J.Soil Sci. and Agric. Eng., Mansoura Univ., Vol. 6 (5): 621 - 636, 2015

EFFECT OF IRRIGATION WITH DRAINAGE WATER ON PHYSIOLOGICAL PROPERTIES OF WHEAT PLANT

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ABSTRACT

The impact of irrigation with wastewater supplied from drain No. 7, Kafr El-Shiekh, Egypt on wheat plant, was investigated. Growth properties, photosynthetic pigment content and the antioxidant system of wheat plant were estimated. Furthermore, heavy metals contents in the collected samples of soil, water from different sites and heavy metals accumulation in the studied plants. For this purpose, two groups of wheat plants were considered. The first group obtained from fields which irrigated using fresh water, while the other group was irrigated using water of drain No.7 from the selected five sites of drain 7. The obtained results revealed that drainage water contained significant amounts of heavy metals (Cd, Ni and Cu) warranted a pollution problem as their amounts exceed the maximum recommended concentrations according to FAO guidelines for trace metals in irrigation water. The wheat plants accumulate significant amounts of heavy metals in their shoots, straw and grains and showed a significant decrease in, fresh weight and dry weight of shoots and roots, accompanied by a marked reduction in photosynthetic pigment content. Significant increase in the activities of antioxidant enzymes and in total carbohydrate content in response to irrigation with wastewater. Cadmium was higher than critical levels at all sites in water. Cupper, Cd and Pb concentration at all sites were lower than critical levels in soil. Cupper,Cd and Pb concentration (ppm) in grains and straw of different sites were increased gradually from site 1 up to site 5. Lead values were the highest and Cd values were the lowest in grains and straw, but Pb concentrations at straw were higher than in grains. Cupper, Cd and Pb concentrations were lower than critical levels in grains. Cupper and Cd concentration were lower than critical levels, but Pb concentration was higher than critical levels in straw.
Keywords: Drainage Water, Irrigation, Wheat, Heavy metals and antioxidant enzymes.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most important nutritional cereal crop in Egypt. It occupies about 33% of the total winter crop area. The local production is not sufficient to meet local requirements. Egyptian production is about 7.4 million tons with an average production of 18.12 ardab per feddan (Anonymous, 2007). Food shortage and water deficit are the greatest problems discussed nowadays, and it is linked both with population growth and water allocation to different sectors, such as domestic, agronomic and industrial uses.

Egypt is mostly a rainless country that leads to limited water resources. Increasing pressure in available water resources in many areas of the world creates continued interest in use of marginal quality water such as agriculture drainage water and treated domestic wastewater. In Egypt, one example of reuse of drainage water (mixing with fresh water for irrigation) is El-Salam canal project in the North East Delta and Synaa (El-Komy, 2012). Some researchers showed that drainage water may contain high soluble cations, anions and high EC and pH which affect on soil characters, crops growth and yield (Hendawy *et al*., 2005; Koca *et al*., 2007; Atlassi *et al*., 2009 and Hamid *et al*., 2011).

Today, the world and Egypt are facing the problem of environmental pollution. In most times drainage water contain industrial and municipal wastewater which contain heavy metals, microorganisms and parasitic (Van Breusegem *et al*., 2001 and Koca *et al*., 2007). Several studies have shown the effect of environmental pollutants on vegetation (Maurrary *et al*., 1990 and Abd El Naim *et al*. 1997) and effect of heavy metals as environmental pollutants (Thomason *et al.*, 1975 and Brady, 1984).

The aim of this current study is to: investigate the effect of irrigation with wastewater supplied from different sites of drain No. 7, Kafr El-Shiekh, Egypt on wheat growth and yield production of wheat in addition to its effect on some soil characters.

MATERIALS AND METHODS

Study area

An experiment was conducted at Kafr El-Shiekh Governorate, Egypt using drainage and fresh water for irrigation of wheat crop in 2012 season. Drainage water was collected from different sites namely (site1 to site5) to cover all sites along away 29.39 Km from the Drain No. 7. The five sites represented drain 7 were as follow: Site (1): The beginning of the drain, Site (2): at 8.850 km, Site (3): at 12.50 km, Site (4): at 20 Km, and Site (5): Pump station of drain No. 7 which discharge the drain water into El-Burulus Lake.

Drain 7 is considered to be one of the most important drains in the Governorate of Kafr El-Shiekh with 29.390 km long. It's water used in irrigatting lands of about 86.000 fed and then drained into El-Burulus Lake.

