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EFFECT OF JOJOBA AND CASTOR BEAN SEED RESIDUES AS SOIL AMENDMENTS ON SOME PHYSICAL AND HYDROPHYSICAL SOIL PROPERTIES.

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ABSTRACT

Field experiments were carried out on silty clay loam soil at El-Gemmeiza Agricultural Research Station, El-Gharbia Governorate, during two consecutive growing seasons. Summer season 2007 and winter season 2007/2008 to evaluate the effect and residual effects of oil seed residues of jojoba and /or castor bean as soil amendments on improving some physical and hydrophysical soil properties. The rates of jojoba and castor bean seed residues were 0.0, 1.0 and 2.0 ton/fed. for each amendment which added before planting in the first season, while mineral fertilizers rates were 0.0, 0.5 and 1.0 of the recommended dose for each crop. The experiments were conducted in a split-split plot design with three replicates.

The obtained results can be summarized as follows :-

1- Soil penetration resistance decreased with all added treatments, also, by increasing the addition rates of these amendments, soil penetration resistance was decreased.
2- The soil bulk density (Db) decreased in all treatments, while total soil porosity (E) and void ratio (e) take the opposite trend.
3- The settling percentage of the soil was decreased in all treatments, indicating a higher degree of structural stability.
4- The values of pore size distribution (large, medium and micro pores as a percent of total porosity) were significantly increased in the two growing seasons.
5- Soil hydraulic conductivity (Kh) and soil moisture content, i.e., saturation percent (SP), field capacity (FC), wilting point (WP) available water (AW) and soil moisture content just before harvesting (θw) were significantly increased in all treatments in the two growing seasons.
6- Water consumption (Cu) was decreased and water use efficiency (WUE) was increased with all treatments of the two seasons.
7- From the above results, it is more useful to use those treatments (jojoba and / or castor bean seed residues) as soil amendments to markedly improve both physical and hydro physical properties under silty clay loam soils.

Keywords: Oil seed residues, jojoba, castor bean, soil amendments, physical and hydro physical properties, maize and wheat plants.

INTRODUCTION

One of the most common soil problems in arid and semi-arid regions is continuous decrease in soil organic matter content. Therefore, much emphasis has been placed on the use of manures and plant organic residues to prevent this decrease and even to increase the organic matter content of the soil.

The soil organic matter maintains favorable soil physical, chemical and biological properties and release nutrients to the soil mostly through plant residues decomposition (Kumar *et al.*, 2001).

To maintain this nutrient cycling system, the rate of addition from crop residues and manure must equal the rate of decomposition. If the rate of addition is less than the rate of decomposition, soil organic matter will decline, and conversely, if the rate of addition is greater than the rate of decomposition, soil organic matter will increase. The term steady state has been used to describe a condition where the rate of addition is equal to the rate of decomposition. The production of high yields and the return of crop residues will help to maintain soil organic matter at a satisfactory level (Lickacz and Penny, 2008). However, the organic matter content in Egyptian soils gradually decrease and in order to increase it, the use of different sources of organic residues become necessary (El-Maddah, 2000).

Plant materials are the major source of soil organic matter. The term soil organic matter (SOM) usually includes decomposition products at various stages of decomposition of organic materials and products synthesized by soil microorganisms (Sahrawat, 2004). Soil O.M. also plays a significant role as a buffer in soil against plant nutrients loss, particularly in the sandy soils or the soils having low cation exchange capacity (Olk *et al.*, 2000).

Jojoba or Hohoba (Simmondisa chinensis L.) is now being grown in Egypt as a new raw materials for industry and its seed residues were produced by large amounts as well as the residues of castor bean seeds.

Castor Cake is an excellent fertilizer because of its high content of N (6.4%), Phosphoric Acid (2.55%) and Potash (1%) (Santhanam, 2008). Also, Perez-Gil *et al.*, (1989) found that both jojoba seeds and residual meal were analyzed in regard to their chemical proximal composition: crude protein 14.03 and 25.24%; ether extract, 48.89 and 14.73%; crude fiber, 10.03 and 10.07%; ash, 1.59 and 4.72, and nitrogen-free extract, 25.46 and 45.25, the limiting amino acids being methionine, lysine and isoleucine.

Heal *et al.* (1997) stated that the decomposition of crop residues in soil and their carbon and nitrogen mineralization are largely influenced by the quality of plant materials i.e. by the origin and composition.

El-Maddah (2000) reported that soil amendments such as saw dust, wheat straw, shell of peanut, plant residual and farmyard manure decreased soil bulk density and increased total porosity, hydraulic conductivity, infiltration rate, available water and moisture content. Also, these amendments may increase the ability of clayey soil to store water for plant use.

El-Maddah and Badr (2005) pointed out that soil penetration resistance, soil bulk density, settling percentage and water consumption were decreased while total soil porosity, void ratio, hydraulic conductivity, water holding capacity, available water and water use efficiency were increased with the addition of crop residues i.e., cotton stalks, rice straw and corn stalks as a complete structure placed in moles 30 and 60 cm depths. El-Sodany *et al.* (2007) added that moisture content were increased with the addition of Saw dust, wheat straw, Sugar cane residue and water hyacinth placed on soil surface and filled moles at 30 and 60 cm depths, also it is more useful to use these organic residuals to get a markedly improve in soil physical and hydrophysical properties which reflect on higher yield incorporated with high net revenue.

Talha *et al.*, (1979a) found that the values of hydraulic conductivity, infiltration rate and total porosity of alluvial soil were increased as a result of added clover and wheat straw, while the values of bulk density were decreased. Im (1982) concluded that the addition of organic materials improved the soil permeability to water even if the soil was severely compacted. The improvement of permeability was entirely due to the increase in total porosity. Since organic matter has high water holding capacity, its addition to soil should increase the amount of available water.

Negm *et al.* (1996) found that water holding capacity tended to be increased proportionally by increasing the quantity of saw-dust mixed with soil as a beneficial amendment to improve the physical properties of the soil.

Spaccini *et al.*, (2002) found that the application of organic residues could increase soil organic matter, buffer the soil, improve aggregate stability and enhance water-retention capacity.

Sarkar *et al.*, (2003) reported that the addition of organic materials "wheat straw or farmyard manure" had increased organic carbon, aggregate stability, moisture retention capacity and infiltration rate of the surface soil, while reducing the bulk density.

Talha *et al.*, (1979b) pointed out that the addition of different rates of clover and wheat straw indicated that the correlation coefficient between hydraulic conductivity and total porosity and quick drainable pores are positive and highly significant. However, the simple correlation coefficient between hydraulic conductivity and bulk density and slow drainable pores are negative but highly significant.

Morachan *et al.* (1972) reported that water retention was slightly increased with increasing organic residues. The increases at low suction are evidently due to greater surface area and to greater number of large pores accompanying increased soil organic matter. The increase in high suction must be due to greater surface area. The bulk density was significantly decreased with increasing organic residues.

The present work is to find out the effect and residual effects of applying some seed residues i.e. jojoba and / or castor bean residues as soil amendments on some physical and hydro-physical soil properties.

MATERIALS AND METHODS

Field experiments were carried out on silty clay loam soil at El-Gemmeiza Agricultural Research Station, El-Gharbia Governorate, during two consecutive growing seasons. Summer season 2007 using maize plants (Zea maize) and winter season 2007 / 2008 using wheat plants (Triticum aestivum). Jojoba and / or castor bean residues were used to evaluate the effect and residual effects of these residuals on improving some physical and hydro physical soil properties. Soil properties of the experimental soil are presented in Table (1-a).

Seed residues, i.e., jojoba and / or castor bean residues were used as the two factors in this study with the rates (0, 1 and 2 ton/fed) which placed on the soil surface before sowing, during seed bed preparation in the first season. The analysis results of the used seed residues are shown in Table (1-b). Mineral fertilizer was added in the rates (0.0, 0.5 and 1 of the recommended dose for each growing crop) which placed as the normal practices in the two seasons.

The plot area of the experiment was 6 m^2 (3 m in length and 2 m in width) with three replicates where the area of the experiment was divided into 81 plots using a split-split plot design in randomized complete block design. The main plots were conducted for mineral fertilizer, while castor bean residues were considered as sub-plots and jojoba residues was considered as sub-sub-plots.

Maize grains (Zea maize, three-way cross-321) were planted in the first season (summer 2007) at the rate of 15 kg/fed. during the first week of June 2007. While wheat grains (Sakha 93 variety) were planted in the second season (winter 2007/2008) at the rate of 60 Kg/fed. during the third week of November 2007.

Table (1-a): Some physical and chemical properties of the used soil.

Soil depth, cm	0-20	20-40	Soil depth, cm	0-20	20-40
Soil physical properties					
Bulk density (Db, g cm^{-3})	1.33	1.38	Particle size distribution		
Total porosity (E, %)	49.81	47.92	Sand, %	15.59	14.1
Void ratio (e)	0.99	0.92	Silt, %	49.72	45.66
Settling, %	22.79	23.59	Clay, %	34.69	40.24
Hydraulic conductivity (Kh, cm hr^{-1})	0.52	0.47	Texture class	* Si.C.L.	* Si.C.L.
Soil chemical properties					
Soil EC, dSm^{-1}	5.46	5.91	Soil pH, 1:2.5 (suspension)	7.75	7.98
Soluble ions, meq l^{-1}			$CaCO_3$, %	3.42	3.28
Ca^{++}	13.63	14.13	Organic matter (O.M., %)	2.57	1.95
Mg^{++}	14.73	15.23	Organic carbon (O.C., %)	1.49	1.13
Na^{+}	25.82	29.37	Total nitrogen (T.N., %)	0.142	0.118
K^{+}	0.42	0.37	C/N ratio	10.49	9.58
HCO_3^{-}	5.83	6.46	Available N, mg Kg^{-1}	31.31	27.74
CL^{-}	36.67	37.59	Available P, mg Kg^{-1}	9.78	7.65
SO_4^{--}	12.10	15.05	Available K, mg Kg^{-1}	283.92	275.24

* Si. C. L.: Silty clay loam.

