Table (10) reveal that no significant different between irrigation treatments used in this experiment for both seasons. Also, it is obvious from Table (10) that the soil pH decreased slightly due to the application of all treatments compared to untreated soil (control) after wheat or peanut harvested. Such decrease in pH could be attributed to the production of CO_2 and organic acids by soil microorganisms acting and other chemical transformation of the added organic matter. The effect was more pronounced in the soil treated with FYM and irrigation treatments (100% ETc for wheat plant and 25% ASMD for peanut plant) as compared with other treatments and control. These results are in agreement with **Davar et al. (2002) and Rizk (2016)** they reported that the soil pH values decreased in soil treated with FYM. Finally, the reducing of soil pH as affected by organic amendments application was due to the increase of microbial activity, organic acid production and increase of soil organic matter content compared with control.

1.3. Soil organic matter and cation exchange capacity:

Organic matter is regarded as the ultimate source of nutrients and microbial activity in the soil. It is the deciding factor in soil structure, water holding capacity, infiltration rate, aeration and porosity of the soil. Data presented in Table (10) showed that slightly increased in OM content under irrigation treatments (100% Etc for wheat and 25% ASMD for peanut) as compared to other irrigation treatments. Moreover, data indicated that the OM content in soil increased significantly under different treatments and/or control. The highest increase in OM content values was noticed in the treatment of applied FYM and irrigation treatments (100% ETc for wheat and 25% ASMD for peanut) as compared with other treatments and control. These results are in agreement with those of **El-Eter et al**. (**2019**) who found that the application of compost resulted in increasing of the soil organic matter level.

The cation exchange capacity of the soil as affected by all treatments took the same trend of organic matter. This may be attributed to the soil organic matter which encourages granulation, increases cation exchange capacity (CEC) and is responsible up to 90 % adsorbing power of the soils (**Brady and Weil, 2005**). Data in Table (10) show that the CEC increased significantly as affected by different treatments compared to control. The highest value of CEC was found in the FYM irrigation treatments (100% ETc for wheat and 25% ASMD for peanut) as compared with other treatments and control. **Haynes and Naidu (1998)** stated that the organic manure caused a 30% increase in CEC compared with the control treatment.

Table (10): Chemical properties of the studied soil after wheat- peanut crops harvested

Soil amendments.	Wheat crop														
	Irrigation treatments														
	100% ET_C					75% ET_C					50% ET_C				
	EC dS m^{-1}	pH 1:2.5	O.M %	CEC Cmole/ kg	$CaCO_3$ %	EC dS m^{-1}	pH 1:2.5	O.M %	CEC Cmole/ kg	$CaCO_3$ %	EC dS m^{-1}	pH 1:2.5	O.M %	CEC Cmole/ kg	$CaCO_3$ %
Non	0.72	7.77	0.19	8.13	1.38	0.76	7.79	0.17	8.11	1.39	0.85	7.80	0.16	8.00	1.41
Compost	0.50	7.61	0.27	9.80	1.26	0.54	7.63	0.26	9.55	1.27	0.56	7.64	0.23	9.46	1.32
FYM	0.45	7.56	0.32	11.23	1.22	0.46	7.61	0.29	11.10	1.24	0.48	7.62	0.28	11.04	1.26
PAM	0.53	7.60	0.23	9.65	1.29	0.57	7.63	0.23	9.29	1.30	0.60	7.70	0.21	9.16	1.33

Soil amendments.	Peanut crop														
	Irrigation treatments														
	25% ASMD					50% ASMD					75% ASMD				
	EC dS m^{-1}	pH 1:2.5	O.M %	CEC Cmole/ kg	$CaCO_3$ %	EC dS m^{-1}	pH 1:2.5	O.M %	CEC Cmole/ kg	$CaCO_3$ %	EC dS m^{-1}	pH 1:2.5	O.M %	CEC Cmole/ kg	$CaCO_3$ %
Non	0.79	7.70	0.20	9.34	1.36	0.83	7.71	0.19	8.13	1.37	0.84	7.73	0.17	8.07	1.40
Compost	0.51	7.56	0.28	8.37	1.25	0.54	7.60	0.28	9.69	1.25	0.56	7.62	0.25	9.54	1.31
FYM	0.41	7.54	0.34	10.30	1.21	0.42	7.59	0.31	11.32	1.22	0.47	7.60	0.30	11.21	1.25
PAM	0.56	7.56	0.25	9.86	1.28	0.59	7.62	0.25	9.39	1.28	0.59	7.68	0.21	9.23	1.31

2. Soil physical properties:

The changes in the studied physical properties of sandy soil as related to the application of all treatments during winter and summer seasons were presented in Table (11 and 12). In general, the studied soil characteristics responded markedly to all the studied treatments, either irrigation or soil amendments, in case of both wheat and peanut crops. Data also indicated that the treatments showed a positive effect for improving the soil characteristics, where, the values of bulk density and hydraulic conductivity decreased, on the other hand, the total porosity and retained moisture at field capacity, wilting point and available water increased as a result of the soil amendment application.

