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ENVIRONMENTAL IMPACT OF USING LOW QUALITY WATER IN IRRIGATION

El Tohamy, S. A.; Y.I. Mahmoud; M. M. I. Afifi and Wafaa A. Hafez
Soils, Water and Environment Research Institute, ARC, Giza, Egypt

ABSTRACT

Egypt has crisis of water and a special after the construction of the Nahda Dam.So, finding other sources release clean water for use in other sectors special wastewater. This research was conducted on the El-Mohate drain (Marioteya Canal) west of Cairo, to determine the differences temporal and spatial persistent organic, non-organic and microbial population during the whole year.Samples were taken from different locations along the waterway under study, as well as some samples of plant and soil (surface layer) and sediment have been sampling to determine the status of pollution along the drain .

The obtained results revealed that El-Mohate drain EC ranged between 0.53 and 5.26 dS/m in winter season, while it reached 1.26-6.72 dS/m in dry season. Ammonia concentration values ranged between 0.93-46.2 mg/l in the wet season and 2.2-21.32 mg / l in dry season. While, nitrates reached concentration of 0.18 - 26.6 and 0.73-23.52 mg / l in both wet and dry seasons, respectively.

The concentrations of heavy metals (iron, manganese, zinc, copper, cobalt, boron, chromium, nickel, cadmium, lead) were less than the limits. As for persistent organic pollutants (Aromatic hydrocarbons) have given the highest concentrations during the wet season compared to that phenols has given the highest concentration during the dry season.

Total coliform bacteria counted higher numbers in summer season than wet season and numbers were higher than WHO guidlie specially in locations 9 to 20. Also, data cleared that, *Escherichia coli*, *Salmonella* and *Shigella* numbers were increased in summer season than winter season.

Total and suspended solids, chemical and biological oxygen demand were significant higher values in summer season than the winter season in El-Mohat drain water.

Different selected sites showed less concentration in the content of heavy metals were less than the allowable limits increase the concentration of phenol in the dry season than in wet season on the reverse hydrocarbons has been focused in the wet season higher than the dry season.

The results indicated that phenol content of plants during wet and dry season was in order of the plants as follows: draw> zeamaize> zucchini >pepper. The concentration of hydrocarbon was the focus as follows: zeamaize <draw <pepper< zucchini.

Keywords: low quality water, heavy metals, biological parameters

INTRODUCTION

With increasing global population, the gap between the supply and demand for water is widening and is reaching such alarming levels that in some parts of the world it is posing a threat to human existence. Scientists are working on new ways for conserving water. It is an opportune time, to refocus on one of the ways to recycle water through the reuse of urban wastewater, for irrigation and other purposes.

In general,wastewater comprises liquid wastes generated by households, industry, commercial sources, as a result of daily usage, production, and consumption activities. Municipal treatment facilities are designed to treat raw wastewater to produce a liquid effluent of suitable quality that can be disposed to the natural surface waters with minimum impact on human health or the environment. The disposal of wastewater is a major problem faced by municipalities, particularly in the case of large metropolitan areas, with limited space for land based treatment and disposal. On the other hand, wastewater is also a resource that can be applied for productive uses since wastewater contains nutrients that have the potential for use in agriculture, aquaculture, and other activities.

As mentioned earlier, wastewater contains pathogenic microorganisms such as bacteria, viruses, and parasites, which have the potential to cause disease. In particular, human parasites such as protozoa and helminth eggs are of special significance in this regard as they prove to be most difficult to remove by treatment processes and have been implicated in a number of infectious gastrointestinal diseases in both developed and developing countries. However, for evaluating health impacts it must be remembered that it is the actual risk that make people fall ill that must be quantified and not the presence of pathogens in water. The use of untreated wastewater for irrigation, no doubt, pose a high risk to human health in all age groups. However, the degree of risk may vary among the various age groups. Untreated wastewater irrigation leads to relatively higher prevalence of hookworm (Feenstra et al. 2000), and Ascariasis infections among children (Cifuentes et al. 2000.)

Heavy metals in wastewater pose a health risk if they are ingested in sufficient concentrations, and can be dangerous. In principle, uptake of heavy metals by crops and the risk posed to consumers may not be an issue as plants cannot resist high concentrations of these pollutants and die off before they become a threat to humans. Shuval et al. (1986), made an extensive study of health effects of pathogens however, there are no comprehensive studies which assess the impact of heavy metals and the real risks posed to human health.

Wastewater is extensively used in agriculture because it is a rich source of nutrients which necessary for crop growth. Most crops produce higher than potential yields with wastewater irrigation; reduce the need for chemical fertilizers, resulting in net cost saving to farmers. If the total nitrogen delivered to the crop via wastewater irrigation exceeds the recommended nitrogen dose for optimal yields, it may stimulate vegetative growth, but delay ripening and maturity, and in extreme circumstances, cause yield losses. Many scientists have attempted to quantify the effects of treated and untreated wastewater on a number of quality and yield parameters under various agronomic scenarios, these studies suggested that treated wastewater could be used for producing better quality crops with higher yields than what would otherwise be possible.

The use of untreated wastewater, in many countries, pose a whole set of different problems. Nevertheless, the high concentration of plant food nutrients becomes an incentive for the farmers to use untreated wastewater as it reduces fertilizer costs, even when the higher nutrient concentrations may not necessarily improve crop yields. Many crops, especialy, those grown in peri-urban agriculture, need specific amounts of NPK for maximum yield. Once the recommended level of NPK is exceeded, crop growth and yield may negatively be affected.

For example, urea effluents disearded from fertilizers industry are rich source of liquid fertilizers but in concentrated forms they have adverse effects on rice and corn yields (Singh and Mishra 1987).

Wastewater impact on agricultural soil, is mainly due to the presence of high nutrient contents (Nitrogen and Phosphorus), high total dissolved solids and other constituents such as heavy metals, which are added to the soil over time. Wastewater can also contain salts that may accumulate in the root zone with possible harmful impacts on soil health and crop yields. The leaching of these salts below the root zone cause soil and groundwater pollution (Bond 1999).

Wastewater induced salinity may reduce crop productivity due to general growth suppression, at pre-early seedling stage, due to nutritional imbalance, and growth suppression due to toxic ions (Kijne et al. 1998). The net effect on plant growth could be resulted in reduction of crop yields and potential loss of income to farmers.

Wastewater irrigation may lead to transport of heavy metals to soils and may cause crop contamination affecting soil flora and fauna. Some of these heavy metals may bio-accumulate in the soil while others, e.g., Cd and Cu, may be redistributed by soil fauna such as earthworms (Kruse and Barrett 1985).

The impact of wastewater irrigation on soil may depend on a number of factors such as soil properties, plant characteristics and sources of wastewater. The impact of wastewater from industrial, commercial, domestic, and dairy farm sources are likely to differ widely. The use of dairy factory effluents for 22 years in New Zealand showed that nearly all applied P was stored in the soil while nitrogen storage was minimal, implying nitrogen leaching and consequent nitrate pollution of the groundwater (Degens et al. 2000).

