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SAFELY DISPOSAL OF SOME FIELD WASTES THROUGH THE INJECTION INTO SALT AFFECTED SOILS AT NORTH DELTA USING MOLE DRAIN TO IMPROVE SOIL PRODUCTIVITY

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ABSTRACT

A field experiments were conducted during two successive growing seasons summer (2011) and winter (2011/2012) at Meet El-Deeba Farm, Kafr El-Shiek Governorate, Egypt to evaluate the using of some field wastes as mole drain filling materials to improve some physical and chemical properties and soil productivity as well as some water relations under maize and wheat crops. The experimental treatments were six treatments (control, unfilled moles and moles filled with sand, shredded rice straw, maize stalk or cotton stalk) arranged in a complete randomized block design with four replicates. The obtained results could be summarized as follow:

1- Soil bulk density (ℓ_b) and penetration resistance (PR) were decreased with different treatments as compared to control. The lowest values of these parameters were obtained under shredded cotton stalk filled moles. At the same time, soil porosity (E), basic infiltration rate (IR) and the rate of soil salinity (EC_e) decrement were increased with different treatments, where shredded cotton stalk filled mole gave the highest values.
2- The total yield of both crops were highly significantly increased with different treatments, where the unfilled moles produced the highest maize yield increment rate, while cotton stalk moles gave the highest wheat yield increment rate, relative to the control.
3- The amounts of water applied, water consumptive use, crop and field water use efficiencies of both crops were increased with different treatments.
4- The net return for both crops were increased as a result of applying different treatments, where the highest net return value for maize was achieved with unfilled moles. While for wheat, the highest value was obtained with cotton stalk moles.

It could be concluded that the field wastes could be safely disposed through injection into the soil in moles with proper depth (50-60 cm). These moles seemed to be more effective in improving soil permeability and hence ameliorate saline clay soil and consequently increase crop productivity and helping for reducing pollution factors.

Keywords: Field waste mole, subsoiling, salt affected soil, physical properties

INTRODUCTION

Egyptian rural areas generate large amount of plant residues such as rice straw, maize stalk, cotton stalk, etc., that considered as one of the most critical problems, which face the Egyptian farmers. The quantity of residues in Egypt reached about 18.7 -25 million ton per year and national income might be increased with 1.6 billion LE year^{-1} if we try to recycle it, (El-Berry et al 2001 and Awady et al 2001). These crop residues can be recycled and utilized instead of driving away and/or burning. This leads to increase the benefits from the agricultural sector in rural communities and ensure better environmental conditions. To increase the economic output and environmental benefits from recycling the agricultural residues, integrated system should be considered. El-Ashry (2008) mentioned that the possibility to use the local ditcher for getting mole for depositing crop residuals as complete structure (without grinding). Addition of these crop residuals increase soil permeability and improve drainage condition. Miller and aursted (1971) found that straw incorporation of the furrow bottom increased furrow infiltration in sandy loam soil during 3 years study period. Zamil (2012) stated that using sand as mole filling material increased basic infiltration rate of heavy clay soil.

The Northern part of the Nile Delta represents a large area of heavy clay and salt affected soils with low permeability under shallow and salty ground water. Degradation due to salinization and water logging are the current potential hazard in the irrigated land in Nile Valley and Delta. Good drainage efficiencies and proper soil management are important factors to improve soil characteristics. Therefore, Moukhtar et al (2003-a) reported that saline groundwater is a permanent source of soil salinzation that causes poor productivity in the irrigated areas.

Improved crop growth due to subsoiling and mole drains are generally considered to be the result of the physical shattering of the hardpan which allows to increase water penetration into the subsoil, increase total porosity, create better aeration for the root and increase the availability of nutrients for plant growth. This may also accelerate the leaching of excess salts from the subsoil thereby further reducing the possibility of reformation of the hardpan (Lickacz, 1993; Moukhtar et al., 2002; Moukhtar et al., 2003 a & b; Jodi DeJong, 2004 and Abdel-Mawgoud et al., 2006). Also, Said (2003) concluded that the cumulative and basic infiltration rate and total porosity of the treated soil by subsoiling markedly increased while bulk density and penetration resistance sharply decreased.

The current study aims to evaluate the effect of the injection of some field wastes into the soil using mole drain on some properties and productivity of salt affected soils as well as some crop-water relations.