2.1. Dry –sieved aggregates:

The dry sieving aggregates values were shown in Table (11). Data reveal that, the dry stable aggregates (D.S.A %) which having diameters from 1 to 0.5 mm were found to be the largest size presented in the different studied treatments. Moreover, the percentages of other sizes of dry stable aggregates decrease as their diameters decrease, whereas, the lowest values exist in case of the aggregates having diameters less than 0.063 mm. Thereby, the application of FYM and irrigation treatments (100% Etc for wheat and 25% ASMD for peanut) resulted in the highest increase of diameters 1- 0.5 and 0.5-0.25 mm, compared to control and other treatments**.** **Brian (2015)** reported that the relative importance of soil organic matter in maintaining aggregate stability varies with texture. In sandy soils soil organic matter is the most important factor **(Oades, 1993).**

2.2. **Soil bulk density and total porosity:**

The results obtained in Table (12) showed clearly that the applied organic soil amendments play a dual positive role, i.e., reducing soil bulk density vs increasing total soil porosity. Thus, the promotive effect of organic amendments on the soil porosity in the studied sandy soil may be due to the values of soil bulk density which behaved the opposite trend with those obtained from total porosity. In general, this increase may be related to the increase of storage pores in the studied sandy soil and physical improvement of soil, which can be regarded as an index of an improved soil structure (**Amjad et al., 2010).** Data also showed that the highest value of total soil porosity was found in the soil treated with FYM and irrigation treatments (100% ETc for wheat and 25% ASMD for peanut) compared to control and other treatments**.** In all treatments, soil bulk density decreased when compared to control, because of binding the primary particles in the aggregates, physically and chemically, and thus in turn increases the stability of the aggregates and limits their breakdown during the wetting process, as a result of applying organic soil conditioners. Generally, organic soil conditioners improve soil physical properties, including improving soil porosity and decreasing soil bulk density.

Table (11):- Distribution fractions (%) of dry- sieved aggregates after wheat- peanut crops harvested.

Soil amendment	Wheat crop																				
	Irrigation treatments																				
	100% ETc							75 % ETc							50% ETc						
	Dry Aggregates Diameter (mm)							Dry Aggregates Diameter (mm)							Dry Aggregates Diameter (mm)						
	10-2	2-1	1-0.5	0.5-0.25	0.25-0.125	0.125-0.063	<0.063	10-2	2-1	1-0.5	0.5-0.25	0.25-0.125	0.125-0.063	<0.063	10-2	2-1	1-0.5	0.5-0.25	0.25-0.125	0.125-0.063	<0.063
Non	0.93	1.56	1.75	25.60	55.64	10.78	3.58	0.82	4.25	45.0	30.80	12.88	4.97	1.28	0.92	2.31	40.76	41.88	8.30	4.29	1.54
Compost	0.73	1.63	37.79	42.07	13.94	3.33	0.51	0.46	1.32	45.20	41.64	5.82	3.65	1.91	1.00	2.60	45.08	30.17	16.94	3.40	0.80
FYM	0.48	1.36	49.44	31.84	12.03	4.14	0.51	0.46	0.94	43.54	31.67	15.02	6.33	2.05	1.68	0.98	34.01	45.72	13.14	4.16	0.65
PAM	1.01	1.25	36.88	38.98	16.11	3.89	1.87	0.92	2.56	43.20	35.25	12.87	3.33	2.25	0.86	2.36	38.87	35.99	14.72	5.47	1.74

