Effect of sprinkler irrigation and soil amendments on soil properties in El-Kawamel farm – Sohag "case study"

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ABSTRACT

In the Western desert, on border of the Nile valley at Sohag, soil of El-Kawamel farm – Sohag University is a newly reclaimed sandy soil. The farm is about 150 feddans cultivated partially with field crops such as wheat and clover after spreading 20 – 30 cm of dredged clay materials and organic farmyard manure on the soil surface as soil amendment. Irrigated with sprinkler irrigation system with fixed sprinklers at 10 X 9 m. the present study was proposed to evaluate the effect of the sprinkler irrigation methods and adding the soil amendments on improving the soil physical and chemical properties as well as the soil fertility after 10 years of cultivation " a case study ".

The results showed that applying the sprinkling irrigation method and adding the dredged clay materials led to leaching the salts from the soil as compared to uncultivated control areas, increased the soil fertility (N, P, K, Fe, Mn, Zn and Cu) and improved the soil water holding capacity as compared to uncultivated control soil. All tested measurements were presented by GIS maps and statistically analyzed.

INTRODUCTION

Most of the newly reclaimed areas in Egypt reside in the arid or semi arid conditions, where shortage of water, unfavorable soil properties and nutrient deficiencies in the soil are the main problems facing the agricultural production. The area under study is the newly reclaimed farm of Sohag University in Elkawamel area which is a part of the western desert located in the desert sandy calcareous land between the west bank of the Nile and the western limestone plateau about 15 Km south west of Sohag city. In 1999 the farm was initiated and three artesian wells were digged for irrigation. The water salinity of these wells was 1.8 dSm^{-1} . The soil of the new area varied from low to highly saline. Irrigation was modified to use agricultural drainage water of 0.9 dSm^{-1} in the same time Nile River water of 0.3 dSm^{-1} was introduced as an alternate irrigation source when it is available in the near canal.

Field crops were cultivated in the soil after spreading a layer of the dredged clay materials and were irrigated with sprinkler irrigation system.

The objectives of the study were to evaluate:

1- The effect of sprinkler irrigation on salts leaching and the effect of soil amendments application on improving soil properties.

2- The fertility of soil after 10 years of cultivation as compared with the uncultivated area around the farm

MATERIALS AND METHODS

Elkawamel farm, Sohag University is located at south west of Sohag city between 26°.28`.14`` & 26°.28`.22`` N and 31°.40`.35`` &31°.39`.43`` E (Fig 1) .The farm was cultivated partially with field crops such as wheat and clover (Fig 2). Irrigated with sprinkler irrigation by either ground water (EC = 1.8 dS/m) or agricultural drainage water (EC = 0.9 dS/m) or Nile water (EC = 0.3 dS/m).

In 2000 part of the farm was supplied with fixed sprinkler irrigation system at 10 m x 9 m for growing field crops. The sprinkler was ¾ inch diameter of 0.7-1.0m^3/h discharge, fixed in the top of ¾ inch riser pipe. The working pressure was 1.5-2.5 bar. Each 30 sprinkler (27 m^3) were controlled with one valve.

A layer of about 30cm of dredged clay materials from the irrigation canals has been added to the surface as a soil amendment to improve the physical and chemical properties. Organic farmyard manure was spread on the soil surface at the beginning of cultivation to improve soil fertility.

2- Soil sampling:-

The area of the farm was sampled in 1999 to draw the salinity map of the farm. Total of 29 soil profiles were sampled at three depths (0 – 75 cm) and analyzed for EC_e . The results were drawn by GIS (Arcview, 9.1) and presented in Fig (4).

In 2009 forteen profiles were digged and sampled from sprinkling irrigated sections namely, 2, 3,5,6,7,8,9,10,11 and 12 at four depths (0 – 100 cm) under sprinkler and in the middle between four sprinklers. Four profiles were digged in the uncultivated border around as control (Fig 2). All soil samples were air dried, crushed, sieved by a 2mm sieve and

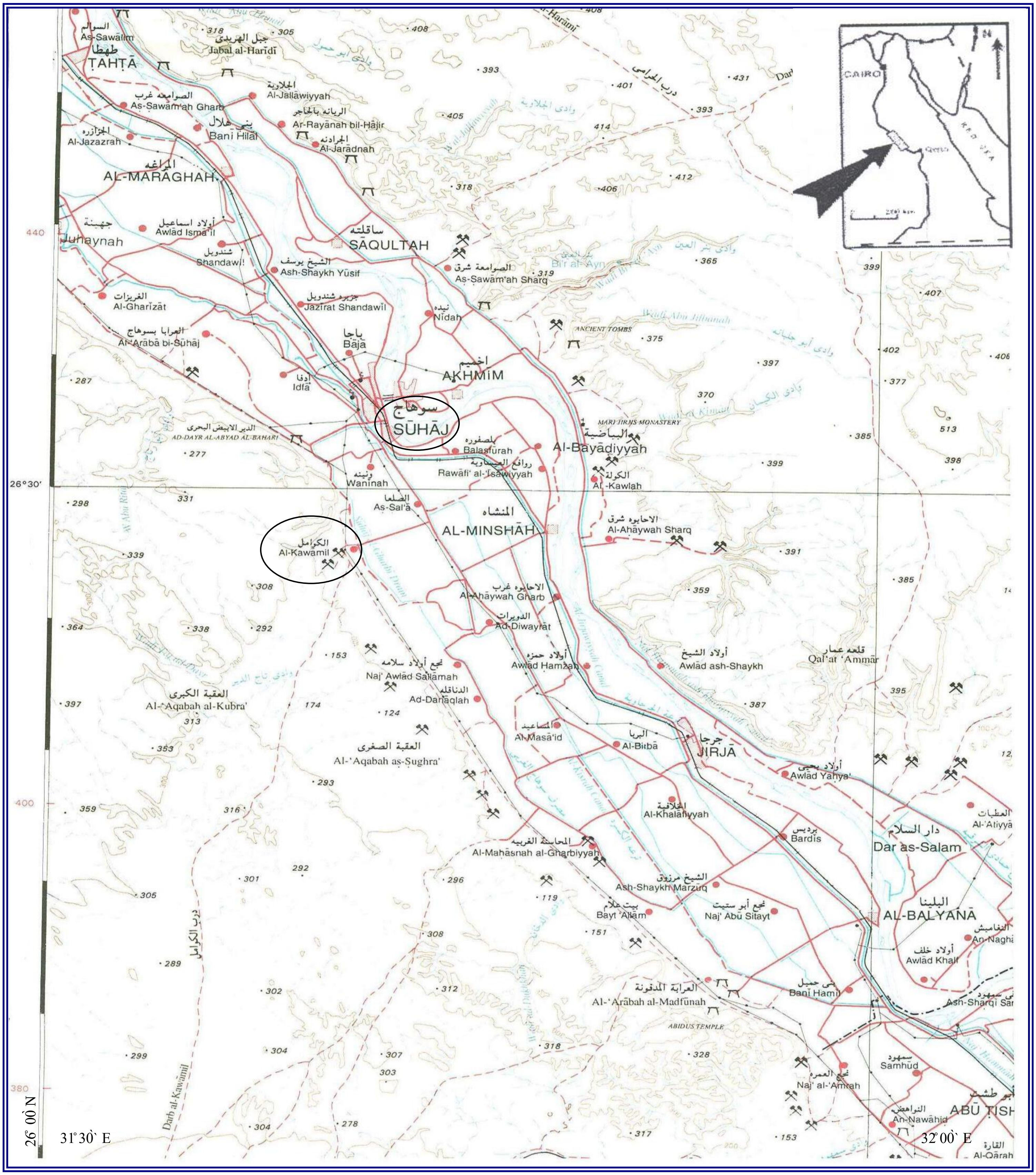


Fig. (1): Map of Sohag Governorate showing El-Kawamel area (the experimental site).

stored in plastic containers for analysis. The weight of the coarser fractions was recorded to measure the gravel percentage.

