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THE INFLUENCE OF TILE DRAINAGE SPACING ON WATER-TABLE FLUCTUATION AND ALFALFA CROP PRODUCTION IN THE NORTHEAST NILE DELTA, EGYPT

El-Samet, Rania, M.[1]; Serag, A. H. I.[2] and Abdel-Razek, Mona, K. M.[1]

[1] Drainage Field Research Department - Soils, Water and Environment Res. Inst., Agric. Res. Center Egypt.

[2] Soil Fertility and Plant Nutrition Department - Soils, Water and Environment Res. Inst., Agric. Res. Center Egypt.

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ABSTRACT: Low-lying areas, heavy clay soils with little permeability, saline and saline-sodic soils, and shallow and saline groundwater are all problems in Egypt's northeast. An experimental field was established on heavy clay soil in the northeastern Delta (Damietta Governorate) to compared the effects of different tile drainage spacings on groundwater level decline, productivity increase and soil degradation prevention over three growing seasons. The experiment was designed as a complete block randomization with four replications. The treatments consisted of three tile drainage spacings, as follow: 15m (T4), 30m (T3) and 60m (T2) at a depth of 1.5 m fixed, separated by buffer zones. There was no tile drain treatment (T1) used, and the crop grown was alfalfa**.**

In the four cuts, fresh and dry alfalfa yield weights, root volume, and fresh and dry root weights increased with subsurface drain compared to control treatment, as increased with decreasing the drainage spacings. The drain spacings also, had an effect on the water table depths in the following order: T4 > T3 T2 > T1. T4 is the best three seasons treatment for lower water table. In all treatments, the soil salinity in the upper surface layer is lower than in the deeper layers but the soil salinity decreased significantly with the reduced spacing tile drain. Finally, narrow tile drainage spacing provided a better cropping environment with faster water-table drop, lower water-table depths, and lower soil salinity.

Key words: Alfalfa, drain spacing, salt affected soil, subsurface drainage, water-table and heavy clay soil.

INTRODUCTION

The problem areas in Egypt are in the country's northeast. The fundamental issues are related to low regions, clayey to heavy clay soils with little permeability, saline to saline-sodic soils, and a shallow and saline water-table that is frequently subject to artesian pressure. Drainage is a critical component in resolving these issues. In general, studies conducted in the Delta's north showed that the water-table level and salinity are higher than in the south (Moukhtar *et al*., 2000). Agricultural drainage is required for sustainable farmland and, as a result, food productivity all over the world. Drainage is critical in dry and semiarid regions for waterlogging and salinity control. The tile drainage system comprises the vast majority of agricultural soil in Egypt's Nile Delta in order to remove excess water from the soil, improve crop yield, and ensure long-term agricultural irrigation. Muhammad *et al.* (2021). Subsurface drainage (also known as "tile" drainage) is a common water management practice in agricultural areas with rising ground water levels. Tile drainage is a practice. Many agricultural and environmental benefits are available, including increased water infiltration, reduced surface runoff and erosion, and improved crop growth and productivity when compared to comparable farm land without tile drainage (Skaggs and Schilfgaarde, 1999). Tile drainage is a highly effective technique for addressing flood and salinity risks, as well as an important parameter for improving soil salinity (Tian *et al.* 2018), and is useful for both drainage and watertable level control (Bahceci and Nacar 2010; Yu *et al.* 2016). When installing a new drainage system in the field, growers must determine the required drainage density

*Corresponding author: rania.elsamet@gmail.com

(drainage spacing and depth). This choice was traditionally made to improve economic return based on crop productivity (Skaggs *et al.,* 2006). Tile drainage requires pipe spacing, which has an immediate impact on the effectiveness of reducing soil salinity and engineering costs. Intensive and in-depth studies have been conducted to determine the type of change in soil moisture and salinity conditions, as well as crop productivity, in response to changes in drainage pipe spacing (Singh *et al.* 2006). Egyptian clover (*Trifolium alexandrinum L.*) is Egypt's main winter fodder and an essential component of a sustainable agriculture system. It has kept cattle and crop yields stable for centuries in areas where natural pastures are scarce. It produces high fodder yields whether consumed as pasturage, green cutting, saved as hay or silage, or industrialized into pellets, cubes, or other feed materials. Alfalfa accounts for nearly a third of the winter planted area in Egypt, including full-season and short-season crops, as well as seed production (Muhammad *et al.,* 2014).

In terms of crop productivity, numerous studies have shown that tile drainage improves crop productivity during wet years. In a long-term field drainage trial in the Middle Nile Delta, installing tile drainage significantly increased cotton, alfalfa, rice, and wheat yields (Moustafa *et al.,* 1987). Crop productivity was found to be 39% and 16% higher in fields with spacing of 12.5 and 15 meters, respectively, than in fields with lateral spacing of 50 meters. Lal and Fausey (1998) found that crop productivity increased as tile drainage spacing decreased in central Ohio. Clover production results showed that the fresh or dry weight content increased with decreasing drain spacing treatments (15 m spacing) compared to El-Sheikh (2000)'s wider drain spacing (60 m spacing). Schott *et al.* (2017) demonstrated that average 5-year corn and soybean yields for no-drain trails were 6% lower than traditional drainage; however, controlled drainage did not reduce corn production in Iowa from 2011 to 2015.