Soil amendment	Peanut crop																				
	Irrigation treatments																				
	25% ASMD							50% ASMD							75% ASMD						
	Dry Aggregates Diameter (mm)							Dry Aggregates Diameter (mm)							Dry Aggregates Diameter (mm)						
	10-2	2-1	1-0.5	0.5-0.25	0.25-0.125	0.125-0.063	<0.063	10-2	2-1	1-0.5	0.5-0.25	0.25-0.125	0.125-0.063	<0.063	10-2	2-1	1-0.5	0.5-0.25	0.25-0.125	0.125-0.063	<0.063
Non	0.42	1.45	26.05	56.75	9.66	3.81	1.85	0.46	4.43	41.29	33.85	12.94	5.21	1.81	0.58	1.77	40.19	45.14	8.21	5.71	2.17
Compost	0.34	1.78	33.35	44.56	13.17	4.09	2.71	0.42	1.43	43.02	43.96	5.41	4.09	1.68	0.61	2.27	41.77	34.10	16.01	3.78	1.47
FYM	0.61	1.16	37.22	43.21	11.34	4.42	2.04	0.47	1.03	38.42	38.87	13.53	5.53	2.15	0.39	0.86	32.60	47.05	12.71	4.28	2.11
PAM	0.31	1.20	36.16	43.12	12.99	4.06	2.15	0.46	2.52	40.09	37.78	12.54	3.85	2.76	0.65	2.52	36.42	38.81	14.08	5.40	2.12

Table (12):- Soil moisture constants (%), total porosity (%), Hydraulic conductivity and Bulk density after wheat-peanut plants harvested

Soil amendment	Wheat crop																	
	Irrigation treatments																	
	100% ETc						75 % ETc						50% ETc					
	Hydrulic conductivity (cm h^{-1})	T.P. %	BD (g/cm^3)	Soil moisture constants %			Hydraulic conductivity (cm h^{-1})	T.P. %	BD (g/cm^3)	Soil moisture constants %			Hydrulic conductivity (cm h^{-1})	T.P. %	BD (g/cm^3)	Soil moisture constants %		
				F.C.	W.P	A.W.				F.C.	W.P	A.W.				F.C	W.P.	A.W.
Non	11.96	34.84	1.73	12.13	7.71	4.41	12.81	32.95	1.78	12.08	8.04	4.04	13.01	31.95	1.80	12.00	8.10	3.90
Compost	9.88	40.50	1.58	15.88	5.04	10.82	9.95	40.0	1.59	15.43	5.09	10.34	9.79	38.62	1.63	15.01	5.39	9.63
FYM	8.33	48.81	1.36	18.73	4.53	14.19	8.47	48.05	1.38	18.02	4.37	13.65	8.52	46.67	1.41	17.65	4.62	13.03
PAM	9.90	37.61	1.65	13.87	5.61	8.33	10.00	36.48	1.68	13.59	5.77	7.82	10.01	35.98	1.70	13.59	5.02	8.57

Soil Amendment.	Peanut crop																	
	Irrigation treatments																	
	25% ASMD						50% ASMD						75% ASMD					
	Hydrulic conductivity (cm h^{-1})	T.P. %	BD (g/cm^3)	Soil moisture constants %			Hydraulic conductivity (cm h^{-1})	T.P. %	BD (g/cm^3)	Soil moisture constants %			Hydrulic conductivity (cm h^{-1})	T.P. %	BD (g/cm^3)	Soil moisture constants %		
				F.C.	W.P.	A.W.				F.C.	W.P.	A.W.				F.C.	W.P.	A.W.
Non	11.92	37.48	1.66	12.25	7.12	5.13	12.76	34.09	1.75	12.12	8.01	4.11	12.30	33.20	1.77	11.65	7.93	3.72
Compost	9.81	41.90	1.54	16.73	4.91	11.82	9.89	40.38	1.58	15.46	4.92	10.54	9.94	39.50	1.60	16.27	5.3	10.97
FYM	8.22	49.68	1.33	18.81	4.45	14.36	8.28	48.68	1.36	18.33	3.8	14.53	8.34	46.92	1.41	17.92	3.73	14.19
PAM	9.79	39.25	1.61	14.09	5.43	8.66	9.86	38.24	1.64	13.54	5.45	8.09	10.01	36.73	1.68	12.81	3.55	8.07

2.3. Hydraulic conductivity and soil moisture constants:

Values of soil hydraulic conductivity after harvested wheat and peanut crops as affected by different treatments are given in Table (12). It is clear that the application of all treatments decreased soil HC (cm h^{-1}) values when compared to the control. The improvement or the pronounced decrease in hydraulic conductivity of the studied sandy soil may be attributed to the creation of micro pores, and the dominance of meso and micro pores compared with other pore sizes. These results are in agreement with those of **El-Fayoumy and Ramadan (2002)**. The best treatment in decreasing soil HC (cm h^{-1}) values was FYM compared to control and other treatments**.**

