# IMPACT OF TILE DRAINAGE SYSTEM AND WATER QUALITY ON SOME SOIL PROPERTIES AND CROP YIELDS OF WHEAT AND MAIZE

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**ABSTRACT:**  *The current study was carried out in two successive seasons (winter 2015/2016 and summer 2016) on two areas (Mahallet Rooh and Saft Torab). Both areas belong to El-Santa District (about 13 km to Tanta, Gharbia Governorate, Egypt). This work was conducted in clay loam soils to study the feasibility of installing tile drainage at farm level and using fresh and mixed water (fresh and drainage water i.e.1:1) on some soil properties, wheat and maize productivity. Moreover, the obtained field data were used to evaluate the field drains through comparing the calculated drain spacing using Hooghoud equation with the actual drain spacing.*

*Both areas have a covered drainage system. The laterals were constructed at 1.2 m depth and 30 m drain spacing with a length varies from 250-275 m. Five feddans in each area were selected to carry out this study. Moreover, non- tiled drained areas were selected in both two areas as control areas.*

*The results of irrigation water analysis revealed that generally, both fresh and mixed water applied in this study could be used safely according to the standard guidelines of FAO (1994) which means that, using such mixed water safely can save about 50% of fresh water needed for crop water requirements. Also the results proved that, at Mahallet Rooh area where fresh irrigation water is used, the soil salinity reduced by about 30.7% as compared with the initial value in the area not provided with tile drainage, but the reduction in soil salinity was about 58.9% in the area provided with tile drainage system. The total amounts of leached salts from the top 60 cm of soil were 1850.4 and 2051.8 kg/fed for non- tiled and tiled areas of Mahllet Rooh area, respectively. Concerning Saft Torab area, where mixed water is used for irrigation, these amounts were 1222.1 and 1965.2 kg/fed for the top 60 cm of soil, respectively. The obtained results confirmed that, the tiled areas at Mahallet Rooh, where fresh irrigation water is applied, showed a relatively higher values of quickly drainable pores (QDP), slowly drainable pores (SDP) and consequently, the total drainable pores (TDP) as compared with that of Saft Torab area where mixed water is used for irrigation. On contrary, the water holding pores (I.e. fine and coarse capillary pores values) were relatively higher as compared with that of Mahallet Rooh area.  The non-tiled areas in both Mahallet Rooh and Saft Torab showed almost the same values of pore size distribution components, but the fine capillary pores value (FCP) was slightly higher for Saft Torab as compared with that obtained for Mahallet Rooh area.*

*The results showed that soil bulk density values were lower in areas provided with tile drainage either in Mahallet Rooh or Saft Torab area resulting higher total porosity values as compared with that not provided with tile drainage. The results indicate that water table levels during winter season were much deeper than that observed in summer season in both areas under this study. The tile drainage areas showed a pronounced effect on lowering water table level as compared with the areas that not provided with tile drainage system. The results indicate that using mixed irrigation water which has a relatively higher salt content caused a higher salinity of water table as compared with that of Mahallet Rooh area where fresh irrigation water is used.*

*Drain spacing is calculated according to Hooghoudt equation using the field data measurements of soil hydraulic conductivity and water table levels midway between drains. The results revealed that, using the field data the calculated drain spacing was 27 m at Mahallet Rooh area, while it was to 30 m spacing at Saft Torab. The designed values were 30 m which is almost the same as the calculated values. These results indicate to the good performance of tile drains in both areas under the study according to the field actual measurements.*

*The results revealed that, both grain and biological wheat and maize yields in drained areas and that irrigated with fresh water are higher than that obtained in non-drained areas and that irrigated with mixed water.*

*Key words: Irrigation water quality, tile drainage, mixed water, leached salts , wheat yield*

## INTRODUCTION

One of the major problems confronting irrigated agriculture, nowadays throughout the world is the decreasing availability of fresh water. In many countries and regions, fresh water is relatively scarce, but there are considerable resources of saline water, which could be utilized for irrigation if proper crops, soil and water management practices were established (Mantell *et al.,* 1985; Rhoades *et al.*, 1992; Jessica, 2014).

In Egypt, less fresh water is available for agriculture with increasing population and rapid economic growth, and saline water has been included as an important substitutable resource for fresh water in agricultural irrigation. The safe and efficient use of saline water for irrigation is to undertake appropriate practices to prevent the development of excessive soil salinization for crop production. Many factors should be considered in making management strategies, such as crops, crop cultivars, local climate, soil texture type of salt, salinity levels, irrigation method and water management practices (Ferreyra *et al.,* 1997; Shannon and Grieve, 1999; Bustan *et al.,* 2004; Genxiang *et al.,* 2017). Shalhevet (1994) and Minhas (1996) indicated that applying non-saline water in sensitive stages of plant growth and saline water in relatively tolerant stages could minimize the reduction in yield by salinity. So, the growth stage at which salinization is initiated must be taken into account. Due to the decreasing availability of fresh water to agriculture in many regions, saline water utilization in irrigation gets more and more attention. In order to facilitate the safe use of saline water for irrigation, the effects of salinity on crops should be understood, and optimal management strategies should be developed. (Wan, *et al,* 2007).

The increasing demand for water resources in the world, especially in the arid and semi-arid regions, has forced farmers to use low quality water for irrigation, such as agricultural drainage water and marginal quality ground water. Irrigation with these low quality water during the whole growing season of the crops, even the tolerant ones, does not always produce high yield. Mixing agricultural drainage water as well as low quality ground water with good quality water in ratios to keep the salinity of the irrigation water below the threshold of the target crop is an acceptable practice and is used by many scientists (Pasternak *et al.,* 1986; Suarez and Lebron, 1993; Oster, 1994; Abdel Gawad and Ghaibeh, 2001; Hamidereza *et al.,* 2018). Alternating good quality water with drainage (saline water) ; Increasing the salt tolerance of crops through plant breeding could increase the sustainability of irrigation with low quality water by reducing the need for leaching and allowing the use of poorer quality water is another management practice. Its

application is easier because it does not need reservoirs for mixing two sources of irrigation water. Moreover, some scientists, in practicing the alternating management, used the good quality water during the sensitive stages of plant growth and the poor quality river during the non-sensitive stages (Chanduvi, 1997; Pasternak and De Malach, 1993; Rhoades, 1997).

Use of poor quality waters requires three changes from standard irrigation practices: ( 1 ) selection of appropriately salt-tolerant crops; (2) improvements in water management, and in some cases, the adoption of advanced irrigation technology; and (3) maintenance of soil-physical properties to assure soil tilth and adequate soil permeability to meet crop water and leaching requirement, (Phogat *et al.,* 2018).