Wastewater application has the potential to affect the quality of groundwater resources in the long run through nutrients and salts found in wastewater leaching below the plant root zone. However, the actual impact depends on a host of factors including depth of water table, quality of groundwater, soil drainage, and scale of wastewater irrigation. For instance the quality of groundwater would determine the magnitude of the impact from leaching of nitrates. If the groundwater is brackish the leaching of nitrates would be of little concern as the water has no valuable use attached to it.

Groundwater constitutes a major source of potable water for many developing country communities. Hence the potential of groundwater contamination needs to be evaluated before embarking on a major wastewater irrigation program. In addition to the accretion of salts and nitrates under certain conditions, wastewater irrigation has the potential to translocate pathogenic bacteria and viruses to groundwater (NRC report 1996). Farid et al. (1993), reported that in El-Gabal el Asfar Farm in the Greater Cairo region, where untreated or primary treated wastewater has been used for irrigation since 1915, the long-term use of wastewater for crop irrigation has interestingly led to an improvement in the salinity of the groundwater. This was offset by evidence of coliform contamination of groundwater which was also observed in Mexico (Downs et al. 1999, Gallegos et al. 1999). Acompanion study (Rashed et al. 1995), revealed that in the wastewater irrigated of El- Gabal el Asfar region, the concentrations of chloride, sulfate, TDS, and dissolved oxygen in groundwater is much higher than average concentrations in sewage effluents. The leaching and drainage of wastewater, applied for crop irrigation, to groundwater aquifer may serve as a source of groundwater recharge. In some regions, 50-70 percent of irrigation water may percolate to groundwater aquifer (Rashed et al. 1995).

When drainage water from wastewater irrigation schemes drains particularly into small confined lakes and water bodies and surface water, and if phosphates in the orthophosphate form are present, the remains of nutrients may cause eutrophication. This causes imbalances in plant microbiological communities of water bodies (Smith et al. 1999).

The aim of the research to assess the chemical and biological pollution caused in El،Mohate drain (Marioteya Canal) due to human activities and the impacts on soils and plants grown in

MATERIALS AND METHODS

Study area and sampling:

Samples of surface water, soil, sediment and plant were collected during twelve months. Twenty sampling locations along El-Mohate drain were selected and are shown in Fig. (1) and tabulated in Table (1). El-Mohate drain passes through many villages dotted along it receiving drainage water, house wastes and commercial activities.

Samples Collection:

Soil:

Surface soil samples (0-30 cm) from the studied area were collected from location described as shown in Table (1) and Fig. (1). The locations were selected to cover the whole area of the El-Mohate drain. The collected soil samples were air dried in a clean room to avoid contamination and ground to pass through a 2 mm sieve and stored in polyethylene bags for analysis.

Sediments:

During the two seasons, at least one sediment sample was collected from the same location of each soil sample. The sediment samples were then preserved in plastic bags and kept frozen until further analyses.

Table 1. Locations and description of the soil, plant, sediment, and surface water sample locations along El-Mohate drain.

Site number	Site description
1	Bridge Kerdasa
2	Drain of tiger 5
3	El-mohate Drain after the Drain of confused tiger 5
4	Drain Abdel Aal tribal
5	El-mohate after the Drain of confused Abdel Aal tribal
6	Abdel Aal Maritime Drain
7	El-mohate drain after mixing drain of Abdel Aal Maritime
8	Sewage lift station South Pacific
9	Drain Allpiny
10	Drain Nahia against infectious
11	Drain after mixing Drain of Nahia
12	Drain after mixing the bottom axis
13	Drain of the El-mohate from the top of the bridge traffic
14	Ncla Allpiny after the end of the drain branch wind Nazareth
15	El-mohate drain after mixing Ballpiny
16	Agricultural drain of Umm dinars
17	El-mohate drain after mixing or dinars Agricultural
18	Alrhowy drain
19	El-mohate drain after mixing drain Alrhowy
20	Nile after mixing with the El-mohate drain

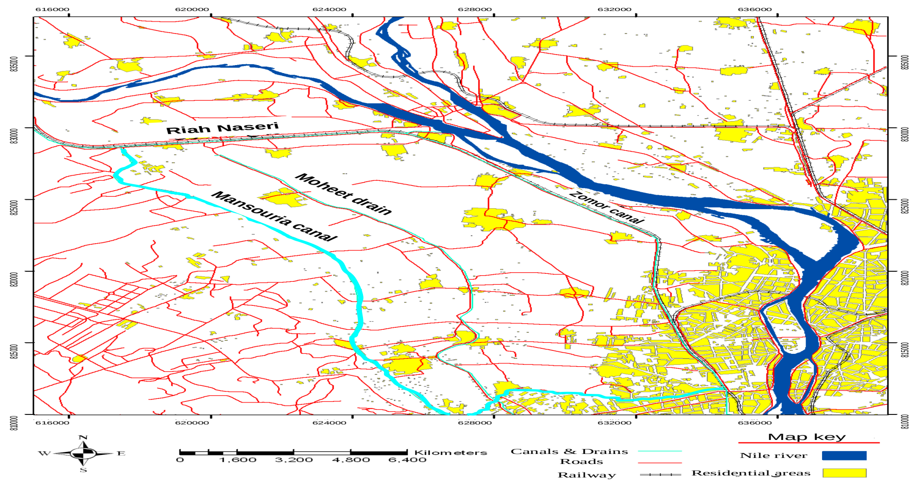


Fig.1.Map of the study area and sampling sites

Plant:

Plants which were found at the same site of soil sampling were collected, washed with tap water then with distilled water. The plant materials were air dried in a dust free room then in an oven at 70°C for 48 h. The plant samples were ground in a stainless steel mill and passed through a 0.5 mm sieve and stored in polyethylene bags for analysis.

Water:

Water samples were collected monthly for twelve month from January to December of 2013 in pre-cleaned plastic bottles then stored at 4º C until analysis , while microbiological determinations were run directly after taking sample.

Analytical methods:

Inorganic chemical analysis

Heavy metal contents of the sediment and soil samples were extracted using DTPA according to the method of Lindsay and Novell (1978). Heavy metal concentrations were determined in resulting extracts using ICP.

For the plant samples, dried plant materials were digested by using a mixture of concentrated sulphuric- perchloric acids according to the procedure of Chapman and Pratt (1961) and the elements were determined by (ICP Plasma)

Organic chemical analysis:

Total poly cyclic aromatic hydrocarbon (PAHs) were extracted from water, soil, sediment and plant samples then determined by UV-Spectrometer according to the procedure described by IOC (1984). Phenol was detected in water samples analyzed during Monitoring Survey (EPA 1980).The total soluble phenolic compounds in the different extracts of some plants were determined with Folin-Ciocalteu reagent using gallic acid as a standard (Singleton 1999).

Biochemical analysis:

Chemical oxygen demand (COD) was determined using the reactor digestion method as described by jirka and Carter (1975). Biological Oxygen Demand (BOD) was determined using method described by (HMSO publication,1980).

Total coliforms bacteria were counted on Macconkey agar medium using the serial dilution poured plate method. The inoculated plates were plates incubated at 37C0 for 24 hour according APHA (1989).Fecal coliform were counted using the same previous medium, but inoculated plates were incubated at 44.5 C^o for 48 hour, according APHA (1989).