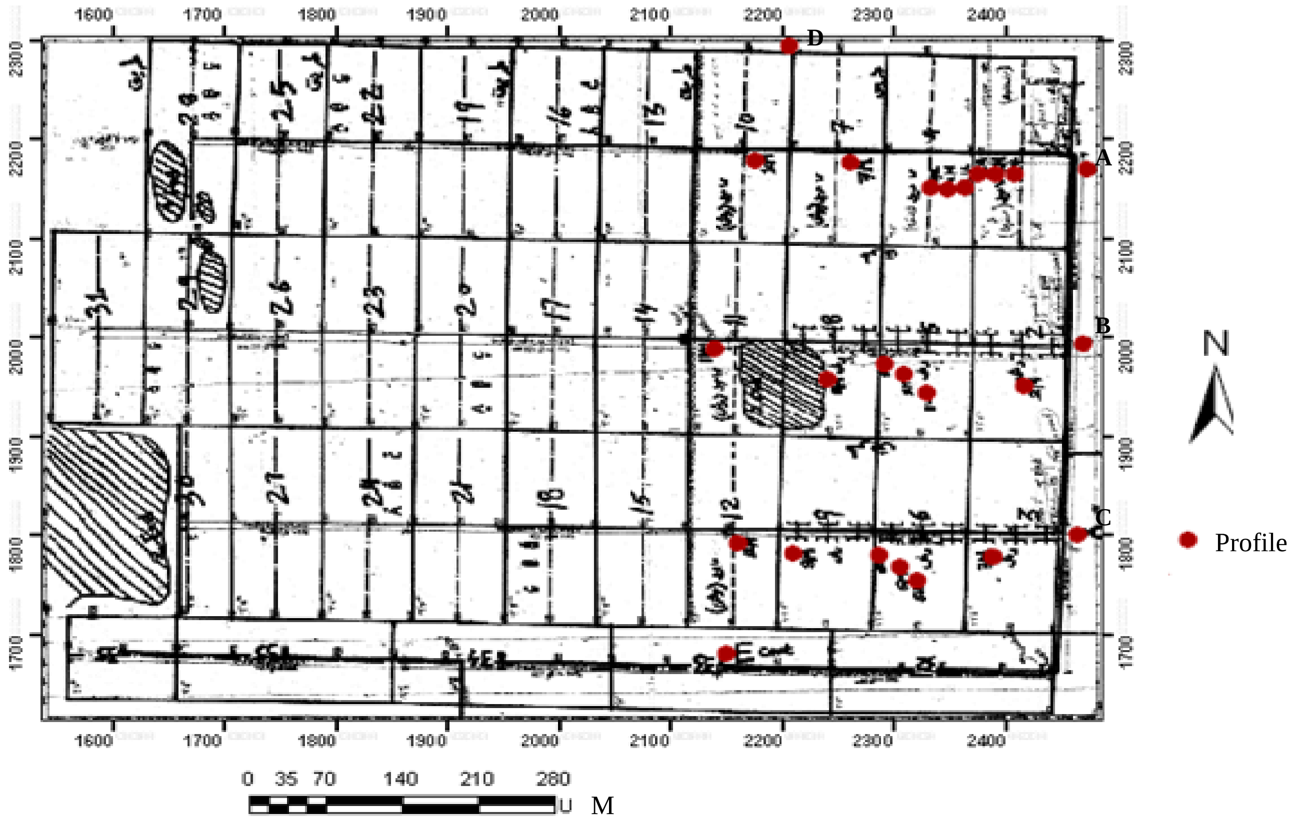


Fig. (2): El-Kawamel farm map.

3- Soil physical and chemical analysis:-

Mechanical analysis was carried out using the pipette method (Piper, 1950). **Soil pH**$_{1:1}$ was measured by pH meter using a glass electrode (Orion model 410A) (Jackson, 1967). **Total calcium carbonate content** was estimated volumetrically using the calibrated Collin's Calcimeter method. **Soil organic matter** was determined using the modified Walkley and Black method (**Jackson**, 1973). **The electrical conductivity** of the soil paste extract (EC_e) was measured using electrical conductivity meter (Orion model 150) (Jackson, 1973).Soluble anions and cations were measured in the saturated soil paste extract according to Jackson, 1973. **Total nitrogen** content was measured by the modified Kjeldahl procedure according to **Jackson (1973)**. **Available phosphorus** was extracted by 0.5 M $NaHCO_3$ at pH 8.5 (**Olsen et al., 1954**) and measured colorimetrically. **Exchangeable potassium** was extracted by 1N NH_4 OAc at pH 7.0 as described by **Jackson (1973).**

Available micronutrients Fe, Mn, Zn ,and Cu were extracted by 0.005M DTPA at pH 7.3 according to **Lindsay and Norvell(1969)** and measured using ICP mass Spectrometer (iCAP 6000 Series – Thermo Fisher Scientific company) . The obtained data were statistically analyzed for the various statistical parameters and graphic presentations using the SPSS 16 for windows 7 computer program. The results of soil properties were drawn using the GIS (Arcview, 9.1).

RESULTS AND DISCUSSION

1- Effect of Sprinkler irrigation and application of soil amendments on soil physical properties :

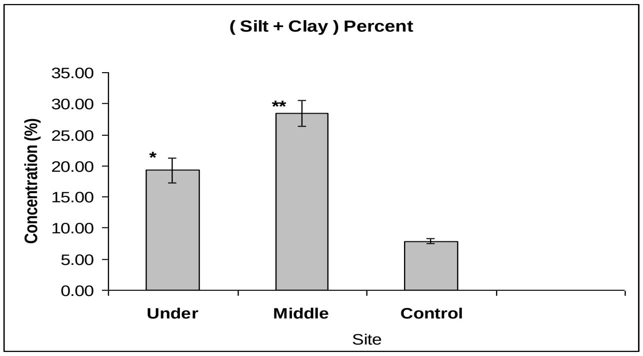
1-1-Fine Particles Percentage (% Silt + Clay):

To evaluate the soil development with a clear measure, (Silt + Clay) percentage was considered as a measure. Since the alluvial dredged clay materials were added to the surface layer, it caused high significant increases in the fine particles percentage of the surface soil (Table 1 & Fig 3). The average of fine particles percentage increased from 7.88% in the control soil to 19.29 - 28.49% in the area received amendments (Table 1 & Fig 3).

In the three subsurface layers, the average of fine particles percentage increased but not significantly from 7.98% in the control soil to 10.25 - 10.43% in the areas received amendments (Table 1 & Fig 3). The poor values of fine particles percentage in the control soil reflect the sand texture of the original soil of the western desert.

1-2- Maximum Water Holding Capacity (SP):

Application of alluvial dredged clay materials to the sandy soil of El-Kawamel farm increased the water holding capacity (SP) markedly (Table 1and Fig 3).



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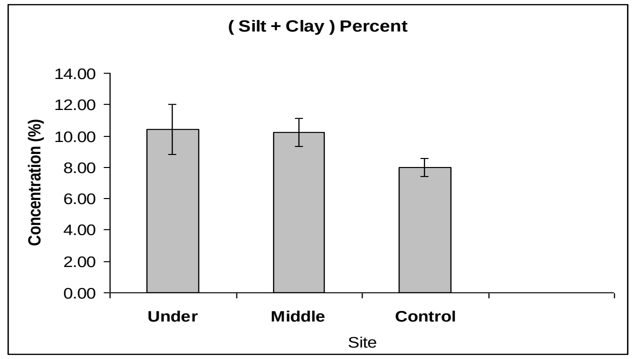

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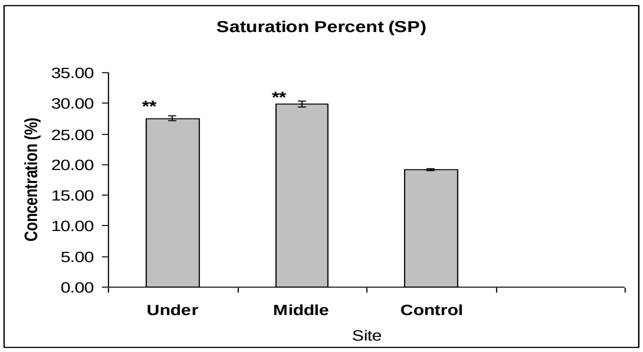

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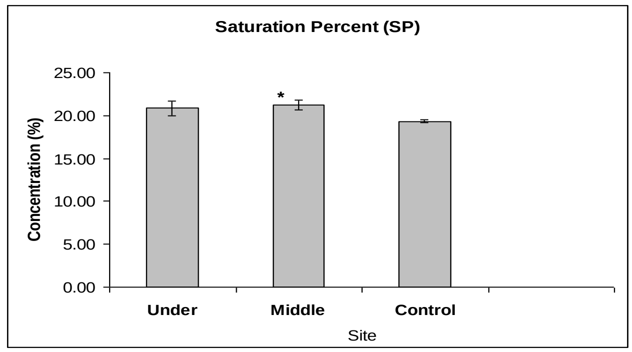

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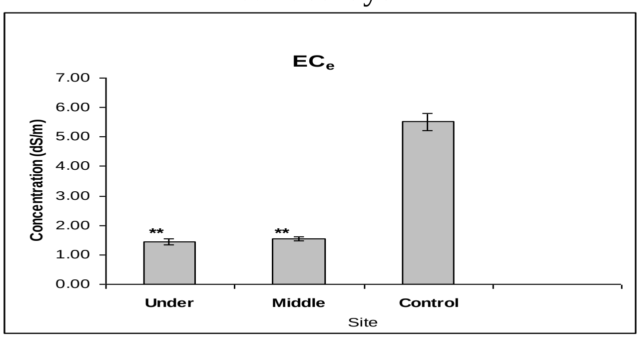