Increasing salts in the soil, as a result of irrigate with saline water, led to decreasing the water uptake by growing plants. If its damage effects continued along the duration of the crop growth without facing, it will extend the damage to the crop output quantitatively and qualitatively (Abou El-Defan *et al,* 2016). The key to salinity control and to irrigation sustainability is leaching (i.e. net downward movement of soil water and salt through the root zone). The net downward movement of both water and salt controls salt accumulation in the soil generates drainage water and influences drainage requirements and drainage water quality. The greater the salinity of the irrigation water, the greater the leaching, or drainage, required to maintain salinity in the soil at levels which are not toxic to crops. (Xiaobin, 2018).

One implication of the increased need for leaching as the salinity of the irrigation water increases is that soil-physical properties, must be maintained, and in some instances improved, so that the additional water required for leaching will

infiltrate and move through the soil. Since the increased levels of salinity in municipal wastewaters and agricultural drainage waters are usually associated with increased levels of sodium, there is also a need to be aware of the sodicity hazards associated with water infiltration, hydraulic conductivity, and soil tilth (Qadir *et al,* 2007). The aim of this investigation is to evaluate the drain performance and also to study the effect of tile drainage system and irrigation water quality on some soil properties and wheat crop yield.

## MATERIALS AND METHODS
## 1. Experimental field location

The current study was carried out in two successive seasons (winter 2015/2016 and summer 2016) on two areas (Mahallet Rooh and Saft Torab). Both areas belong to El-Santa District (about 13 km to Tanta, Gharbia Governorate, Egypt). The coordinates of the areas is approximately 30° 52ʹ N 31o 7ʹ E. The total area of Mahallet Rooh is approximately 3000 feddans (1260 hectare). The soil texture of both areas was clay loam. Fresh irrigation water was taken from Mahallet Rooh Canal. On the other hand, the total area of Saft Torab is approximately 2000 feddans (840 hectare). Mixed irrigation water was taken from Meet Yazeed Canal and Saft Torab open drain (ratio of mixing 1:1). Both areas have a covered drainage system. The laterals were constructed at 1.2 m depth and 30 m drain spacing with a length varies from 250-275 m. Five feddans (2.1 hectare) in each area were selected to carry out this study. Moreover, non-tiled drained areas were selected in both areas as control areas. The major cultivated crops in both areas are wheat in winter and maize and rice in summer.

## 2. Chemical and physical characteristics of the soil and irrigation water

Soil samples, which either were taken at depths of 0-30, 30-60, 60-90 and 90-120 cm, air dried, crushed, sieved through a 2 mm sieve and then kept to subjected to the different soil analyses. The samples were subjected to determine some chemical and physical properties (Table 1):

- Soil reaction (pH) in a 1:2.5 soil to water suspension and for irrigation water was measured using Becman's pH-meter, The electrical conductivity ($EC_e$) values of the soil samples were measured in soil paste extract and in irrigation water using the electrical conductivity – meter, Soluble cations and anions in soil and irrigation water according to Jackson, (1967) and page *et al.* (1982).

- Sodium adsorption ratio (SAR) value is estimated according to (USSL, 1954).

- Adjusted Sodium adsorption ratio (Adj.SAR) value is estimated and Theoretical pH of irrigation water ($pH_c$) is calculated according to Ayers and Wescot (1976).

- Residual Sodium Carbonate (RSC) = ($CO_3^-+HCO_3^-$)-($Ca^{++}$ +$Mg^{++}$) according to (Eaton, 1950).

- Saturation Index (SI) = $pH_a$ − $pH_c$ according to Wilcox (1966).

- Permeability index (PI %)  (PI % = {($Na^+$ + $\sqrt{HCO3}$) ÷ ($Ca^{++}$ + $Mg^{++}$ +$Na^+$)}*100) according to Doneen (1964).

- Mg Adsorption Ratio = (Mg) / (Ca + Mg) where ions expressed as meq.$l^{-1}$ according to FAO (1994).

- Particle size distribution was carried out by the international pipette method, Soil bulk density and Soil organic matter according to the standard methods described by Richard's (1954) and Klute (1986).

- Pore size distribution was calculated according to De Leenheer and De Boodr (1965).
- The hydraulic conductivity was determined by the Auger Hole Method (Van Beers, 1976).
- As for the hydrological measurements, a set of observation wells has been installed midway between the laterals and also in the middle of the non-drained plots to determine water table level according to the method described by (Dieleman and Trafford, 1976).

## 3. Drain spacing evaluation according to actual field measurements

Drain spacing is calculated using Hooghoudt's fourmula (Hooghoudt, 1940), as follows:

$L^2$ = (8Kdh + 4Kh$^2$) /q

Where:
    L = drain spacing (m)
    K = hydraulic conductivity (m/day)
    d = equivalent depth (m)
    h = hydraulic head (m)
    q = drain discharge rate (m/day)

## 4. Wheat and maize yields

The wheat and maize yields were determined and straw samples were dried, grounded and wet digested (Thomas *et al.,* 1967).

## RESULTS AND DISCUSSION
## 1. Irrigation water evaluation criteria

Data of irrigation water analysis applied in this study is presented in Table (2). On the other hand, to evaluate the irrigation water used in this study some parameters were estimated and presented in Table (3).

**Table (1): Some physical and chemical characteristics of the soil under investigation.**

| | Mahallet Rooh (Fresh water) | Saft Torab (Mixed water) |
|---|---|---|
| **1-Soil chemical analysis** | | |
| pH | 8.6 | 7.9 |

| | | |
|---|---|---|
| $EC_e$ (dS/m) | 4.6 | 5.3 |
| - Soluble cations (meq/l) | | |
| $Ca^{++}$ | 8.3 | 10.5 |
| $Mg^{++}$ | 4.7 | 6.3 |
| $Na^+$ | 31.4 | 36.0 |
| $K^+$ | 1.2 | 1.0 |
| - Souble anions (meq/l) | | |
| $CO_3^-$ | 0.0 | 0.0 |
| $HCO_3^{--}$ | 0.6 | 0.7 |
| $SO_4^{--}$ | 7.5 | 7.5 |
| $Cl^-$ | 37.5 | 45.6 |
| 2-Soil physical properties | | |
| Organic matter % | 0.8 | 0.9 |
| Bulk density (gm/cm³) | 1.35 | 1.35 |
| Sat.K (m/day) | 0.08 | 0.09 |
| -Particle size distribution (%) | | |
| Coarse sand % | 5.6 | 5.6 |
| Fine sand % | 17.9 | 17.4 |
| silt% | 38.5 | 39.0 |
| Clay % | 38.0 | 38.0 |
| Texture class | clay loam | clay loam |
| - Field Capacity (%) | 37.6 % | 37.7 % |
| - Wilting point (%) | 23.3 % | 23.3 % |

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**Table (2): Chemical analysis of irrigation water applied in the study.**

| | Mahallet Rooh (Fresh water) | Saft Torab (Mixed water) |
|---|---|---|
| $EC_{iw}$ ( dS/m) | 0.4 | 1.3 |
| pH | 7.3 | 7.85 |
| - Soluble cations (meq/l) | | |
| $Ca^{++}$ | 1.0 | 3.5 |
| $Mg^{++}$ | 0.8 | 1.1 |
| $Na^+$ | 1.9 | 7.5 |
| $K^+$ | 0.3 | 0.9 |
| - Souble anions (meq/l) | | |
| $CO_3^-$ | 0.0 | 0.0 |
| $HCO_3^{--}$ | 0.4 | 0.5 |
| $SO_4^{--}$ | 1.3 | 1.5 |
| $Cl^-$ | 2.3 | 11.0 |