Sampling

Five water samples were collected from subsurface (1.5 m) of the selected sites (site 1- site 5). The samples were taken into pre-sterilized bottles kept in iceboxes, which were further transported to the laboratory for physico-chemical analysis. For soil, samples were collected at surface level (0-30 cm in depth) from the tested five sites. The collected soil samples were air dried and sieved into course and fine fractions. Well mixed samples of 2 g of each fraction were taken in 250 mL glass beakers and digested with 8 mL of aqua regia on a sand bath for 2 h. After evaporation to near dryness, the samples were dissolved with 10 mL of 2% nitric acid, filtered and then diluted to 50 mL with distilled water.

Physico-chemical analysis

Water temperature and pH of the collected samples were measured in the sites. Water samples were analyzed for Electrical Conductivity (EC), Dissolved Oxygen (DO), and Biological Oxygen Demand (BOD) according to standard methods (APHA, 1992).

EC of soil samples were determined in the soil paste extract by conductivity meter. Measurement of pH of the soil samples were done (soil :

water ratio 1: 2.5) were done with the help of glass electrode pH meter.

Heavy metal concentration (Cu, Cd and Pb) of each soil fraction, water samples and wheat crop (grains and straw) were assayed by Atomic Absorption Spectrophotometer using GBC. Avanta version 1.31 by flame Automization (Hanna, 1992). Quality assurance was guaranteed through double determinations and use of blanks for correction of background and other sources of error.

Experimental design

Each experiment was conducted using randomized complete blocks with three replicates. Wheat grains (*Triticum aestivum* L) were obtained from Sakha Agricultural Research Station, Kafr El-Shaikh, Egypt. Viability of wheat grains, germination percentage was estimated (95%).

Growth conditions

Wheat grains were sterilized, divided into six groups and cultivated in the selected site (near to drain No.7). One field group was irrigated with fresh water as control group. The remaining groups; were irrigated with the tested wastewater supplied from the above mentioned five sites.

Wheat grains were left to grow till the end of season, and samples (triplicates) from each group were collected at seedling (15-day old), vegetative (45-day old), flowering (70-day old) and harvesting (160-day old) stages. Each sample was subjected to the different measurements.

Measurements

Growth criteria

At vegetative and flowering stages, wheat plant were removed carefully from the cultivated soil, washed thoroughly with tap water and divided into roots and shoots. Fresh weights, dry weights and lengths of both roots and shoot were used as an indicator for studying the effect of irrigations with wastewater on wheat growth.

Photosynthetic pigments

The photosynthetic pigments; Chlorophyll a (Chl a) and Chlorophyll b (Chl b) were estimated in wheat leaves at vegetative and flowering stages as described by Arnon (1949). Briefly, 0.5 cm^2 of fresh leaves were homogenized immediately after harvesting in 5-10 ml aqueous acetone (85%) and kept in a dark, then centrifuged at 3000 rpm. The pigment contents were measured using a spectrophotometer at 664 and 645 nm, respectively. Final chlorophyll content (mg/g fresh. weight) was calculated according to the following equations:

Chlorophyll a = 10.3 E664 - 0.91 E645

Chlorophyll b = 19.7 E645 -3.8 E664

Mineral nutrient contents

The powdered oven dry plant materials (shoots, roots and grains) were exposed to acid digestion as described by Chapman and Pratt (1961). Briefly, 0.2 g of plant sample was digested in 5 ml of H_2SO_4 and 1 ml $HClO_4$. The extract of digested plant materials was used for the determination of mineral nutrient contents as follow: Nitrogen (N) content by micro-Kjeldahl (Page, 1982), Total phosphorus (P) content by spectrophotometer (Snell and Snell, 1967), potassium (K) content using flame photometer (Jackson, 1967).

Carbohydrate content:

Carbohydrate content was determined in plant samples (shoots and grains) according to Naguib (1962). A powdered oven dry samples (0.2g) were transferred to test tubes by 10 ml 0.5 N HCl, the tubes were kept in water bath at 100ºC for one hour, cooled and filtered. The filtrate was completed to 50 ml with distilled water. The reagents used were: (a) 5% phenol and (b) 95% reagent grade sulphuric acid. One ml of the extract was pipetted in a colorimetric tube. One ml of 5% phenol solution was added and mixed, 5 ml of 95% sulphuric acid was added to each tube and tubes were agitated after acid addition. After 10 minutes, the tubes were re-shaken and placed in a water bath at 25-50°C for 20 min. The absorbance was measured at 450 nm. The carbohydrate content (mg/g DW) was determined from a standard curve using glucose sugar.