MATERIALS AND METHODS

A field experiments were conducted in clayey textured soil during two successive growing seasons; summer (2011) and winter (2011/2012) at Meet El-Deeba Farm, Kafr El-Shiek Governorate, Egypt, to evaluate the effect of the injection of some field wastes into the soil using mole drain on the properties and productivity of salt affected soils as well as some crop-water relations .

The experimental design was a complete randomized block design with four replicates. The treatments of the experiment were:

1) Control (without subsoiling).
2) Shredded rice straw moles (about 2 ton fed^{-1}).

3) Sandy moles (about 20 m^3 fed^{-1}).
4) Shredded maize stalk moles (about 3 ton fed^{-1}).
5) Shredded cotton stalk moles (about 5 ton fed^{-1}).
6) Unfilled moles.

Mole drains are unlined channels formed in a clay subsoil with a ripper blade with a cylindrical foot, often with an expander which helps compact the channel wall (subsoilar plow unit). Sand and shredded plant residues were injected into the mole using the injection unit. These two unites constitutes mole machine is shown in the schematic diagram in Fig (1). The depth of mole drain in the present work was 60 cm and the distance between moles was 4 m. The cultivated crops were maize (Zea mays L.) single cross 10 as a summer crop and wheat (Triticum aestivum L.) as a winter crop. All recommended agricultural practices in North Delta were used with both crops. Soil samples were taken from each treatment before planting and after harvesting of both crops. The samples were taken from soil layers namely; 0-15, 15-30 and 30-60 cm and prepared for physical and chemical analysis according to Page et al (1982), Klute (1986), Jackson (1973), Garcia (1978) and Richards (1954) as shown in Table (1).

Fig (1): A schematic diagram of the mole machine and injection plow:

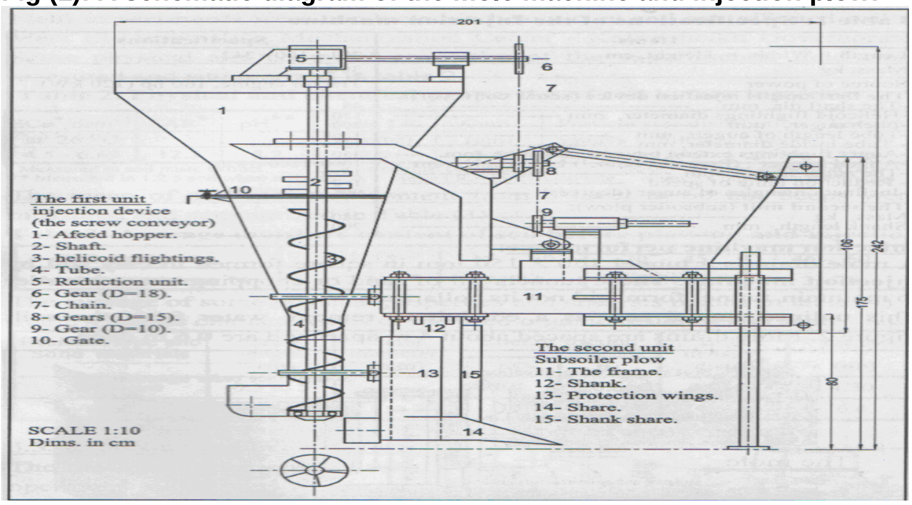

Table (1): Some soil physical and chemical properties of the experimental field before experiment.

Soil depth (cm)	Particle size distribution			Texture grade	EC (dSm^{-1})	ESP %	Bulk density Mg m^{-3}	Total porosity %	PR (MPa)	IR cm h^{-1}
	Sand %	Silt %	Clay %							
0-20	23.62	26.88	49.50	Clayey	6.46	14.48	1.40	48.95	1.95	**0.63**
15-30	21.12	27.68	51.20	Clayey	6.82	15.10	1.50	46.54	2.15	
30-60	24.15	23.15	52.70	Clayey	7.12	15.42	1.54	42.19	2.24	
Mean	22.96	25.91	51.13	Clayey	6.80	14.99	1.48	45.89	2.11	

Crop-water relationship:-

Water consumptive use: was calculated according to the following equation (Israelson and Hanson, 1962) as follows:

$$CU = \frac{\theta_2 - \theta_1}{100} \text{ X Db } \frac{\text{X D}}{100} \text{ X } 4200$$

Where, cu = water consumptive use (m^3 fed^{-1})
n = number of irrigations
θ_1 = soil moisture content (%) after two days from irrigation
θ_2 = soil moisture content (%) before the next irrigation
B_d = bulk density of soil (g cm^{-3})
D = depth of soil(m).