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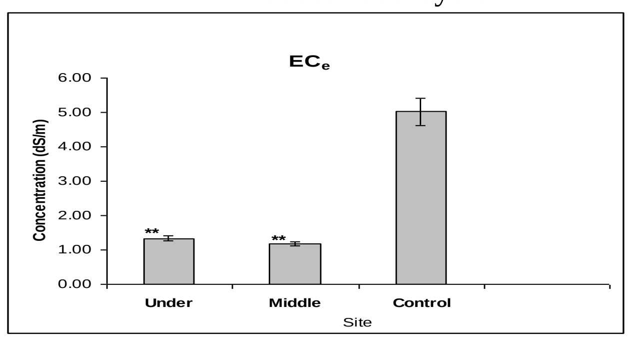

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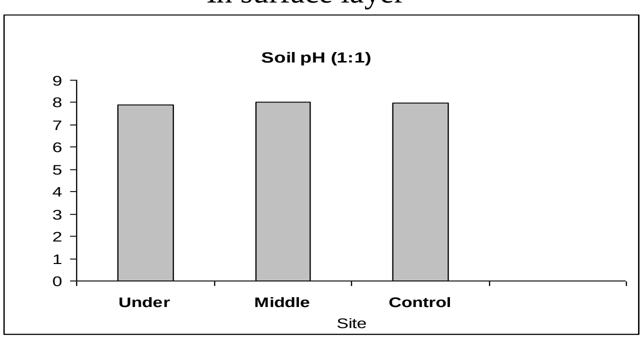

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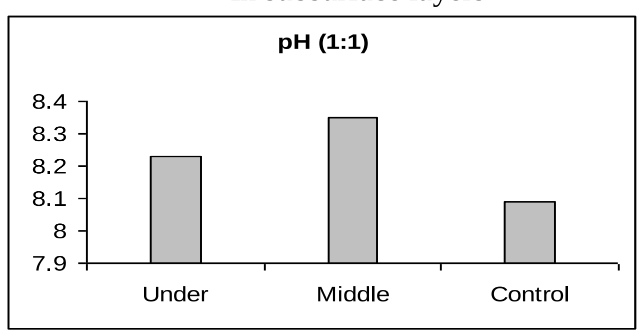


In subsurface layers

Fig(3):The mean and significance of the % fine particles, SP, EC_e and pH in the surface and sub surface layers of studied soil profiles in sprinkler irrigated crops area under sprinklers (at 0.5m), in the middle between sprinklers and control .

The average of SP value increased in the surface layer from 19.2% in the control soil to 27.55 - 29.89% for the amended area (Table 1, Fig 3). These increases were highly significant, which may be due to adding the clay materials and organic residues on the surface layer of soil which in good agreement with those obtained by **Nobel, et al. 2000 and Howard, 2008.** However there were no changes in the in the average of the SP values of the three subsurface layers, Since the value of SP was 19.33% for the control soil and 20.85 - 21.23% in the subsurface layers of the amended area (Table 1, Fig 3).

2- Effect of Sprinkler irrigation and application of soil amendments on the soil chemical properties:

2-1- The EC_e of the soil:

The EC_e of the soil under sprinkler irrigation system was changed greatly as result of sprinkler irrigation comparing with the control soil without irrigation either in the surface or in the sub surface layers of soil (Table 1, Fig 3).

The reduction in the average of EC_e value was from 5.51 dS/m in the control soil to average of 1.45 and 1.55 dS/m in the surface layer under the sprinkler and in the middle between sprinklers respectively (Table 1 , Fig 4). And from 5.03 dS/m in the control soil to average of 1.34 and 1.18 dS/m in the next three sub surface layers under the sprinkler and in the middle between sprinklers respectively (Table 1 , Fig 3). These differences were highly significant. It is noticeable that the surface layer had a slight non significant higher EC_e than the subsurface layers which may be due to the added the alluvial dredged clay materials which maintain salts.

The results of ECe values were drawn using GIS program (Arc View 9). The original EC_e of the farm before cultivation (in 1999) were presented in Fig (4).

In 1999, the EC_e values of the uncultivated surface layer ranged from 5.2 to 10.6 dS/m for the surface layer (0-25 cm) and from 2.6 to 13.5 dS/m in the sub surface layer of (25-50 cm). However the bottom layer of (50-75 cm), the EC_e ranged from 5.8 to 53.6 dS/m. These EC_e values are either saline or very highly saline according to the salinity classification **(Metson, 1961)** (Table 2).

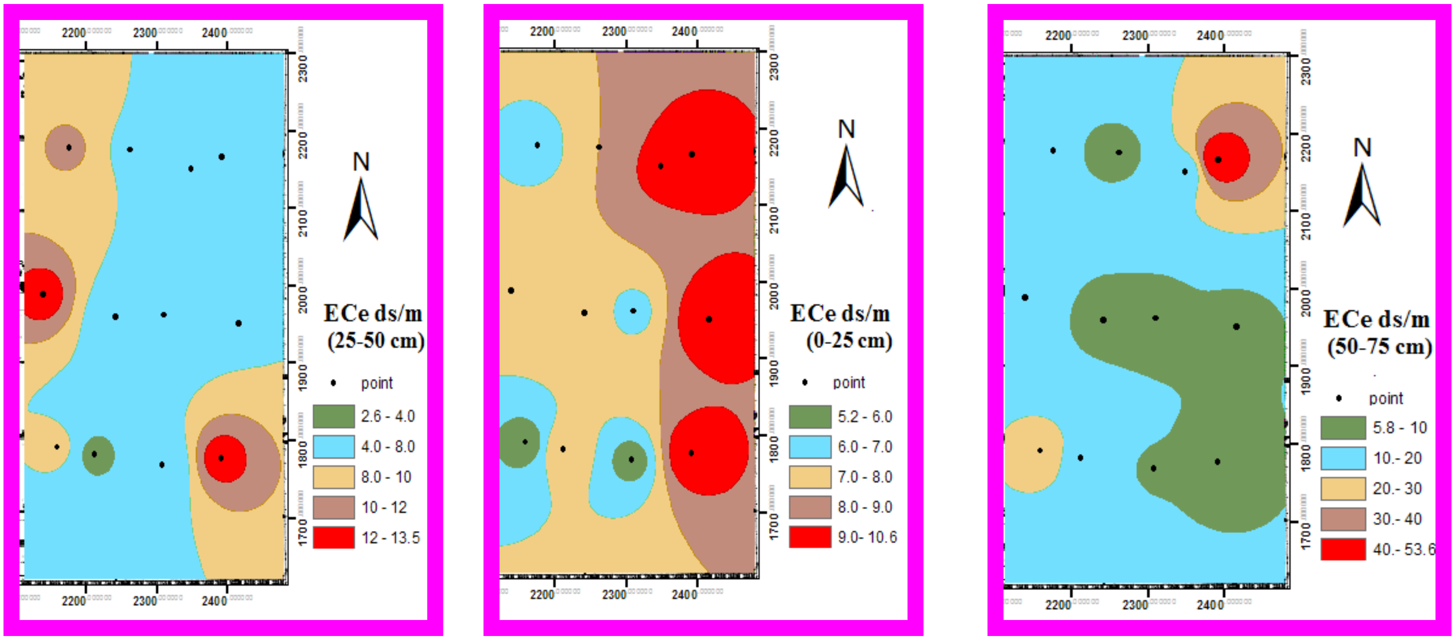


Fig. (4): GIS maps show the distribution of soluble salts in the layers of soil profiles in the study area before cultivation as a control maps.