**Table (3): Irrigation water quality criteria used in water quality evaluation**

| | Mahallet Rooh (Fresh water ) | Saft Torab (Mixed water) |
|---|---|---|
| 1- Salinity Hazard | | |
| ECiw ( dS/m) | 0.4 | 1.3 |

2- <u>Sodicity Hazard</u>

|  |  |  |  |
|---|---|---|---|
| | a- SAR | 2.0 | 4.95 |
| | b- Adj.SAR | 5.41 | 5.69 |
| | c- $pH_c$ | 7.8 | 8.25 |
| | d- Saturation Index (SI) +0.5 | | -0.4 |

3- <u>Alkalinity Hazard</u>

| | | |
|---|---|---|
| RSC | - 0.8 | - 4.1 |

4- <u>Permeability and Infiltration rate</u>

| | | |
|---|---|---|
| Permeability Index (PI) | 53% | 58% |

5- <u>Toxity Hazard</u>

| | | |
|---|---|---|
| Cl (meq/l) | 2.3 | 11.0 |
| SO4 (meq/l) | 1.3 | 1.5 |
| Boron (ppm) | 0.1 | 0.2 |
| Potential Salinity ($PS_{iw}$) | 2.95 | 11.75 |

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The results of irrigation water analysis (Table 2) and criteria used for evaluation of irrigation water (Table 3) revealed that both fresh and mixed water applied in this study can be used safely according to the standard guidelines of FAO (1994) which means that, using such mixed water safely can save about 50% of fresh water needed for crop requirements.

## 2. Effect of irrigation water quality and drainage on soil salinity and leached salts

The effect of using fresh and mixed irrigation water in areas with and without tile drainage system on soil salinity is studied. At Mahallet Rooh area where fresh irrigation water is used, the soil salinity in saturated extract expressed as ECe (dS/m) reduced from 3.9 (control salinity) to 2.7 (dS/m) which represents about 30.7% as compared to the initial value in the area not provided with tile drainage, but the reduction in soil salinity was about 58.9% in the area provided with tile drainage system. On the other hand, soil salinity at Saft Torab area where

mixed water is used ,reduced from 5.3 (control salinity) to 3.9 (dS/m) in the area not provided with tile drainage which indicates a reduction in soil salinity about 26.4% , while the reduction in soil salinity was about 47.2% in the area provided with tile drainage.

The amounts of leached salts from the soil depth 0-30 cm were 947.1 and 1059.9 kg/fed for non- tiled and tiled areas of Mahllet Rooh area where fresh water is used for irrigation, respectively. On the other hand, these amounts of leached salts from the soil depth 30-60 cm below soil surface were 903.3 and 991.9 kg/fed, respectively. Concerning Saft Torab area, where mixed water is used for irrigation, these amounts were 673.9 and 1066.4 kg/fed for the depth 0-30 cm and 548.2 and 898.7 kg/fed for the depth 30-60 cm below soil surface for non- tiled and tiled drainage areas respectively. Figure (1) illustrates the amounts of leached salts removed from the top 60 cm of the soil for both areas under this study.
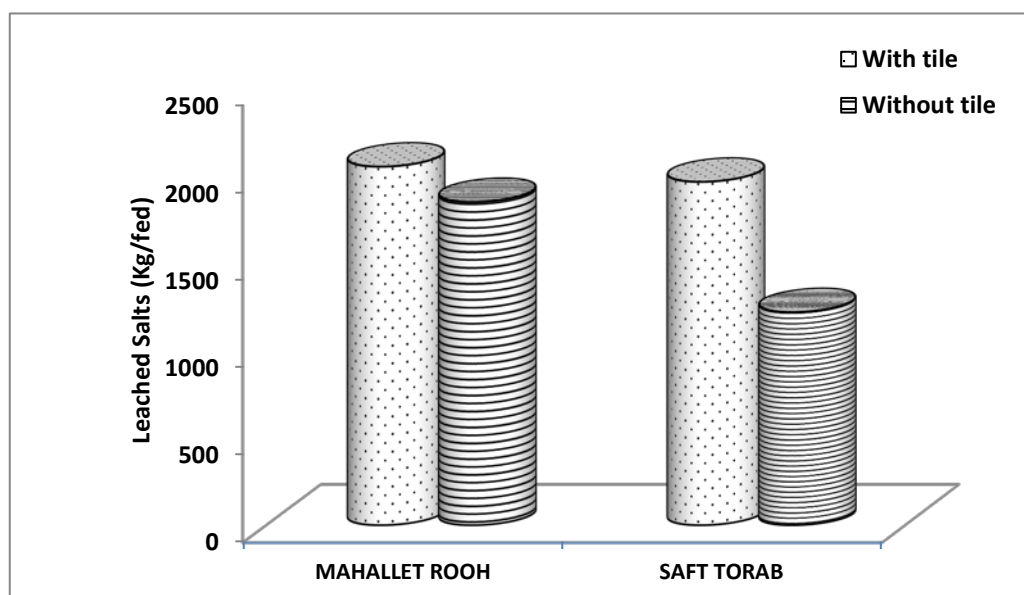
**Fig. (1):  Amounts of leached salts (kg/fed) for both areas under study.**

## 3. Effect of irrigation water quality and drainage on some physical soil properties:

### 3.1. Pore size distribution

Pore size distribution of the top 60 cm soil layer in both studied areas was estimated from the pF curves. The results indicated differences between the studied areas and between the areas that have tile drainage system and that have not provided with tile drainage as shown in Figures (2 and 3).

Generally, it can be concluded from the obtained results (Fig. 2, 3, 4 and 5) and that, the tiled areas at Mahallet Rooh, where fresh irrigation water is applied, were relatively higher in quickly drainable pores QDP (>28.8 μ), slowly drainable pores SDP (28.8-8.62 μ) and consequently the total drainable pores TDP (>8.62 μ) as compared to that of Saft Torab area where mixed water is used for irrigation (Fig. 4). On contrary, the water holding pores WHP (8.62-0.19 μ), fine capillary pores FCP (<0.19 μ) and coarse capillary pores CCP (28.8 -0.19 μ) values were relatively higher as compared to that of Mahallet Rooh area.  The non-tiled areas both in Mahallet

Rooh and Saft Torab showed almost the same values of pore size distribution components, except the fine capillary pores value (FCP) was slightly higher for Saft Torab as compared to Mahallet Rooh area (Fig. 5).

### 3.2. Soil bulk density

Soil bulk density values were estimated and illustrated in Fig. (6). The results indicated that soil bulk density values were lower in areas provided with tile drainage either in Mahallet Rooh or Saft Torab area resulting in higher total porosity values as compared to that not provided with tile drainage.