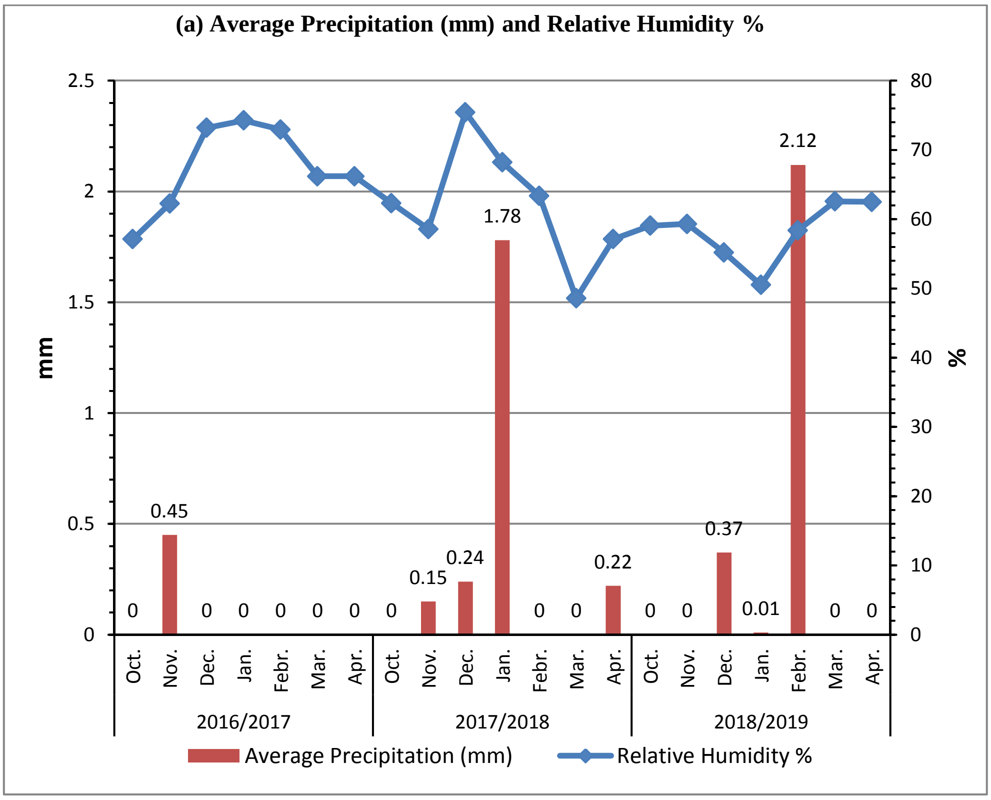
According to Moukhtar *et al.* (2004) discovered that fresh or dry clover weights at the second and third cut excess with reduce tile drain spacing treatments in other studies. Behairy (2007) discovered that narrow drain spacing improves root zone conditions for cotton plants as a result of desalination and faster water-table decline, thereby increasing cotton productivity. According to Mahmoud *et al.* (2016), a drainage spacing of 25 m resulted in the highest productivity of sugar beet roots. This increase was 7.57 tons fed.$^{-1}$, or approximately 75.85% more than the control treatments. According to Yang *et al.* (2022), subsurface drainage reduced soil salinity, which improved root vigor, dry matter, and cotton yield when compared to the control treatment. The improvement becomes clearer as the drainage pipe spacing is reduced.

On the other hand, El-Ghannam *et al.* (2020) demonstrated that the relative depth of groundwater decreases with increasing drainage spacing, and it was also demonstrated that a tight drainage spacing of 20 m was more effective than a wide drainage spacing of 40 m in decreasing soil salinity. In general, it can be stated that drainage conditions improve gradually over time, particularly in the treatment of 15 m spacing compared to wider distances of 30 m and 60 m, as demonstrated by (Abdel-Khalik, 2000; El-Sheikh, 2000; and Moukhtar *et al.,* 2000 and 2004). They also discovered that soil desalinization in relation to drainage spacing treatment results in a decrease in soil salinity as 15 > 30 > 60 spacing. Soil salinity decreased by 13.3 and 41.1% in the upper layer, and by 25.7 and 38.85% in the under layer, when drainage spacing was increased to 30 and 60 meters, respectively, compared to 15 meters (Abdel-Mawgoud *et al.,* 2007; El-Sheikh, 2000, and Mahmoud, *et al.,* 2016).

MATERIALS AND DISCUSSION

1. Location of the experimental area and climate conditions

The field trails were conducted at the experimental farm of El-Serw Agriculture Research Station, Agriculture Research Center, Damietta governorate ($31^0$14N and $31^0$48E) in northern Egypt. The experiment was carried out on an area of 8.4 ha on two plots which divided into three drainage spacing treatments (15 m, 30 m and 60 m) separated by buffer areas. Soil samples were taken from the surface layer (0 - 30 cm) for analysis before planting. The soil texture is clayey (15.64% sand, 22.21% silt and 62.15% clay), EC was 3.8 dS m^{-1} with pH 8.1. The region has a sub-tropical climate with hot and dry summers and cool wet winters. The weather conditions (average precipitation (mm), humidity percent- age, maximum–minimum temperature and Dew/Forest Point C^o) at the experimental location during maize growing seasons were quite variable in the two years of experimentation (Figure 1a and b):