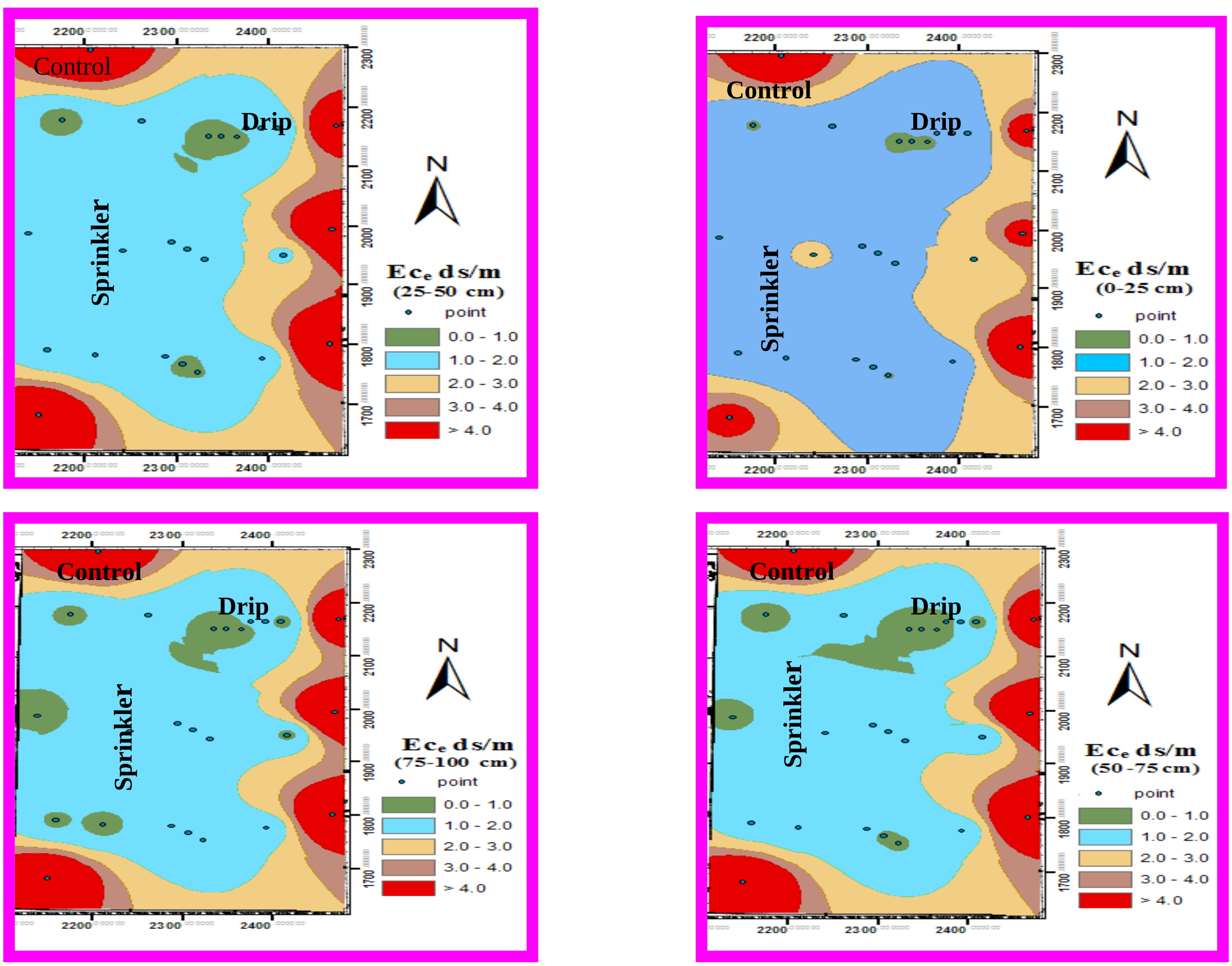


Fig. (5): GIS maps showing the distribution of salts in the layers of soil profiles in the sprinkler irrigated crop area and uncultivated control profiles around the farm after cultivation.

After sprinkling irrigation for 10 years, the EC_e in the four layers (Fig 5) ranged from 0 to 2 dS/m which consider a good advantage of sprinkler irrigation. This result was obtained due to the good infiltration of the gravely soil profiles which encouraged the salt leaching from the soil. Similar results were obtained with **Abdel-Razek et al., 1992.**

The EC_e values in the in the uncultivated circumference of the farm (control soil) was ranged from 4 to 6.6 dS/m of all layers. These results consider the best advantages of applying sprinkler irrigation which leached salts from the soil and turn it to high productive soil.

2-2- Soil pH $_{(1:1)}$:

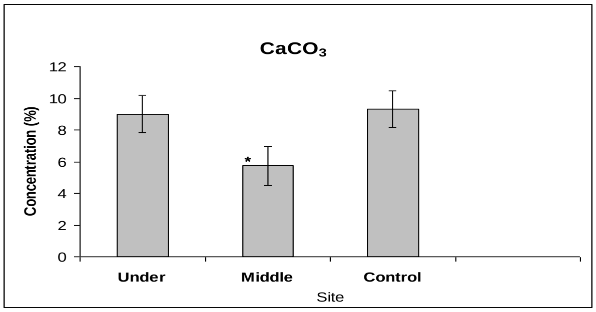
The changes in the average of soil pH values as a result of sprinkler irrigation were very slight and not significant (Table 1, Fig 3) especially in the surface layer of the sprinkler irrigated area comparing with the control soil.

The average of soil pH in the three subsurface layers increased non significantly from 8.09 in the control soil to 8.23-8.35 in the sprinkler irrigated area (Table 1, Fig 3) . These changes of the soil pH may be due to the leaching of salts from the irrigated area. The correlation between EC_e and soil pH was negative and not significant (r = - 0.229) (Table 3).

2-3- Total Calcium Carbonates (% $CaCO_3$):

The average of total calcium carbonates values for the surface layer of soil in the sprinkler irrigated area was reduced significantly from 9.3% in the control soil to 5.73% in the middle areas between sprinklers (Table 1 & Fig 6). That may be due to application of the alluvial dredged clay materials. These results are in agreement with **El-Desoky et al., 2000.** However, the average of total calcium carbonate under sprinklers at 0.5m was not changed as compared with the control soil because it did not receive these amendments.

In the next three subsurface layers it was the same trend since the average of total calcium carbonate reduced significantly from 10.44% in the control soil to 7.97% in the middle between the sprinklers (Table 1 & Fig 6).



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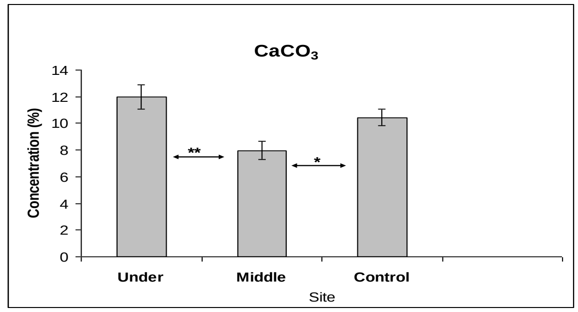
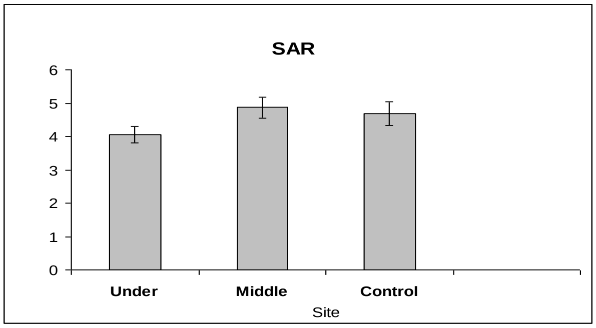


In subsurface layers



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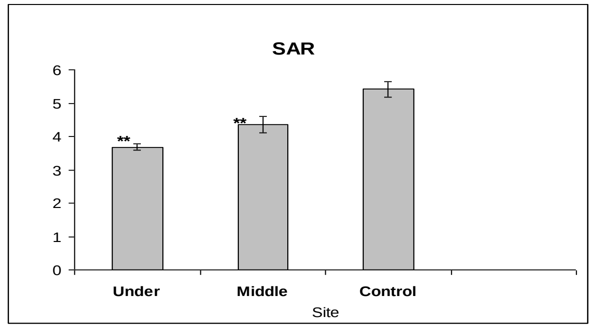

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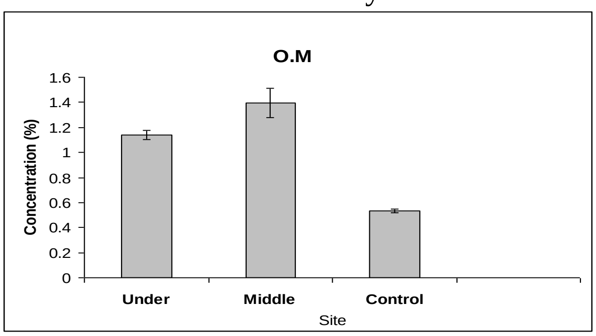

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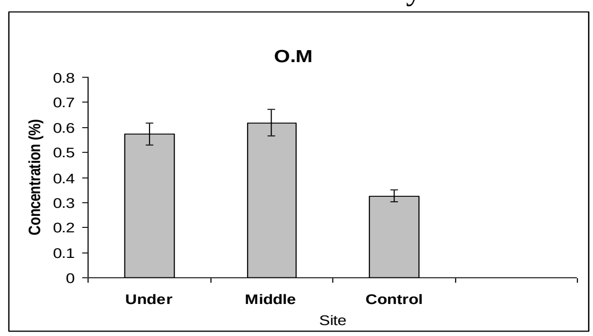


In subsurface layers

Fig(6): The mean and significance of total $CaCO_3$, SAR and % O.M in the surface and sub surface layers of studied soil profiles in sprinkler irrigated crops area under sprinkler (at 0.5m), in the middle between sprinklers and control.

2-4- Sodium Adsorption Ratio (SAR):

The average values of sodium adsorption ratio (SAR) (as measured in the soil paste extract) in the sprinkler irrigated area did not show changes due to the sprinkler irrigation or adding soil amendments comparing with the average values of sodium adsorption ratio (SAR) in the control soil for the surface layer. The average values of SAR stayed in the safe level of 4 (Table 1). In the next three subsurface layers, the average of SAR values significantly reduced from 5.41 in the control soil to 3.68 - 4.35 for the sprinkler irrigated area soil (Table 1, Fig 6). These results may be due to the salt leaching from the sprinkler irrigated area subsurface soil. The concentrations of the components of the SAR such as Na, Ca and Mg are balanced therefore the results of the equation was low for the whole area.