## 4. Effect of irrigation water quality and drainage on water table level and its salinity

Water table levels below soil surface were monitored and recorded during summer and winter seasons of this study, the data are illustrated in Fig. (7 and 8) for Mahallet Rooh area and Fig. (9 and 10) for Saft torab area. The results indicated that water table levels during winter season were much deeper than that observed in summer season in both studied areas.

The tile drainage areas showed a pronounced effect on lowering water table level as compared to the areas that not provided with tile drainage system.
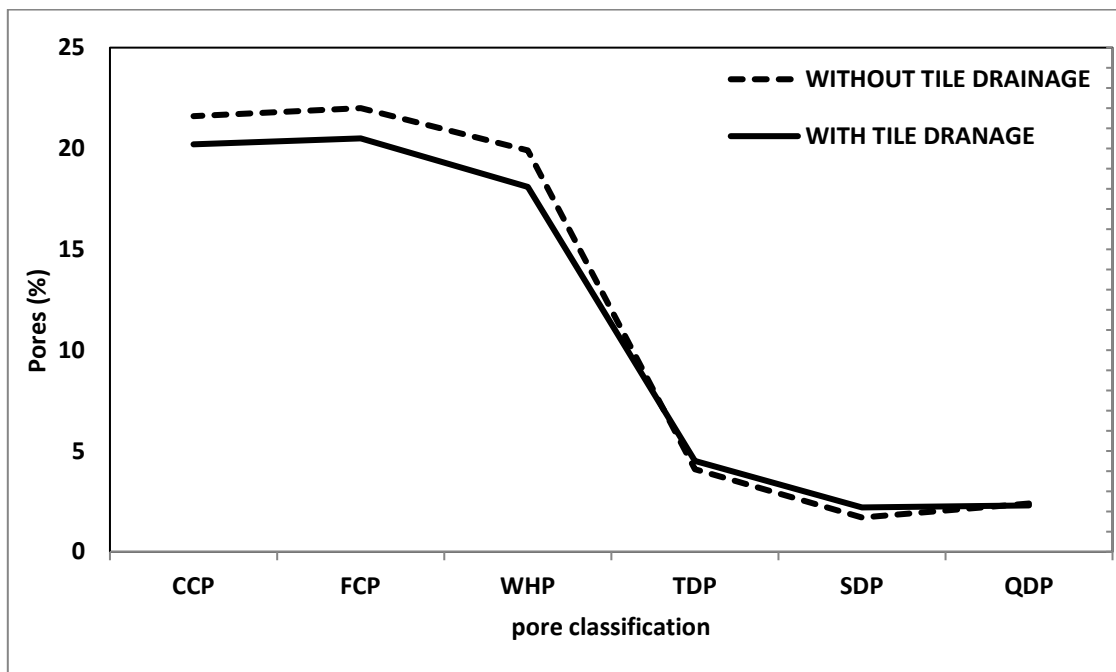


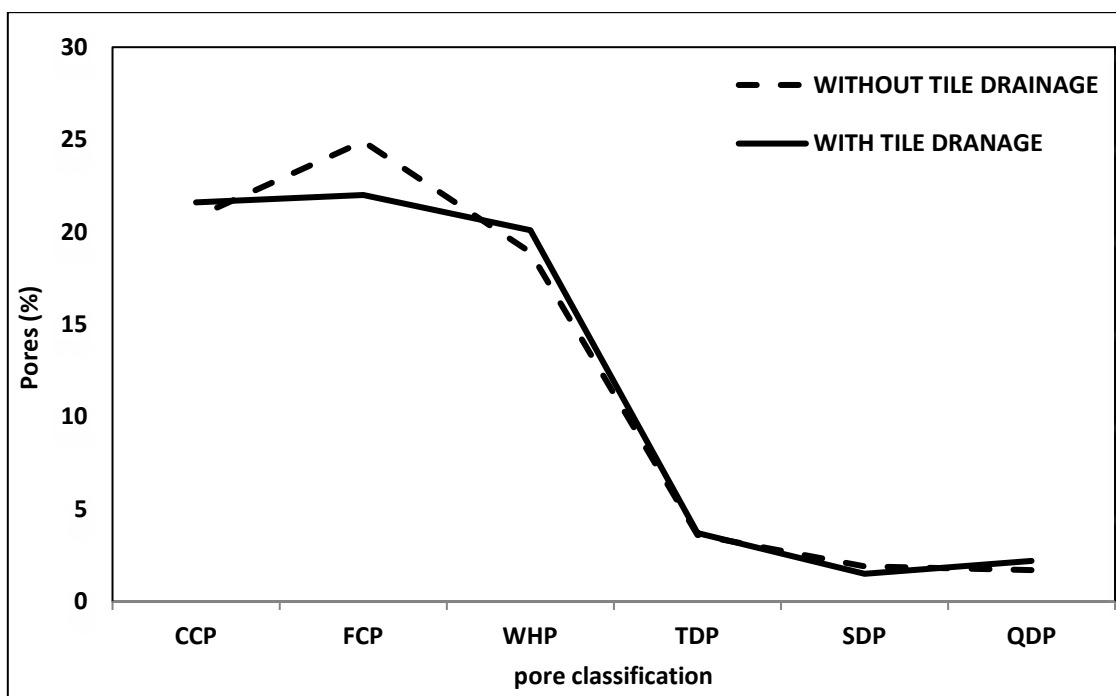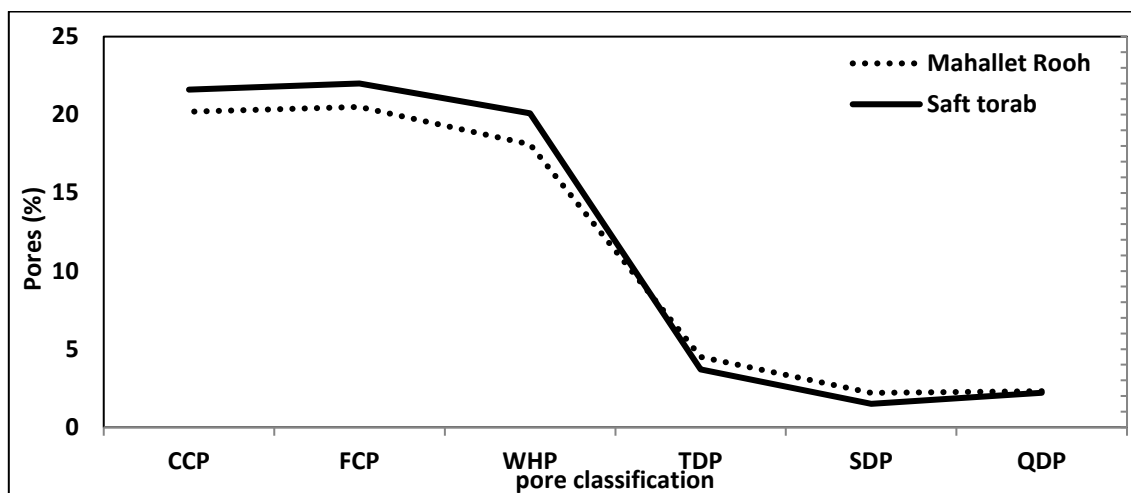**Fig. (2): Pore size distribution of Mahallet Rooh area for the top 60 cm of soil.**