Table(1-b):Characteristics of different used seeds residues

Properties	Jojoba residues	Castor bean residues
Humidity, %	10.50	10.80
Ash, %	7.60	15.00
Oil content, %	5.50	5.40
Crude protein, %	32.50	23.90
Fibers, %	43.90	44.90
Organic matter, %	92.40	85.00
Total nitrogen, %	5.20	3.82
Organic carbon, %	53.60	49.30
C/N ratio	10.30	12.91
P, %	0.44	0.89
K, %	0.53	0.74

The addition of seeds residues were done before maize planting in the first season only and the residual effect of these materials was studied on wheat crop in the second one, where the same experimental plots were left without application of any amendments to study the residual effects of applied seed residues in the first season. The normal agricultural practices were carried out as usual for each crop according to the recommendations of El-Gemmeiza Research Station.

Japanese cone penetrometer, modle SR-2Dik 5500 was used to measure the penetration resistance of soil. This measurement was done 4 times. The first 3 times, each was done 10 days after the primary three irrigation, while the last was done direct before harvesting in the two growing seasons.

After harvesting of each growing season, soil samples (0-20 and 20-40 cm depths) were taken from each plot to determine some soil physical and hydrophysical properties. Soil bulk density (Db, g/cm^3) was determined using the core methods (Vomocil, 1986). Total porosity (E,%) and void ratio (e) were calculated using the following equations:-

$$E,\ \% = \left(1 - \frac{Db}{Dr}\right) \times 100$$

and $$e = \frac{Dr}{Db} - 1$$

Where: Db = the bulk density, g/cm^3

Dr = the real density, taken as 2.65 g/cm^3

Settling percentage of the soil aggregates was determined in soil aggregates of 2 – 5 mm size, as the method described by Williams and Cooke (1961) and Hartge (1969).

Hydraulic conductivity (cm/hr) was determined using undisturbed soil cores using a constant water head according to Richards (1954). Soil moisture characteristics and soil moisture content (Ɵw,%) were determined using the method outlined by Stakman (1969) and pore size distribution was calculated according to De Leenher and De Boodt (1965).

Water consumption (CU) was determined by collecting soil samples from each plot before and after 48 hours of every irrigation and computed according to the Israelsen and Hansen's equation (1962)

$$Water\ consuption,\ \ cm = \frac{\theta_2 - \theta_1}{100} \times Db \times D$$

Where: θ_2 = Soil moisture percentage on weight basis after 48 hours from irrigation.

θ_1 = Soil moisture percentage before irrigation.

Db = Bulk density, g/cm^3

D = Soil depth, cm

Water use efficiency (WUE) was calculated by dividing the grain yield of maize and wheat (kg/fed.) by water consumptive use (cm) according to Jensen equation's (1983):

$$WUE\ ,\ \mathrm{kg\ \ fed^{-1}\ cm^{-1}} = \frac{Grain\ yield,\ (kg\ \ fed^{-1})}{Water\ consumption\ (cm)}$$

The collected data were statistically analyzed according to procedure out lined by Snedecor and Cochran (1981). The main values were compared at 0.05 level using L.S.D.

RESULTS AND DISCUSSION

I-Effect of different treatments on some soil physical properties.

1- Soil penetration resistance.

The effect of jojoba and castor bean seed residues and mineral fertilizers on soil penetration resistance at sequence measuring timed were presented in Table (2). The results indicate that all added treatments led to a significant decrease in soil penetration resistance values in the two growing seasons as compared with the control (untreated soil). Similar results were obtained by El-Maddah and Badr (2005) and El-Sodany *et al.* (2007).

As for jojoba seed residues on penetration resistance values, it could be observed that the increase of jojoba seed residues addition rates led to decrease of soil penetration resistance values where the best mean values were obtained by 2 ton/fed jojoba seed residues which were 2.04, 2.06, 2.10 and 2.16 MPa and were 2.01, 2.03, 2.05 and 2.12 MPa in the first and second seasons, respectively as compared with the control. Also, it can be noticed that, there are significant decreases in soil penetration resistance by increasing the addition rates of castor bean seed residues, where the best mean values were obtained at 2 ton/fed castor bean seed residues which were 2.32, 2.34, 2.37 and 2.42 MPa and were 2.28, 2.30, 2.34 and 2.39 MPa in the first and second seasons, respectively. Similar results were obtained by Khalil *et al.* (1997), they indicated that the decrease of soil penetration resistance with organic residual treatments may be related to the products of organic materials decomposition during growth seasons, microbial gums and promoting root growth enhanced soil aggregation processes, subsequently soil penetrability resistance decreases.

On the other hand, the same trend was obtained by increasing mineral fertilizer addition rates but with did not significantly decreased where the best mean values were obtained at the recommended dose of mineral fertilizer which were 2.41, 2.43, 2.46 and 2.51 MPa and were 2.38, 2.39, 2.43 and 2.47 MPa in the first and second seasons, respectively.

It is obvious that, the effect of different treatments on decreasing soil penetration resistance during the two growing seasons can be arranged in the following order : jojoba seed residues > castor bean seed residues > mineral fertilizers > control (untreated soil). Also, it can be noticed that soil penetration resistance just before harvesting have the highest values. This may be because of natural dries of soil during the growing period. These results are in line with El-Maddah *et al.* (2003), El-Maddah and Badr (2005) and El-Sodany *et al.* (2007).

Concerning the combined effect of different treatments on soil penetration resistance, it can be observed that all seed residues kinds besides mineral fertilizer decreased soil penetration resistance values comparing to the control. The best treatment was found at 2 ton/fed of jojoba seed residues with 2 ton/fed of castor bean seed residues at recommended dose of mineral fertilizer, since it recorded the lowest values which were 1.78, 1.81, 1.83 and 1.96 MPa in the first season and were 1.76, 1.79, 1.80 and 1.93 MPa in the second one, respectively for the primary three irrigation and just before harvesting. While, the control gave the highest values which were 2.96, 2.98, 2.99 and 3.01 MPa and were 2.99, 3.01, 3.03 and 3.05 MPa in the first and second seasons, respectively.

Table (2): Effect of different treatments on penetration resistance (Mpa) at sequence measuring time.

Jojoba ton/fed	Castor bean ton/ fed	Mineral fertilizer R.D*	First season (Zea maize)				Second season (Wheat)			
			10 days after 1st irri.	10 days after 2nd irri.	10 days after 3rd irri.	Just before harves-ting	10 days after 1st irri.	10 days after 2nd irri.	10 days after 3rd irri.	Just before harves-ting
0	0	Control	2.96	2.98	2.99	3.01	2.99	3.01	3.03	3.05
		0.5	2.93	2.94	2.96	2.98	2.95	2.97	2.99	3.01
		1.0	2.90	2.91	2.94	2.96	2.91	2.93	2.95	2.97
	1	0.0	2.86	2.87	2.89	2.92	2.86	2.86	2.89	2.91
		0.5	2.83	2.85	2.87	2.90	2.83	2.84	2.86	2.89
		1.0	2.80	2.81	2.84	2.86	2.79	2.80	2.83	2.84
	2	0.0	2.78	2.79	2.82	2.84	2.75	2.77	2.80	2.82
		0.5	2.75	2.76	2.79	2.80	2.71	2.73	2.77	2.78
		1.0	2.71	2.72	2.76	2.78	2.67	2.68	2.72	2.73
1	0	0.0	2.68	2.70	2.73	2.76	2.63	2.64	2.69	2.70
		0.5	2.63	2.65	2.69	2.72	2.58	2.59	2.66	2.67
		1.0	2.60	2.62	2.65	2.68	2.53	2.54	2.60	2.64
	1	0.0	2.56	2.58	2.61	2.64	2.49	2.51	2.57	2.60
		0.5	2.51	2.53	2.57	2.60	2.44	2.46	2.52	2.56
		1.0	2.46	2.48	2.50	2.52	2.39	2.41	2.47	2.50
	2	0.0	2.40	2.42	2.46	2.49	2.34	2.36	2.42	2.45
		0.5	2.36	2.39	2.41	2.44	2.30	2.31	2.37	2.40
		1.0	2.30	2.33	2.36	2.40	2.25	2.27	2.32	2.35
2	0	0.0	2.26	2.29	2.33	2.36	2.21	2.22	2.26	2.30
		0.5	2.20	2.22	2.27	2.31	2.17	2.19	2.21	2.25
		1.0	2.16	2.18	2.21	2.27	2.11	2.13	2.16	2.21
	1	0.0	2.12	2.14	2.17	2.20	2.06	2.08	2.11	2.15
		0.5	2.05	2.08	2.12	2.16	2.02	2.04	2.06	2.10
		1.0	2.00	2.02	2.08	2.12	1.97	1.99	2.02	2.07
	2	0.0	1.94	1.95	1.97	2.05	1.92	1.94	1.95	2.03
		0.5	1.88	1.89	1.90	1.98	1.86	1.87	1.88	2.00
		1.0	1.78	1.81	1.83	1.96	1.76	1.79	1.80	1.93
(A) Castor bean ton/fed		0	2.84	2.85	2.87	2.89	2.83	2.84	2.87	2.89
		1	2.50	2.52	2.55	2.58	2.44	2.45	2.51	2.54
		2	2.04	2.06	2.10	2.16	2.01	2.03	2.05	2.12
		F	*	*	*	*	*	*	*	*
		LSD_{05}	0.13	0.13	0.13	0.12	0.12	0.13	0.13	0.12
(B) Jojoba ton/fed		0	2.59	2.61	2.64	2.67	2.56	2.58	2.62	2.64
		1	2.47	2.48	2.52	2.55	2.43	2.44	2.48	2.51
		2	2.32	2.34	2.37	2.42	2.28	2.30	2.34	2.39
		F	*	*	*	*	*	*	*	*
		LSD_{05}	0.13	0.13	0.13	0.14	0.12	0.13	0.13	0.13
(C) Mineral fertilizer		0	2.51	2.52	2.55	2.59	2.47	2.49	2.52	2.56
		0.5	2.46	2.48	2.51	2.54	2.43	2.44	2.48	2.52
		1.0	2.41	2.43	2.46	2.51	2.38	2.39	2.43	2.47
		F	NS	NS	NS	NS	NS	NS	NS	NS
		LSD_{05}								
ABC		F	NS	NS	NS	NS	NS	NS	NS	NS
		LSD_{05}								

* R.D = Recommended dose

2- Soil bulk density (Db), total soil porosity (E) and void ratio (e).