Salmonella and Shigella (SS) bacteria were counted on SS Agar medium using the serial dilution poured plate method. The inoculated plates were incubated at 33-37 C^o for 24 hour. Black centered or mirror colonies were counted as *Salmonella and Shigella* microorganisms (Difco Manual, 1977).

Statistical analysis:

The randomized complete blocks design was used. Each experimental design has its previously mentioned replication. Data were transformed before subjection to analysis of variance using COSTAT Computer Program and zero values were replaced by minimum values before transforming the data. Means were compared using LSD at 0.05 level of significant method and multiple range tests according to Sendecor and Cochran (1980).

RESULTS AND DISCUSSION

Chemical characteristics of wastewater and heavy metals content :

The contaminated water used for irrigation was analyzed for chemical oxygen demand (COD) and biological oxygen demand (BOD),electrical conductivity ,dissolved nitrogen and heavy metals.

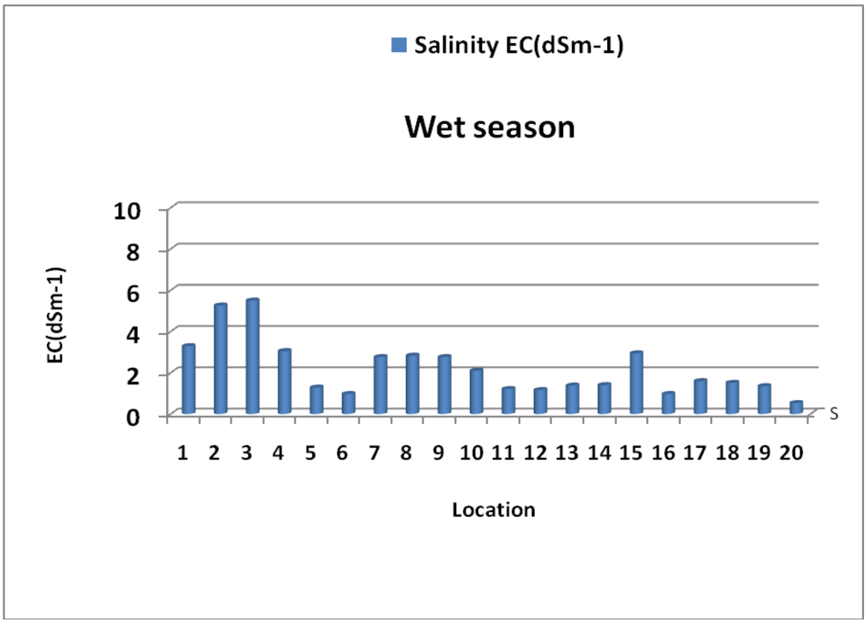
The results revealed that Fig.(2) all, locations of the study area,Values of EC recorded in the wet season were within the range concentration of 0.53-5.26 dSm^{-1}, however, slight increase of EC values were determined with site No. 20 and No.5 during during dry season. In dry season the values of EC within the range concentration of 1.26-6.72 dSm^{-1}. in position of Nile after mixing with the El- mohate drain and drain Abdel Al Tribal.

Dissolved nitrogen (NH_4^+ and NO_3^-) content of the water drain was relatively high in the different seasons, Fig (3) however, concentrations of ammonium and nitrate varied widely. The values of ammonium fluctuated between 0.93 to 46.2 mg/l in wet season , 2.2 to 21.32 mg/l in dry season. Nitrate (NO_3^-) values showed variations being in wet season where they were average of 0.18- 26.6 mgL^{-1} and 0.73-23.52mgL^{-1} in dry season. The relatively high concentration of nitrogen species in drain may be attributed to the nitrogen content of the waste waters.

Concerning seasonal variation in water salinity and nitrogen content of the waters from the studied sites Elmohate drain. A similar trend was noticed for NO_3-N may be due to the human activity.

Heavy metal concentrations in water at the different locations studied are presented in Fig. (4). Data revealed that all concentrations of the studied heavy metals in water samples were still far below the critical range. This might be attributed to precipitation of the heavy metals on the colloid of particles of the drain sediment.

Data of organic pollutant contents illustrated graphically in Fig. (5) showed that total phenol and PAHs of all the tested samples were found to be in higher concentrations in dry season than the wet season especially PAHs.



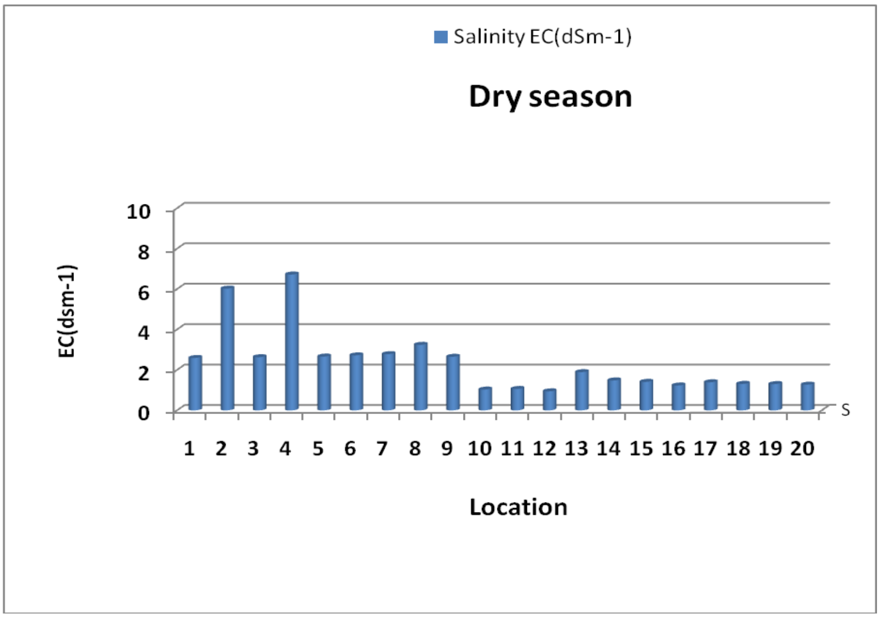
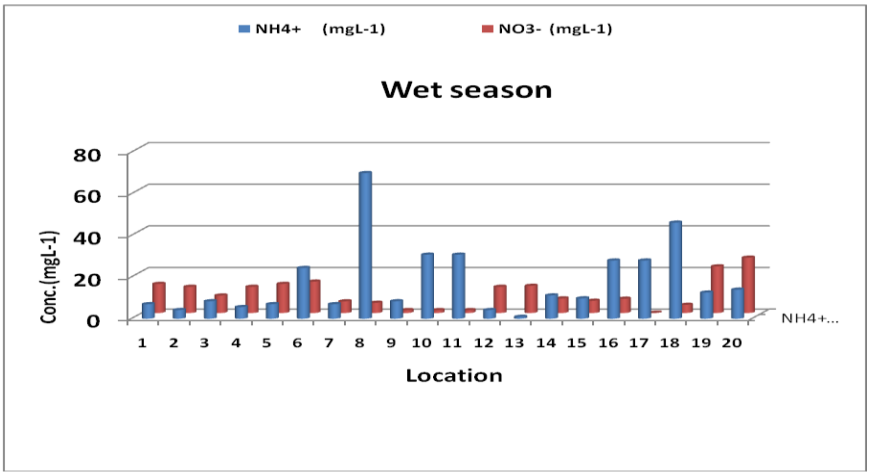