**Fig. (3): Pore size distribution of Saft Torab area for the top 60 cm of soil.**

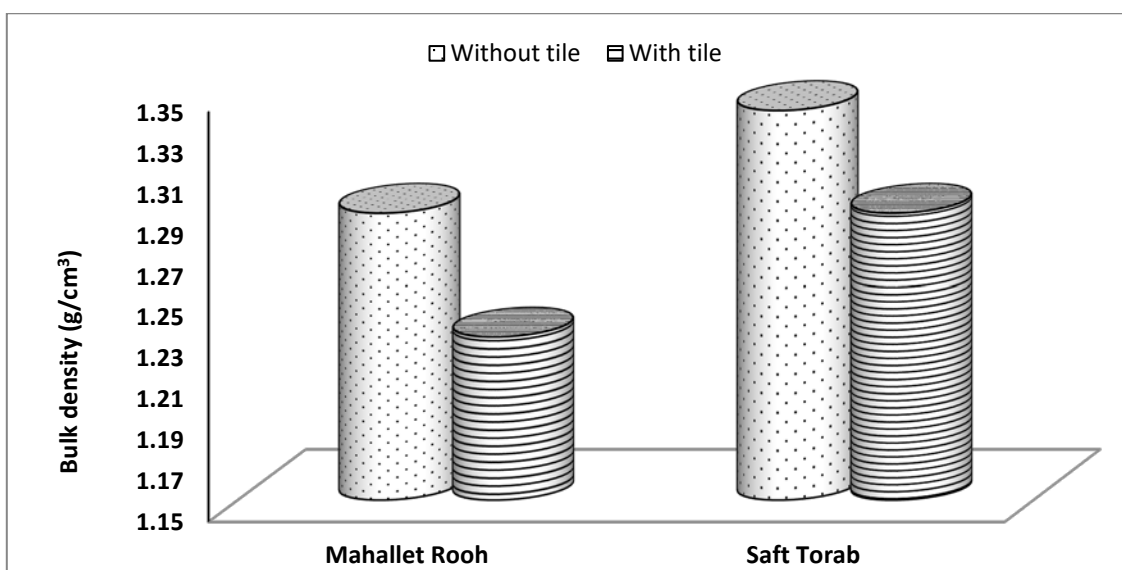**Fig. (4): Pore size distribution of tiled areas for top 60 cm of soil.**
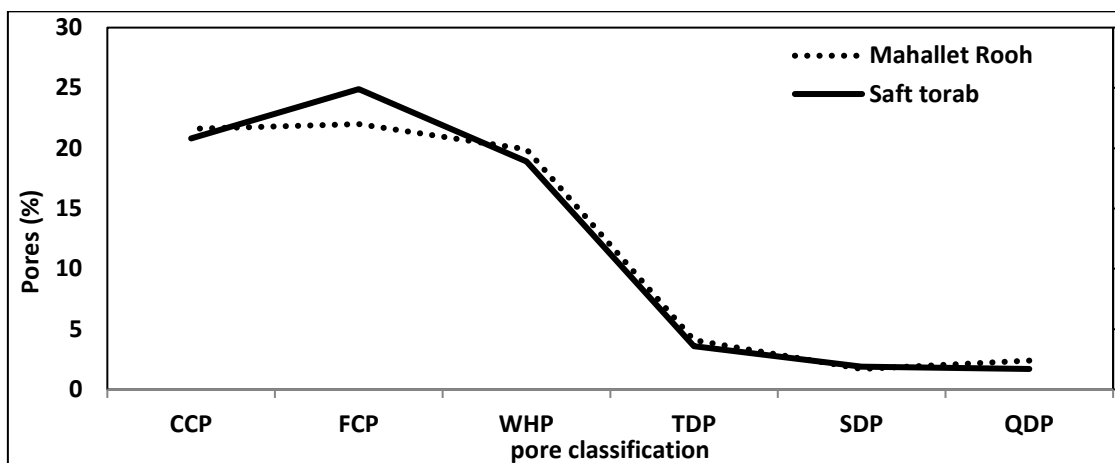


**Fig. (5): Pore size distribution of non-tiled areas for top 60 cm of soil.**



**Fig. (6): Soil bulk density (g/cm³) for tiled and non-tiled areas.**
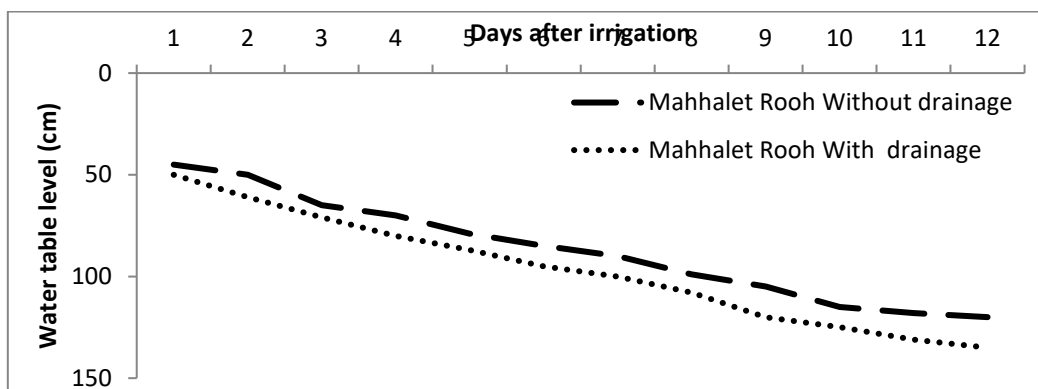
**Fig. (7): Effect of tile drainage on water table level below soil surface at Mahallet Rooh area during winter season .**
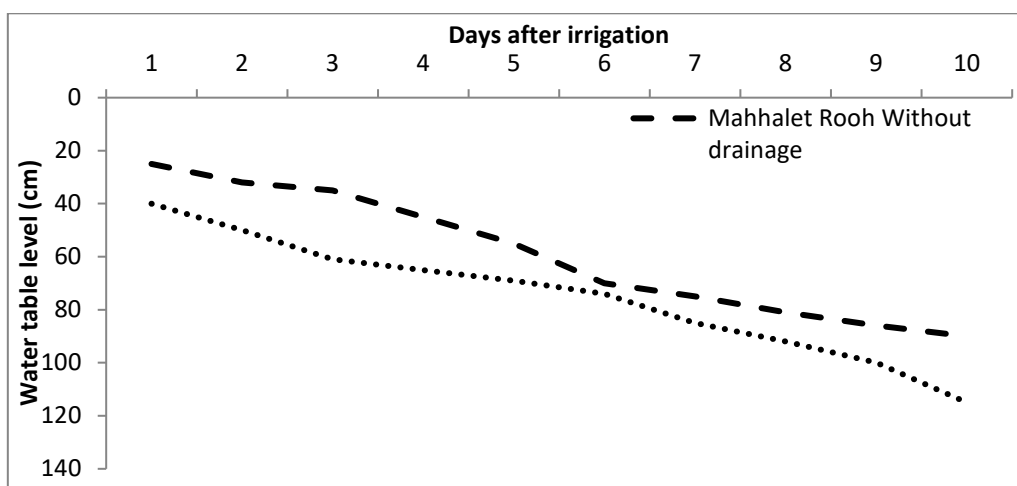


