Studies on title drainage in some egyption soils

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This study aims to evaluate the function of sub-surface drainage system installed in some Egyptian agricultural lands. This waork was carried out in three agricultural areas, i.e., Bahteem, Nobaria and Kafe-El-Sheikh with three different kinds of soil, (clayey, salt affected heavy clay and calcareous soils, respectively). Each area has different drain spacings systems, i.e. 20, 40 and 80m for Bahteem area; 12.5, 25 and 50m for Kafr El-Sheikh area and 25, 40, 60 and 80m for Nobaria area.For measuring water table depth, a piezometer net work was established for every drain spacing. Lines of piezometers were installed perpendicularly on tile drains which connected with manholes of distance of 1/2, 1/4, 1/8 ml (L= distance between two drain laterals) in addition to a piezometr was put in the vicinity just over the drain (0.4m distance from the drain).Four periods of investigation were chosen to carry out the study i.e. at the l' of the study, after one 2" , 3rd and 4th years.Concerning the Kafr El-Sheikh location, the period was chosen after 5th years of drain installation.During the course of experiment, soil and water samples were collected along the periods of investigation depths at depth of 0-30, 30-60, 60-90, 90-120 and 120- 150cm. these samples were chemically and physically analysed. Also, the hydraulic properties of the soil were determined i.e.water table level, discharge rate, hydraulic head and shape of water table. In addition evaluation of the performance of the drainage system for each location was carried out using the rating classification of Dielman and Trafford (1976). The obtained results can be summarized as follows:A-Effect of drainage on soil properties of Bahteem area.1- The values of electrical conductivity (EC) of soil paste extract are decreased in soils of all drain spacings (20, 40 and 80m) by time where values decreased at the end of experiment. It is also found that the (EC) values decreased in the 20m drain spacing than the other ones at all periods of investigation. The obtained results indicate that the soil salt leaching took place steadily and significantly for spacings at all periods for both soil surface (0-60cm) and sub-surface (60-120cm) layers and whole soil profiles. It is observed that the rate of salt leaching is higher in the surface layers than those of thesub-surface ones. The 20m drain spacing has the highest rate of soil salt leaching than those of the 40 and 80m, respectively, at all periods of investigation.2-Concerning the effect of drainage on soil soluble sodium Na+ and exchangeable sodium percentage ESP, it is noticed that their values took the same trend of EC values. They decreased by time and by depth in all drain spacings. Smaller spacing has lower values of Na+. A significant decreasing of (Na+) and (ESP) values are observed in the 20m drain spacing than the other ones.3-Regarding the relation between water table depth and each of soil and water table salinity (EC), it is observed that each of them are affected by water table movement. where the water table is lowered, the (EC) values of soil and water table are also, decreased. The water table levels are also affected by drain spacings. The lowest water table levels are found in the smallest drain spacing (20m).4-Studying the effect of drainage on soil pore size distribution. The results reveal that there are a significant and negative correlation between drain spacing and the percentage of the pore responsible of drain (drainable pores (DP). The high percentages arefound in soil of the narrow spacings at all periods of study. It is also, observed that the soil surface layers have the highest values of drainables (DP) than those of the subsurface ones in all drain spacing treatments. Those values are increased by time, which revealed that the soil characteristics are enhanced by time as a result of installing dranage system. The values of water holding pores (WHIP) took the same trend as those of DP but with low significant and negative correlation between them and drain spacing. On the other hand, the values of the fine capillary

pores (ECP) took a reverse trend of those of DP and WHP. A positive and significant correlation is found between FCP and the drain spacing. Smaller values of FCP are found in soils of the narrow drain spacing and increased by time, which reflect the influence of installing drainage system on soil properties.5- Measuring soil hydraulic conductivity (K), it is observed that there is an inverse relation between (K) values and drain spacing and they also increased by time. The rate of increasing is higher in the surface layers than those of the sub-surface ones. The highest (K) values are found in the narrow drain spacing treatments.6-Soil aggregates of different fraction of (10-2), (2-1), (1-0.5), (0.5-0.25) and (0.25-0.125mm) were determined in soil samples at the different drain spacing treatments. The data show that values of all soil aggregate fractions are increased in all drain spacing treatments at the end of the experiment except those of the fraction of (0.5- 0.125mm) is decreased. It is also, noticed that the bigger aggregate fraction are increased yearly and the highest values are observed for the treatment of 20m. It is also observed that the high values of the bigger fraction are found in the surface layers.7-Studying soil moisture retention, the field capacity (FC) values decreased by time. The data also, show that the (FC) values of the 40m drain spacing are higher than those of the 20 and 80m either at the beginning or at the end of the studded. The permanent wilting point (PWP) values show a slightly increasing for the 40m drain spacing than those of the 80m and 20m at the beginning. This increase continued until the end of the experiment. The results reveal that the soil available water (AW) values are increased by depth in all soil profiles under the study. They also increase at the end of theexperiment. The treatment of 40m drain spacing has the highest values of (AW).8- Studying soil hydraulic properties, it is observed that water table depths are lowered by time and by narrow drain spacings, while the hydraulic head elevation took the reverse trend. The shape of water table is elliptical. The highest water table level is found in the space mid-way between any tow drains with a sharp gradient near the drain as a result of the faster water flow near the drain. The highest discharge rate (q) is found in the order of 20 > 40 > 80m drain spacing. The (q) values are lowered by time.9-Evaluating the drain system performance it is found that the system function is enhanced by time. The drain intensity factor ”a” is found higher at the last year of investigation and for the treatment of 20m.10-Another tool used to determine the