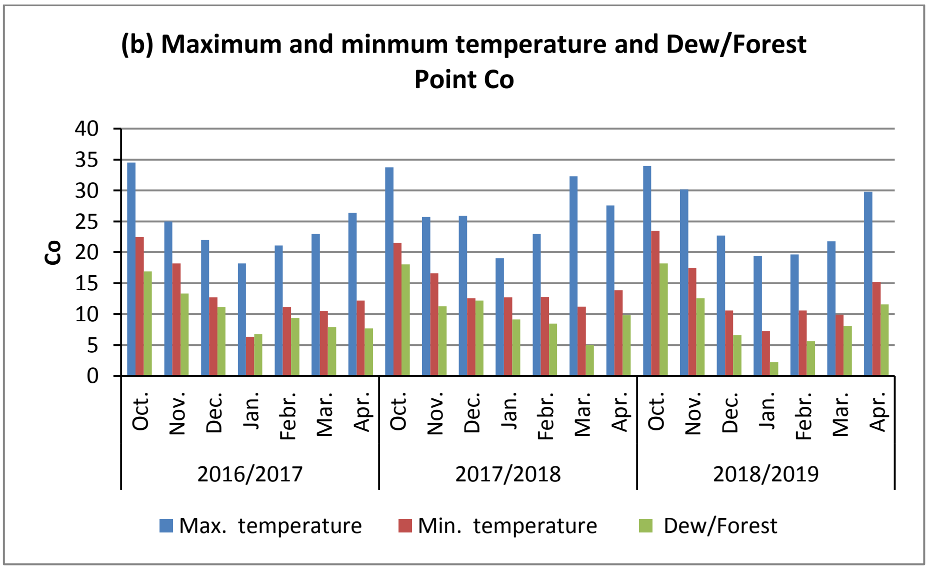


Figure 1. (a): Average precipitation (mm/day), relative humidity % and (b) maximum and minimum temperature and Dew/Forest Point (C^o) of experimental site during three grown seasons.

2. The experimental treatments and design

This experiment employed a completely randomized block design. Control no tile drain treatment (T1) and subsurface drainage spacing 60 m (T2), 30 m (T3), and 15 m (T4) between lateral and with four replicates for three winter seasons from 2016/2017, 2017/2018, and 2018/2019. The cultivated crop was alfalfa. Each cut of the plant was sampled to determine the fresh and dry root weight, root volume, and fresh and dry yield weight.

3. Ground water level

Groundwater level was measured by observation wells between the irrigation intervals using a copper sounder. The wells were placed midway between each two laterals on depth 1.5 m. Measurements were recorded daily after irrigation during the growing seasons.

4. The statistical analysis

The data was statistically examined carefully, and the standard error was determined. The LSD test was used to calculate mean values at (p 0.05) and (p 0.01) levels. The calculation for variance analysis (ANOVA) was also done according to (Snedecor and Cochran 1981).

RESULTS AND DISSECTION

1. The first crop cut growth parameters

Data in Table 1 illustrated the impact of drain spacing between laterals compared with the control treatment (T1) on roots volume, fresh and dry roots weight and fresh and dry yield weight in the three seasons. The results indicated to remarkable increase in roots volume, fresh and dry roots weight and fresh and dry yield weight with decreasing drain spacing treatments as compared with the control treatment. Statistical analysis revealed that there is a highly significant effect on roots volume, fresh and dry roots weight and fresh and dry yield weight. The increase in studied growth components may be due to the effect of tile drainage spacing of 15 m, which makes good drainage conditions, increasing soil micro-organisms activity, improving the physical and chemical properties of soil, increasing root extension and improving water-air balance in the root zone. These results are in agreement with those obtained by Moustafa *et al.*, (1987); Moukhtar *et al.*, (2004) and Schott *et al.*, (2017). In addition, improving soil conditions (such as density and soil structure) allows alfalfa roots to go deep and spread into the soil, thus increasing root size and root weight fresh and dry.

2. The second crop cut growth parameters

The main effect of root volume, fresh and dry root weight and fresh and dry yield weight for tile drainage spacing treatments were highly significant for the three studied seasons compared with control shown in Table 2. The response of alfalfa to drainage spacing was consistent over the three cultivation seasons. The properties studied were highest at a drainage spacing of 15 m over three years, and lowest at a drainage spacing of 60 m, but they were slightly higher than the control treatment. These results may be due to the fact that narrow drainage spacing improves soil physical and chemical properties, both as a direct effect on desalination and indirectly on sodium removal, thus improving rhizosphere conditions. These results stand in well agreement with those obtained by El-Sheikh (2000); Moukhtar *et al.* (2004); Behairy (2007) and Skaggs and Schilfgaarde (1999).

Table (1): Effect of drain spacing on growth parameters of alfalfa in the first cut for three growing seasons.

Drain spacing (m)	Root volume (cm^3 $plant^{-1}$)	Fresh root weight (g $plant^{-1}$)	Dry Root weight (g $plant^{-1}$)	Fresh yield weight (ton fed^{-1})	Dry yield weight (ton fed^{-1})
First Season					
T1	0.9	0.322	0.029	4.205	0.450
T2	1.25	0.418	0.047	4.554	0.474
T3	1.525	0.573	0.076	5.621	0.600
T4	2.025	0.709	0.100	6.521	0.719
F Test	**	**	**	**	**
LSD5%	0.107	0.018	0.005	0.014	0.005
Second Season					
T1	0.95	0.335	0.034	4.255	0.465
T2	1.3	0.493	0.059	4.590	0.485
T3	1.65	0.605	0.086	5.826	0.623
T4	2.2	0.777	0.106	6.766	0.777
F Test	**	**	**	**	**
LSD5%	0.107	0.006	0.008	0.007	0.007
Third Season					
T1	1	0.341	0.038	4.266	0.456
T2	1.375	0.519	0.071	4.908	0.517
T3	1.7	0.649	0.092	6.084	0.641
T4	2.325	0.804	0.110	6.973	0.800
F Test	**	**	**	**	**
LSD5%	0.119	0.011	0.006	0.018	0.010

Table 2: Effect of drain spacing on growth parameters of alfalfa in the second cut for three growing seasons.