Extraction of soluble proteins

A frozen sample (0.5 g) of wheat seedlings stage (15-day old) was homogenized in 8 ml of 50 mM cold phosphate buffer at pH 7 as described by Beauchamp and Fridovich (1971) with slight modifications. The homogenates were centrifuged at 4000 rpm for 20 min, the collected supernatant was used as a crude extract for the following antioxidant enzymes assay:

1- Catalase

Catalase was assayed by measuring the initial rate of disappearance of H_2O_2 (Kato and Shimizu, 1987). A sample of 3 ml of reaction mixture contained 0.1 M sodium phosphate buffer (pH 7), 2 mM H_2O_2 and 0.1 ml enzyme extract. The decrease in H_2O_2 was followed as a decline in the absorbance at 240 nm. The activity was expressed in units of µM of the substrate converted per minute per gram fresh weight.

2- Peroxidase

Peroxidase activity was measured according to Kato and Shimizu, (1987). The assay medium contained 0.1 M sodium phosphate buffer (pH 5.8), 7.2 mM guaiacol, 11.8 mM H_2O_2 and 0.1 ml enzyme extract and the final assay volume was 3 ml. The reaction was initiated by the addition of H_2O_2 and the change in absorbance was at 470 nm. Enzyme activity was expressed in units of µM of the substrate converted per min per gram fresh weight.

3- Superoxide dismutase

Superoxide dismutase was assayed on the basis of its ability to inhibit the photochemical reduction of nitro blue tetrazolium (Beauchamp and Fridovich, 1971). Three ml of the reaction mixture contained 50 mM sodium phosphate buffer (pH 7.8), 13 mM methionine, 75 mM nitro blue tetrazolium, 2 µM riboflavin, 100 mM EDTA and 0-200 µl enzyme extract.Absorbance by the reaction mixture was at 560 nm.

Statistical analysis

All the obtained data was statistically analyzed using the methods described by Cochran and Cox (1960).

RESULTS AND DISCUSSION

According to the FAO Land and Plant Nutrition Management Service, over 6% of the world's land is affected by either salinity or sodicity. Moreover, the low water quality and the poor drainage systems are the greatest causes of these stresses, and this problem is more acute with higher evaporation, especially in arid and semi-arid zones. Use of industrial or municipal waste water for irrigation purpose is a common practice (Singh *et al.,* 2004). The effluent not only affects the plant growth but also deteriorate the soil properties when used for irrigation where saline soils are wide spread that induced the decreasing of land productivity in many countries over the world (Atlassi *et al*., 2009).

Physico-chemical analysis

Resulte in Table (1) showed the variation of EC, Na^+, Ca^{++}, Mg^{++}, K^+, HCO_3^- and Cl^- values at different five sites along drain No.7. The values of Na^+, Ca^{++}, Mg^{++}, HCO_3 and Cl were heigher than ISI (standard for irrigation). The lowest values of EC, Na^+, Ca^{++}, Mg^{++}, K^+, HCO_3^- and Cl^- were recorded at site 1 (0.82, 5.6, 1.3, 1.8, 0.1, 3.5 and 3.9) respectivelly, while the heighest values were recorded at site 2 (5.58, 37.6, 8.9, 12.3, 0.6, 0.6 and 26.6) respectively.

This may be de to soluble salts discharged to the drain from the soils surrounded by the drain throught the drainage or soluble salts from municiple wastewater, industerial water discharged to the drain No.7.This resulte are agreed with those obtained by El-Maghraby, (2008).