Fig 2. Seasonal variation of salinity in water samples of El-Mohate Drain



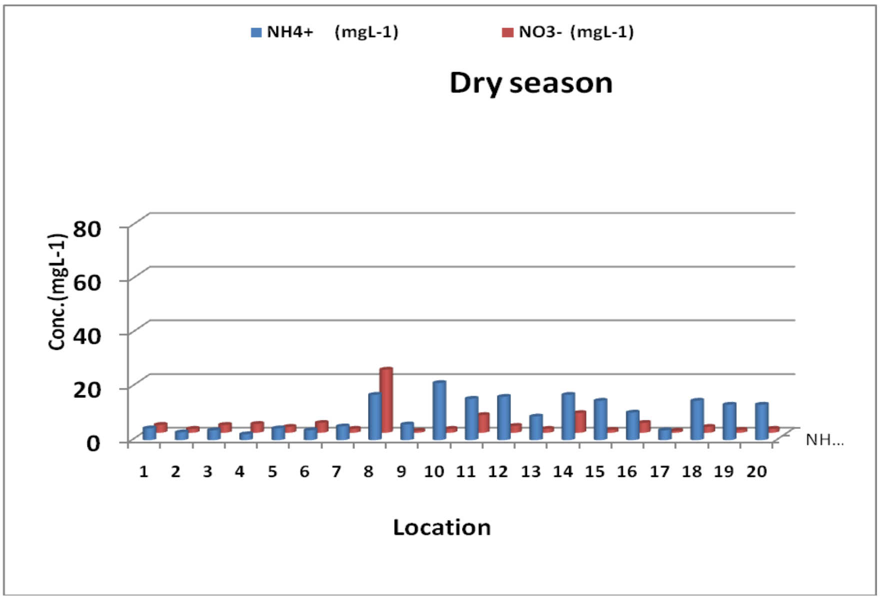


Fig 3. Seasonal variation of Nitrogen in water samples of El-Mohate Drain

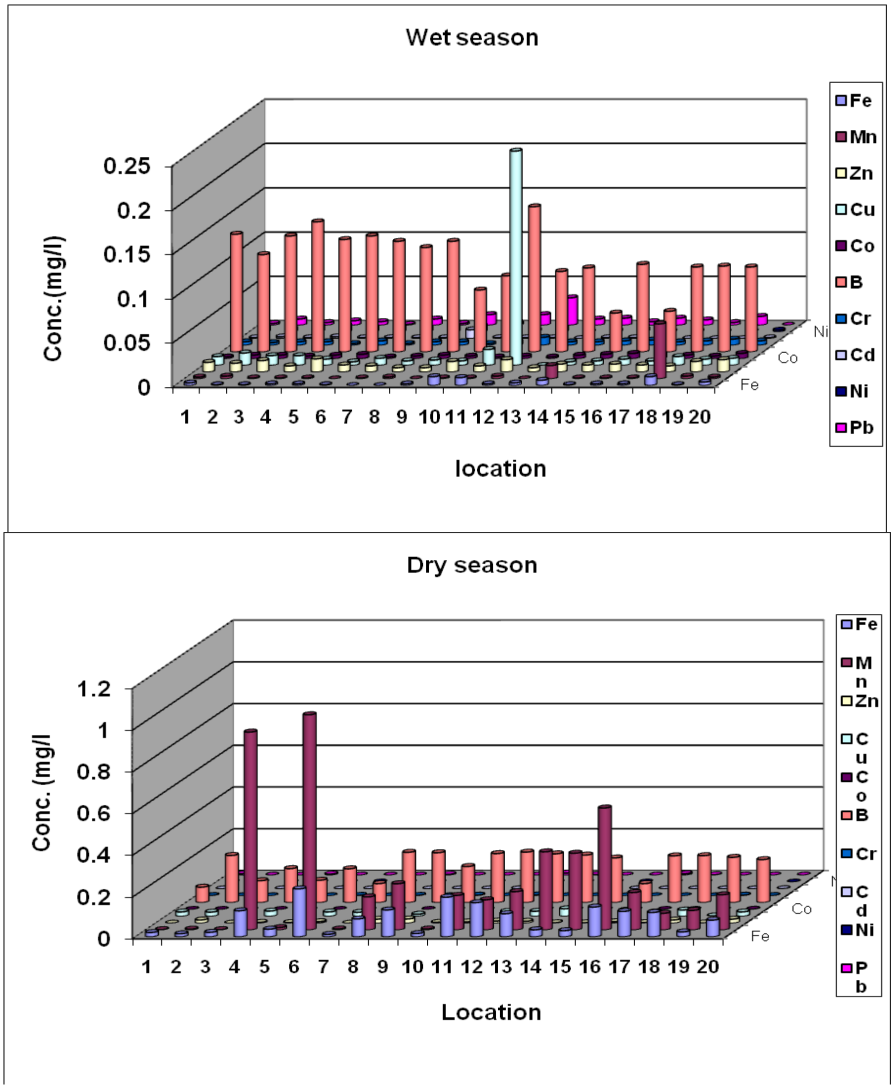


Fig 4. Seasonal variation of heavy metals in water samples of El-Mohate drain

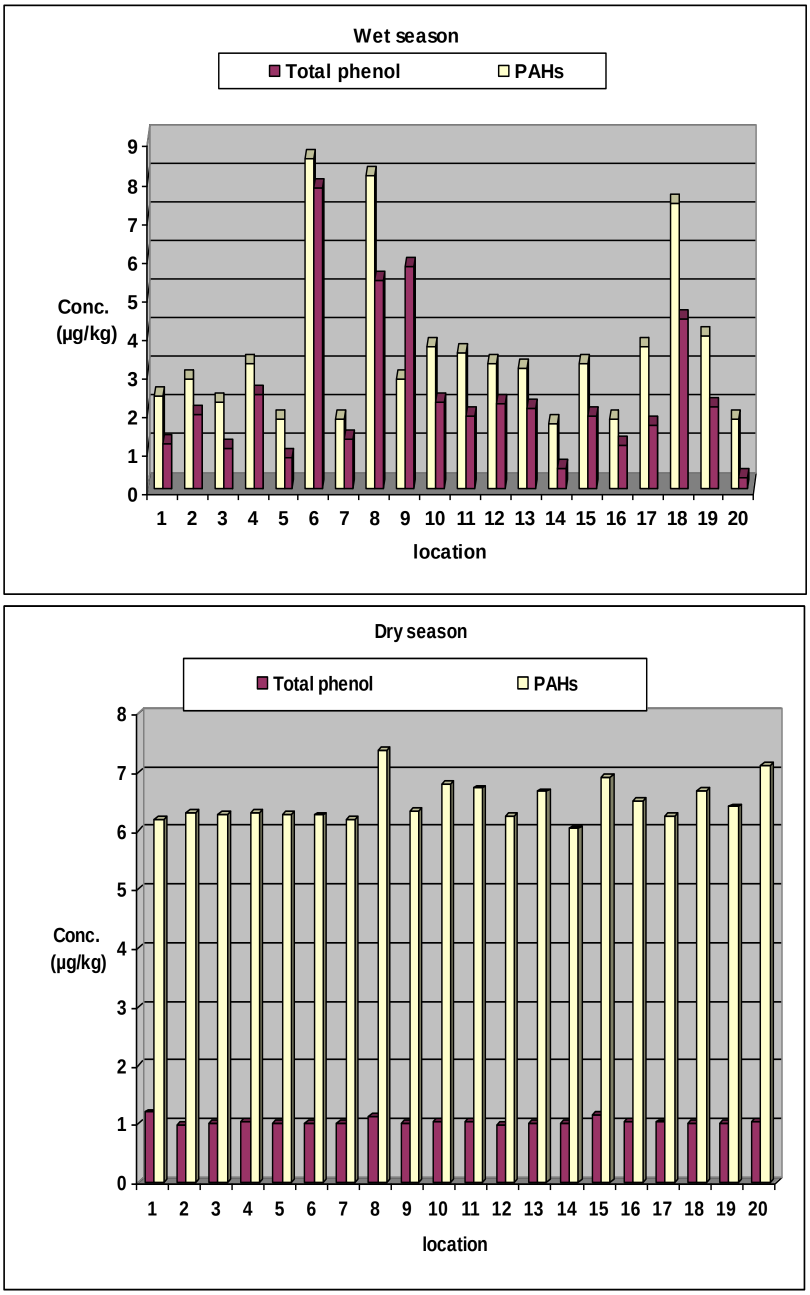


Fig 5. Seasonal variation of organic pollution in water samples of El-Mohate Drain

Biological pollution:

The most important criteria for evaluation of suitability of treated wastewater for irrigation use are as follows: 1) Health aspects. 2) biological and chemical loads of wastewater. 3) Heavy metals and harmful organic substances. Biological criteria are difficult to establish wastewater guidelines and regulations that can suit all regions in the world. In this research we will get an overview of Egyptian's wastewater comparison with guidelines of World Health Organization (WHO, 1989). Important guideline of biological criteria are finding of total *Escherichia coli*, *Salmonella and Shigella* spp .beside, total coliform bacteria. *Escherichia coli is* human intestinal, finding it in water considered as indicator for water polluted by human wastes, meanwhile *Salmonella and Shigella* spp. are pathogen bacteria . Generally, total coliform bacteria, *Escherichia coli*, *Salmonella and Shigella* spp. are counte in different numbers from season to other and from location of sample to other. Total coliform bacteria in wet season and dry season comparison with WHO standard are obvious in Fig.(6).

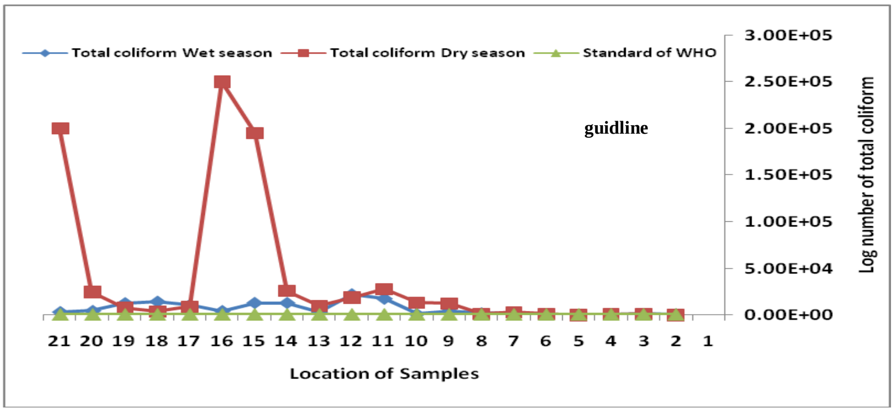


Fig 6. log numbers of total coliform during two seasons comparison with WHO guidline.