Drain spacing (m)	Root volume (cm^3 $plant^{-1}$)	Fresh root weight (g $plant^{-1}$)	Dry Root weight (g $plant^{-1}$)	Fresh yield weight (ton fed^{-1})	Dry yield weight (ton fed^{-1})
First Season					
T1	1.2	0.417	0.110	6.443	0.692
T2	2.125	0.548	0.141	6.736	0.783
T3	2.7	0.772	0.196	7.697	0.855
T4	3.225	0.939	0.272	8.329	1.073
F Test	**	**	**	**	**
LSD5%	0.234	0.007	0.007	0.010	0.006
Second Season					
T1	1.225	0.418	0.110	6.471	0.695
T2	2.25	0.612	0.167	6.887	0.796
T3	2.775	0.932	0.214	7.895	0.866
T4	3.475	1.127	0.304	8.687	1.090
F Test	**	**	**	**	**
LSD5%	0.137	0.009	0.006	0.013	0.006
Third Season					
T1	1.25	0.419	0.132	6.496	0.717
T2	2.3	0.700	0.179	6.918	0.890
T3	2.975	1.023	0.245	8.003	0.939
T4	3.625	1.282	0.386	9.036	1.108
F Test	**	**	**	**	**
LSD5%	0.110	0.008	0.033	0.029	0.007

3. The third crop cut growth parameters

In terms of drainage spacing treatments, the results in Table 3 show that high drainage spacing treatments significantly increased growth parameters. These findings are consistent with those of El-Sheikh (2000) and Moukhtar *et al.* (2004).

Tile drainage improved soil water content and salinity conditions, according to Feng *et al.* (2019). Surface soil salinity increased with the order of W10 < W20 < W30 < CK in this study, and soil water content distribution was more homogeneous under tile drainage. Homogeneous soil water content is not only beneficial for plant root growth, as water stress can harm the root system but it is also theoretically possible to reduce the concentration of inorganic salt in the soil solution.

Table 3: Effect of drain spacing on growth parameters of alfalfa in the third cut for three growing seasons.

Drain spacing (m)	Root volume (cm^3 $plant^{-1}$)	Fresh root weight (g $plant^{-1}$)	Dry Root weight (g $plant^{-1}$)	Fresh yield weight (ton fed^{-1})	Dry yield weight (ton fed^{-1})
First Season					
T1	1.5	0.686	0.182	6.743	0.724
T2	2	0.801	0.208	6.836	0.810
T3	2.925	1.396	0.516	7.847	0.930
T4	3.875	2.078	0.775	8.439	1.224
F Test	**	**	**	**	**
LSD5%	0.181	0.043	0.037	0.045	0.008
Second Season					
T1	1.525	0.698	0.186	6.779	0.733
T2	2.05	0.813	0.210	7.068	0.853
T3	3.15	1.756	0.609	8.008	0.969
T4	4	2.165	0.828	9.093	1.280
F Test	**	**	**	**	**
LSD5%	0.156	0.131	0.011	0.018	0.060
Third Season					
T1	1.575	0.702	0.187	6.794	0.767
T2	2.1	0.814	0.216	7.185	0.916
T3	3.325	1.562	0.655	8.116	1.008
T4	4.1	2.216	0.906	9.121	1.290
F Test	**	**	**	**	**
LSD5%	0.192	0.011	0.011	0.013	0.010

4. The fourth crop cut growth parameters

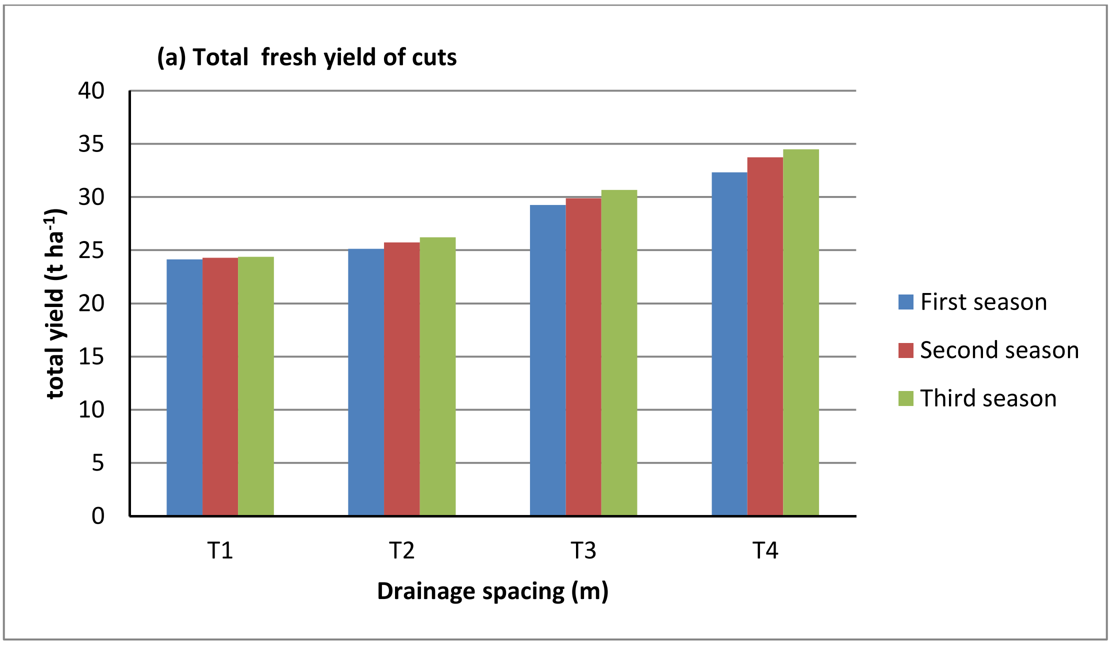
Analysis of variance ANOVA measurement explained that there were statistically high significant differences in studied parameters because of drain spacing. The studied characteristics of alfalfa plants were higher in narrow tile drainage spacings than wider ones due to larger flow in the narrow subsurface drainage spaces. The improved performance of plant growth under drainage conditions can be attributed to the maintenance of adequate moisture content in the root zone, which allows plants to more efficiently absorb useful water and nutrients. Anjium and colleagues (2005). From the above discussions it can be concluded that tile drainage is one of the most probable factors for improving the hazardous environmental impact which causes significant adverse effects on cultivated plants and thus soil productivity. Hence, subsurface drainage should be installed with suitable spacing, depth and materials obtained by (Mohamedin and El-Sawaf, 2005).