Concerning the magnitudes of the changes in available water range, field capacity and wilting point at different applied treatments, data presented in Table (12), in general, showed that the content (%) of available water in soil increased .The soils treated with FYM relatively high values of available water as compared to control and other treatments**.** This is due to the fact that organic substances attain a pronounced high content of active organic compounds that enhancing the water molecules to be chelated **(Moustafa et al., 2005).** The highly magnitude of these results is saving a lot of irrigation water which can be used to reclaim, cultivate new areas and to enhance water use efficiency of most crops. These results are in harmony with the findings of **Usman et al. (2005) and Hassan and Abdel Wahab (2013).**

In general, FYM effect of the applied treatments on the studied different soil physical properties under the application of FYM and irrigation treatments (100% ETc for wheat and 25% ASMD for peanut) could be arranged in the following order: FYM> compost> polyacrylamide>control .

CONCLUSION

From the abovementioned results, it could be concluded that applied irrigation treatments (100% ETc for wheat and 25% ASMD for peanut) and used organic and synthetic soil amendments such as compost, farmyard manure and polyacrylamide can improve the soil physical and chemicals properties of sandy soil along with decreased irrigation water consumptive use and increased water use efficiency. Moreover, wheat and peanut yields increased significantly under the irrigation treatment (100% ETc for wheat and 25% ASMD for peanut) in presence of FYM soil amendment as compared to other treatments or control treatment.

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تـأثير معاملات الرى و بعض محسنات التربة على خواص الارض و انتاجية محصولى القمح و الفول السودانى فى الارض الرملية

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تم اجراء تجربه حقليه في مزرعة محطة البحوث الزراعية بالأسماعيلية ،مصر خلال موسمى (2014 و 2015). تم زراعه القمح صنف (جيزة 168) في موسم الشتاء2014 **تحت مستويات رى 100% ، 75% ، 50% من البخر نتح (ET_C)** و الفول السوداني صنف (جيزه 6) تم زراعته فى موسم الصيف 2015 ايضا تحت ثلاث معاملات للرى **75%، 50%،25% استنفاذ مستوى رطوبة التربة (ASMD) من اجمالى الماء الميسر الكلى للتربة.**

و كانت المعاملات كما يلي :-

1- كنترول
2- كمبوست
3- FYM
4- بولي اكريلاميد

وكانت النتائج كما يلى:

1) كانت أفضل معاملة رى للقمح عند 100%(ET_C) و أفضل معاملة رى للفول السودانى كانت عند 25%(ASMD) مقارنة" بالمعاملات الاخرى و الكنترول.

2) كان لكل المعاملات دور فى حدوث انخفاض في قيم pH التربة والملوحة مقارنة مع الكنترول وكانت أفضل المعاملات تأثيرا" هى FYM و معاملات الرى 100%(ET_C) للقمح و 25%(ASMD) للفول السودانى مقارنتا" بالمعاملات الاخرى و الكنترول

3) زاد محتوى التربة من المادة العضوية و كذلك ازدادت قيم السعة التبادلية الكاتيونية بأستخدام كل المعاملات بالمقارنة مع الكنترول.

4) حدوث تحسن طفيف في الكثافة الظاهرية وازدادت المسامية الكلية و كذلك ازدادت قيم ثوابت الرطوبة عند كل من السعة الحقلية و الماء الميسر ولكن انخفضت قيم التوصيل الهيدروليكى **وكانت أفضل المعاملات تأثيرا" هى FYM و معاملات الرى 100%(ET_C) للقمح و 25% (ASMD) للفول السودانى مقارنة" بالمعاملات الاخرى و الكنترول.**

5) أظهرت النتائج أيضا زيادة فى محصول القمح والفول السوداني فى جميع المعاملات مقارنة بالكنترول **وكانت أفضل المعاملات تأثيرا" هى FYM و معاملات الرى 100% (ET_C) للقمح و 25% (ASMD) للفول السودانى .**

.* وبصفة عامة توصى الدارسة باستخدام **FYM و معاملات الرى 100%(ET_C) للقمح و 25%(ASMD) للفول السودانى** لأن هذه المعاملات تعمل على تحسين خواص الارض الكيميائية و الطبيعية وبالتالي زيادة محصولى القمح و الفول السوداني في الأراضى الرملية.