Table 1. Chemical characteristics of irrigation water from different sites of drain No. 7 :

Water analysis	site1	site2	site3	site4	site5	IS standards for irrigation (ISI)
EC dSm^{-1}	0.82	5.58	1.47	1.71	4.16	0.42
Na^+ meq/l	5.6	37.6	10	11.6	28.3	1.3
Ca^{++} meq/l	1.3	8.9	2.4	2.4	6.7	1.7
Mg^{++} meq/l	1.8	12.3	3.2	3.2	9.2	0.97
K^+ meq/l	0.1	0.6	0.1	0.1	0.4	0.23
CO_3^{--} meq/l	0	0	0	0	0	0
HCO_3^- meq/l	3.5	0.6	7	6.5	6	3.09
Cl meq/l	3.9	26.6	0.7	8.1	19.9	0.75

Chemical characteristics of soil from drain No.7 :

Table (2) showed that the variation of EC, Na^+, Ca^{++}, Mg^{++}, K^+, CO_3, HCO_3^- and Cl^- values at different five sites of soil from drain No.7. in soil of different locations at drain no. 7 The lowest values of EC, Na^+, Ca^{++}, Mg^{++}, K^+, CO_3, HCO_3^- and Cl^- were recorded at site 3 (1, 6.8, 1.6, 2.2, 0.1, 0, 7 and 4.8) respectivelly, while the heighest values were recorded at site 5 (4.5, 30.6, 7.2, 9.9, 0.5, 0, 9 and 21.4), respectively, followed by site 4 and the lowest site was site 3. EC at site 5 were the heighest. These resultes are relatively in complete accordance with the resultes which recorded by Ladwani *et al*., (2012) and Mir *et al*., (2012) who they reported that the untreated or partially treated waste water from industries are continuously used in irrigating the agricultural fields in developing countries and continous use of this waste water for irrigation effects of soil quality.

Table 2. Chemical characteristics of soil samples from different sites of drain No. 7 :

Water analysis	site1	site2	site3	site4	site5	IS standards for irrigation (ISI)
EC dSm^{-1}	2.25	2.11	1	3.9	4.5	5.0
Na^{+} meq/l	15.3	14.3	6.8	26.5	30.6	14.8
Ca^{++} meq/l	3.6	3.4	1.6	6.2	7.2	21.2
Mg^{++} meq/l	5	4.6	2.2	8.6	9.9	10.4
K^{+} meq/l	0.2	0.2	0.1	0.4	0.5	0.3
CO_3^{--} meq/l	0	0	0	0	0	0.0
HCO_3^{-} meq/l	7	8	7	7	9	2.8
Cl^{-} meq/l	10.7	10	4.8	18.6	21.4	10.8

Heavy metals (Cu, Cd and Pb) concentrations (mg/L) were estimated in the collected wastewater and soil samples at different sites (site.1-site.5) as represented in Table 3. The obtained data revealed that the highest values of the three heavy metals were recorded in site.5 and the lowest values recorded in siet.1. As observed, Pb concentrations ranged between 4.6; (site1) to 6.3; (site4) and 0.075; (site 1) to 1.5; site.4 ppm in soil and wastewater samples, respectively. On other hand Cd concentrations recorded the lowest values in collected soil and wastewater samples. The highest value (.119 ppm) of Cu concentration was estimated in water samples collected from site.5 and the lowest value (0.036) was detected in site 1.

The increases of the studied three heavy metals in samples of site 1) may be due to that site 1 is near from the first drainage source. Also the three heavy metals were increased gradually due increases of heavy metals leached from the soils during reuse of the drainage water. These results agreement with El-Guindy and Amer, (1989) who reported that trace elements occur in almost all drainage water but at low concentrations, Mohamed *et al.,* (1998) detected that in spite of the low concentration of heavy metals in irrigation water, high accumulation of Pb and Cu were observed in the soil and crop yields, Alnenaei (2003) stated that, the contamination of water bodies in the Egyptian Nile Delta by metals is caused by the discharge of massive amounts of domestic sewage as well as agricultural and industrial effluents, Franca *et al*., (2005) observed that heavy metals occur in the environment both as a result of natural processes and as pollutants through various pollution sources from human activities. Maceda-Veiga *et al*., (2012) detected that domestic wastewaters can contain fairly high concentrations of metals, such as Al, Ni, Cu, Fe, Pb and Zn, which are derived from a wide variety of household products, such as cleaning materials, toothpaste and cosmetics. Ghannam *et al*., (2014) concluded that Cd was not detectable (below the detection limits with ICP -OES <0.001 and <0.005) in water samples (El-Bahr El-Pharaony drain). On the other hand, Cu and Pb exceeded the permissible limits of Egyptian law.