Table (4): Effect of drain spacing on growth parameters of alfalfa in the fourth cut for three growing seasons.

Drain spacing (m)	Root volume (cm^3 $plant^{-1}$)	Fresh root weight (g $plant^{-1}$)	Dry Root weight (g $plant^{-1}$)	Fresh yield weight (ton fed^{-1})	Dry yield weight (ton fed^{-1})
First Season					
T1	2	1.726	0.368	6.750	0.761
T2	2.4	2.087	0.421	6.997	0.858
T3	3.475	2.519	0.834	8.105	1.011
T4	4.5	3.111	1.002	9.027	1.385
F Test	**	**	**	**	**
LSD5%	0.147	0.015	0.014	0.007	0.007
Second Season					
T1	2.025	1.728	0.371	6.795	0.777
T2	2.5	2.094	0.438	7.177	0.907
T3	3.575	2.714	0.998	8.164	1.112
T4	4.6	3.328	1.300	9.209	1.413
F Test	**	**	**	**	**
LSD5%	0.119	0.012	0.008	0.009	0.010
Third Season					
T1	2.05	1.73	0.374	6.826	0.792
T2	2.55	2.102	0.443	7.198	0.930
T3	3.65	2.908	1.044	8.246	1.139
T4	4.7	3.638	1.491	9.377	1.500
F Test	**	**	**	**	**
LSD5%	0.103	0.044	0.011	0.010	0.006

5. Total yield of alfalfa

The results illustrated in (Fig. 2 a and b) showed that the fresh and dry weight of clover yield decreased in the order of T1 > T2 > T3 > T4, with high significant differences (Fig. 2 a and b). There is higher significance when there is subsurface drainage than when there is no subsurface drainage. Moreover, as tile drainage spacing was reduced, the fresh and dry yield weight of alfalfa increased significantly. These findings demonstrated that tile drainage significantly improved the yield components and thus the overall yield of alfalfa. As the tile drainage spacing was reduced, the improvement became more clearer. Moustafa *et al.* (1987), El-Sheikh (2000), Abdel-Khalik (2000), Moukhtar *et al.* (2000 and 2004), EL-Ghannam *et al.* (2020), and Yang *et al.* (2022) all found similar results.



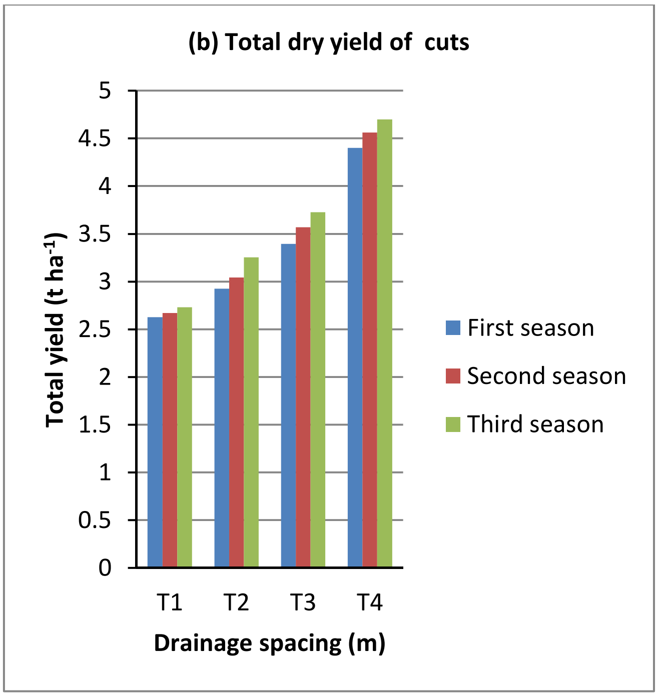


Figure 2: (a) Effect drain spacing on total fresh yield of cuts and (b) dry yield of cuts (t ha^{-1}) comparing to control.

6. Water-table depth

The water-table depths during the three grown seasons of the study are demonstrated in Figure (3). The effectiveness of studied treatments in lowering water table depth was greater by using narrow drain spacing treatment. Results of groundwater level fluctuations affected by subsurface drainage spacing comparing with control. Generally, it may be distressing that an amelioration in drainage conditions was achieved more gradually over time, particularly in treatment 15 m spacing. For this spacing treatment, improvement continuous at a rapid rate. It is may worth to note that drop changes irregularly from day to another. It may be attributed to preferential flow through macro-pores “bypass” flow.