Data in Tables (3 and 4) and Fig. (1) show that all different treatments led to significant decreases in soil bulk density and significant increases in total soil porosity and void ratio of the two sequence soil depths (0-20 and 20-40cm) at the end of the two seasons compared with the control (untreated soil). The decrease percent in soil bulk density were differed between 0.76 and 29.55%, 0.73 and 17.52% and between 1.53 and 30.53%, 0.74 and 18.52%, respectively under the control (untreated soil) of the two soil depths in the first and second seasons. While, the values of total soil porosity and void ratio take the opposite trend.

Table (3): Effect of different treatments on some soil physical properties in the first season (summer 2007).

Jojoba ton/fed	Castor bean ton/fed	Mineral fertilizer R.D*	Bulk density, Db, gm/cm^3		Total porosity (E, %)		Void ratio (e)		Settling, %		Pore size distribution, %					
											> 9 µ		9 - 0.2 µ		< 0.2 µ	
			0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40cm
0	0	Control	1.32	1.37	50.19	48.30	1.01	0.93	22.79	23.59	23.06	22.19	12.47	12.07	14.66	14.04
		0.5	1.31	1.36	50.57	48.68	1.02	0.95	22.71	23.27	23.23	22.37	12.64	12.16	14.70	14.15
		1.0	1.29	1.35	51.32	49.06	1.05	0.96	22.65	23.11	23.58	22.54	12.83	12.26	14.91	14.26
	1	0.0	1.30	1.35	50.94	49.06	1.04	0.96	21.95	22.72	23.41	22.54	12.73	12.26	14.80	14.26
		0.5	1.28	1.34	51.70	49.43	1.07	0.98	21.82	22.56	23.75	22.71	12.92	12.36	15.02	14.36
		1.0	1.25	1.32	52.83	50.19	1.12	1.01	21.75	22.35	24.28	23.06	13.20	12.55	15.35	14.58
	2	0.0	1.26	1.33	52.45	49.81	1.10	0.99	19.41	20.11	24.10	22.88	13.11	12.45	15.24	14.48
		0.5	1.22	1.31	53.96	50.57	1.17	1.02	19.22	19.98	24.79	23.23	13.49	12.64	15.68	14.70
		1.0	1.21	1.30	54.34	50.94	1.19	1.04	19.05	19.84	24.97	23.40	13.58	12.73	15.80	14.80
1	0	0.0	1.24	1.31	53.21	50.57	1.14	1.02	20.87	21.60	24.29	23.09	13.29	12.71	15.63	14.78
		0.5	1.18	1.28	55.47	51.70	1.25	1.07	20.69	21.44	25.33	23.60	13.76	12.83	16.38	15.27
		1.0	1.15	1.26	56.60	52.45	1.30	1.10	20.58	21.19	25.84	23.94	14.04	13.02	16.72	15.49
	1	0.0	1.17	1.27	55.85	52.08	1.26	1.09	17.65	18.29	25.50	23.77	13.85	12.92	16.50	15.38
		0.5	1.11	1.24	58.11	53.21	1.39	1.14	17.29	18.10	26.53	24.29	14.42	13.21	17.16	15.72
		1.0	1.10	1.23	58.49	53.58	1.41	1.15	17.18	18.97	26.70	24.46	14.51	13.29	17.28	15.83
	2	0.0	1.13	1.26	57.36	52.45	1.35	1.10	14.39	15.11	26.19	23.95	14.23	13.01	16.94	15.49
		0.5	1.08	1.22	59.25	53.96	1.45	1.17	14.17	15.04	27.05	24.63	14.70	13.39	17.50	15.94
		1.0	1.07	1.22	59.62	53.96	1.48	1.17	14.03	14.92	27.22	24.63	14.79	13.39	17.61	15.94
2	0	0.0	1.19	1.29	55.09	51.32	1.23	1.05	15.69	16.25	24.98	23.43	13.66	12.65	16.45	15.24
		0.5	1.12	1.25	57.74	52.83	1.37	1.12	15.27	16.04	26.19	23.96	14.31	13.09	17.24	15.78
		1.0	1.04	1.20	60.75	54.72	1.55	1.21	15.11	15.93	27.55	24.82	15.06	13.56	18.14	16.34
	1	0.0	1.05	1.21	60.38	54.34	1.52	1.19	13.84	14.33	27.38	24.65	14.96	13.47	18.03	16.23
		0.5	1.00	1.16	62.26	56.23	1.65	1.28	13.67	14.18	28.24	25.51	15.43	13.94	18.60	16.79
		1.0	0.98	1.15	63.02	56.60	1.70	1.30	13.42	14.06	28.58	25.67	15.62	14.03	18.82	16.90
	2	0.0	1.02	1.18	61.51	55.47	1.60	1.25	10.94	11.32	27.90	25.16	15.24	13.75	18.37	16.56
		0.5	0.95	1.14	64.15	56.98	1.79	1.32	10.75	11.18	29.10	25.84	15.90	14.12	19.15	17.01
		1.0	0.93	1.13	64.91	57.36	1.85	1.35	10.62	11.05	29.44	26.01	16.09	14.22	19.38	17.13
(A) Jojoba ton/fed		0	1.27	1.34	52.03	49.56	1.09	0.98	21.26	21.95	23.91	22.77	13.00	12.39	15.13	14.40
		1	1.14	1.25	57.11	52.66	1.34	1.11	17.43	18.30	26.07	24.04	14.18	13.09	16.86	15.54
		2	1.03	1.19	61.09	55.09	1.58	1.23	13.26	13.82	27.71	25.01	15.14	13.65	18.24	16.44
		F	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		LSD_{05}	0.04	0.08	1.60	3.10	0.11	0.13	0.59	0.88	1.35	1.56	0.61	0.78	0.58	1.20
(B) Castor bean ton/fed		0	1.20	1.30	54.55	51.07	1.21	1.05	19.60	20.27	24.89	23.33	13.56	12.71	16.09	15.04
		1	1.14	1.25	57.06	52.75	1.35	1.12	17.62	18.40	26.04	24.07	14.18	13.11	16.84	15.56
		2	1.10	1.23	58.62	53.50	1.44	1.16	14.73	15.39	26.75	24.41	14.57	13.30	17.30	15.78
		F	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		LSD_{05}	0.06	0.04	2.28	1.71	0.11	0.07	0.52	0.42	1.10	0.79	0.57	0.40	0.67	0.52
(C) Mineral fertilizer		0	1.19	1.29	55.22	51.49	1.25	1.06	17.50	18.15	25.20	23.52	13.73	12.81	16.29	15.16
		0.5	1.14	1.26	57.02	52.62	1.35	1.12	17.29	17.98	26.02	24.02	14.17	13.08	16.83	15.52
		1.0	1.11	1.24	57.99	53.21	1.41	1.14	17.15	17.94	26.46	24.28	14.41	13.23	17.11	15.70
		F	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		LSD_{05}														
ABC		F	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		LSD_{05}														

* R.D = Recommended dose

Table (4): Effect of different treatments on some soil physical properties in the second season (winter 2007/2008).