2-5- Soil Organic Matter:

Application of soil amendments and cultivation for 10 years to the surface layer increased the organic matter content significantly from 0.53% before cultivation in the control soil to 1.14 %, 1.40% under sprinklers at 0.5m and in the middle between sprinklers in the surface layer (Table 1, Fig 6). Similar results obtained with **Vidhaya et al., 2004.**

However the average of organic matter content in the next subsurface layers increased not significantly from 0.32% in the control soil to 0.57% and 0.62% O.M under sprinklers at 0.5m and in the middle between sprinklers which due to movement of some colloidal organic mater from the top layer to the next layers especially to the second layer.

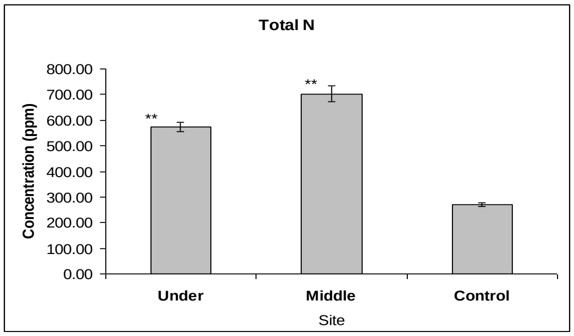
3- Effect of Sprinkler irrigation and application of soil amendments on soil fertility:

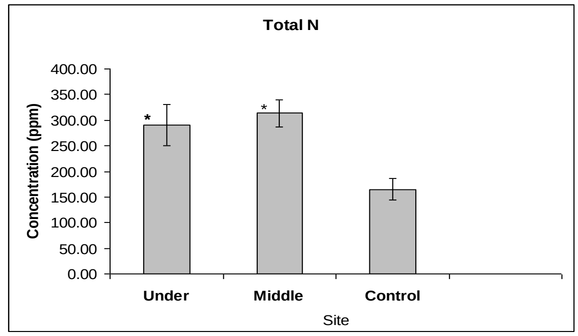
3-1- Macronutrients Status:

3-1-1- Total Nitrogen:

The changes in the total nitrogen in the cultivated soil were clear and highly significant. The values of the total nitrogen were doubled either in the surface or in the mean of the subsurface layers, (Table 1 and Fig 7).

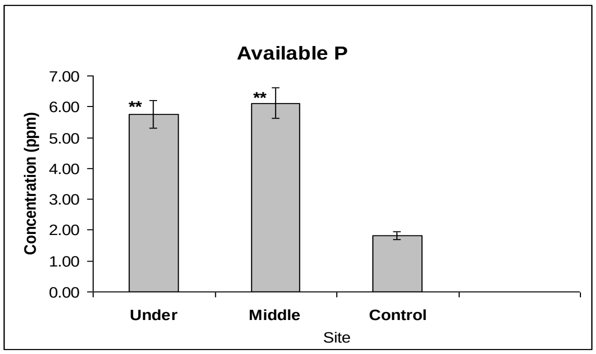
The average of total Nitrogen increased highly significant from 271 ppm in the control soil to 573-709 ppm in the cultivated soil for the surface layer, while it increased significantly from 165 ppm in the control soil to range of 290-313 ppm in the cultivated soil for the next three subsurface layers (Table 1, Fig 7) . The values of the surface layer were double of those of the subsurface layers because of application of amendments, cultivation and fertilization. The total nitrogen highly significantly positively correlated with the fine particles percentage ($r = 0.637^{**}$) (Table 3). These results in a good agreement with **Faragallah, 1995 ; Nobel, et al. 2000.** In spite of the increases in the total nitrogen in the soil were significant, but all these values still lower than the sufficiency levels for plants according to **Amacher et al., (2007)** (Table 2)**.**

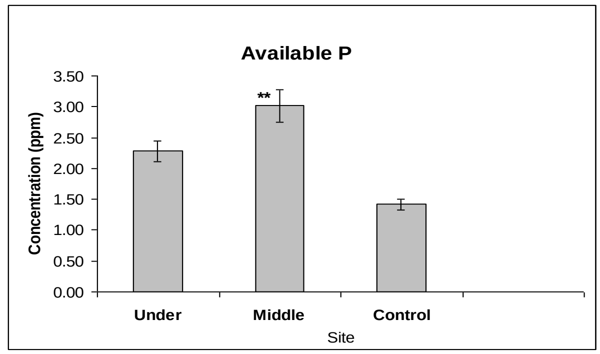




In surface layer

In subsurface layers





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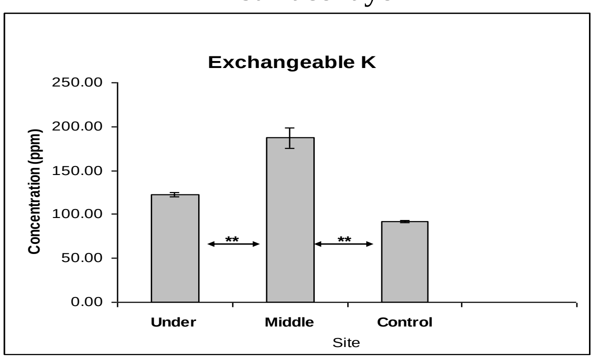

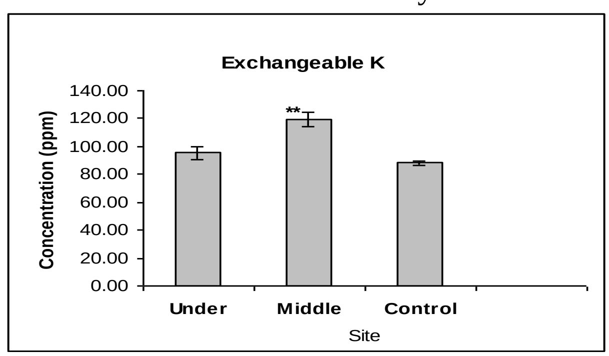

In surface layer

In subsurface layers

Fig(7): The mean and significance of total N , available P and exchangeable K in the surface and sub surface layers of studied soil profiles in sprinkler irrigated crops area under sprinkler (at 0.5m), in the middle between sprinklers and control .

From the GIS maps in Fig (8), the total nitrogen in the uncultivated borders of the farm was less than 300 ppm for the two upper soil layers. However, the top layer (0-25cm) has range of 300-1050 ppm nitrogen but the second layer 25-50cm has range of 300-583 ppm Nitrogen in the cultivated area. These increases were significant as stated before. Nitrogen in the deep two deep layers (50-75, 75-100 cm) was very poor. Since the total Nitrogen in the prefer area was less than 200, 100 ppm for the third and fourth layer respectively. While, it was ranged from 200 - 534, 100-412 ppm for cultivated area in the two deep layers in the original sand soil. It is clear that the fertility is going up with adding amendments. The effect of irrigation methods may be was not clear, but it may be increased the leaching of the organic particles or soluble nitrogen to the next layer.