Data showed that numbers of total coliform bacteria were greater in dry season than wet season and they were higher than WHO guidline specially from location 9 to 20, Agricultural drain of Umm drain locationttanded the greatest numbers being 2.5 x 10^5cfu/100 ml. Meanwhile, wet season numbers were near or little higher than WHO guidline in locations 11, 12,14,15,18 and 19. This may be due to, temperature low which considered as an obstacle to increase microbial activity beside, low organic wastes in water during wet season.

Also data cleared that, *Escherichia coli* numbers were increased in summer season than winter season, location Agricultural drain of Umm drain and Nile after mixing with El-Mohate drain location recorded the highest numbers (1.2 x 10^5cfu/100ml). Winter season, *Escherichia coli* numbers were higher than WHO guidline at locations11, 12,14,15,18 and 19.

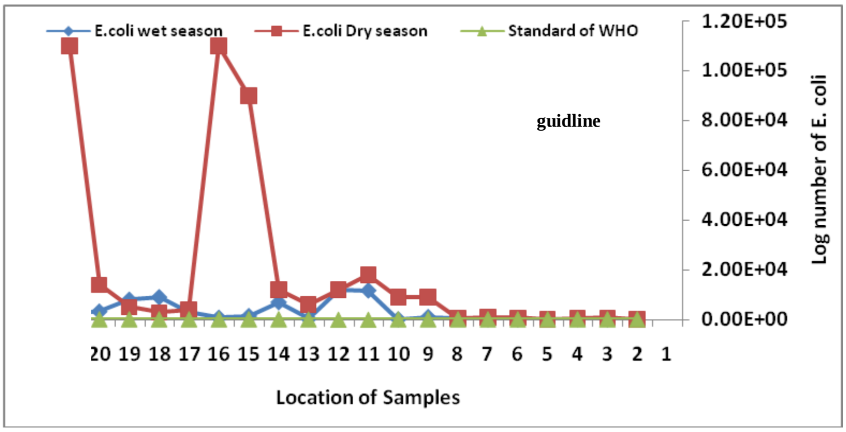


Fig 7. log numbers of *Escherichia coli* during two seasons comparison with WHO guidline.

World Health Organization guidline is not allowing the existence of any colony of *Salmonella* and *Shigella* in irrigation water because they are pathogen bacteria for human. Mohate water is polluted by *Salmonella* and *Shigella* either in wet season or dry season. Finding *Salmonella* and *Shigella* may be due to, some people have bad behavior, they throw the dead animals in moheat drain too, sludge from trench specially in rural environment *Salmonella* and *Shigella* numbers were highest in location Agricultural drain of Umm drain (8 x 10^3 cfu/100 ml) as shown in Fig.(8).Generally, *Salmonella and shigella* numbers were higher in summer season than winter season

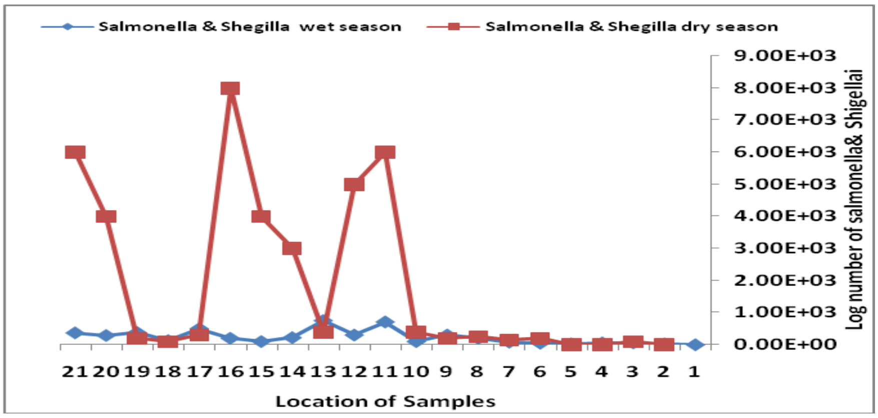


Fig 8. Log numbers of *Salmonella and Shigella* in wet and dry seasons.