The increases of the studied three heavy metals (Cu, Cd, Pb) from site 1 up to site 5 in soil of different locations at drain 7 may be due to using water of drain 7 for irrigation which precipitate heavy metals in the soil. Results are relatively in complete accordance with the results recorded by Nriagn and Pacyna, (1988) who reported that about 2 million tons of copper are released each year as a result of human activity, causing locally raised levels in terrestrial and aquatic environments, Franca *et al*., (2005) observed that heavy metals occur in the environment both as a result of natural processes and as pollutants through various pollution sources from human activities. And Ladwani *et al*., (2012) and Mir *et al*., (2012) so they reported that the untreated or partially treated waste water from industries are continuously used in irrigating the agricultural fields in developing countries and continuous use of this waste water for irrigation effects of soil quality.

Table (3) Heavy metals content (ppm) of different waste water and soil sample collected from different sites of drain No.7.

Collected samples from different sites	Soil			Water		
	Cu	Cd	Pb	Cu	Cd	Pb
Site.1	3.34±0.314	0.108 ±0.011	4.3±0.2	0.036±0.006	0.027±0.097	1.102±0.097
Site.2	3.65±0.216	0.082±0.011**	4.63±0.157*	0.039±0.001	0.082±0.011**	1.05±0.010
Site.3	5.49 ±0.012**	0.089±0.009**	5.23±0.208**	0.12±0.01**	0.089±0.009**	1.306 ±0.015**
Site.4	8.02±0.020**	0.132±0.006**	5.6±1.087**	0.112±0.001**	0.132±0.006**	1.484±0.014**
Site.5	8.83 ±0.079**	0.139±0.00**	6.33±0.152**	0.119±0.001**	0.139±0.00**	1.532±0.010**
ISI	0.05	0.0991	3.97	0.015	0.005	0.075
L.S.D $_{0.05}$	0.317	0.015	0.293	0.010	0.015	0.081
L.S.D $_{0.01}$	0.451	0.021	0.417	0.014	0.021	0.115

(ISI) Is Standards for Irrigation
Critical levels in soil according to Kabata –Pendias and Pendias (1992) for Cu, Cd and Pb were 60 : 125, 3 : 8 and100 : 400 ppm respectively.
Critical levels in water according to FAO (1985) for Cu, Cd and Pb were 0.2, 0.01 and 5 ppm, respectively.
*** Results are significantly different from control at (p<0.05)**
**** Results are significantly different from control at (p<0.01).**

Effect of irrigations with wastewater on growth of wheat

Growth criteria of wheat plant irrigated with water from the different sites of drain No.7, at vegetative and flowering stages were measured. The obtained results presented in Fig (1) indicated that the maximum growth of wheat plants was recorded in group irrigated with fresh water (control) rather than the wastewater (site 1- site5). Shoot fresh weight at vegetative and flowering stages of plant samples were significantly decreased in comparing with control samples (1.2-2.8 g vs 3.0 g and 0.06 - 0.6 g vs 0.9, respectively). Noticely, site 5 showed the upper most deleterious effect on growth criteria obtained from wheat crop. These results are agreed with those obtained by

Atlassi *et al*., (2009). Heandway *et al*., (2005) and Koca *et al*., 2007 who stated that , waste water and polluted soil decreases in growth of crops, may be due to toxicity of high level of dissolved solids. The increase of shoot and root fresh weight of samples irrigated with water from site 3 may be due to discharged of drainage water less in EC and soluble cations and anions.

Fig. 1 . Growth criteria of wheat plant groups at vegetative and flowering stages.

Effect of irrigations with wastewater on chlorophyll content of wheat

The chlorophyll (a and b) content in wheat shoots of all wheat groups were presented in Fig 2. The data indicated that chlorophyll content in wheat plants irrigated with fresh water recorded higher values than those irrigated by wastewater at both vegetative and flowering stages. Chl a and Chl b content of wheat plant irrigated with wastewater from site1 at vegetative stage was decreased with about 7.5% and 1.82%, respectively with comparing to control group . While, at flowering stage the decrease of Chl a and Chl b content was about 2.65% and 3.37% respectively, compared to control. However, samples from site 5 showed a highly significant decrease in Chl a and Chl b content (38% and 36.36%, respectively) at vegetative stage while it reached (39.07%) and (38.65%) reduction at flowering stage. Enhancement of chlorophyll content in both wheat samples irrigated with water from site 1 and control samples may be due to higher nutrient uptake from the water. Nagda *et al*., (2006) in their experiment on seed germination found similar result. Srivastava and Sanhai (1987) also found similar results using distillery wastewater. Higher concentration of wastewater are inhibitory to synthesis of chlorophyll molecules particularly chlorophyll *a* (Khan *et al*., 2011). The variation in chlorophyll content was found to be statistically significant with treatment at various sites of drain No. 7.