The data also revealed that the drain treatments have a reinforcing effect on groundwater receding, particularly when spaced closely. After irrigation, the increased downward movement of water allows the active root zone to dry out, shrink, and form waterways. It is worth noting that the drying process and its aftermath are important in heavy clay soil drainage because they improve soil structure and permeability. The findings are comparable to those of El-Sheikh (2000), Abdel-Khalik (2000), Moukhtar *et al.* (2000 and 2004), and EL-Ghannam *et al.* (2020).

7. Soil salinity

The results in the Figure 4 show that the EC values at all studied soil depths decreased as a result of the narrow drainage spacing comparing with control. The obtained results showed that the drainage spacing of 15 m led to a reduction in soil salinity at the studied soil depths, especially in the three upper soil depths. From the results, it can be concluded that the 15 m spacing treatment was better at reducing soil salinity than the other drainage spacing treatments studied (30 m and 60 m) and control treatment. Such findings are in harmony with those of Mahmoud, *et al.*, (2016); EL-Ghannam *et al.* (2020) and Yang *et al.* (2022). Also, El-Sheikh (2000); Abdel-Khalik (2000); Moukhtar *et al.* (2004) and Abdel-Mawgoud *et al.* (2007) who found that the decreasing in soil salinity followed the order of: 15 > 30 > 60 m drain spacing treatments.

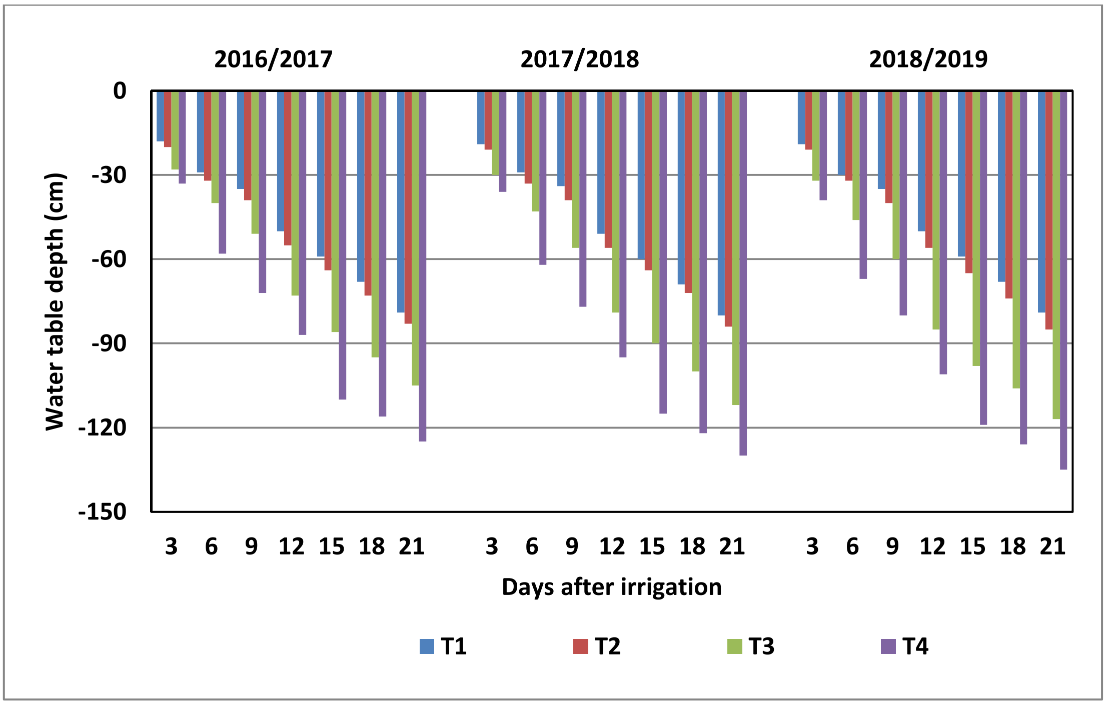


Fig. 3: Water-table depth during three grown seasons as affected by drainage spacing comparing with control.