Jojoba ton/fed	Castor bean ton/fed	Mineral fertilizer R.D*	Bulk density, Db, gm/cm^3		Total porosity (E, %)		Void ratio (e)		Settling, %		Pore size distribution, %					
											> 9 µ		9 - 0.2 µ		< 0.2 µ	
			0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm
0	0	Control	1.31	1.35	50.57	49.06	1.02	0.96	22.83	23.64	23.24	22.54	12.64	12.26	14.70	14.25
		0.5	1.29	1.34	51.32	49.43	1.05	0.98	22.15	22.89	23.58	22.71	12.82	12.35	14.91	14.37
		1.0	1.27	1.33	52.08	49.81	1.09	0.99	21.92	22.58	23.93	22.59	13.01	12.58	15.14	14.63
	1	0.0	1.28	1.33	51.70	49.81	1.07	0.99	20.65	22.11	23.76	22.89	12.92	12.45	15.02	14.47
		0.5	1.26	1.31	52.45	50.57	1.10	1.02	20.34	22.00	24.10	23.24	13.11	12.64	15.24	14.69
		1.0	1.23	1.30	53.58	50.94	1.15	1.04	20.15	21.82	24.62	23.41	13.39	12.73	15.57	14.80
	2	0.0	1.25	1.30	52.83	50.94	1.12	1.04	18.21	19.89	24.27	23.40	13.21	12.73	15.35	14.80
		0.5	1.20	1.28	54.72	51.70	1.21	1.07	18.05	19.62	25.14	23.76	13.67	12.92	15.90	15.02
		1.0	1.19	1.28	55.09	51.70	1.23	1.07	17.87	19.43	25.31	23.75	13.76	12.92	16.01	15.03
1	0	0.0	1.22	1.29	53.96	51.32	1.17	1.05	19.45	20.82	24.63	23.43	13.39	12.74	15.94	15.16
		0.5	1.16	1.26	56.23	52.45	1.28	1.10	19.22	20.67	25.67	23.99	13.95	12.99	16.61	15.47
		1.0	1.13	1.23	57.36	53.58	1.35	1.15	19.06	20.39	26.19	24.46	14.23	13.29	16.94	15.83
	1	0.0	1.16	1.25	56.23	52.83	1.28	1.12	16.93	17.91	25.67	24.12	13.95	13.10	16.61	15.61
		0.5	1.08	1.21	59.25	54.34	1.45	1.19	16.64	17.68	27.05	24.81	14.70	13.49	17.50	16.05
		1.0	1.07	1.21	59.62	54.34	1.48	1.19	16.27	17.47	27.22	24.80	14.79	13.48	17.61	16.06
	2	0.0	1.11	1.23	58.11	53.58	1.39	1.15	14.16	15.00	26.53	24.46	14.42	13.30	17.16	15.83
		0.5	1.06	1.20	60.00	54.72	1.50	1.21	14.02	14.83	27.39	24.98	14.88	13.58	17.72	16.16
		1.0	1.05	1.19	60.38	55.09	1.52	1.23	13.79	14.66	27.57	25.15	14.98	13.66	17.83	16.27
2	0	0.0	1.17	1.27	55.85	52.08	1.26	1.09	14.95	16.07	25.33	23.62	13.85	12.90	16.68	15.55
		0.5	1.10	1.22	58.49	53.96	1.41	1.17	14.68	15.88	26.52	24.48	14.50	13.37	17.47	16.11
		1.0	1.02	1.17	61.51	55.85	1.60	1.26	14.45	15.59	27.90	25.33	15.24	13.84	18.37	16.68
	1	0.0	1.03	1.19	61.13	55.09	1.57	1.23	13.41	14.12	27.72	24.99	15.15	13.65	18.26	16.45
		0.5	0.98	1.14	63.02	56.98	1.70	1.32	13.21	13.98	28.58	25.84	15.62	14.12	18.82	17.02
		1.0	0.96	1.12	63.77	57.74	1.76	1.37	13.06	13.75	28.93	26.19	15.81	14.31	19.04	17.24
	2	0.0	1.00	1.16	62.26	56.23	1.65	1.28	10.25	11.14	28.23	25.50	15.43	13.93	18.59	16.79
		0.5	0.93	1.11	64.91	58.11	1.85	1.39	10.07	10.93	29.44	26.36	16.09	14.40	19.38	17.35
		1.0	0.91	1.10	65.66	58.49	1.91	1.41	9.94	10.78	29.98	26.53	16.18	14.49	19.50	17.47
(A) Jojoba ton/fed		0	1.25	1.31	52.70	50.44	1.12	1.02	20.24	21.55	24.22	23.14	13.17	12.62	15.32	14.67
		1	1.12	1.23	57.90	53.58	1.38	1.15	16.62	17.71	26.44	24.47	14.37	13.29	17.10	15.83
		2	1.01	1.16	61.84	56.06	1.63	1.28	12.67	13.58	28.07	25.43	15.32	13.89	18.46	16.74
		F	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		LSD_{05}	0.04	0.08	2.05	3.04	0.11	0.13	0.60	1.02	1.28	1.59	0.63	0.71	0.57	1.20
(B) Castor bean ton/fed		0	1.19	1.27	55.26	51.95	1.25	1.08	18.75	19.84	25.22	23.68	13.74	12.92	16.31	15.34
		1	1.12	1.23	57.86	53.63	1.40	1.16	16.74	17.87	26.41	24.48	14.38	13.33	17.07	15.82
		2	1.08	1.21	59.33	54.51	1.49	1.21	14.04	15.14	27.10	24.88	14.74	13.55	17.49	16.08
		F	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		LSD_{05}	0.06	0.04	2.47	1.67	0.12	0.07	0.70	0.54	1.03	0.74	0.55	0.43	0.65	0.51
(C) Mineral fertilizer		0	1.17	1.26	55.85	52.33	1.28	1.10	16.76	17.86	25.49	23.88	13.88	13.01	16.48	15.43
		0.5	1.12	1.23	57.82	53.58	1.39	1.16	16.49	17.61	26.39	24.46	14.37	13.32	17.06	15.80
		1.0	1.09	1.21	58.78	54.17	1.45	1.19	16.28	17.39	26.85	24.69	14.60	13.48	17.33	16.00
		F	NS	NS	*	NS	NS	S	NS	NS	NS	NS	NS	NS	NS	NS
		LSD_{05}			2.66											
ABC		F	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
		LSD_{05}														

* R.D = Recommended dose

Jojoba seed residues addition rates tended to lower soil bulk density and higher total soil porosity and void ratio. The decreases in (Db) which caused by 2 ton/fed of jojoba seed residues were 21.97, 13.14 % and 22.90, 14.07 % under the control for the two layer depths in the first and second seasons, respectively. As well the increases in (E) and (e) were 21.72, 14.06 % and 56.44, 32.26 % over the control for the two soil depths in the first season and were 22.29, 14.24 % and 37.24, 33.33 %, respectively for both the same depths and characters in the second one.

Concerning the effect of castor bean seed residues, data in Tables (3 and 4) indicate that the increase of its addition rates led to a significant decrease in (Db) and significant increases in (E) and (e) of the two sequence soil depths (0-20 and 20-40 cm) at the end of the two seasons. The decreases in (Db) were 16.67, 10.22 % and 17.56, 0.37 % under the control for the two soil depths in the first and second seasons respectively. While the increases in (E) and (e) were 16.80, 10.78 % and 42.57, 24.73 % over the control for the two soil depths in the first season, and were 17.32, 11.11 % and 46.08, 26.04 % respectively for the same characters and depths in the second one.

On the other hand, the addition of mineral fertilizers did not significantly affected (Db), (E) or (e) in both two growing seasons. Where the recommended dose decrease it by 6.72, 3.88 % and 6.84, 3.97 % under zero mineral fertilizer treatment for the two soil depths in the first and second seasons respectively. Contrary (E) and (e) were increased by 5.02, 3.34 % and 12.80, 7.55 % over zero mineral fertilizer treatment in the first season and by 5.25, 3.52 % and 13.25, 8.18 % in the second one respectively, for (E) and (e).

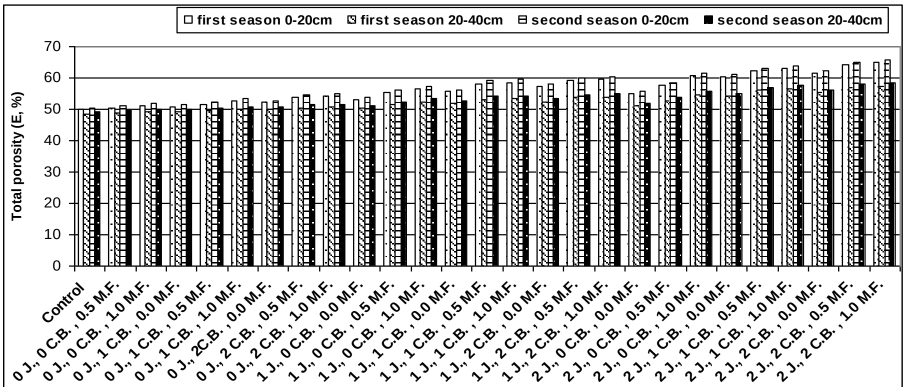

Fig.(1): Effect of different treatments on total porosity (E, %) in the first and second seasons

In general, the addition of jojoba and castor bean seed residues with mineral fertilizers induced progressive decreases in (Db) and progressive increases in (E) and (e) in the following order : jojoba seed residues > castor bean seed residues > mineral fertilizer > control.

Regarding the combined effect of different treatments, data in Tables (3 and 4) and Fig (1) reveal that the addition of 2 ton/fed of jojoba seed residues mixed with 2 ton/fed of castor bean seed residues at the recommended dose of mineral fertilizer was the best treatment, since it induced the lowest bulk density value (Db) 0.93, 1.13 g/cm^3 and 0.91, 1.10 g/cm^3 for the two soil depths in the first and second seasons, respectively. While, total porosity (E) and void ratio (e) gave the highest values 64.91, 57.36% and 1.85, 1.35 in the first season and 65.66, 58.49% and 1.91, 1.41 in the second one for the two soil depths, respectively (Fig., 1).

The decrease of soil bulk density may be due to the high content of organic matter in jojoba and castor bean seed residues which refers to formation of soil aggregates and may be indicated by the improvement in soil structure (Table 1-b). The results agree with that obtained by Sarkar *et al.*, (2003), El-Maddah and Badr (2005) and El-Sodany *et al.* (2007). Also, it can be noticed that the higher (Db) of the treated soil with plant residues at the end of the first season compared with the second one may be due to the slight decomposition of these materials after the first season.