The change in chlorophyll content indicates that the chlorophyll synthesizing capacity have diminished affecting of the photosynthetic process. Krupa *et al.,* (1993) reported values in the same trends as we were investigated, they mentioned that cadmium content in wastewater reduced plant growth, biomas and leaf pigments, and cadmium can harness photosynthetic activity as well as the chlorophyll content.

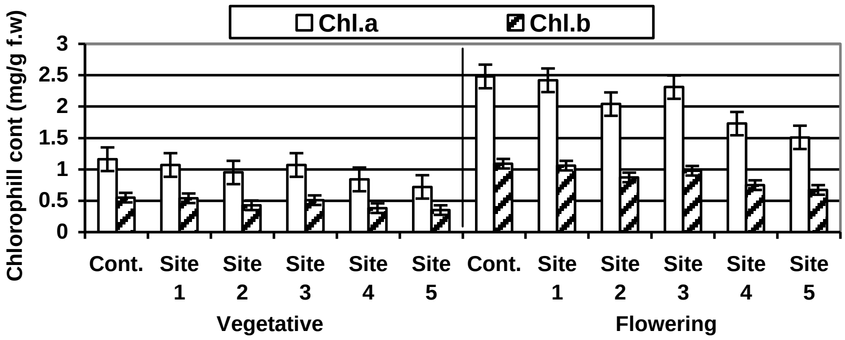

Fig. 2. Chlorophyll a and b content on wheat crop groups at vegetative and flowering stages.

Effect of irrigations with wastewater on total carbohydrates % of wheat

Total carbohydrate (mg\gm DW) in shoot at flowering stage of wheat plant groups (G1-G5) were increased than those of control samples as shown in Table 4. At flowering stage of wheat plant G5, were increased by 37.9%, 8.2% and 27.8 % in shoot, grains and straw, respectively compared with control samples. The lowest values of carbohydrate content was recorded samples irrigated with water from site 1, however, total carbohydrate in grains and straw at harvest stage decreased significantly with about (1.7%) and (1.4%) respectively.

This may be due to stress effect which reflected on wheat leaf area. Carbohydrate content in straw and grain at harvest stage (Table 4) were decreased in samples obtained from site 1, this may be due to leaf area was less than plants which irrigated by drainage water comparing with control which irrigated by fresh water so effect on photosynthesis and carbohydrate accumulation. These results are harmony with those obtained by Rong *et al.,* (2007) who showed that stress induces the decline in protein contents in plants but increase in soluble sugar content. Several studies suggested that the accumulation of soluble carbohydrates was significantly related to salt tolerance (Teimouria *et al.,* 2009; Yin *et al*., 2010 and Zhang *et al*., 2012). Hirich *et al*., 2014, stated that soluble sugars increased with increasing irrigation water salinity.

Table 4 . Total carbohydrate (mg\gm DW) in shoot, grains and straw, of wheat plants irrigated by water from different locations of drain No. 7.

Wheat crop group	shoot	grains	straw
control	62.496± 2.739	74.837±12.32	65.879±3.733
Site 1	66.117±.818*	73.577±2.769	64.947±2.868
Site2	81.370±1.516**	80.0±0**	68.290±2.211
Site3	75.122 ±3.530**	55.943±0.863**	62.097±2.539
Site 4	85.694±.795**	85.057±2.280**	78.643±1.794**
Site 5	86.182 ±.743**	88.470±1.371 **	84.190±2.786**
L.S.D 0.05	3.566	2.995	4.843
L.S.D 0.01	5.000	4.199	6.790

***Results are significantly different from control at (p <0.05)**
****Results are significantly different from control at (p <0.01).**
Each result is triplicate reading

Heavy metals concentration in straw and grains of wheat

Heavy metals (Cu, Cd, Pb) content in straw and grains of wheat plant irrigated with water collected from different station in drain No.7 are shown in (Table 5).

Concentrations of three heavy metals (Cu, Cd and Pb) ppm in grains and straw at harvest stage of samples irrigated with water from the different sites of drain 7 increased significantly than those of the control samples. Meanwhile samples of the site 1 showed the lowest concentration.Three heavy metals (Cu, Cd, and pb) in grains of site1 was increased with about (42.8%), (103.3%) and (325.6%), respectively. However, site 5 showed a highly significant increase were about (126.1%), (155.9%) and (545.83%), respectively, compared to control treatment.