**Fig. (8): Effect of tile drainage on water table level below soil surface at Mahallet Rooh area during summer season .**
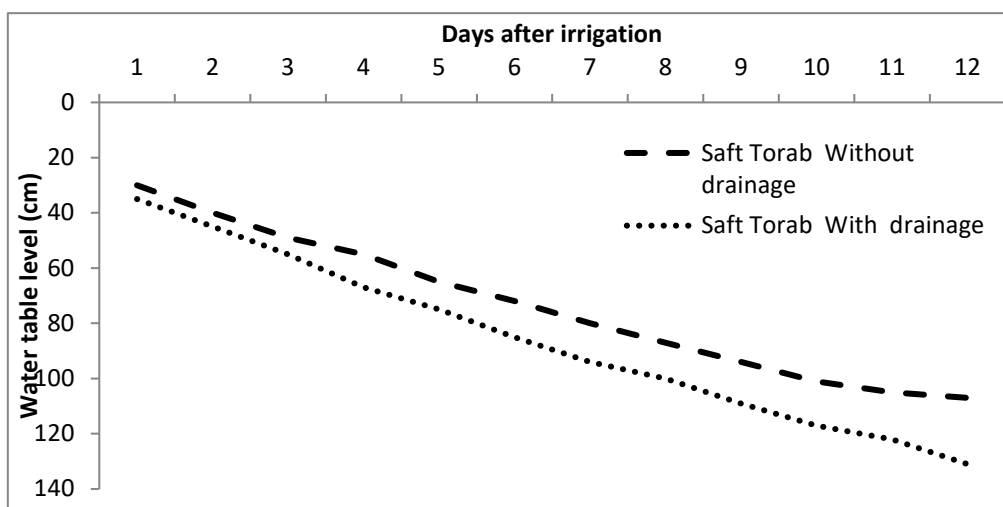


**Fig. (9): Effect of tile drainage on water table level below soil surface at Saft Torab area during winter season .**
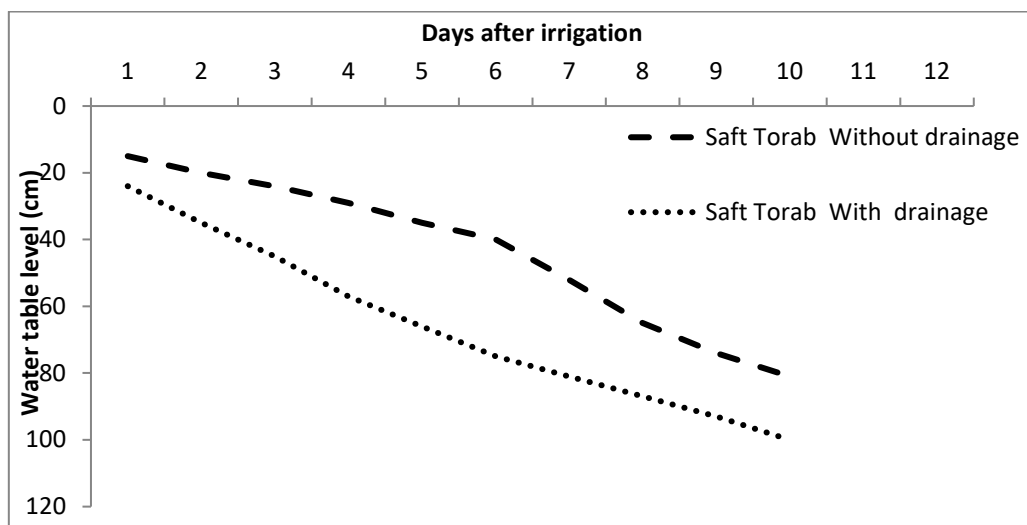
**Fig. (10): Effect of tile drainage on water table level below soil surface at Saft Torab area during summer season .**

Salinity of water table was estimated for both areas under the study. The results revealed that the average salinity of water table of Mahallet Rooh area where fresh irrigation water is used were 0.86 dS/m and 0.75 dS/m for the areas non provided and provided with tile drainage , respectively. On the other hand, the average water table salinity values of Saft Torab where mixed irrigation water is used were higher than that observed in Mahallet Rooh area, these values were 1.85 and 1.24 dS/m for the area not provided tile drainage and that provided with tile drainage system,respectively. These results indicate that using mixed irrigation water, which has a relatively higher salt content, caused a higher salinity of water table as compared to that of Mahallet Rooh area where fresh irrigation water is used.

## 5. Drain spacing evaluation according to actual field measurements

To evaluate if the applied drain spacing fulfills the actual field conditions, drain spacing is calculated according to Hooghoudt equation using the field data measurements of soil hydraulic conductivity and water table levels midway between drains. The results revealed that using the field data the calculated drain spacing is 27 m at Mahallet Rooh area, while it was to 30 m spacing at Saft Torab. The designed values were 30 m which is almost the same as the calculated values. These results indicate to the good performance of tile drains in both areas under the study according to the field actual measurements.

## 6. Effect of irrigation water quality and drainage on wheat and maize yields

The effect of using fresh and mixed irrigation water in drained and non-drained areas under the study on both grain and biological wheat and maize yields are monitored. The results are illustrated in Figures (11 and 12) for wheat yield whereas; Figures (13 and 14) illustrated the results of maize yield.