3- Structural stability (settling percentage)

The percentage of settling of the soil aggregates was determined to get an aspect of structural stability. The low value of settling percentage indicate high degree of structural stability and vice versa. Results in Tables (3 and 4) and Fig. (2) show that all different treatments led to significant decreases in settling percentage. So, the effect of different treatments on soil structural stability was obvious. The decreases in settling % were differed between 0.35 and 53.40 %, 1.36 and 53.16 % respectively under the control (untreated soil) of the two soil depths in the first season and between 2.98 and 56.46 %, 3.17 and 54.40 %, respectively under the control in the second one.

Concerning the effect of jojoba seed residues addition rates, the results indicate that the lowest mean values of settling % (i.e., higher degree of soil structure stability) was resulted under the high rate of jojoba seed residues (2 ton/fed), which were 13.26 and 13.82 % respectively for the two sequence soil depths (0-20 and 20-40 cm) in the first season, while it was 12.67 and 13.58 %, respectively at the same depths in the second one.

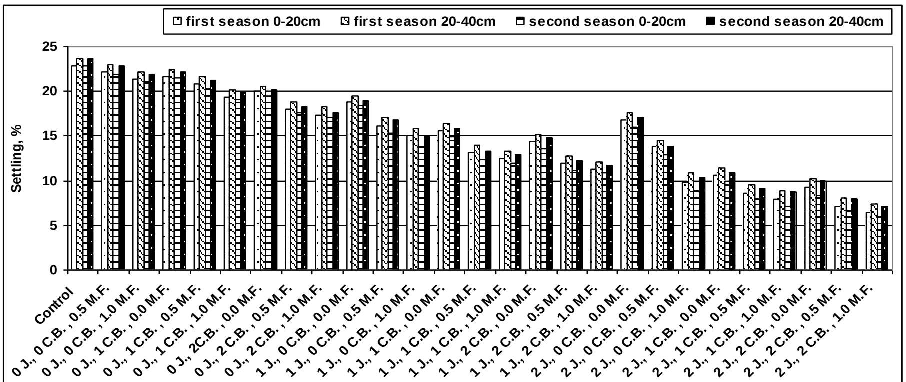

Fig.(2): Effect of different treatments on settling percentage in the first and second seasons

With regard to castor bean seed residues addition rates, the results reveal that the lowest mean values of settling % was obtained under the high rate of castor bean seed residues (2 ton/fed) which were 14.73 and 15.39 % and were 14.04 and 15.14 %, respectively for 0-20 and 20-40cm soil depths in the first and second seasons. These results agree with that obtained by Spaccini *et al.* (2002), Sarkar *et al.* (2003) and El-Maddah and Badr (2005).

Mineral fertilizers did not significantly decrease settling percentage in both the first and second seasons.

Thus, the addition of jojoba and castor bean seed residues with mineral fertilizers induced progressive decreases in settling % (i.e., higher degree of soil structure stability) in the following order : jojoba seed residues > castor bean seed residues > mineral fertilizers > control.

Regarding the combined effect, data show that the 2 ton/fed jojoba seed residues mixed with 2 ton/fed of castor bean seed residues at the recommended dose of mineral fertilizers was the best treatment, since it induced the lowest values of settling % which decreased to be 10.62, 11.05 % and to be 9.94, 10.78 % for the two soil depths in the first and second seasons, respectively. While, the highest values of settling % (i.e., lower degree of soil structure stability) was recorded with the control (untreated soil), which they were 22.79, 23.59 % and were 22.83, 23.64 %, respectively for the two soil depths in the first and second seasons.

The improvement effect of these treatments may be attributed to the formation of water stable aggregates as a result of root exudates, root growth and decay besides the decomposition of the added plant residues. These results agree with that obtained by El-Maddah and Badr (2005) and El-Sodany *et al.* (2007).

4- Pore size distribution.

Pore size distribution as a percent of total porosity were presented in Tables (3 and 4) where the total soil porosity was equal to large pores (macro pores or drainable, >9µ) plus the medium pores (9-0.2 µ) plus micro pores (capillary pores, < 0.2 µ). The results indicate that all different treatments led to significant increases in the large, medium and micro pores at the two soil depths (0-20 and 20-40cm) in the first and second seasons. The increases in pore size distribution were ranged from 0.74 to 27.67 %, 1.36 to 29.03 %, 0.27 to 32.20 % over the control (untreated soil) for 0-20cm soil depth, and from 0.81 to 17.21 %, 0.75 to 17.81 %, 0.78 to 22.01 % over the control for 20-40cm soil depth in the first season, and from 1.46 to 29.00 %, 1.42 to 28.00 %, 1.43 to 32.65 % over the control for 0-20cm soil depth, and from 0.75 to 17.70 %, 0.73 to 18.19 %, 0.84 to 22.60 % over the control for 20-40cm soil depth in the second one, respectively.

Regarding the effect of jojoba and / or castor bean seed residues, the results indicate that increasing jojoba and / or castor bean seed residues from 0.0 to 2.0 ton/fed led to significantly increases in pore size distribution, where the large, medium and micro pores values were increased by 15.89, 16.46, 20.56 % and by 9.84, 10.17 and 14.17 % with increasing jojoba rate from 0.0 to 2.0 ton/fed. in the first season, and increased by 15.90, 16.32, 20.50 % and by 9.90, 10.06 and 14.11 % in the second one. While, in case of increasing castor bean seed residues addition rates to 2 ton/fed., the values were increased by 7.47, 7.45, 7.52 % and by 4.63, 4.64, 4.92 % in the first season and by 7.45, 7.28, 7.23 % and 5.07, 4.88, 4.82 % for the same soil layers and characters in the second one. Similar results were obtained by Talha *et al.* (1979b).

Data in Tables (3 and 4) indicate that mineral fertilizers did not significantly increased the values of pore size distribution in surface and subsurface soil depths in both first and second seasons.

Regarding the combined effect, the results indicate that all different treatments increased pore size distribution values compared with the control (untreated soil). The highest values of large, medium and micro pores were resulted by 2 ton/fed of jojoba seed residues plus 2 ton/fed of castor bean seed residues at the recommended dose of mineral fertilizers, since it reached to 29.44, 16.09, 19.38 % and 26.01, 14.22, 17.13 % in the first season and reached to 29.98, 16.18, 19.50 % and 26.53, 14.49, 17.47 % in the second one for the two soil depths (0-20 and 20-40cm) respectively.

II- Effect of different treatments on some soil hydrophysical properties.

1-Soil hydraulic conductivity.

Soil saturated hydraulic conductivity and soil infiltration characteristics are supposed to be increased with the presence of wide and continuous pores. Thus their values are affected by any factors that affect the soil porosity such as organic residues. Data in Tables (5 and 6) and Fig. (3) indicate that all different treatments led to progressive increases in soil hydraulic conductivity (Kh) of the two soil layers (0-20 and 20-40 cm) at the end of the two seasons compared with the control (untreated soil). The increases in (Kh) values were ranged between 1.75 and 61.40 %, 1.89 and 60.38 % respectively of the two soil depths in the first season, and between 1.66 and 63.33 %, 1.75 and 63.16 %, respectively of the two soil depths in the second one.

Concerning the jojoba and castor bean seed residues, it can be noticed from Tables (5 and 6) that increasing the addition rates of jojoba and / or castor bean seed residues to 2 ton/fed led to significant increases in hydraulic conductivity values by 36.07, 34.48 % and 14.93, 12.50 %, respectively for the two organic residues and the two soil depths in the first season, and by 37.50, 39.35 % and 14.08, 14.71 %, respectively for the same residues and depths in the second one, over the values with 0.0 addition. These results are confirmed with El-Maddah (2000) and El-Maddah and Badr (2005). Generally, these increases in (Kh) values may be due to modification in pore size distribution, i.e., the increase in drainable pores, Tables (3 and 4) (Abdel-Aziz *et al.*, 1996).

Mineral fertilizers did not significantly affected (Kh) in both the two soil depths either in the first season or in the second one.

Concerning the combined effects, the results indicate that all different treatments led to progressively increases in (Kh) values. The highest value of (Kh) was obtained by 2 ton/fed of jojoba seed residues with 2 ton/fed of castor bean seed residues at the recommended dose of mineral fertilizers, since it gave 0.92 and 0.85 cm/hr, 0.98 and 0.93 cm/hr of the two soil depths in the first and second seasons, respectively while the control (untreated soil) was recorded the lowest (Kh) values.

2- Soil moisture characters.

Soil moisture content is one of the limiting factors on agricultural development, particularly in arid and semi-arid areas, where the amount of water is very limited. The capacity of soils to receive or store water which is available to grow plants is a great importance to agricultural production.

Concerning soil moisture content retained at saturation percent (S.P), field capacity (F.C) and wilting point (W.P), results in Tables (5 and 6) indicate that all different treatments caused significant increases in soil moisture content retained at SP, FC and WP at the end of the two seasons compared with the control.

Table (5): Effect of different treatments on some soil hydrophysical properties in the first season (summer 2007).