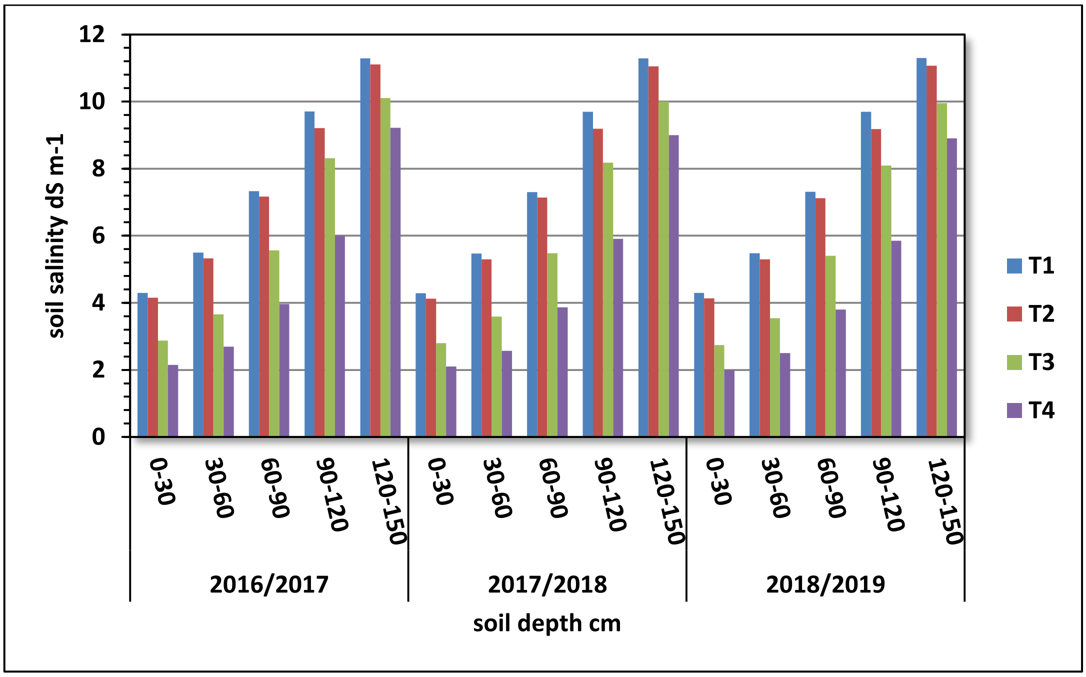


Fig. 4: Soil salinity (dS m^{-1}) during soil profile (from 0-150 cm) as affected by drain spacing comparing with control in three grown seasons.

Conclusion

In conclusion, tile drain spacing treatments had a reinforcing effect by lowering the water-table level and hastening its decline, particularly at 15 m spacing. It was also noted that drainage conditions improved progressively over time, especially with the treatment 15 m tile drainage spacing. It should be noted, however, that the treatment of wider drainage spacing (30 m) yields satisfactory results in terms of decreasing water-table level and lowering salinity. It additionally saves money on drainage. Tile drainage spacing treatments contributed to the existence of a favorable condition by lowering soil salinity and increasing soil moisture content, both of which play an important role in improving soil moisture-aeration status in the root zone.

REFERENCES

Abdel-Khalik, M. I. I. (2000). Nitrogen loss and uptake as affected by nitrogen application and tile drainage. Ph.D. thesis, Fac. Agric., Mans. Univ., Egypt.

Abdel-Mawgoud, A.S.A.; El-Sheikh, M. B.A. and Abdel-Khalik, M.I.I. (2007). Impact of agriculture drainage conditions on watertable recession and some soil properties, Nile Delta. J. Agric. Sci. Mansoura Univ., 32 (1): 737-746.

Anjum, A.; M.Z. Abdin and M. Iqbal (2005). Ameliorative effects of CaCl2 on growth, ionic relations and proline content of Senna under salinity stress. J. Plant Nutri., 28(1): 101-125.

Bahceci, I. and Nacar, AS. (2010). Subsurface drainage and salt leaching in irrigated land in south-east turkey. Irrig. Drain., 58 (3): 346–356.

Behairy, S.S. (2007). Effect of drain spacing on some soil characteristics and cotton yield in Eastern North Delta, Egypt. J. Agric. Sci. Mansoura Univ., 32 (7): 6067-6075.

El-Ghannam, M. Kh., R. M. Khalifa and B. B. Mikhael (2020). Effect of laterals drain spacing and groundwater depth on soil water relation and rice productivity in the north Nile Delta. Menoufia J. Soil Sci., 5: 217-234.

El-Sheikh, M.A.B (2000). Soil properties and crop production as affected by drainage types. Ph.D. thesis, Fac. Agric., Mans. Univ., Egypt.

Feng, G.; Zhang, Z. and Zhang, Z. (2019). Evaluating the sustainable use of saline water irrigation on soil water-salt content and grain yield under subsurface drainage condition. Sustainability, 11(22): 6431.

Lal, R., and N.R. Fausey (1998). Drainage and tillage effects on leaf tissue nuutrient contents of corn and soybeans on Crosby–Kokomo soils in Ohio. In: Proceedings International Drainage Symposium, 7th, Orlando, FL. 8–11 Mar. 1998. Am. Soc. Agric. Eng., St. Joseph, MI. p.: 465–471.

Mahmoud, A. A.; M.A.M. Hassan and A.M. Talaat (2016). Impact of some soil management practices on some chemical properties of salt affected soil and sugar beet production. SINAI J. Applied Sci., 5 (2): 209-222.

Mohamedin, A.A.M. and N.A. El-Sawaf (2005). Drainage effectiveness to improve environmental conditions in a probelamtic soil of Fayoum. J. Botany. Fac. Agric., Assiut Univ., ISSN 1110-0958. 34 (2).

Moukhtar, M.M., Abdel-Aal, A.I.N. and Abdel-Mawgoud, A.S.A. (2000). Crop productivity and Drainage in deteriorated soil of Egypt. 3rd international crop sci. congress, 17-22 August 2000, Hambourg, Germany.

Moukhtar, M. M., El-Hadidy, E.M. and El-Sheikh, M.A.B(2004). Crop production and drainage in conjunction with subsoiling role in deteriorated Egyptian soil. hppt://www.agronomyaustraliaproceeding.org/images/sampledata/2004/poster/1/5/1112.

Moustafa, A.T.A., W.H. Ahmed, A.C. Chang, and G.J. Hoffman (1987). Influence of depth and spacing of tile drains on crop productivity in Nile Delta. Am. Soc. Agric. Eng. 30(5):1374-1377.