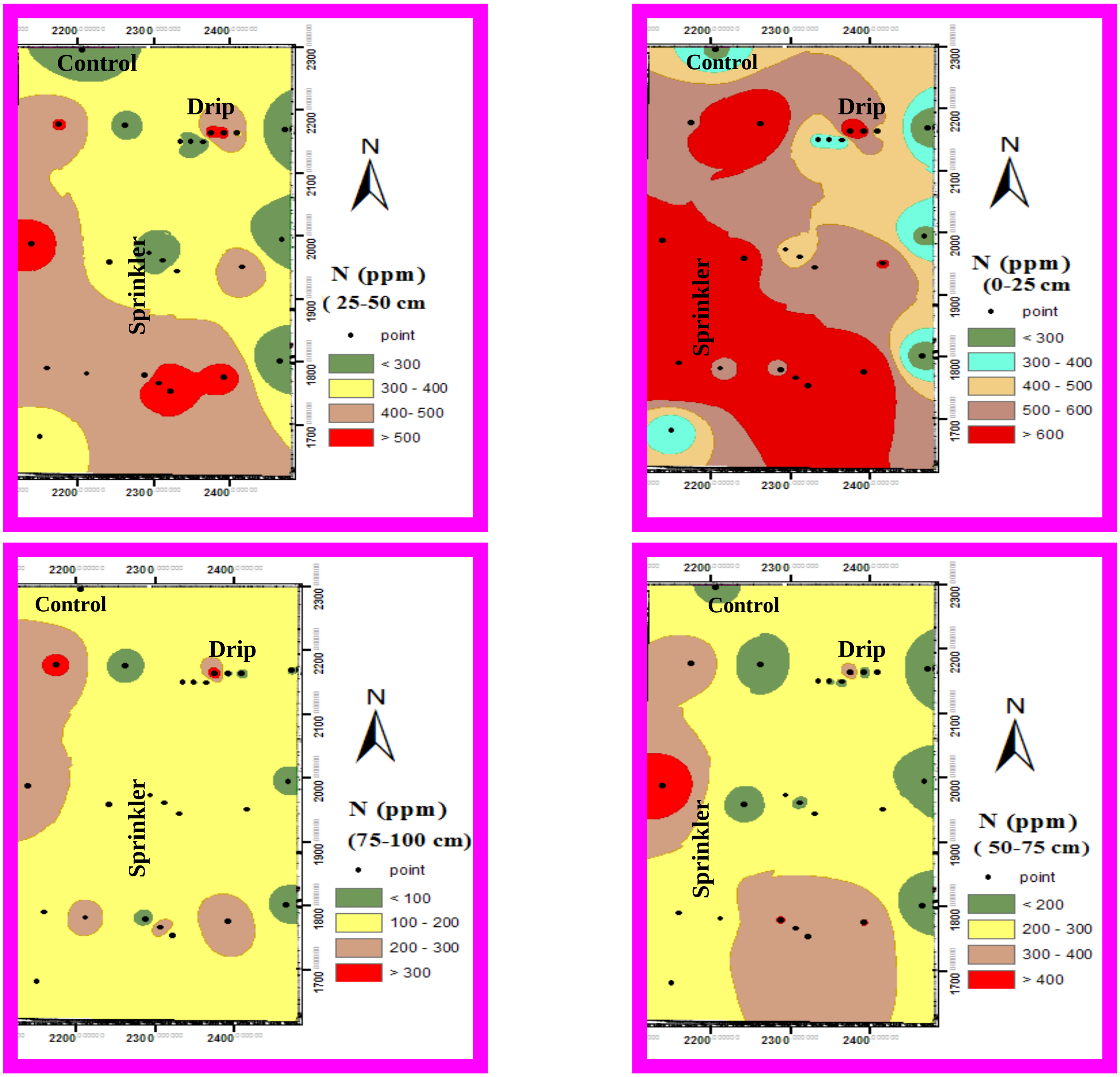

Fig. (8): GIS maps show the distribution of total nitrogen in the layers of soil profiles in the sprinkler irrigated crop area and uncultivated control profiles around the farm.

3-1-2- Available Phosphorus:

The changes in available phosphorus in the cultivated area were clear and highly significant. The average of available phosphorus increased significantly from 1.83 ppm in the uncultivated control soil to 5.75 and 6.11 ppm for the surface layer under the sprinklers and in the middle between sprinklers in the cultivated area which received soil amendments. Similar results were reported by **Silva & Uchida, 2000 and Moustafa, 2006.**

The same trend was noticed in the next three subsurface layers since the available P average increased from 1.42 in the control soil to 2.82 and 3.01 ppm under the sprinklers and in the middle between sprinklers in the cultivated area (Table 1, Fig 7). There was no significant difference in available phosphorus concentration under the sprinkler and far from sprinkler (in the middle between sprinklers).

It is noticeable that the average concentration of available phosphorus was tripled in the surface layer as compared with control. Whoever, these values still in the medium rang (6-10 ppm) according to criteria stated by **Halvorson (1971)** (Table 2). The available P highly significantly positively correlated the fine particles percentage (r = 0.493^{**}) (Table 3).

From the GIS maps in Figure (9), the minimum level of the available phosphorus was less than < 3, < 2, < 2, < 1.4 ppm in the control border for the four subsequent layers. The dominant value of available phosphorus in the surface layer ranged from 3 to 9 ppm. However, in the second layer the range was 2-6 ppm, and in the third layer it was from 2 to 4 ppm and in the bottom layer it was1.4 - 2.2 ppm. These maps help in the recommendation of phosphorus fertilizers application in the farm and may be suggested to be used as a tool for fertilization managements.

Table (2): The critical limits of some soil nutrients and properties.

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<tr><th>Soil properties</th><th>Low</th><th>Medium</th><th>High</th><th colspan="3">Reference</th></tr>
<tr><td>SAR</td><td>< 15</td><td>-</td><td>> 15</td><td colspan="3">Metson,1967</td></tr>
<tr><td colspan="7">Macronutrients (ppm)</td></tr>
<tr><td>Total N</td><td>< 1000</td><td>1000 - 5000</td><td>> 5000</td><td colspan="3">Amacher et.al., 2007</td></tr>
<tr><td>Available P</td><td>0-5</td><td>6-10</td><td>>10</td><td colspan="3">Halvorson, 1971</td></tr>
<tr><td>Exchangeable K</td><td>100 - 200</td><td>200 - 310</td><td>> 310</td><td colspan="3">Metson,1967</td></tr>
<tr><td colspan="7">Micronutrients (ppm)</td></tr>
<tr><td>Available Fe</td><td><2.5</td><td>2.5-4.5</td><td>>4.5</td><td colspan="3">Lindsay and Norvell, 1969</td></tr>
<tr><td>Available Mn</td><td><1.0</td><td>1.0 – 2.0</td><td>>٢.0</td><td colspan="3">Vites and Lindsay,1973</td></tr>
<tr><td>Available Zn</td><td><0.5</td><td>0.5-1.0</td><td>>1.0</td><td colspan="3">Lindsay and Norvell, 1969</td></tr>
<tr><td>Available Cu</td><td><0.2</td><td>-</td><td>>0.2</td><td colspan="3">Lindsay and Norvell, 1969</td></tr>
<tr><td rowspan="2">ECe (ds/m)</td><td>Very low</td><td>Low</td><td>Medium</td><td>High</td><td>Very high</td><td>Reference</td></tr>
<tr><td>< 2</td><td>2 - 4</td><td>4 - 8</td><td>8 - 16</td><td>>16</td><td>Metson,1961</td></tr>
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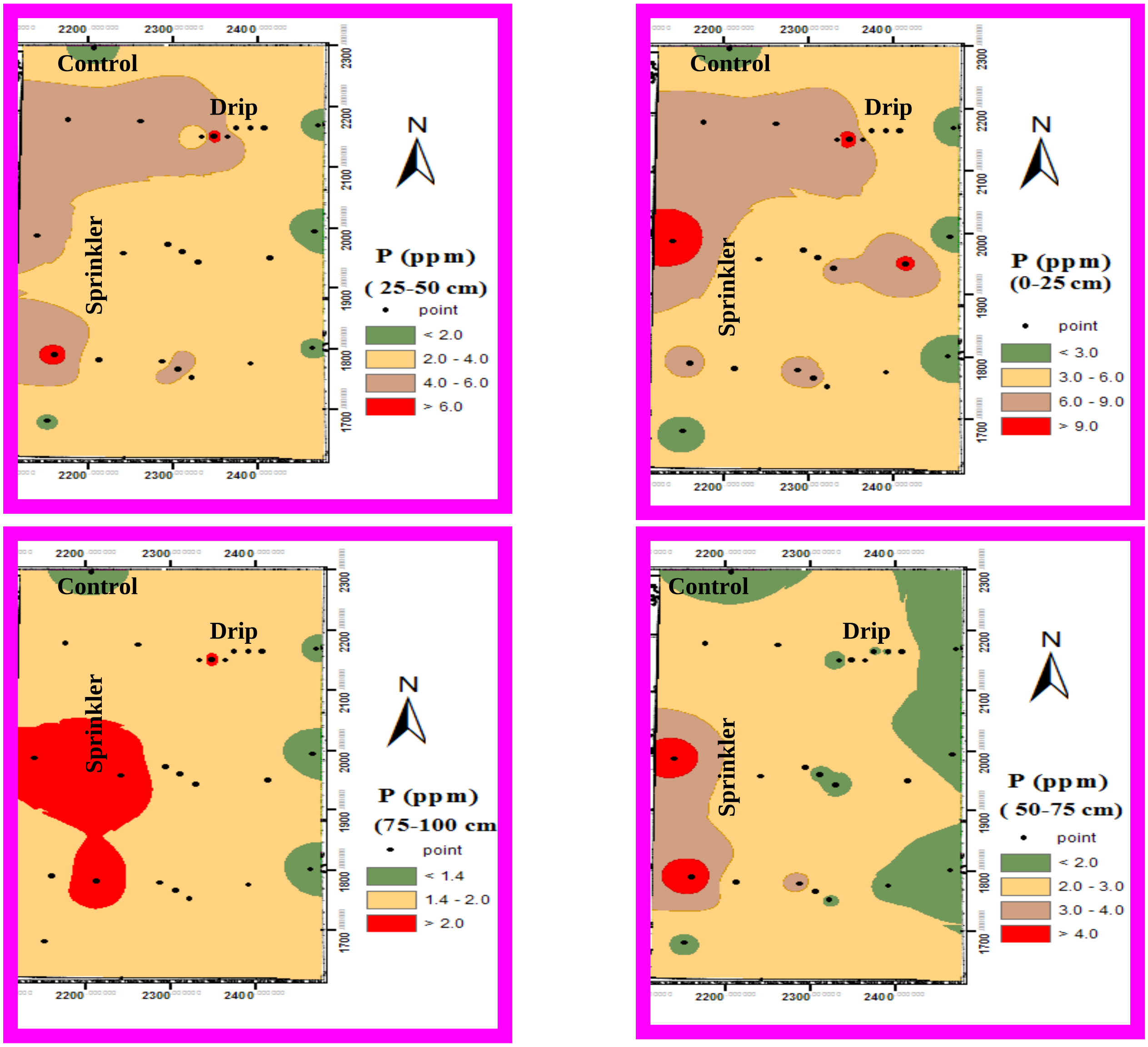


Fig. (9): GIS maps show the distribution of available phosphorus in the layers of soil profiles in the sprinkler irrigated crop area and uncultivated control profiles around the farm.