In addition biological parameters, regulations often include chemical parameters in order to protect human and environmental health, but also to provide for long-term soil productivity and functioning of irrigation schemes like Total and Suspended Solid and Chemical and Biological Oxygen demand.

Total Solids (TS) are dissolved solids plus suspended and settleable solids in water. The concentration of total dissolved solids affects the water balance in the cells of aquatic organisms. An organism placed in water with a very low level of solids, such as distilled water, will swell up because water will tend to move into its cells, which have a higher concentration of solids. An organism placed in water with a high concentration of solids will shrink somewhat because the water in its cells will tend to move out. Sources of total solids include industrial discharges, sewage, fertilizers, road runoff, and soil erosion. Total solids are measured in (mg/L). Total solids measurements can be useful as an indicator of the effects of runoff from construction, agricultural practices, logging activities, sewage treatment plant discharges, and other sources.

Table 1. Some chemical properties of EL-Mohate water during Wet Season.

Location	TS mg/l Mean ± SE	TSS mg/l Mean ± SE	COD mg/l Mean ± SE	BOD mg/l Mean ± SE
1	1280^{bcde}± 1.45	250^{k}±1.42	1.04^{i}±0.01	0.0
2	2000^{a} ±1.58	722^{b}±0.88	1.7^{h}±0.01	0.0
3	1200^{cde} ±1.15	500^{d}±0.44	1.04^{i}±0.01	0.0
4	2010^{a} ±1.32	743^{a}±0.33	1.07^{i}±0.01	0.0
5	1100^{cdef} ±1.85	80^{q}±1.15	2.4^{f}±0.15	0.0
6	1400^{bcd} ±1.45	100^{p}±0.95	1.04^{i}±0.01	0.0
7	1960^{b} ±1.85	624^{c}±0.88	1.04^{i}±0.01	0.0
8	1300^{bcde} ±1.20	320^{h}±0.88	2.04^{g}±0.03	0.0
9	1760^{bc} ±1.76	456^{f}±0.88	2.04^{g}±0002	0.0
10	560^{ef} ±1.45	210^{m}±0.85	5.9^{a}±0.04	0.0
11	840^{def} ±1.85	60^{r}±2.02	5.2^{b}±0.07	0.0
12	1440^{bcd} ±1.46	50^{s}±1.04	4.5^{c}±0.05	0.0
13	960^{de}f ±2.1	220^{l}±1.86	3.1^{e}±0.1	0.0
14	880^{def} ±1.44	100^{p}±1.02	4.5^{c}±0.04	0.0
15	400^{f} ±1.3	200^{n}±1.76	3.1^{e}±0.16	0.0
16	800^{def} ±2.1	494^{e}±0.33	4.5^{c}±0.08	0.0
17	900^{def} ±1.52	130^{o}±1.53	3.1^{e}±0.19	0.0
18	720^{def}±1.76	376^{g}±0.67	3.8^{d}±0.19	0.0
19	640^{ef} ±2.5	287^{i}±1.76	3.8^{d}±0.08	0.0
20	600^{ef}±2.02	256^{j}±1.53	3.8^{d}±0.04	0.0
LSD(0.05)	638.5	3.88	0.2543	

Data in table (1) showed that TS in two locations (2 and 4) were the highest being recorded 2000 and 2010 mg/l in wet season respectively. on the other hand, the location number 15 attended was the lowest value (400 mg/l) of TS. Guidelines for Interpretations of Water Quality for Irrigation

(Adapted from University of California Committee of Consultants 1974) reported that there three degree of restriction on use non restriction TS are lower than 450 mg/l , moderate restriction TS is 450 – 2000 mg/l and highly restriction TS are more than 2000 mg/l . From there El Mohate waters are nearly in limited range except location Drain Abdel Aal tribal (recorded 2010 mg/l).

Total Suspended Solid (TSS), are solids in water that can be trapped by a filter. Suspended solids include silt and clay particles, plankton, algae, fine organic debris, and other particulate matter. TSS can lead to sludge deposits and anaerobic conditions. Excessive amounts cause clogging of irrigation systems Measures of particles in wastewater can be related to microbial contamination. Total suspended solid in winter season shown in table (1), location Drain Abdel Aal tribal achieved the highest significant value of TSS 743 mg /l and the lowest value was detected location number 12 (50 mg/l).

Some counters are limited TSS to three levels. Good class water content TSS irrage 20-30 mg/l, (usable for irrigation) second class effluent (usable) TSS in the range 45-60 mg/l and third class effluent (cannot be used) TSS are more than 100 mg/l Turkey (1991), Jordan (2002) and Mediterranean countries (2003) according to Annika and Julika, (2005) and Kamizoulis, et al. (2003).

Chemical Oxygen Demand (COD). The COD values indicate the amount of oxygen which is needed for the oxidation of all organic substances in water in mg/l or g/m3, Chemical Oxygen Demand test procedure is based on the chemical decomposition of organic and inorganic contaminants, dissolved or suspended in water. The higher the chemical oxygen demand, the higher the amount of pollution in the test sample. The food and agriculture organization (FAO, 1985) stated that COD standard must not be excess than 10-30 mg/l , hence the Mohate water in wet season is range suitable because all location of samples not significant increase about the standard FAO . Also data in table (1) cleared, the biological oxygen demand (BOD), test procedure is based on the activities of bacteria and other aerobic microorganisms (microbes), which feed on organic matter in presence of oxygen. The result of a BOD test indicates the amount of water-dissolved oxygen (expressed as parts per million or mg/l) consumed by microbes incubated in darkness for five days at an ambient temperature of 20°C. Higher the BOD, higher the amount of pollution in the test sample. ElMohate water is not content BOD during the wet season. The standard of WHO reported the BOD range from 10-30 mg/ l.

Estimated TS,TSS,COD and BOD in summer season are shown in table (2), location number 15 (El-mohate drain after mixing Ballpiny) achieved 2100 mg/l , Meanwhile location number 6 (Abdel Aal Maritime Drain) achieved the lowest TS (450 mg/l).