Jojoba ton/fed	Castor bean ton/fed	Mineral fertilizer R.D*	Kh, cm/hr 0-20 cm	Kh, cm/hr 20-40 cm	Soil moisture content, % SP 0-20 cm	SP 20-40 cm	FC 0-20 cm	FC 20-40 cm	WP 0-20 cm	WP 20-40 cm	AW, % 0-20 cm	AW, % 20-40 cm	θw, % Just before harvesting 0-20 cm	θw, % 20-40 cm	CU, cm	WUE, Kg $fed^{-1}cm^{-1}$	Yield, kg/fed
0	0	Control	0.57	0.53	73.32	72.28	39.63	39.07	21.42	21.01	18.21	18.06	20.35	21.76	113.19	17.56	1987.40
		0.5	0.58	0.54	73.77	72.63	39.88	39.26	21.54	21.11	18.34	18.15	20.59	22.00	112.82	20.90	2357.90
		1.0	0.60	0.56	74.68	73.34	40.37	39.64	21.70	21.31	18.67	18.33	21.14	22.65	110.92	24.39	2705.20
	1	0.0	0.59	0.55	74.23	72.98	40.12	39.45	21.57	21.21	18.55	18.24	20.84	22.32	112.35	21.14	2374.80
		0.5	0.61	0.57	75.13	73.69	40.61	39.83	21.83	21.41	18.78	18.42	21.45	22.96	110.45	24.48	2703.40
		1.0	0.63	0.59	76.04	74.45	41.10	40.24	22.10	21.63	19.00	18.61	21.97	23.58	108.24	27.04	2927.10
	2	0.0	0.62	0.58	75.58	74.05	40.85	40.03	21.96	21.52	18.89	18.51	21.69	23.26	111.52	22.46	2504.70
		0.5	0.65	0.62	76.92	75.11	41.58	40.60	22.35	21.83	19.23	18.77	22.54	24.20	109.85	26.72	2935.40
		1.0	0.67	0.64	77.40	75.46	41.84	40.79	22.50	21.93	19.34	18.86	22.79	24.50	107.63	28.97	3118.50
1	0	0.0	0.64	0.61	76.49	74.78	41.57	40.64	22.47	21.85	19.10	18.79	22.25	23.89	108.24	21.64	2342.70
		0.5	0.69	0.66	78.31	76.17	42.56	41.40	23.13	22.50	19.43	18.90	23.32	25.18	107.63	26.10	2809.30
		1.0	0.72	0.69	79.22	76.89	43.05	41.79	23.40	22.71	19.65	19.08	23.89	25.82	106.62	27.99	2984.80
	1	0.0	0.70	0.67	78.77	76.52	42.81	41.59	23.27	22.60	19.54	18.99	23.59	25.48	102.73	24.64	2531.60
		0.5	0.75	0.72	80.61	77.97	43.81	42.38	23.81	23.03	20.00	19.35	24.79	26.82	98.85	40.41	3994.30
		1.0	0.77	0.73	81.05	78.31	44.05	42.56	23.94	23.13	20.11	19.43	25.11	27.11	97.93	41.07	4021.70
	2	0.0	0.73	0.70	79.68	77.27	43.30	41.99	23.53	22.82	19.77	19.17	24.15	26.14	101.69	27.09	2754.70
		0.5	0.78	0.74	81.57	78.65	44.33	42.75	24.09	23.23	20.24	19.52	25.41	27.42	97.36	41.50	4040.50
		1.0	0.80	0.76	82.00	79.04	44.57	42.96	24.22	23.35	20.35	19.61	25.72	27.75	96.45	42.65	4113.20
2	0	0.0	0.68	0.65	77.86	75.42	42.55	40.99	23.25	22.40	19.30	18.59	23.08	24.86	106.85	25.97	2774.40
		0.5	0.74	0.71	80.14	78.65	43.79	42.98	23.93	23.49	19.86	19.49	24.79	26.82	103.81	28.39	2947.20
		1.0	0.83	0.78	84.97	79.04	46.43	43.19	25.37	23.60	21.06	19.59	26.27	28.42	102.73	30.10	3091.70
	1	0.0	0.81	0.77	84.45	75.82	46.15	41.43	25.22	22.64	20.93	18.79	25.99	28.25	101.69	28.16	2863.40
		0.5	0.86	0.81	85.88	80.49	46.93	43.98	25.65	24.03	21.28	19.95	26.84	28.97	96.42	42.33	4081.70
		1.0	0.88	0.82	86.33	80.84	47.18	44.18	25.78	24.14	21.40	20.04	27.15	29.27	95.89	42.75	4099.50
	2	0.0	0.85	0.79	85.43	80.12	46.68	43.78	25.51	23.92	21.17	19.86	26.53	28.76	100.35	29.13	2923.50
		0.5	0.90	0.84	86.78	81.18	47.42	44.36	25.91	24.24	21.51	20.12	27.37	29.59	94.17	43.54	4100.00
		1.0	0.92	0.85	87.23	81.52	47.67	44.55	26.05	24.34	21.62	20.21	27.64	29.89	92.85	44.76	4156.00
(A) Jojoba ton/fed		0	0.61	0.58	75.23	73.78	40.66	39.88	21.89	21.44	18.78	18.44	21.48	23.03	110.77	23.74	2623.82
		1	0.73	0.70	79.74	77.29	43.34	42.01	23.54	22.80	19.80	19.20	24.25	26.18	101.94	32.57	3288.09
		2	0.83	0.78	84.34	79.23	46.09	43.27	25.19	23.64	20.90	19.63	26.18	28.31	99.42	35.01	3448.60
		F	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		LSD_{05}	0.05	0.05	2.41	2.43	1.25	1.38	1.08	1.23	0.82	0.72	1.23	1.36	2.14	0.74	0.67
(B) Castor bean ton/fed		0	0.67	0.64	77.64	75.47	42.20	41.00	22.91	22.22	19.29	18.78	22.85	24.60	108.09	24.78	2666.73
		1	0.73	0.69	80.28	76.79	43.64	41.74	23.69	22.65	19.95	19.09	24.19	26.08	102.73	32.45	3288.61
		2	0.77	0.72	81.40	78.04	44.25	42.42	24.01	23.02	20.24	19.40	24.87	26.83	101.32	34.09	3405.17
		F	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		LSD_{05}	0.05	0.04	1.69	1.87	0.92	0.91	0.51	0.50	0.42	0.42	1.43	1.55	1.78	0.54	1.55
(C) Mineral fertilizer		0	0.69	0.65	78.42	75.47	42.63	41.00	23.13	22.22	19.50	18.78	23.16	24.97	106.51	24.20	2561.91
		0.5	0.73	0.69	79.90	77.17	43.43	41.95	23.58	22.76	19.85	19.19	24.12	26.00	103.48	32.71	3329.97
		1.0	0.76	0.71	80.99	77.65	44.03	42.21	23.90	22.90	20.13	19.31	24.63	26.55	102.14	34.41	3468.63
		F	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	*	*	*
		LSD_{05}													1.19	0.46	1.09
ABC		F	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	*	*
		LSD_{05}														1.38	3.26

* R.D = Recommended dose

Table (6): Effect of different treatments on some soil hydrophysical properties in the second season (winter 2007/2008).