3-1-3- Exchangeable Potassium:

Applying the alluvial dredged clay materials increased the soil CEC so the average of the exchangeable K increased significantly from 91.89 ppm in the control soil to 187.2 ppm in the cultivated soil for the surface layer and from 88.43ppm in the control soil to 119.32 ppm in the cultivated area for the next three subsurface layers (Table 1, Fig 7) ,These results were in a good agreement with what obtained by **Brady & Weil, 2002**.

There was significant difference between the average of exchangeable K in the middle between sprinklers soil and the under sprinklers soil just for the surface layer and non significant difference between under the sprinklers soil and the uncultivated control soil. The exchangeable K highly significantly positively correlated with the fine particles percentage ($r = 0.636^{**}$) (Table 3) .according to criteria stated by **Metson (1961)** (Table 2)**,** the exchangeable K in the whole layers considered low.

From the GIS maps in Fig (10), the dominant value of exchangeable potassium in the surface layer of the cultivated area was 100 - 300 ppm. The exchangeable potassium in the cultivated border control was less than 100 ppm for the surface layer. The ranges of the next three subsurface layers were 100-159.9 ppm, 100-156 ppm and 80-144.6 ppm consequently. That reflects the need for potassium fertilizers application in the farm.

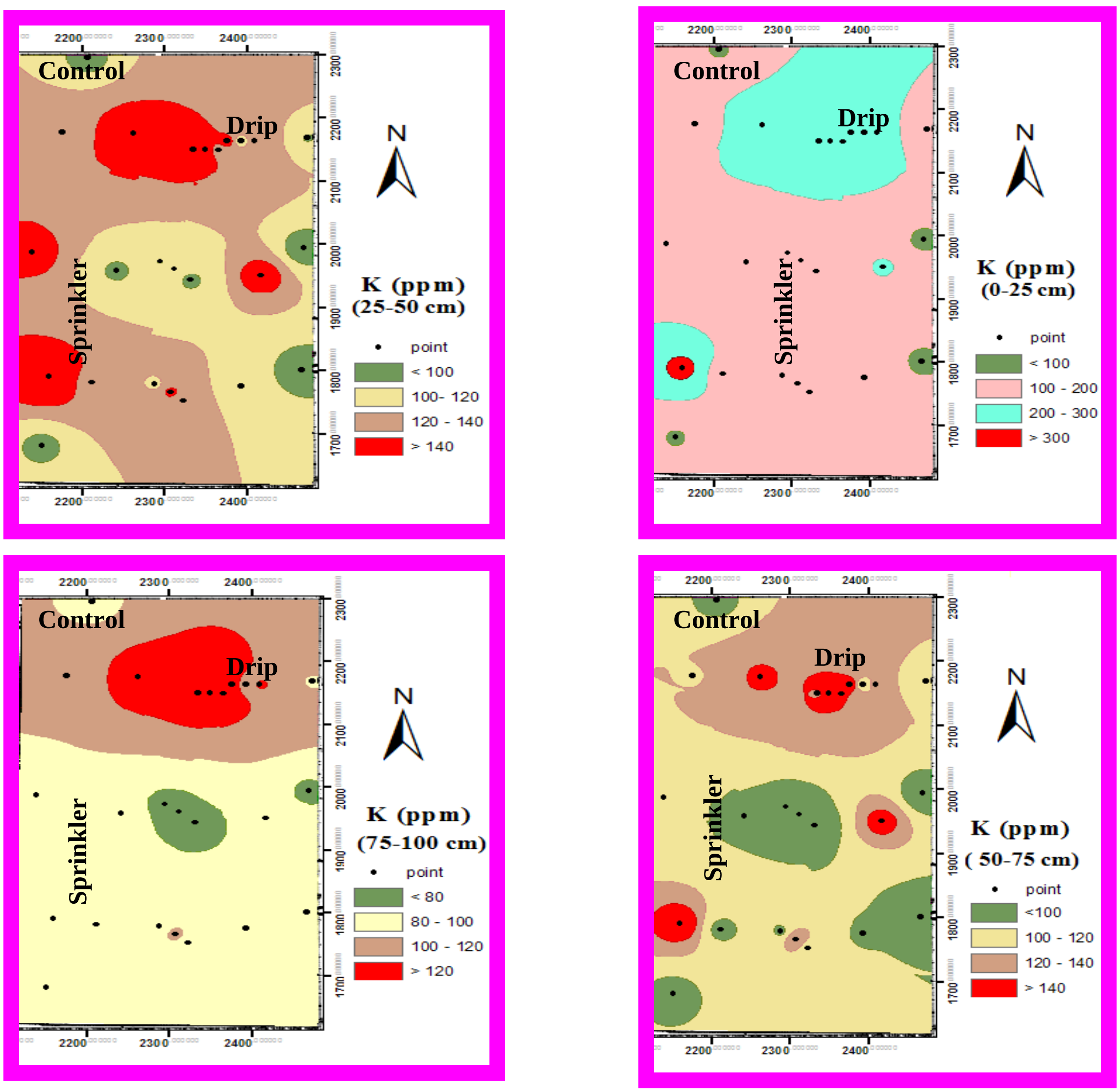


Fig. (10): GIS maps show the distribution of exchangeable potassium in the layers of soil profiles in the sprinkler irrigated crop area and uncultivated control profiles around the farm.

Table (3): Correlations in sprinkler irrigated crops area between some soil properties.

Variable 1	Variable 2	Correlation coefficient (r)	Correlation type
Total N (ppm)	Fine particles percentage (% Silt + Clay)	0.637^{**}	High significant positive correlation
Available P (ppm)		0.493^{**}	High significant positive correlation
Exchangeable K (ppm)		0.636^{**}	High significant positive correlation
Available Fe (ppm)		0.626^{**}	High significant positive correlation
Available Mn (ppm)		0.662^{**}	High significant positive correlation
Available Zn (ppm)		0.670^{**}	High significant positive correlation
Available Cu (ppm)		0.659^{**}	High significant positive correlation
EC_e (dS/m)	pH $_{(1:1)}$	- 0.229	non significant negative correlation
Available Fe (ppm)	pH $_{(1:1)}$	- 0.213	non significant negative correlation
Available Mn (ppm)		$- 0.322^{**}$	High significant negative correlation
Available Zn (ppm)		$- 0.280^{*}$	Significant negative correlation
Available Cu (ppm)		$- 0.238^{*}$	Significant negative correlation

3-2- Availability of Micronutrients:

3-2-1- Available Iron:

The average of the available iron in the soil for the surface layer increased significantly from 2.34 ppm in the control soil to 17.27and 28.92 ppm in the middle soil between the sprinklers and under sprinklers respectively (Table1, Fig 11). However, in the next three subsurface layers, the average of the available iron increased significantly from 2.5 ppm in the control soil to 8.89 ppm in the areas under sprinklers and non significantly increased from 2.5 ppm in the control soil to 5.76 ppm in the middle areas between sprinklers (Table1, Fig 11) .

Comparing the level of the available iron in the surface and the next three subsurface layers, the values were almost tripled which reflects the effect of applying soil amendments, organic matter and cultivation the farm for 10 years. Similar results were obtained with **Ibrahim et al., 2001.**

It was a high significant positive correlation between the available iron and fine particles percentage ($r = 0.626^{**}$) and a non significant negative correlation between available Fe and soil pH $_{(1:1)}$ (r = - 0.213) (Table 3). All the above values of available Fe considered from medium to high according to the classification of **Lindsay and Norvelle (1969)** (Table 2) **.**

3-2-2- Available Manganese:

The average of available Mn in the soil for the surface layer increased significantly from 1.96 ppm in the control soil to 29.28 and 52.81 ppm in the middle soil between the sprinklers and under sprinklers soil respectively (Table1, Figure 11) which due to applying the clay materials and organic matter on the surface layer. These results are in agreement with **Amer et al., 1991.** However the average of the next three subsurface layers of available Mn increased but non significantly from 1.6 ppm in the control soil to 2.93 ppm in the middle soil between the sprinklers and increased significantly to 4.00 ppm under sprinklers soil (Table1, Figure 9). The available Mn highly significantly positively correlated with the fine particles percentage ($r = 0.662^{**}$) and negatively with the soil pH (1:1) ($r = -0.322^{**}$) (Table 3).