Water efficiencies:

A. Field water use efficiency (FWUE): was calculated according to Doorenbos and Pruitt (1979) as follows:

$$\text{FWUE (kg m}^{-3}\text{)} = \frac{\text{Yield kg fed}^{-1}.}{\text{Water applied (m}^3\text{ fed}^{-1}.\text{)}}$$

B. Crop water use efficiency (CWUE): was calculated according to Doorenbos and Pruitt (1979) as follows:

$$\text{CWUE (kg m}^{-3}\text{)} = \frac{\text{Yield kg fed}^{-1}.}{\text{Water consumptive use (m}^3\text{ fed}^{-1}.\text{)}}$$

Statistical analysis: Data were subjected to statistical analysis according to Snedecor and Cochran (1980).

Economic Evaluation: The profitability was calculated according to the equations outlined by FAO, (2000) as follows:

1-Yield increase = yield of treatment - yield of control.
2-Total return = yield increase * price in L.E for grain + straw.
3- Net return (NR) = total return - total cost.
4-Marginal rate return (MRR) = total return / variable cost.

RESULTS AND DISCUSSION

1) Soil bulk density and total porosity as affected by different treatments:-

Soil bulk density is considered as one of the main parameters which indicate the status of soil structure and consequently, soil water, air and heat regime (Richards 1954). Results in Table (2) showed that soil bulk density values were generally increased with increasing soil depth in all treatments. This increase may be resulted from increasing soil compaction due to soil layers weight. The mean values of soil bulk density and soil penetration resistance (0-60cm) at the end of the 2 nd season as affected by different treatments were decreased in the following upward order: cotton stalk moles < unfilled moles < maize stalk moles < sandy moles < rice straw moles < control. The highest values of these parameters (1.44 Mg m^{-3} and 2.03 Mp^a, respectively) were obtained under control treatment while shredded cotton stalk filled mole treatment gave the lowest values of these parameters (1.29 Mg m^{-3} and 1.26 Mp^{a}, respectively).

At the same time soil porosity, basic infiltration rate follow an opposite trend (increased with different treatments as compared to control), where the control treatment gave the lowest values of these parameters (0.65 cm h^{-1} and 45.79%, respectively) while shredded cotton stalk filled mole gave the highest values (1.65 cm h^{-1} and 51.45%, respectively). This might be attributed to the ability of cotton stalk mole in improving soil drainage condition, where cotton stalk was shredded into coarse pieces that allow water to drain easily through their large pores. The ability of cotton stalk and other residues in improving soil drainage conditions will be decreased with the time because of its decomposition and consequently decrease its pore size.

It could be concluded that filled or unfilled moles seemed to be effective in reducing soil bulk density, increasing soil porosity and consequently increasing soil penetration resistance and infiltration rate as compared to the control. This trend could be attributed to the effects of mole construction on breaking soil clods and bigger granular into smaller crumbs as well as breaking and cracking the compacted layers. These results are in harmony with those reported with Amer (1999), Said (2002), Jodi DeJong (2004), Abdel-Mawgoud et al., (2006) and Antar et al., (2008).

Table (2): Some soil properties as affected by different treatments at the end of the experiment.