Muhammad, D.; B. Misri; M. EL-Nahrawy; S. Khan and A. Serkan (2014). "Egyptian Clover (*Trifolium alexandrinum*)". Food and Agriculture Organization of the United Nations Regional Office for the Near East and North Africa Cairo, 2014. ISBN 9787-108004-5-92

Muhammad, E.Sh; M.M. Ibrahim and A. Ashraf (2021). Effects of drain depth on crop yields and salinity in subsurface drainage in Nile Delta of Egypt. Ain Shams Engin. J., 12: 1595-1606.

Schott, L., A. Lagzdins, A.L.M. Daigh, K. Craft, C. Pederson, G. Brenneman, and M.J. Helmers (2017). Drainage water management effects over five years on water tables, drainage, and yields in southeast Iowa. J. Soil Water Conserv. 72(3):251–259. doi:10.2489/jswc.72.3.251.

Singh, R.; Helmers, MJ. and Qi, Z. (2006). Calibration and validation of DRAINMOD to design subsurface drainage systems for Iowa's tile landscapes. Agric Water Manag., 85 (3): 221–232.

Skaggs, R. W., Youssef, M. A., & Chescheir, G. M. (2006). Drainage design coefficients for astern United States. Agric. Water Manag., 86, 40–49. https://doi.org/10.1016/j.agwat.2006.06.007

Skaggs, R.W. and J. V. Schilfgaarde (1999). Agricultural drainage. Agron. Monogr. 38. ASA, Madison, WI.

Snedecor, G. W and W. G. Cochran (1981). Statistical methods. 7th ed. USA Iowa State University P0ress.

Tian, G.; Gitau, M.; Merwade, V.; Arnold, J and Engel, B. (2018). Comparison of performance of tile drainage routines in swat 2009 and 2012 in an extensively tile-drained watershed in the Midwest. Hydrol. Earth Sys. Sci., 22: 89–110.

Yang, Y.; Zhou, X.; Gao, Y.; Li, D.; Wang, X. and Li, Z. (2022). Factors influencing usage of subsurface drainage to improve soil desalination and cotton yield in the Tarim Basin Oasis in China. Irrig. Sci., 4: 857–871.

Yu, S.; Liu, J.; Eneji, AE.; Han, L.; Tan, L. and Liu, H. (2016). Dynamics of soil water and salinity under subsurface drainage of a coastal area with high groundwater table in spring and rainy season. Irrig. Drain., 65 (3): 360–370.

مدي تأثير مسافات الصرف المغطي علي تذبذب مستوي الماء الأرضي وعلي إنتاج محصول البرسيم شمال شرق دلتا النيل بمصر.

رانيا محمد الصامت[١]، أيمن حاكم إبراهيم سراج[٢]، مني كمال مصطفي عبد الرازق[١]

[١] قسم بحوث الصرف الحقلي- معهد بحوث الأراضي والمياة والبيئة- مركز البحوث الزراعية- الجيزة- مصر.

[٢] قسم بحوث خصوبة التربة وتغذية النبات- معهد بحوث الأراضي والمياة والبيئة- مركز البحوث الزراعية- الجيزة-مصر.

الملخص العربي

في مصر ، ترتبط المشاكل في الأجزاء الشمالية الشرقية بالمناطق المنخفضة ، والتربة الطينية الثقيلة ذات النفاذية المنخفضة ، والتربة الملحية والملحية القلوية ، وارتفاع مستوي الماء الأرضي وملوحته وبناءً علي ذلك تم إنشاء حقل تجريبي على تربة طينية ثقيلة شمال شرق الدلتا (محافظة دمياط) لدراسة تأثير مسافات الصرف المختلفة على خفض منسوب الماء الأرضي ومنع تدهور التربة وزيادة الإنتاجية لمحصول البرسيم وتمت الدراسة لثلاث مواسم نمو متتالية مع المقارنة بمعاملة الكنترول(بدون صرف مغطي). صممت التجربة على شكل قطاعات كاملة العشوائية بأربعة مكررات و كانت المعاملات عبارة عن ثلاث مسافات بين المصارف المغطاه وهي كالتالي: ١٥ م و ٣٠ م و ٦٠ م على عمق ثابت ١.٥ متر مفصولة بمناطق عازلة بالإضافة لمعاملة الكنترول مع زراعة البرسيم بكل المعاملات تحت الدراسة.

واوضحت النتائج المتحصل عليها من الدراسة زيادة واضحة فى أوزان البرسيم الطازج والجاف وحجم الجذر وأوزان الجذور الطازجة والجافة فى المعاملات المنفذ بها الصرف المغطى بصفة عامة مقارنة بالمعاملات الغير منفذ بها نظام الصرف المغطى كذلك كانت الزيادة اكبر مع تقليل المسافة بين المصارف . أيضًا ، أثرت المسافات بين المصارف على مستوي الماء الأرضي بهذا الترتيب: ١٥ م> ٣٠ م> ٦٠ م وكانت أفضل لانخفاض مستوي الماء الأرضي هي مسافة صرف ١٥ متر للثلاث مواسم. كما أكدت النتائج المتحصل عليها ان ملوحة التربة في الطبقة السطحية العلوية أقل من الطبقات العميقة في جميع المعاملات لكن ملوحة التربة انخفضت بشكل ملحوظ مع تقليل مسافات الصرف التحت السطحي. كما أظهرت النتائج أن مسافات الصرف الضيقة وفرت بيئة محصولية أفضل مع انخفاض أسرع في منسوب الماء الأرضي وانخفاض ملوحة التربة.