All the above values of available Mn considered from medium to high according to classification of **Lindsay and Norvelle (1969)** (Table 2).

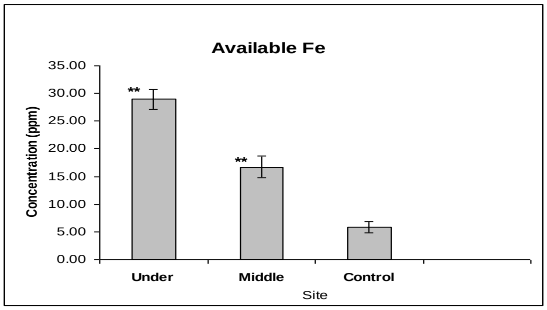
3-2-3- Available Zinc:

The average of available Zn in the soil for the surface layer increased significantly from 0.24 ppm in the control soil to 0.57 and 0.95 ppm under the sprinklers and in the middle areas between the sprinklers consequently (Table1, Fig 11).

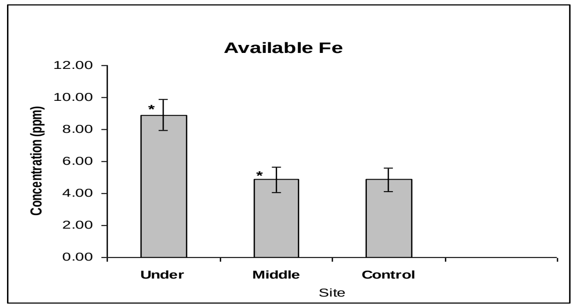
However in the next three subsurface layers, the average of the available Zn increased significantly from 0.19 ppm in the control soil to 0.37 ppm in the middle areas between the sprinklers and increased not significantly to 0.25 ppm in the areas at 0.5m from the sprinkler (Table1, Fig 11) .

The available Zn highly significantly positively correlated with the fine particles percentage ($r = 0.670^{**}$) and negatively with the soil pH $_{(1:1)}$ ($r = - 0.280^{*}$) (Table 3).
Comparing the level of available Zn in the surface layer and the next subsurface layers of the cultivated area, the values were doubled (Table 1) which reflects the effect of applying clay materials, organic matter. Similar results were obtained with **Moustafa, 2006.** All the above

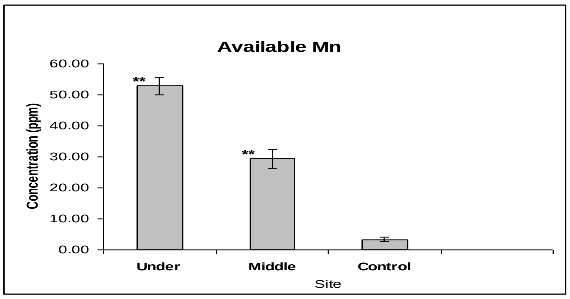
values of available Zn considered from low to medium according to classification of **Lindsay and Norvelle (1969)** (Table 2).



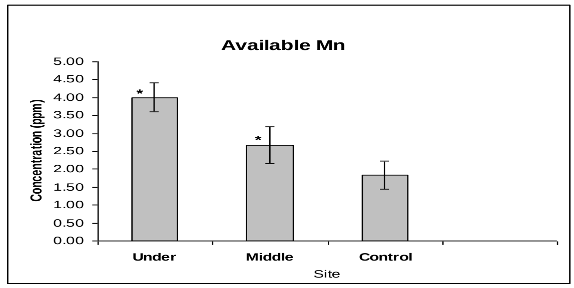
In surface layer



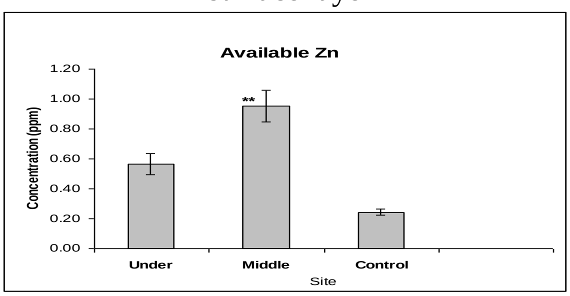
In subsurface layers



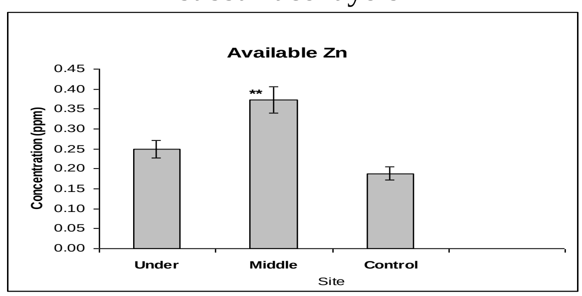
In surface layer



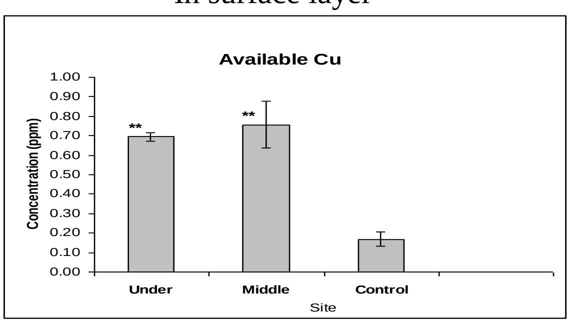
In subsurface layers



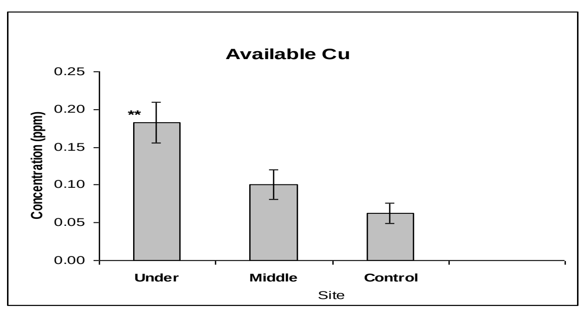
In surface layer



In subsurface layers



In surface layer



In subsurface layers

Fig(11): The mean and significance of available (Fe, Mn, Zn, Cu) in the surface and sub surface layers of studied soil profiles in sprinkler irrigated crops area under sprinkler (at 0.5m), in the middle between sprinklers and control .

3-2-4- Available Cupper:

The average of available Cu in the surface soil layer increased significantly from 0.17 ppm in the control soil to 0.70 and 0.76 ppm under the sprinklers soil and in the middle areas between the sprinklers consequently because of adding the clay materials and organic matter on the surface layer. (Table1, Fig ١١). Similar results were obtained with **Brady & Weil, 2002 and Moustafa, 2006.**

However in the next three subsurface layers, the average of the available Cu increased significantly from 0.06 ppm in the control soil to 0.18 ppm under the sprinklers and non significantly 0.10 ppm in the middle areas between the sprinklers (Table1, Fig ١١) .

The available Cu highly significantly positively correlated with the fine particles percentage ($r = 0.659^{**}$) and negatively with the soil pH (1:1) as ($r = - 0.238^{*}$) (Table 3). However, all the above values of available Cu considered was from low to high according to classification of **Lindsay and Norvelle (1969)** (Table ٢).

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تأثير الرى بالرش واضافة محسنات التربة على خواص التربة بمزرعة الكوامل بسوهاج "دراسة حالة"

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الملخص العربى

تقع مزرعة جامعة سوهاج بالكوامل فى الصحراء الغربية على حدود وادى النيل وهى تعتبر من الاراضى الرملية حديثة الاستصلاح تمت زراعتها جزئيا بالمحاصيل الحقلية مثل القمح والبرسيم ومروية بنظام الرى بالرش بعد اضافة طبقة من الطمية الناتجة من تطهير الترع بعمق (٢٠ -٣٠ سم)على السطح وطبقة من السماد البلدى فى بداية الزراعة كمحسنات للتربة وتصميم شبكة رى بالرش بأستخدام رشاشات مثبتة على أبعاد (١٠x٩ متر). الدراسة الحالية تهدف الى تقييم تأثير الرى بالرش واضافة محسنات التربة على تحسين خواص التربة الطبيعية والكيميائية وكذلك خصوبة التربة بعد عشرة أعوام من الزراعة كدراسة حالة.و النتائج أظهرت أن :-

١- الرى بالرش ادى الى غسيل الأملاح من التربة بالمقارنة بالقطاعات الكنترول .

٢- اضافة محسنات التربة أدت الى زيادة خصوبة التربة (محتواها من النيتروجين ، الفوسفور ، البوتاسيوم ، الحديد ، المنجنيز ، الزنك ، النحاس) وزيادة قدرة التربة على الأحتفاظ بالماء بالمقارنة بالقطاعات الكنترول . النتائج المتحصل عليها تم تحليلها احصائيا و عرضها فى خرائط نظم المعلومات الجغرافية .