performance of the drainage system, is the head loss fraction (he /htot). The results reveal that the efficiency of the drainage system increased by time and in the treatment of the smaller drain spacing. The efficiency rating (according to Dielman and Traford, 1976) is between ”poor” and”very poor”.B- Effects of drainage on soil properties of Kafr El-Sheikh Area1-Soil electrical conductivity values (EC) are increased with increasing drain lateral spacing in all soils (12.5, 25 and 50m) . It is also, observed that the soil salinity increased with depth. It is noticed that the salinity increased at the end of the experiment in soils of drain spacings.2-Regarding the values of soluble and exchangeable sodium, they took the same trend of soil salinity where they increased with depth, with increasing drain spacing and with time. This means that the drainage network is not efficient.3-Results indicate that the water table depth is raised at the end and so; soil and water table salinity increased along the years of the study and in soils of all drain spacings.4-The hydraulic conductivity (K) of the studied soils decreased at the end of the study period. The percentages of decreasing are 40%, 53% and 62% for 12.5, 25 and 50m drain spacings, respectively.5-Concerning the effect of drainage on soil pore size distribution, the results show that the drainable poresDP and water holding pores (WHP) values are decreased by increasing drain spacing and by depth. On the other hand fine capillary pores (FCP) increasing by dicreasing drain spacing and by time.6- Studying the relation between drainage and soil aggregates, the results show that the soil aggregates with big diameters i.e.(10-2), (2-1), (1-0.5mm) decreased by time. The highest rate of decrease is observed in the 50m drain spacing than the other ones, while the aggregates with the small diameters increased with time causing soil deterioration as a result of imperfect drainage,7- Regarding the soil hydraulic properties, the results show that the water table levels are raised and become near the soil surface as a result of inefficient drainage system. It is also, noticed that the hydraulic head (h) levels increased upon the level of tile drains. Along the periods of investigation, in this particular location, the discharge rate (q) from the drains could not be measured as a result of blocking the manholes by undrained water.8- Evaluating the performance of drains by means of drainage intensity factor ”a” and the rate of head lossfraction (he /htot) 1 indicates that the drainage system is of very low efficiency and could be considered ”very poor” according to Dielman and Trafford evaluation rating (Dielman and Trafford, 1976).C- Effect of drainage on soil properties of Nobaria Area1-Values of soil electrical conductivity (EC) decreased by time in soils of all drainage spacings (25, 40, 60 and 80m). The lowest values are observed at the end of experiment and for the treatment 25m. It is observed, also that those values decreased in the surface layers (0-60cm) than those of the sub-surface ones (60-120m). This means that the salt leaching process took place continuously and steadily in soils of drainage spacings.2-Values of soluble and echangeable sodium (Na+, ESP) decreased at the end of the study period and in all drainage spacings. The highest rate values are found in soils of the narrow spacing (25m). Also, it is observed that those values decreased in the surface layers than those of the sub-surface ones.2573- The values of oil and water table EC are also, influenced by the water table fluctuation. The relation between them is positive; where the water table depth are lowered the values of soil and water table EC are also, decreased. On the other hand, the water table depths are affected by the spacing between drains; where the lowest water table depth is found in the treatment of 25m.4-The physical properties are influenced by differentdrainage spacings. The hydraulic conductivity (K)values increased with time as well as with thedecrees in drain spacing. This reflects the positiveeffect of drainage on enhancing soil permeability.5-Studying the effect of installing dranage system on soil pore size distribution, the results indicate that the values of volume drainable pores (DP) increased with time in all the drainage spacings. The relation between (DP) and drain spacing is negative and significant. The highest values of (DP) are found in the treatment of the smaller drain spacing of 25m. Concerning the water holding pores (WHP), their values have shown no marked effect by drain spacing. The values of fine capillary pores (FCP)decreased with time. A significant and positive relation is found between (FCP) values _ and drain spacing treatment, since decreasing the drain spacing was associated with decrease in FCP values.6-Concerning the effect of drainage on soil moisture retention, the data show that the values of available water (AW) increased with time in soils of all drain spacings and the highest values are observed in the soils of the narrow drain spacing (25m). On the other hand, the values of field capacity FC took a reveres trend to those of (AW) value Singh all drain spacings.7-Evaluating diameters of soil aggregates in different drain spacing treatments. The results indicate that the big fractions of diameters of (10-2), (1-0.5) and (0.5- 0.25mm) are significantly increased with decreasing drain spacing. One exception is found, that the soil aggregates of diameter of (10-2mm) are increased in the soils of the 40m drain spacing at the end of experiment. On the other hand, decreases were 13, 18 and 16% for the drain spacing of 80, 60 and 25m respectively. This may be due to the excess quantities of soil calcium carbonate and soil clay contents inthis region. Regarding the soil aggregates of small diameters (0.25-0.125mm) the data show that their values decreased with time in all drain spacings. The highest rate of decreasing is found in the 25m drainspacing.8-Studying the hydraulic properties of the soil, it is found that the water table depth is lowered by time and by decreasing the drain spacing, and soils of the 25m has the lowest water table depth. The results show that the hydraulic head (h) takes the reveres trend than the water table depth. Relating the shape of water table, it takes the elliptical shape where the water table is lower near the drain as a result of increasing water flow in this vicinity.9-Evaluating the performance of the tile drains, dranage intensity factor (a) is calculated. These results reveal that the efficiency of the system is increased by time. The highest values for (a) are found in the treatment of 25m10-Another factor to perform the efficiency of drainage is the head loss fraction he! htotai. The results indicate that the system efficiency is increased by time and in the narrow drain spacing.