Treatments	Soil depth (cm)	Soil bulk density (Mg m^{-3})	Soil porosity (%)	Penetration resistance (Mp^{a})	Infiltration rate (cm hr^{-1})
Control	0-15	1.36	48.68	1.96	**0.65**
	15-30	1.42	46.42	1.98	
	30-60	1.53	42.26	2.15	
	Mean	1.44	45.79	2.03	
Rice straw mole	0-15	1.33	49.81	1.86	**0.92**
	15-30	1.41	46.79	1.91	
	30-60	1.51	43.02	2.05	
	Mean	1.42	46.54	1.94	
Sandy mole	0-15	1.32	50.19	1.75	**1.12**
	15-30	1.41	46.79	1.78	
	30-60	1.48	44.15	1.86	
	Mean	1.40	47.04	1.80	
Maize stalk mole	0-15	1.28	51.69	1.45	**1.25**
	15-30	1.38	47.92	1.52	
	30-60	1.48	44.15	1.73	
	Mean	1.38	47.92	1.57	
Cotton stalk mole	0-15	1.21	54.34	1.15	**1.65**
	15-30	1.29	51.32	1.25	
	30-60	1.36	48.68	1.39	
	Mean	1.29	51.45	1.26	
Unfilled mole	0-15	1.25	52.83	1.29	**1.45**
	15-30	1.34	49.43	1.38	
	30-60	1.38	47.92	1.47	
	Mean	1.32	50.06	1.38	

2) Soil salinity(EC_e):

Data presented in Table (3) indicated that application of mole drains is more effective in decreasing EC_e and ESP_e values, and their values were increased markedly with increasing the soil depth. The unfilled moles, cotton stalk moles and maize stalk moles seem to be more effective in lowering soil salinity than other treatments. The highest value of EC_e reduction after maize and wheat crops (19.58% and 24.60%, respectively) were obtained under unfilled moles and cotton stalk shredded moles, respectively. The reduction of EC_e and ESP after harvesting of wheat was higher than that after maize crop. The values of EC_e and ESP reduction rate (%) after maize crop with different treatments could be arranged in the following order: unfilled moles > cotton stalk moles > maize stalk moles > sandy moles > rice straw moles > control. While this order after wheat crop could be arranged in the following order: cotton stalk moles > unfilled moles > maize stalk moles > sandy moles > rice straw moles > control. Unfilled mole efficiency in the second season was lower than that in the first one this could be attributed to the partially closing of the mole as a result of absence of filling material. The high efficiency of moling and subsoiling in decreasing soil salinity may be due mainly to forming many big fissures from soil surface to sub-soil layer (at least 60 cm depth) and also due to the construction of numerous effective capillary cracks. All these cracks together break the soil matrix and encourage downward water as well as solutes movement. Similar results were obtained by Spoor et al., (1990), Moukhtar et al. (2002), Abdel-Mawgoud et al. (2006), Antar et al (2008), Zamil (2012) and Aiad et al (2012).

Table (3): Values of EC and SAR reduction (%) relative to the control after maize and wheat crops as affected by different treatments.

Soil depth (cm)	Rice straw mole		Sandy mole		Maize stalk mole		Cotton Stalk mole		unfilled mole	
	After Maize									
	EC%	ESP%	EC%	ESP%	EC%	ESP%	EC%	ESP%	EC%	ESP%
0-15	3.76	1.53	6.73	3.07	12.09	6.13	14.05	6.90	15.85	7.67
15-30	6.74	3.54	11.53	5.74	12.87	6.47	15.42	7.94	20.81	10.87
30-60	7.03	2.76	11.33	4.87	12.77	5.59	17.50	8.49	22.09	10.66
Mean	5.84	2.61	9.74	4.56	12.58	6.07	15.66	7.77	19.58	9.73
After Wheat										
0-15	9.97	4.60	11.60	5.37	20.26	10.03	20.75	10.03	22.22	10.80
15-30	16.33	5.74	15.12	7.94	17.96	9.41	26.50	13.88	25.45	13.14
30-60	11.76	5.59	13.20	6.32	18.36	8.49	26.54	12.83	23.82	11.38
Mean	12.69	5.31	13.31	6.54	18.86	9.31	24.60	12.25	23.83	11.78

3) Crop yield:

Data in Table (4) indicate that grain and straw yields of both of maize and wheat crops are highly significantly increased with different treatments as compared to the control. For maize crop, the mean values of grain and straw yields are increased as the following descending trends: unfilled moles > cotton stalk mole > maize stalk moles > sandy moles > rice straw moles > control. While for wheat crop, the trend is: cotton stalk moles > unfilled moles

> maize stalk moles > sandy moles > rice straw moles > control. It is clear from the data that, unfilled moles in the first season are more effective on maize yield than cotton stalk moles, while reversible trend is found with wheat yield in the second season. This could be as a result of decreasing of unfilled moles efficiency due to their gradually closing with the time in absence of filling materials.