Jojoba ton/fed	Castor bean ton/fed	Mineral fertilizer R.D*	Kh, cm/hr		Soil moisture content, %						AW, %		Θw, % Just before harvesting		Cu, cm	WUE, Kg fed^{-1}cm^{-1}	Yield, kg/fed
					SP		FC		WP								
			0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm	0-20 cm	20-40 cm			
0	0	Control	0.60	0.57	76.15	74.17	41.16	40.09	22.13	21.55	19.03	18.54	24.87	26.37	93.22	14.85	1384.50
		0.5	0.61	0.58	76.67	74.63	41.44	40.34	22.28	21.69	19.16	18.65	25.14	26.67	92.71	17.72	1642.70
		1.0	0.63	0.60	77.65	75.56	41.97	41.29	22.57	22.20	19.40	19.09	25.76	27.29	91.23	21.25	1938.30
	1	0.0	0.62	0.59	77.15	75.09	41.70	40.59	22.42	21.82	19.28	18.77	25.46	26.98	92.25	18.59	1715.30
		0.5	0.64	0.61	78.15	76.02	42.24	41.09	22.71	22.09	19.53	19.00	25.97	27.72	91.23	21.35	1947.60
		1.0	0.66	0.63	79.11	76.95	42.76	41.59	22.99	22.36	19.77	19.23	26.48	28.38	89.31	23.18	2070.50
	2	0.0	0.65	0.62	78.60	76.49	42.49	41.35	22.84	22.23	19.65	19.12	26.21	28.04	91.93	21.70	1994.80
		0.5	0.69	0.66	80.11	77.89	43.30	42.10	23.28	22.63	20.02	19.47	27.14	29.12	90.25	24.31	2193.60
		1.0	0.70	0.67	80.65	78.35	43.59	42.35	23.44	22.77	20.15	19.58	27.39	29.52	89.31	26.55	2371.60
1	0	0.0	0.68	0.65	79.63	77.40	43.28	42.07	23.52	22.86	19.76	19.21	26.76	28.72	89.83	19.38	1740.50
		0.5	0.73	0.70	81.67	79.29	44.39	43.03	24.13	23.39	20.26	19.64	27.92	30.14	89.11	23.52	2096.30
		1.0	0.76	0.73	82.67	80.20	44.93	43.59	24.42	23.69	20.51	19.90	28.37	30.75	86.76	24.62	2135.90
	1	0.0	0.74	0.71	82.14	79.75	44.64	43.34	24.26	23.56	20.38	19.78	28.19	30.45	83.74	27.32	2287.50
		0.5	0.80	0.78	84.14	81.64	45.73	44.37	24.85	24.11	20.88	20.26	29.22	31.79	79.73	35.01	2791.60
		1.0	0.81	0.79	84.64	82.11	46.00	44.63	25.00	24.26	21.00	20.37	29.57	32.17	78.97	35.60	2811.00
	2	0.0	0.77	0.75	83.13	80.68	45.18	43.85	24.55	23.83	20.63	20.02	28.69	31.12	82.85	27.96	2316.40
		0.5	0.82	0.80	85.18	82.55	46.29	44.86	25.16	24.38	21.13	20.48	29.88	32.48	78.97	36.69	2897.40
		1.0	0.84	0.82	85.69	83.21	46.57	45.22	25.31	24.58	21.26	20.64	30.16	32.85	78.15	37.37	2920.70
2	0	0.0	0.72	0.69	81.12	78.82	44.33	43.07	24.22	23.54	20.11	19.53	27.65	29.52	87.82	27.70	2432.70
		0.5	0.78	0.76	83.64	81.15	45.71	44.34	24.98	24.23	20.73	20.11	28.95	31.46	84.69	30.64	2594.50
		1.0	0.87	0.85	86.68	83.95	47.37	45.87	25.89	25.07	21.48	20.80	30.79	33.52	83.74	31.38	2627.80
	1	0.0	0.86	0.84	86.15	83.49	47.08	45.62	25.73	24.93	21.35	20.69	30.37	33.16	82.85	33.95	2812.50
		0.5	0.91	0.89	87.69	84.89	47.92	46.39	26.19	25.35	21.73	21.04	31.19	34.13	78.15	37.35	2918.70
		1.0	0.93	0.90	88.12	85.42	48.15	46.68	26.31	25.51	21.84	21.17	31.49	34.42	77.58	38.96	3022.70
	2	0.0	0.89	0.87	87.19	84.42	47.65	46.13	26.04	25.21	21.61	20.92	30.99	33.87	81.96	36.58	2998.20
		0.5	0.96	0.92	88.75	85.92	48.50	46.95	26.50	25.66	22.00	21.29	31.85	34.73	76.94	39.55	3042.70
		1.0	0.98	0.93	89.52	86.72	48.65	47.39	26.59	25.90	22.06	21.49	32.12	34.96	75.45	41.22	3110.40
(A) Jojoba ton/fed		0	0.64	0.61	78.25	76.13	42.29	41.20	22.74	22.15	19.55	19.05	26.05	27.79	91.27	21.06	1917.66
		1	0.77	0.75	83.21	80.76	45.22	43.88	24.58	23.85	20.65	20.03	28.75	31.16	83.12	29.72	2444.14
		2	0.88	0.85	86.54	83.86	47.26	45.83	25.83	25.04	21.43	20.78	30.60	33.31	81.02	35.26	2840.02
		F	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
		LSD_{05}	0.06	0.05	3.62	2.47	1.64	1.43	0.96	1.17	1.25	0.91	1.10	1.50	1.00	0.58	0.01
(B) Castor bean ton/fed		0	0.71	0.68	80.65	78.35	43.84	42.63	23.79	23.14	20.05	19.50	27.36	29.38	88.79	23.45	2065.91
		1	0.77	0.75	83.03	80.60	45.14	43.81	24.50	23.78	20.64	20.03	28.66	31.02	83.76	30.15	2486.38
		2	0.81	0.78	84.31	81.80	45.80	44.47	24.86	24.13	20.95	20.33	29.38	31.85	82.87	32.44	2649.53
		F	*	*	*	*	NS	*	NS	*	NS	*	*	*	*	*	*
		LSD_{05}	0.05	0.05	3.05	1.71		0.94		0.51		0.43	0.62	1.85	1.62	0.60	0.01
(C) Mineral fertilizer		0	0.73	0.70	81.25	78.92	44.17	42.90	23.97	23.28	20.20	19.62	27.69	29.80	87.38	25.34	2186.93
		0.5	0.77	0.74	82.89	80.44	45.06	43.72	24.45	23.73	20.60	19.99	28.58	30.92	84.64	29.57	2458.34
		1.0	0.80	0.77	83.86	81.39	45.55	44.29	24.72	24.04	20.83	20.25	29.13	31.54	83.39	31.13	2556.54
		F	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	*	*	*
		LSD_{05}													0.88	0.36	0.01
ABC		F	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	*	NS
		LSD_{05}														1.07	

* R.D = Recommended dose

The increases in SP, FC and WP values differed between 0.61 and 18.97%, 0.63 and 20.29 %, 0.56 and 21.61 % of surface layer and between 0.48 and 12.78 %, 0.49 and 14.03 %, 0.48 and 15.85 % of subsurface layer in the first season. While, in the second season, the increases differed between 0.68 and 17.56 %, 0.68 and 18.20 %, 0.67 and 20.15 % of the surface layer and between 0.62 and 16.92 %, 0.62 and 18.21 %, 0.65 and 20.19 % of the subsurface layer, respectively.

Concerning the effect of jojoba and castor bean seed residues, data indicate that increasing jojoba and / or castor bean seed residues from 0.0 to 2.0 ton/fed resulted in significant increases in SP, FC and WP, since they increased by 12.11, 13.35, 15.18 %, 7.39, 8.50, 10.26 % and increased by 4.84, 4.86, 4.80 % and 3.40, 3.46, 3.60 %, respectively of the two soil depths in the first season for jojoba and castor bean seed residues, also they increased by 10.59, 11.75, 13.59 % and 10.15, 11.24, 13.05 % and increased by 4.54, 4.47, 4.50 % and 4.40, 4.32, 4.28 %, respectively of the two soil depths in the second one. Similar results were obtained by El-Maddah (2000) and El-Maddah and Badr (2005).

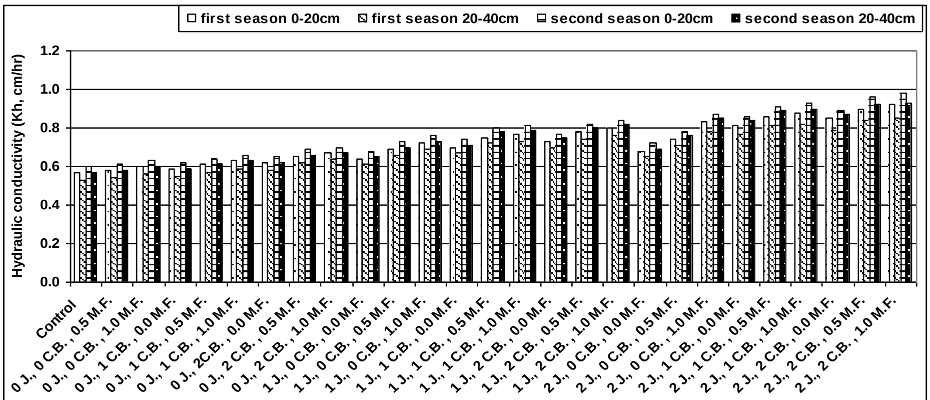

Fig.(3): Effect of different treatments on hydraulic conductivity (Kh, cm/hr) in the first and second seasons

Mineral fertilizers did not significantly affected soil moisture characters either in two soil depths or in two growing seasons.

Concerning the combined effects, the results show that all different treatments led to progressive increases in SP, FC and WP values compared with the control (untreated soil). The highest values of SP, FC and WP were obtained by adding 2 ton/fed of jojoba seed residues mixed with 2 ton/fed of castor bean seed residues at the recommended dose of mineral fertilizers, since it gave 87.23, 47.67, 26.05 % and 81.52, 44.55, 24.34%, respectively of the two soil depths in the first season, and gave 89.52, 48.65, 26.59 % and 86.72, 47.39, 25.90 %, respectively of the two soil depths in the second one.

3- Available water

Data in Tables (5 and 6) and Fig. (4) indicate that available water (AW,%) were significantly increased with increasing all added treatments of the two sequence layer depths (0-20 and 20-40 cm) at the end of the two seasons comparing to the control (untreated soil). The increases in (AW) values were ranged from 0.71 to 18.73 %, 0.50 to 11.90 % and from 0.68 to 15.92 %, 0.59 to 15.91 %, respectively of the two soil depths in the two seasons.

Regarding the effect of jojoba and castor bean seed residues, data reveal that increasing the addition rate of jojoba and / or castor bean seed residues from 0.0 to 2.0 ton/fed led to significant increases in (AW) values, where the highest values were 20.90 and 19.63 %, 21.43 and 20.78 %, respectively for jojoba seed residues of the two soil depths in the first and second seasons, while in case of castor bean seed residues, the highest values were 20.23 and 19.40 %, 20.95 and 20.33 %, respectively of the two soil depths at the end of the two seasons. These results are confirmed with El-Maddah (2000) and El-Maddah and Badr (2005).

Mineral fertilizers did not significantly increase (AW) neither in two soil depths nor in two growing seasons.

Concerning the combined effect, data reveal that the highest values of (AW) was recorded at the addition of 2 ton/fed of jojoba seed residues mixed with 2 ton/fed of castor bean seed residues at the recommended dose of mineral fertilizers, since it gave 21.62 and 20.21 %, 22.06 and 21.49 %, respectively of the two soil depths in the first and second seasons.

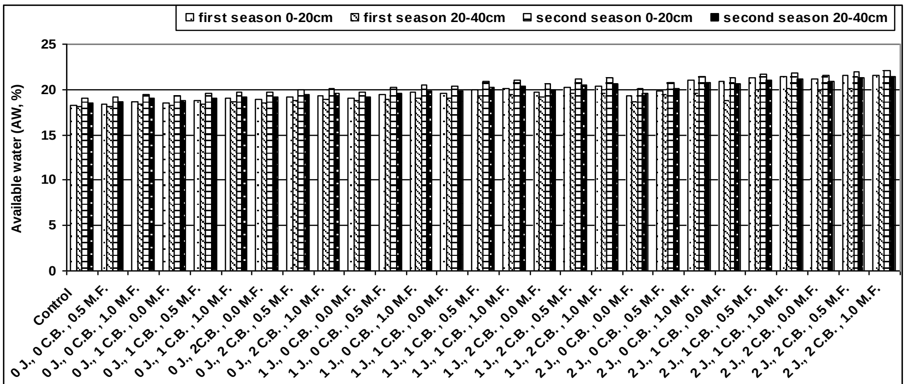

Fig.(4): Effect of different treatments on available water (AW, %) in the first and second seasons

4- Soil moisture content just before harvesting (θw, %).