The results revealed that in general, both grain and biological wheat and maize yields in drained areas and that irrigated with fresh water are higher than that obtained in non-drained areas and that irrigated with mixed water.
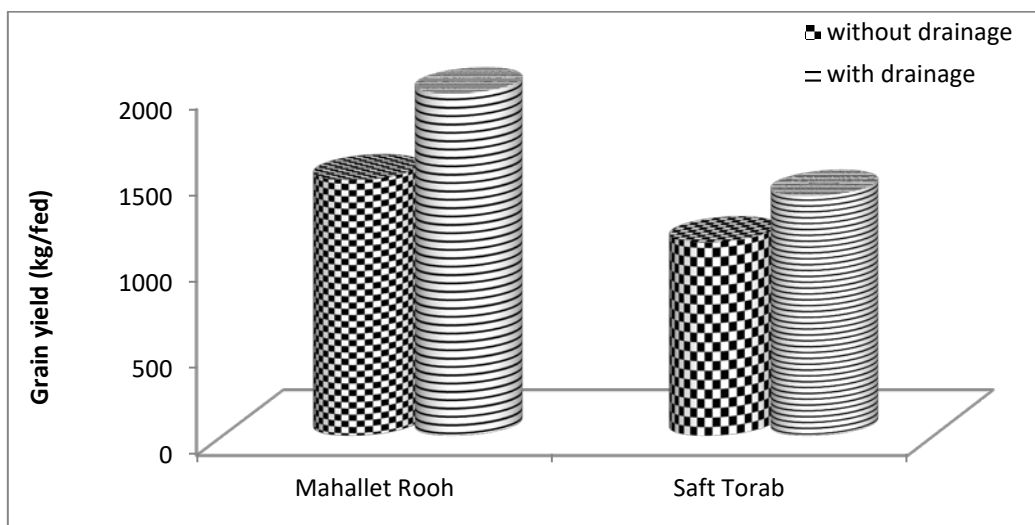
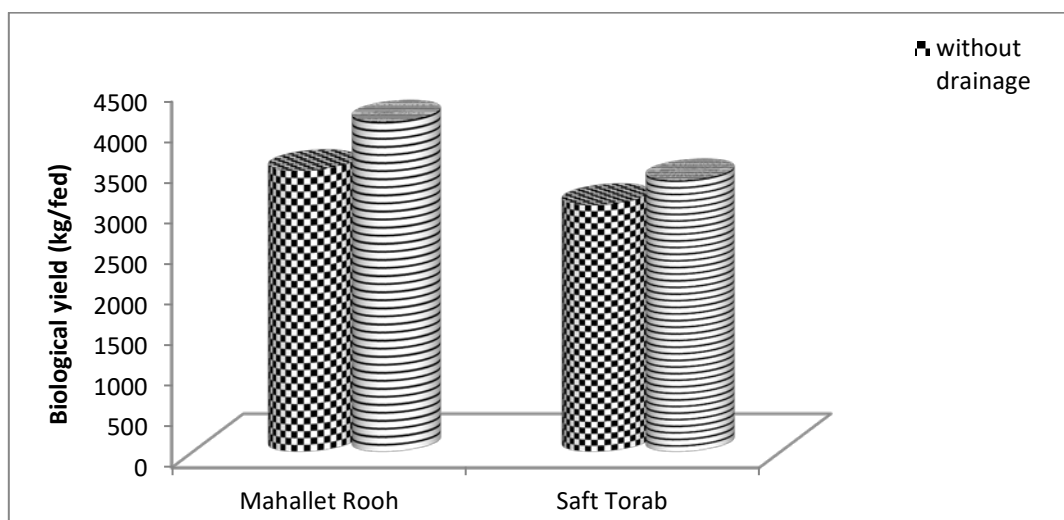**Fig. (11): Effect of tile drainage and irrigation water quality on wheat grain yield.**



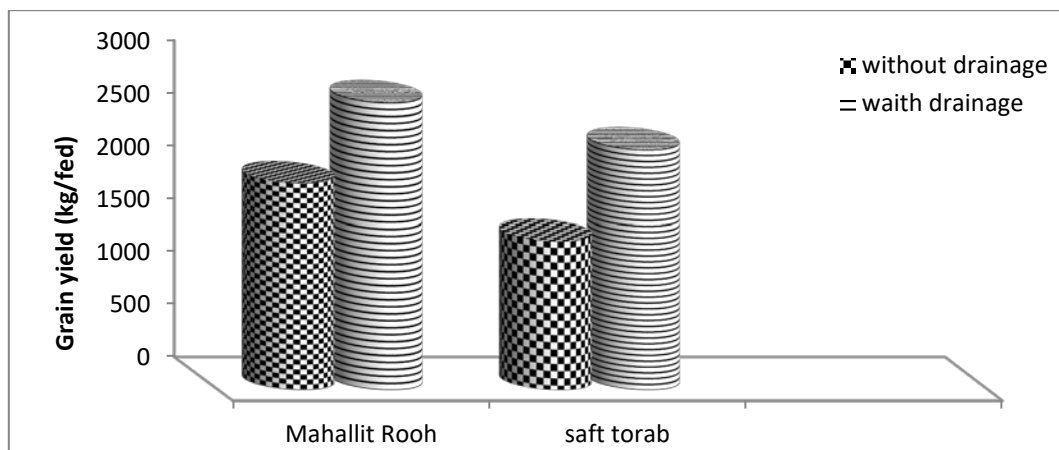**Fig. (12): Effect of tile drainage and irrigation water quality on biological yield of wheat.**



**Fig. (13): Effect of tile drainage and irrigation water quality on maize grain yield.**
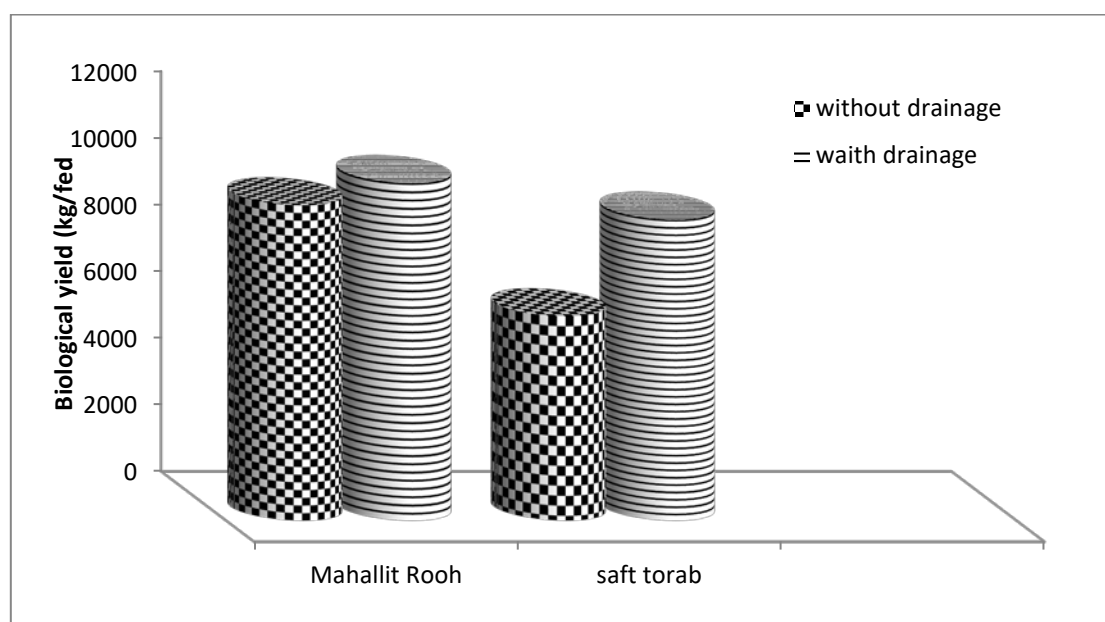
**Fig. (14): Effect of tile drainage and irrigation water quality on biological yield of maize.**