The unfilled moles, cotton stalk moles and maize stalk moles gave the highest yield increase relative to the control. The increases with these treatments are 51.59%, 42.37% and 36.12%, respectively for maize grain and 54.69%, 39.38% and 35.90%, respectively for maize straw. While the increases of wheat grain with these treatments are 44.56%, 51.23% and 36.31%, respectively and 12.22%, 16.34% and 9.63%, respectively for wheat straw. This trend could be attributed to the high efficiency of unfilled moles, cotton stalk moles and maize stalk moles in improving soil drainage condition and hence decreasing soil salinity. These results are in agreement with that obtained by David (2002) and Said (2003).

Table (4) : Yield of Maize and wheat under different studied treatments.

Treatments	Maize (Kg fed^{-1}.)		Wheat (Kg fed^{-1}.)	
	Grain	Straw	Grain	Straw
Control	1897.6	1457.5	1677.6	2398.4
Rice straw mole	2014.9	1603.3	1884.0	2448.9
Sandy mole	2280.3	1735.5	2016.6	2560.5
Maize stalk mole	2583.0	1980.8	2286.8	2629.4
Cotton Stalk mole	2701.7	2031.4	2537.0	2790.3
unfilled mole	2876.6	2254.7	2425.2	2691.5
F. test	**	**	**	**
L.S.D. 0.05	70.04	59.77	56.49	65.32
L.S.D. 0.01	93.30	79.63	75.24	87.01

4) Water relations:

4.1 Water applied:

Data in Table (5) indicate that the water applied to maize and wheat crops were affected greatly by different treatments. The highest values of water applied to maize and wheat crops are recorded under unfilled moles (3948 and 2450 m^3 fed^{-1}, respectively), while the lowest values for both crops are achieved under the control (3235 and 1895 m^3 fed^{-1}, respectively).

4.2 Water consumptive use:-

It clear from the obtained data in Table (5) that water consumptive use of both crops increases with different treatments as the following order: unfilled moles > cotton stalk moles > maize stalk moles> sandy moles > rice straw moles > control. The highest values of water consumptive use for maize and wheat crops (2363 and 1250 m^3 fed^{-1}, respectively) are obtained under unfilled moles. While the lowest values for both crops are detected with the control (2100 and 1075 m^3 fed^{-1}, respectively).

Table (5): Some water relations as affected by different treatments.

Treatments	Water applied (m^3 fed^{-1}.)	Water consumptive use (m^3 fed^{-1}.)	Grain yield (Kg fed^{-1}.)	Straw yield (Kg fed^{-1}.)	Field water use efficiency (Kg m^{-3})		Crop water use efficiency (Kg m^{-3})	
Maize crop								
					Grain	Straw	Grain	Straw
Control	3235	2100	1897.6	1457.5	0.59	0.45	0.90	0.69
Rice straw mole	3261	2178	2014.9	1603.3	0.62	0.49	0.93	0.74
Sandy mole	3475	2193	2280.3	1735.5	0.66	0.50	1.04	0.79
Maize stalk mole	3671	2225	2583.0	1980.8	0.70	0.54	1.16	0.89
Cotton stalk mole	3729	2291	2701.7	2031.4	0.72	0.54	1.18	0.89
unfilled mole	3948	2363	2876.6	2254.7	0.73	0.57	1.22	0.95
Wheat crop								
					Grain	Straw	Grain	Straw
Control	1895	1075	1677.6	2398.4	0.89	1.27	1.56	2.23
Rice straw mole	2105	1125	1884.0	2448.9	0.90	1.16	1.67	2.18
Sandy mole	2185	1150	2016.6	2560.5	0.92	1.17	1.75	2.23
Maize stalk mole	2218	1189	2286.8	2629.4	1.03	1.19	1.92	2.21
Cotton stalk mole	2276	1225	2537.0	2790.3	1.11	1.23	2.07	2.28
Unfilled mole	2450	1250	2425.2	2691.5	0.99	1.10	1.94	2.15

4.3 Field water use efficiency (F W U E):

Data in Table (5) show that FWUE for either maize or wheat is affected by different treatments. The highest FWUE values for grain and straw of maize (0.73 and 0.57 kg m^{-3}, respectively) are achieved with unfilled moles, while the highest values for wheat grain and straw (1.11 and 1.23 kg m^{-3}, respectively) are obtained with cotton stalk moles. On the other hand, the lowest FWUE values for maize grain and straw (0.59 and 0.45 kg m^{-3}, respectively) and for wheat grain and straw (0.89 and 1.27 kg m^{-3}, respectively) are recorded with the control.