Recorded data in Tables (5 and 6) indicate that all different treatments caused significant increase in soil moisture content of the two soil depths at the end of the two seasons compared with the control (untreated soil). The increases in (θw) values differed between 1.18 and 35.82 %, 1.10 and 37.36 % and between 1.09 and 29.15 %, 1.14 and 32.57 %, respectively for the two soil depths in the first and second seasons.

Generally, soil moisture content just before harvesting increased with increasing the addition rates of jojoba and / or castor bean seed residues from 0.0 to 2.0 ton/fed. The highest values of (θw) were 26.18 and 28.31 %, 30.60 and 33.31 %, respectively for jojoba seed residues of the two soil depths at the end of the two seasons. While, the highest values for castor bean seed residues were 24.78 and 26.83 %, 29.38 and 31.85 %, respectively of the two soil depths at the end of the two seasons. Also, mineral fertilizer did not significantly affected (θw) just before harvesting in both the two depths or the two seasons.

With regard to the combined effect, data reveal that the highest (θw) values was recorded at 2 ton/fed of jojoba seed residues with 2 ton/fed of castor bean seed residues at the recommended dose of mineral fertilizers, since it gave 27.64 and 29.89 %, respectively of the two soil depths at the end of the first season and gave 32.12 and 34.96 %, respectively at the end of the second season. Also, it can be noticed that the values of (θw) at the end of the second season were higher than those obtained at the end of the first one, these results may be due to the decomposition of these residues in the second season were greater than its decomposition in the first one. Similar results were obtained by El-Maddah (2000).

5- Water consumption (CU) and water use efficiency (WUE).

The results presented in Tables (5 and 6) and Fig. (5) clear that CU values for maize and wheat plants were significantly decreased by increasing all added treatments compared with the control. The decreases percentage differed between 0.33 and 17.97 %, 0.55 and 19.06 %, respectively for maize and wheat plants under the control. Similar results were obtained by **El-Maddah and Badr (2005).**

Water use efficiency is defined in the present work, as kilograms of maize or wheat seeds produced by one cm of the consumed water by maize or wheat plants per feddan. The results presented in Tables (5 and 6) and Fig. (6) indicate that WUE values for maize and wheat plants take the opposite trend with CU, where the WUE values were significantly increased by increasing all different treatments compared with the control (untreated soil). The increases percentage ranged from 19.02 to 154.90 %, 19.33 to 177.58 %, respectively for maize and wheat plants.

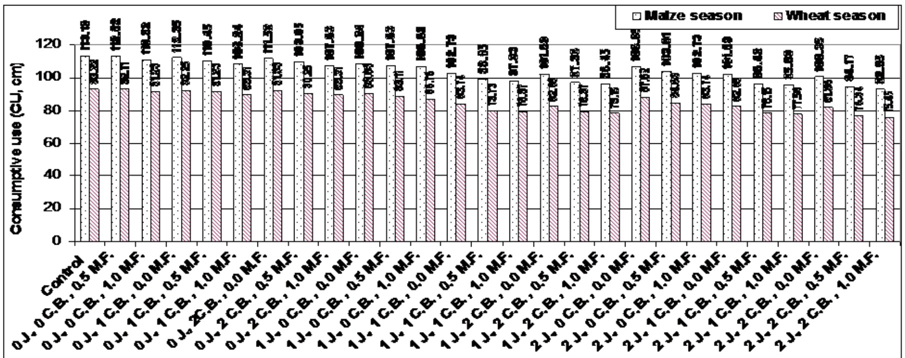

Fig.(5): Effect of different treatments on consumptive use (CU, cm) in the first and second seasons

With regard to the effect of jojoba and / or castor bean seed residues on CU for maize and wheat plants. It can be seen that increasing the addition rates of jojoba and / or castor bean seed residues from 0.0 to 2.0 ton/fed led to significant decreases in CU values from 110.77 to 99.42 cm and 108.09 to 101.32 cm, respectively for jojoba and castor bean seed residues in the first season and from 91.27 to 81.02 cm and 88.79 to 82.87 cm in the second one. Also, increasing mineral fertilizer rates from 0.0 to 1.0 of the recommended dose decreased Cu values from 106.51 to 102.14 cm, and from 87.38 to 83.39 cm for maize and wheat plants.

While, WUE take the opposite trend for maize and wheat plants where the highest values were recorded with 2 ton/fed of jojoba or castor bean seed residues which were 35.01 and 35.26 kg fed^{-1} cm^{-1} of jojoba for maize and wheat plants and were 34.09 and 32.44 kg fed^{-1} cm^{-1} of castor bean seed residues for the same crops. Also, increasing mineral fertilizers to the recommended dose gave the highest values of WUE which were 34.41 and 31.13 kg fed^{-1} cm^{-1} for the same crops.

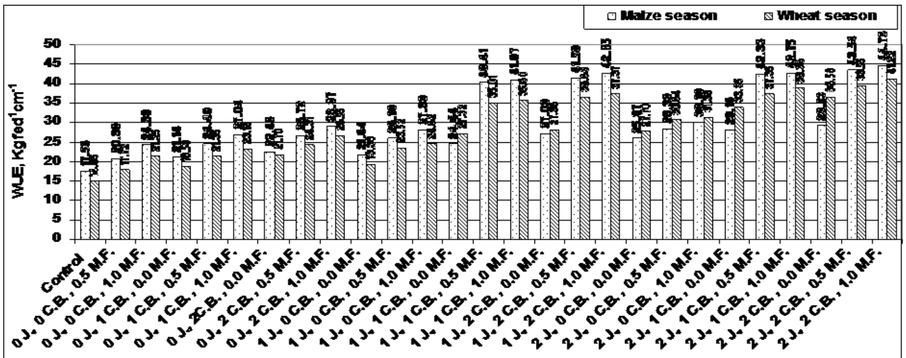

Fig.(6): Effect of different treatments on water use efficiency (WUE, Kg fed^{-1}cm^{-1}) in the first and second seasons

Concerning the combined effect, the results clear that the best treatment was 2 ton/fed of jojoba seed residues mixed with 2 ton/fed of castor bean seed residues at the recommended dose of mineral fertilizers in the first and second seasons, since it gave the lowest values of CU 92.85 and 75.45 cm, respectively and the highest values of WUE 44.76 and 41.22 kg fed^{-1} cm^{-1}, respectively for maize and wheat plants. Also, it can be noticed that the effect of different treatments on decreasing CU values and increasing WUE values can be arranged in the order: jojoba seed residues > castor bean seed residues > mineral fertilizers. These results are in line with those reported by El-Maddah and Badr (2005) and El-Sodany *et al.* (2007).

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تـأثير مخلفـات بـذور الجوجوبـا والخـروع كمحسـنات للتربـه علـي بعض الخـواص الطبيعيه والهيدروفيزيائيه للاراضي .

الحسيني إبراهيم المداح و منصور الدسوقي السوداني
معهد بحوث الأراضي والمياه والبيئة – مركز البحوث الزراعية – الجيزة – مصر

أجريت تجربتان حقليتان علي ارض طمييه طينيه سلتيه في محطة البحوث الزراعيه بالجميزه ، محافظة الغربيه خلال موسمين متعاقبين. الموسم الصيفي ٢٠٠٧ والموسم الشتوى ٢٠٠٨/٢٠٠٧ لتقييم تأثير اضافة مخلفات بذور الجوجوبا والخروع علي تحسين بعض الخواص الطبيعيه والهيدروفيزيائيه للتربه مع دراسة الاثر المتبقي لهذه الاضافات علي نفس الخصائص السابقه. وكان معدل اضافة مخلفات الجوجوبا والخروع صفر ، ١ ، ٢ طن / فدان لكل منهما وقد تم اضافتها قبل زراعة الذره في الموسم الاول فقط . بينما تم اضافة الاسمدة المعدنية بمعدلات صفر ، ونصف وجرعة تسميد كامله حسب كل محصول . وكان تصميم التجربه قطاعات منشقه مرتين في ثلاث مكررات .

ويمكن تلخيص النتائج المتحصل عليها كالتالي :

١- انخفضت مقاومة الأرض للاختراق مع كل المعاملات المضافه، كما أدت زيادة معدلات المحسنات المضافة إلي انخفاضها
٢- انخفضت قيم الكثافة الظاهرية للتربة في كل المعاملات اما المسامية الكلية للتربة ونسبة المسام فإنها تأخذ الاتجاه المضاد .
٣- انخفضت نسبة التحبب في كل المعاملات مما يدل علي وجود درجة عالية من ثبات البناء .
٤- قيم التوزيع الحجمي للمسام (المسام الكبيره والمتوسطه والصغيره كنسبه مئويه من المساميه الكليه) زادت معنويا في موسمي النمو .
٥- زيادة قيم التوصيل الهيدروليكي للتربة وكذلك زيادة المحتوى الرطوبي بها (سواء قيم الثوابت الرطوبيه او المحتوى الرطوبي قبل الحصاد) معنويا في كل المعاملات في موسمي النمو.
٦- حدث انخفاض في قيم الاستهلاك المائي وزيادة في قيم كفاءة استخدام المياه في كل المعاملات في موسمي النمو .
٧- مما سبق يتبين انه من المفيد إستخدام هذه المعاملات (مخلفات بذور الجوجوبا والخروع كمحسنات للتربة) للحصول علي تحسن واضح في الخصائص الطبيعيه والهيدروفيزيائيه للارض الطمييه الطينيه السلتيه .