Table 2. Some chemical properties of Mohate water during summer season

Location	TS mg/l Mean ± SE	TSS mg/l Mean ± SE	COD mg/l Mean ± SE	BOD mg/l Mean ± SE
1	720^{g} ±1.5	200^{h}±2.33	12.31^{j}±0.15	Nd
2	600^{k} ±1.2	130^{k}±2.52	16.31^{i}±0.58	Nd
3	500^{l} ±1.30	118^{l}±2.08	12.31^{j}±0.09	Nd
4	1160^{c} ±1.80	233^{f}±2.40	18.46^{h}±0.31	Nd
5	720^{g} ±1.40	189^{i}±2.65	16.31^{i}±0.55	Nd
6	450^{m}±1.81	110^{m}±1.15	12.3^{1}±0.26	5
7	920^{e} ±1.2	197^{h}±2.52	18.56^{h}±0.19	Nd
8	640j ±1.70	140^{j}±1.45	24.62^{e}±0.47	5
9	680^{h} ±1.45	120^{l}±2.33	26.15^{d}±0.12	5
10	660^{i} ±1.85	189^{i}±1.73	21.54^{g}±0.29	5
11	1200^{b} ±1.42	250^{e}±2.52	23.31^{f}±0.21	5
12	960^{d} ±2.12	340^{b}±1.15	21.5^{g}±0.26	5
13	680^{h} ±1.40	143^{j}±2.08	27.69^{c}±0.03	5
14	1200^{b} ±1.30	280^{d}±2.31	33.15^{b}±0.09	9
15	2100^{a} ±2.1	358^{a}±1.15	40.46^{a}±0.1	10
16	960^{d} ±1.5	300^{cd}±1.86	22.31^{f}±0.14	5
17	900^{f} ±1.70	320^{c}±0.88	12.31^{j}±0.17	Nd
18	1200^{b} ±2.51	220^{g}±2.08	18.54^{h}±0.29	Nd
19	640^{j} ±1.70	129^{k}±1.86	24.62^{e}±0.35	5
20	720^{g} ±2.1	283^{d}±2.85	21.5^{g}±0.15	5
LSD(0.05)	6.284	2.352	0.8067	

Also, data cleared that the same location number 6 obtained the lowest value of TSS (110 mg/l). However, the location number fifteen gave the highest value of TSS (358 mg/l).

Chemical and oxygen demand in this location (15) were the highest values recorded

40.46 and 10 mg/l for both COD and BOD respectively, while locations 1,3,6 and 17 were the lowest in COD recorded 12.31 mg/l in summer season.

Generally, Total solids and suspended, chemical and oxygen demand were significant higher values in summer season than winter season in El-Mohat drain water.

pollutants in soil:

Heavy metals contents in the different soil sites are given in Fig.(8) Results revealed that all metals except Cd were detected in the wet season however both Cd and Ni were not detected in the dry season. Results showed that the concentrations of all the studied metals were still below the critical range in all the samples collected from the investigated locations.

Table3. Different counters standers for heavy metals.

Element	USA	UK	EU
Cd	20	3	1-3
Cr	1500	400	100-150
Cu	750	135	50-140
Ni	210	75	30-75
Pb	150	300	50-300
Zn	1400	300	150-300
Mn	-	-	-
Fe	-	-	-

Data of Organic pollutant contents in the soil sample collected during the two seasons from the different locations under investigation are illustrated graphically in Fig (9).The results showed higher values in phenol contents of all samples which were collected during the dry season from the different locations compared with the wet season. The highest phenol level i.e. 1030 µg/kg was recorded for the sample NO(5) collected during the dry season, while the lowest phenol level i.e. 78.3 µg/kg was that of sample No(4)which was collected during the wet season. Concerning the PAHs content, the highest value was recorded with sample No (3) that was collected during the wet season while the lowest one was recorded with sample No(7) that was collected during dry the season. However the average values of PAHs content in the different seasons were almost similar where they were 114 and 102 µg/kg for the wet and dry seasons, respectively.

pollutants in plants:

Data of pollutant contents in plant samples collected from different locations under investigation are illustrated graphically in Fig.(9). Most of the investigated plant samples, collected from the different studied sites contained detectable amounts of heavy metals. Location No 4 showed plants of relatively higher contents of the metal ions compared with other locations. Likewise, the highest levels of Fe, Zn, Cu, Co, and Cr were detected in the Cauliflower plants. Wide variations in pepper contents of the heavy metals were found among the studied sites where concentrations of most of these metal ions were detected in site 8 in relatively higher levels than the other investigated sites. However, Cd was not detected in either of the studied plants. Higher contents of organic pollutants were observed in certain collected plant, i.e. total phenol in cauliflower and PAHs in Draoh. The content of total phenol in the plants collected from the different locations during the different seasons were in the following increasing order: pepper < zucchini <zeamaize< draw. The content of PAHs in different plants was in the following order: zeamaize > draw> zucchini > pepper.

Fig 9.Seasonal variation of organic, Biological and heavy metal pollution in soil samples of El-Mohate Drain

These results are quite reasonable and expected. It is most likely that soil samples collected from these areas were contaminated in varying degrees by spillage of fuels or oils from heavy trucks and vehicles containing PAH of interest. Other activities that may produce PAHs in these areas include electrical generation from diesel-fueled generators, emissions from petrochemical and heavy chemical industries, light and heavy vehicles burning gasoline and diesel. This concentration is typical in area with increase anthropogenic pollution sources, and emissions from onions plants may be an important source of soil PAH in this area. Polycyclic aromatic hydrocarbons (PAHs) emitted in the environment originate mainly from anthropogenic sources. They are the products of thermal decomposition, formed during incomplete combustion of organic materials and geochemical formation of fossil fuels. The most significant anthropogenic sources of PAH include heat and power generation from coal and other fossil fuels, coal production, petroleum refining, cracking of crude petroleum, incineration of industrial and domestic wastes and chemical manufacturing (Suess, 1976; Neff, 1979). PAH in soils can arise from a number of sources, and these include hydrocarbon spillage (Benner, *et al.*, 1990), products of incomplete combustion of fossil fuels, i.e. wood burning (Freeman and Catteil, 1990), use of organic waste as compost and fertilizer (Smith *et al.*, 2001) and power plants and blast furnaces (Van Brummelen *et al*, 1996). There is also evidence to indicate that PAH are transported over long distances by atmosphere movement (Halsall *et al.*, 2001). Therefore, significant accumulation of PAH is observed in soil, sediments, plants and water bodies when the rate of their emissions from polluting sources exceeds the degradation capacity. Soil contamination originates mainly from PAH emissions to the atmosphere, which reached the soil via precipitation. The other pathways of PAHs dissipation in contaminated soil may be volatilization, irreversible sorption, leaching, accumulation by plants and biodegradation (Reilley *et al.*, 1996). PAHs with three or more rings tend to be strongly adsorbed to the soil. The PAHs concentration in soil were found to correlate significantly with the corresponding levels in air (Vogt *et al.*, 1987); house dust (Chuang *et al.*1995); urban street dust (Takada *et al.*1990) and plants (Wang and Meresz, 1982), therefore, PAHs determination in soils may provide important information on the state of environmental pollution of an area. Characteristic elemental ratio of PAH and PAH profiles can be used for quantitative and qualitative estimation of the source (Yang *et al.*, 1991).

Phenol is released into environment through emission and discharge of effluents from manufacturing units, wood burning and auto exhaust. Phenol disappears rapidly in air, but may persist in water for somewhat longer periods. It enters water mainly from industrial effluent discharges. Phenol may release to soil during its manufacturing process, loading and transport when spills occur, and when it leaches from hazardous waste sites and landfills. Phenol may remains in air, water, and soil for much longer periods if it is continually or consistently released to these media from point sources (Gupta and Singh; 2009).