4.4 Crop water use efficiency (CWUE):-

Data in Table (5) show that the values of CWUE for maize and wheat are affected by different treatments. The highest CWUE values for maize grain and straw are achieved with unfilled moles (1.22 and 0.95 kg m-3, respectively), while the highest CWUE values for wheat grain and straw (2.07 and 2.28 kg m-3, respectively) are obtained with cotton stalk moles. The lowest CWUE values for maize grain and straw (0.90 and 0.69 kg m-3) and for wheat grain and straw (1.56 and 2.23 kg m-3) are given with the control. These results are in harmony with those found with Zamil (2012).

5) Economic Evaluation:

It is important to compare total costs and total return for different treatments. Data in Table (6) show the total cost, total income and net return for maize and wheat with different types of mole filling materials. Total income is based on the productivity of seeds and stalk of maize and seeds and straw of wheat in kg fed-1. Total costs included the following items; the mole installation, agricultural practices, fertilizers, pesticide, seeds and land rent. Data indicate that the net return for maize and wheat were affected by mole drain type where the net return value with mole drain was higher than the control for both crops. The highest net return value for maize (1827.6 L.E. fed-1.) was achieved with unfilled moles. While for wheat, the highest value (2099.4 L.E fed-1.) was obtained with cotton stalk moles. The highest values of marginal rate return for maize and wheat (22.5 and 24.3, respectively) were achieved with the unfilled moles. It can be concluded that the construction of mole drains achieved high income for the farmer.

Table (6): Economic analysis of different treatments for maize and wheat.

Crop	Treatments	Yield increased over control kg fed.-1		Cost of Treatments L.E.	Total return L.E.	Net return (NR)LE	Marginal rate return (MRR)
		Grain	Straw				
Maize	Control	1897.6	1457.5				
	Rice straw moles	117.3	145.8	210	241.7	31.7	1.2
	Sandy mole	382.7	278	380	739.2	359.2	1.9
	Maize stalk mole	685.4	523.3	260	1330.3	1070.3	5.1
	cotton stalk moles	804.1	573.9	310	1550.7	1240.7	5.0
	Unfilled moles	979	797.2	85	1912.6	1827.6	22.5
wheat	Control	1677.6	2398.4				
	Rice straw mole	206.4	50.5	210	552.5	342.5	2.6
	Sandy mole	339	162.1	380	954.9	574.9	2.5
	Maize stalk mole	609.2	231	260	1679.9	1419.9	6.5
	cotton stalk moles	859.4	391.9	310	2409.4	2099.4	7.8
	Unfilled moles	747.6	293.1	85	2067.3	1982.3	24.3

Conclusion: Some field wastes can be safely disposed through the injection into the soil in tunnels or in moles with proper depth (50-60 cm). These moles are good way to protect the environment and to improve soil permeability and assist the old drainage system. These practices improve soil physio-chemical characteristics and enhance salt leaching and draw water table level down the effective root zone and consequently increase soil productivity and helping for reducing pollution factors.

REFERENCES

Abdel-Mawgoud A.S.A, A.A.S. Gendy and S.A. Ramadan (2006). Improving root zone environment and production of a salty clay soil using subsoiling and gypsum application. Assiut J. of Agri. Sci., 37, 2: 147-164.

Awady, M.N.; M. Shaaban; I. Yehia and M.S. Mira (2001). Review on equipment industry for agricultural-residues management in Egypt. Misr. J. Agric. Eng., 18(4): 96-108.

Aiad M.A.F., M.A. Abd El-Aziz, B.A.A. Zamil and A.S. Antar (2012). Combating of soil deterioration at North Delta , Egypt. . J. Agric. Res. Kafr El-Sheikh Univ., 38 (2) 2012.

Amer, M. H. (1999). Effect of tillage operations on some soil physical properties and water relations of corn. Egypt, J. Appl. Sci., 14 (6):354-365.