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# تأثير الصرف المغطى ونوعية المياه المستخدمة فى الرى على بعض خواص التربة ومحصولى القمح والذرة

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## الملخص العربى

أجريت هذه الدراسة على مناطق ارض طينية طمبية لمعرفة تأثير تنفيذ شبكة الصرف المغطى على مستوى الحقل مع استخدام مياه رى عذبة واخرى مخلوطة بمياه الصرف الزراعى بنسبة خلط ١:١ على بعض خواص التربة ومحصول القمح(٢٠١٥/٢٠١٦) والذرة (٢٠١٦). بالاضافة الى ذلك ، فقد تم استخدام النتائج الحقلية المتحصل عليها لتقييم مدى مطابقة المسافة بين الحقليات المنفذة فعليا ومقارنتها بالقيم المحسوبة من القياسات الحقلية وذلك بهدف معرفة مدى كفاءة عمل شبكة الصرف الحقلية الموجودة .

ولإجراء هذه الدراسة تم اختيار منطقتى محلة روح وصفت تراب والتابعتين لمركز السنطة بمحافظة الغربية ، حيث يتم استخدام مياه عذبة للرى من خلال ترعة محلة روح فى منطقة محلة روح ، بينما فى منطقة صفت تراب يتم خلط مياه الرى العذبة من ترعه ميت يزيد بمياه الصرف الموجودة بمصرف صفت تراب المكشوف بنسبة خلط ١:١، والمنطقتان منفذ بهما شبكة صرف مغطى حيث عمق الحقليات ١,٢ م والمسافة بين الحقليات ٣٠ م ويتراوح طول الحقليات بين ٢٥٠-٢٧٥ م . وقد تم اختيار ٥ أفدنة فى كل منطقة لاجراء الدراسة كما تم اختيار مساحة مماثلة بكلتا المنطقتين غير منفذ بها شبكة صرف مغطى للمقارنة.

وقد اشارت النتائج المتحصل عليها من خلال التحليل الكيميائى لمياه الرى المستخدمة فى كلا المنطقتين أن كلا من المياه العذبة والمياه المخلوطة بمياه الصرف بنسبة ١:١ يمكن استخدامهما بأمان دون أى مشاكل تذكر طبقا للمعايير الدولية المتبعة فى تقييم صلاحية المياه للرى والتى تطبقها منظمة الاغذية والزراعة –الفاو (FAO,1994) وهذا يعنى انه يمكن استخدام المياه المخلوطة بمياه الصرف الزراعى بنسبة ١:١ فى مثل هذه المناطق دون حدوث مشاكل من استخدامها مما يشكل اهمية كبرى حيث ان هذا يعنى امكانية توفير ٥٠% من الاحتياجات المائية للمحاصيل من المياه العذبة فى ظل ندرة المياه وازمة المياه التى تعانيها البلاد فى الوقت الحالى .

كما اثبتت النتائج ايضا انخفاض ملوحةالتربة بنسبة ٣٠,٧% فى منطقة محلة روح –والغير منفذ بها شبكة الصرف المغطى وحيث الرى بمياه عذبه – مقارنة بالملوحة الابتدائية للتربة، بينما وصل الانخفاض فى الملوحة لنسبة ٥٨,٩% فى المنطقة المنفذ بها شبكة صرف مغطى بنفس المنطقة .

وبحساب كميات الاملاح المزالة من الـ ٦٠ سم السطحية من التربة وجد انها ١٨٥٠,٤ ، ٢٠٥١,٨ كجم/فدان بمنطقة محلة روح على التوالى بينما فى منطقة صفت تراب حيث تستخدم مياه رى مخلوطة بنسبة ١:١ كانت هذه الكميات ١٢٢٢,١ ، ١٩٦٥,٢ كجم /فدان للمنطقة الغير مزودة بصرف والمزودة بصرف مغطى على التوالى.

كما اكدت النتائج الارتفاع النسبى لكلا من قيم مسام الصرف السريعه QDP ومسام الصرف البطيئة SDP وبالتالى مسام الصرف الكلية TDP فى منطقة محلة روح المنفذ بها شبكة الصرف المغطى والمستخدم فيها مياه عذبة فى الرى مقارنة بتلك المتحصل عليها فى منطقة صفت تراب المنفذ بها شبكة الصرف المغطى والمستخدم فيها مياه خلط فى الرى ، وعلى العكس لوحظ الارتفاع النسبى لقيم WHP والمسام الشعرية سواء الدقيقة او الخشنة فى منطقة صفت تراب

مقارنة بتلك المتحصل عليها بمنطقة محلة روح. كما لوحظ ان قيم التوزيع الحجمى للمسام فى المنطقتين الغير مزودتين بشبكة الصرف المغطى سواء فى منطقة محلة روح او صفت تراب متقاربة ، ولكن قيم المسام الشعرية الدقيقة FCP كانت اعلى نسبيا فى صفت تراب مقارنة بتلك فى محلة روح.

كما اشارت النتائج بصفة عامة انخفاض قيم الكثافة الظاهرية فى المناطق الغير مزودة بشبكة الصرف المغطى بالمنطقتين تحت الدراسة مقارنة بتلك المنفذ بها شبكة الصرف المغطى وذلك نتيجة ارتفاع المسامية الكلية.

وفيما يتعلق بمستوى وملوحة الماء الارضى فقد اثبتت النتائج انخفاض مستوى الماء الارضى بصفة عامة خلال الموسم الشتوى مقارنة بالموسم الصيفى بالمنطقتين. ولوحظ حدوث انخفاض ملحوظ فى منسوب الماء الارضى فى الاراضى المنفذ بها شبكة صرف مغطى مقارنة بتلك الغير منفذ بها . كما بينت النتائج ارتفاع ملوحة المياه الارضية نسبيا مع استخدام مياه الخلط.

وقد تم استخدام القياسات الحقلية المتحصل عليها (نفاذية التربة – مستوى الماء الارضى فى منتصف المسافة بين الحقليات) لحساب المسافة بين المصارف باستخدام معادلة هوخ-هاودت. واشارت النتائج ان قيمة المسافة بين الحقليات المحسوبة ٢٧ م بمنطقة محلة روح بينما كانت ٣٠ م فى منطقة صفت تراب . وبمقارنة هذه القيم بالقيمة التصميمية المنفذة (٣٠ م) نجد انها تقريبا متطابقة مع تلك المتحصل عليها من القياسات الحقلية مما يشير الى كفاءة عمل شبكة الصرف .

وقد اكدت النتائج ان انتاجية محصولي القمح والذرة كانت اعلى فى المناطق المزوده بشبكة الصرف المغطى والتى تروى بمياه عذبة مقارنة بتلك التى لم تزود بشبكة صرف مغطى او تروى بمياه خلط.

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