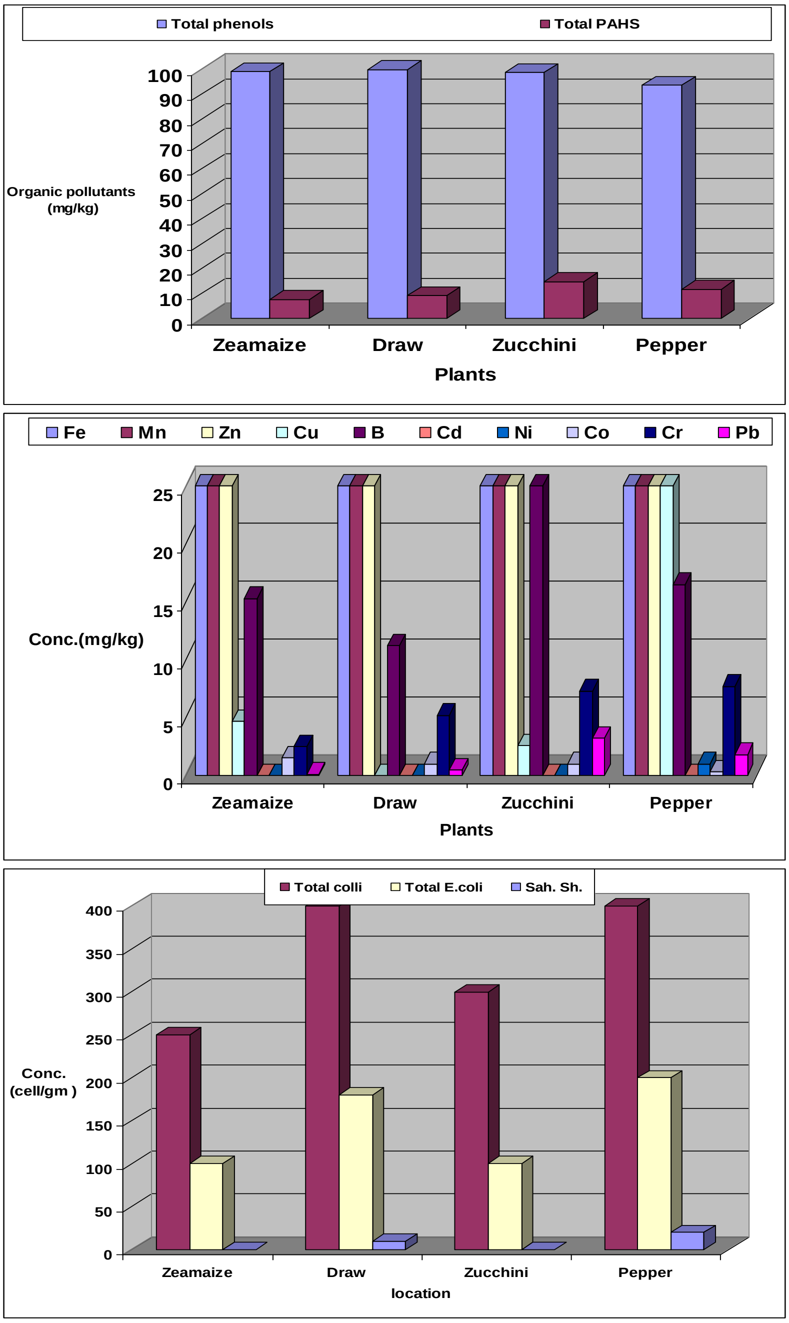


Fig 10.Seasonal variation of organic, Biological and heavy metal in plant samples of El-Mohate Drain

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الأثر البيئى لإستخدام المياه المنخفضة الجودة فى الرى.

سيد أحمد التهامى , يحيى محمود إبراهيم , محمد محمود إبراهيم عفيفى و وفاء عبد الكريم حافظ
معهد بحوث الاراضى والمياه والبيئة - مركز البحوث الزراعية

فى الأونة الأخيرة وقعت مصر فى ازمة من جهة المياه وخاصة بعد بناء سد النهضة ولذا يجب عليها ايجاد مصادر اخرى بديلة للمياه النظيفة وخاصة مياه الصرف. كانت الدراسة على مصرف المحيط (ترعة المريوطية) غرب القاهرة لتقييم التلوث العضوى والغير عضوى والعد الميكروبي وذلك بأخذ عينات على مدار السنة اخذت من اماكن مختلفة على طول الترعة كما اخذت عينات نباتية ومن سطح التربة كما اخذت من الرواسب وذلك لتقدير مدى التلوث على طول المحيط.

أوضحت النتائج ان درجة التوصيل الكهربائى (درجة الملوحة) تراوحت مابين 0,53 و 5,26 dS/m ديس/متر فى فصل الشتاء فيما وصلت فى فصل الصيف 1,26 – dS/m6,72 . كما اوضحت النتائج ان تركيز الأمونيا تراوحت مابين 0,93 – 46,2 ملليجرام/لتر فى فصل الشتاء وفى الصيف 2,2 -2,32 ملليجرام /لتر بينما النترات وصلت الى 0,18 الى 26,6 و 0,73 , 23,52 ملليجرام/لتر فى فصل الشتاء والصيف على التوالى.

تركيز العناصر الصغرى والثقيلة (الحديد – المنجنيز – الزنك – النحاس – الكوبلت – البورون – الكروميوم – النيكل – الكادميوم – الرصاص) كانت اقل من الحدود المسموح بها. كما تم تقدير الملوثات العضوية (الهيدرو كربون الأرومانية) والتى اوضحت النتائج ان مستواها كان اعلى فى فصل الشتاء بالمقارنة بفصل الصيف وكانت الفيولات اعلى تركيز من الملوثات العضوية الأخرى.

وكانت اعداد القولون الكلية اعلى فى فصل الصيف عن فصل الشتاء وسجلت اعداد اعلى من الدليل الارشادى لمنظمة الصحة العالمية وخاصا فى المواقع 9 حتى الموقع 20 كما اوضحت النتائج ان بكتريا السالمونيلا والشجيلا كانت زيادة فى فصل الصيف عن الشتاء

كما اوضحت النتائج ان المواد الصلبة الكلية والمواد والمعلقة والأوكسجين اللازم للأكسدة كيماويا وحيويا كانت قيمة عالية معنويا فى فصل الصيف عن الشتاء فى مياه مصرف المحيط.

المواقع المختلفة التى اختيرت اوضحت ان تركيز العناصر الثقيلة كانت اقل من المسموح به كما زادت تركيزات الفيولات فى فصل الصيف الشتاء وبالعكس مع الهيدرو كربون والتى زادت تركيزها فى فصل الشتاء عن فصل الصيف.

اوضحت النتائج ان تركيز الفيولات فى النباتات اثناء فصل الشتاء اعلى من فصل الصيف وكانت كالاتى:

الدراوه > الذرة > الكوسة > الفلفل فيما كانت تركيزات الهيدروكربون كالأتى:-

الذرة > الدراوه > الفلفل > الفلفل < الكوسة .