Antar, S. A.; A. S. El-Henawy and A. A. E. Atwa (2008). Improving some properties of heavy clay salt affected soil as a result of different subsurface tillage. J. Agric. Sci. Mansoura Univ., 33 (10): 7675- 7687.

David Hopkins, Colac (2002). Managing wet soils: mole drainage. WWW.dse. Vic. Gov.

Doorenbos ,J .and W.O .Pruit (1979). Yield response o water ,FAO Irrigaion and Drainage paper ,33 ,Rome.

El-Ashry, A.S. (2008). Improving performance of a ditcher for depositing residues. Misr J. Agric. Eng.. 25(2):373-388.

El-Berry, A.M.; M.A. Baiomy; H.A. Radwan and E.M. Arif.(2001). Evaluation of (hematol) machine in rice straw chopping. Misr J. Agric. Eng.. 18(4):65-76.

FAO (2000). Fertilizers And Their Use, Evaluation of Fertilizer Demonstrations. A pocket guide for extension officers. Fourth edition. Food and Agriculture organization of The United Nations. International Fertilizer Industry Association Rome, Fourth edition.

Garcia, G. (1978). Soil water Engineering Laboratory Manual. Colorado State Univ. Dept. of Agric. and Chemical Engineering. Fort Collins, Colorado.

Israelson,O.W.and Hansen,V.E. (1962). Irrigation principles and practices 3rd ed.John Wiley and sons .Inc.New York.

Jodi DeJong, H. (2004). Can subsoiling increase crop yields in Minnesota? Agric. World Wide Correspondent. Meredith Corporation.

Jackson, M.L. (1973). Soil Chemical Analysis .constable and company Ltd. London.

Klute (1986). Water retention laboratory methods in: A.Klute ed. Methods of soil analysis, part 1,2nd ed. gron.Monogrg.A.S.A.Madson,W1.USA,p.635

Lickacz, J. (1993). Management of solonetzic soils. Agdex 518-8. Revised, Edmonton, Alberta, Canada.

Millar, D.E. and J.S. Aursted (1971). Furrow infiltration rates as affected by incorporation of straw or furrow cultivation. Soil Sci. Am. Proc. 35: 492-495.

Moukhtar M. M., Aly I.N.Abdel-Aal, M.A.B. El-Sheikh and M.I.I. Abdel-Khalik (2002). The Role of Mole Drainage in Degradation Soils Under Saline Ground water table in Egypt. The Second International Conference on Sustainable Agriculture for Food, Energy and Industry September 8-13, Beijing, China

Moukhtar, M.M., M.Y.S. El-Arquan, E.M. El-Hadidy and M.A.B. El-Shewikh (2003a). Amelioration of salt affected soils in north Dakhlia Governorate through application of tile drainage and subsoiling. J. Agric. Sci. Mansoura Univ., Special Issue, Sci. Symp. On Problems of soils and waters in Dakhlia and Damietta Governorate. March 18.

Moukhtar M. M., Madiha H. El-Hakim, A, S.A. Abdel-Mawgoud, A. I. N. Abdel-Aal, M. B. El Shewikh and M.I.I. Abdel-Khalik (2003b). Drainage and role of mole drains for heavy clay soils under saline water table, Egypt. Paper No 078. Presented at the 9th International Drainage Workshop, September 10 – 13, 2003, Utrecht, The Netherlands.

Page, A.L.; R.H. Miller and D.R. Keeney (1982). Methods of soil analysis. Part Π: Chemical and microbiological properties, 2nd ed. Soil Sci. Soc. Am. Inc., Madison, USA.

Richards, L.A. (1954). Diagnosis and Improvement of Saline and Alkali Soils U.S.D.A. Hand Book No. 60.

Said H. M. (2002). Effect of deep ploughing on some physical properties and corn yield in calcareous sandy clay loam soil. Egyp. J. Soil Sci. 42: 57-70.

Said H. M. (2003). Effect of tillage implements on the state of compaction in different soils. Egyp. J. Soil Sci. 43: 91-107.

Snedecor, G.W. and W.G. Cochran (1980). "Statistical Methods" 7th ed., 225-330. Iowa state Univ., Press., Ames., Iowa, USA.

Spoor, G., C. J. Cronion and P. B. Leeds-Harrison (1990). Mole drain installation for leaching purposes. Proc. Symp. On Land Drainage for Salinity Control in Arid and Semi-Arid Regions. 3:47-45, Cairo, Egypt.

Zamil B. A. (2012). Effect of mole drain spacing and filling material on some soil properties, yield of flax and kenaf and some water relations in the north middle nile delta region. J. Agric. Sci. Minufiya J. Agric. Vol. 37 No.4 (2): 1007-1017.

التخلص الآمن من بعض المخلفات الحقلية عن طريق الحقن في بعض الاراضى المتأثرة بالأملاح بمنطقة شمال الدلتا من خلال أنفاق الصرف ودوره في تحسين إنتاجية التربة

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أقيمت تجربة حقلية بمنطقة ميت الديبة بمحافظة كفر الشيخ خلال موسمي صيف 2011 و شتاء 2012/2011 وذلك لدراسة تأثير حقن بعض المخلفات الحقلية من خلال أنفاق الصرف على بعض الخواص الطبيعية والكيماوية لبعض الاراضى المتأثرة بالأملاح وإنتاجية هذه الاراضى وبعض العلاقات المائية. صممت هذه التجربة بنظام القطاعات تامة العشوائية بأربعة مكررات حيث كانت المعاملات المستخدمة كالاتى:

1) معاملة مقارنة (حرث عادى). 2) مول بدون مادة مالئة.
3) مول ممتلئ بالرمل (20 م^3/فدان). 4) مول ممتلئ بقش الأرز المقطع (2 طن/فدان).
5) مول ممتلئ بحطب الاذرة المطحون (3 طن/فدان).
6) مول ممتلئ بحطب القطن المطحون (5 طن/فدان).

وكان عمق المول المستخدم 60 سم وعلى مسافات 4 أمتار وكانت المحاصيل المنزرعة الاذرة والقمح.

ويمكن تلخيص النتائج المتحصل عليها فيما يلي:

1) انخفضت كل من الكثافة الظاهرية ومقاومة التربة للاختراق في نهاية التجربة نتيجة تطبيق المعاملات المختلفة مقارنة بالكنترول. حيث تم الحصول على اقل قيم لهذه الخواص تحت معاملة مول حطب القطن ومن جهة أخرى أخذت المسامية الكلية للتربة ومعدل الرشح اتجاه عكسي (زادت مع المعاملات المختلفة مقارنة بالكنترول)، حيث أعطت معاملة مول حطب القطن أعلى القيم.

2) سجل أعلى معدل انخفاض في ملوحة التربة مع محصول الاذرة في الموسم الأول تحت معاملة المول بدون مادة مالئة. أما بالنسبة لمحصول القمح في الموسم الثاني فقد تم الحصول على أعلى معدل لانخفاض الملوحة مع معاملة مول حطب القطن (مقارنة بالكنترول). وقد أخذت نسبة الصوديوم المتبادل (ESP) نفس اتجاه الملوحة.
3) ازداد كل من محصولي الاذرة والقمح مع المعاملات المختلفة زيادة معنوية مقارنة بالكنترول، حيث أعطت معاملة المول بدون مادة مالئة أعلى معدل للزيادة في محصول الاذرة بينما أعطت معاملة مول حطب القطن أعلى معدل زيادة في محصول القمح.
4) ازدادت كمية المياه المضافة و الاستهلاك المائي وكفاءة الاستخدام المائي لكل من محصولي الاذرة والقمح مع المعاملات المختلفة مقارنة بالكنترول.
5) تأثر العائد الصافي للفدان ايجابيا نتيجة تطبيق المعاملات المختلفة حيث حققت معاملة المول بدون مادة مالئة أعلى عائد صافى من الاذرة، بينما حققت معاملة مول حطب القطن أعلى عائد من محصول القمح.

من النتائج المتحصل عليها في هذا البحث يمكن استنتاج ما يلي:انه يمكن التخلص الآمن من بعض المخلفات الحقلية عن طريق حقنها في أنفاق تحت التربة على عمق 50-60 سم لتعمل كأنفاق صرف تساعد على رفع كفاءة الصرف الحقلي وتقليل ملوحة التربة وبالتالي زيادة إنتاجية المحاصيل والمساعدة في الحد من عوامل تلوث البيئة.

قام بتحكيم البحث

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