However, evolution for three heavy metal (Cu, Cd and pb) in straw of site 1was increased significantly with about (20.9%), (5.1%) and (223%)

respectively. And of site 5 showed a highly significant increase was about (112.4%), (106.3%) and (263.6%), respectively, compared to control treatment. Pb concentration in grains and straw were higher than Cu and Cd concentration. While concentrations of (Cu,Cd and Pb) in straw are higher than in grains. Pb concentration in straw were higher than critical levels in according to FAO (1985) .

The increases of the studied three heavy metals (Cu, Cd, Pb) in straw and grains of wheat plant which irrigated with water of different sites from drain No.7 (Table 5) may be due to the presence of these heavy metals in the water and the soil, similar results were obtained by Pietz *et al*., (1978) and Amin, (1997) who reported that Pb concentration in all studied crop irrigated with fresh and drainage water was higher than the permissible levels for human consumption.

Table 5 . Heavy metals contents (mg/ Kg) of grains and straw samples at harvest stages from wheat plant.

Water used for irrigations collected from different sites	Collected samples of wheat irrigated by wastewater					
	Grains			Straw		
	Cu	Cd	Pb	Cu	Cd	Pb
CG	0.84±0.05	0.059±0.01	0.336±0.208	6.78±0.243	0.253±0.0585	5.5±0.2
St.1	1.2±0.01**	0.12±0.01**	1.43±0.09**	8.2±0.1	0.24±0.01	17.8±0.328
St.2	1.28±0.026 **	0.34±.01**	3.21±0.05**	9.5±0.141**	0.525±0.005**	18.4±0.1**
St.3	1.5±0.1**	0.12±0.01**	1.67±0.49**	10.46±0.057**	0.336±0.025**	18.5±0.0**
St.4	1.73±0.01**	0.176±0.015**	2.64±0.17**	13.2±0.1**	0.736±0.015**	19.7±0.132**
St. 5	1.9±0.055**	0.151±0.005**	2.17±0.06**	14.4±0.1**	0.522±0.006**	20±0.0577**
L.S.D $_{0.05}$	0.118	0.018	0.423	0.243	0.048	0.307
L.S.D $_{0.01}$	0.165	0.026	0.593	0.341	0.068	0.43

Critical levels in grains and straw according to FAO (1985) for Cu, Cd and Pb were 4:15, 0.2:0.8 and4:15 ppm respectively.
*** Results are significantly different from control at (p<0.05)**
**** Results are significantly different from control at (p<0.01)**

Effect of irrigations with wastewater in antioxidant enzymes produced in wheat seedlings

The activities of antioxidant enzymes Catalase (CAT), Peroxidase (APX) and Superoxide Dismutase (SOD) in leaves of wheat plant irrigated by wastewater (G1 to G5) are shown in Fig. (3). Antioxidant enzymes activities (µ l/ g f.w) of wheat samples groups irrigated with wastewater were increased significantly than those of CG. Meanwhile, catalase, SOD and APX in G1 samples were increased than CG by 16%, 19.3% and 11.7%, respectively. Samples of G5 has the highest increase with 88.2 %, 69.1% and 64.7 % for catalase, peroxidase and SOD, respectively.

Drainage water contains salts and heavy metals in varied degrees led to oxidative stress in plant irrigated with water and cause several physiological changes due to chance in metabolic pathway (Lee *et al*., 2001;

Panda and Upadhyay, 2003). Production of several Active Oxygen Species (AOS) increases in the presence of NaCl and has been stated to damage almost every macromolecule (Khan and Panda, 2002). However, in many plant cells exposed to oxidative stress the lead to induction of both enzymatic (Superoxide Dismutase (SOD), Catalase (CAT).

Changes of antioxidant enzymes activity under environmental stresses have been suggested as indicators for biotic or abiotic stresses (Lee, 1997; Pakniyat and Abedi 2010 and Tian *et al.*, 2012).

Fig. 3. Effect of irrigation with water from different sites on antioxidant enzymes activities (catalas, super oxide dismutase, and peroxidase).

- This it can be concluded that water from site 1 have the lower deliterius effect so we can use it in irrigation, however water from site 5 have the most deliterius effect so we must not use it in irrigation.

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تأثير الرى بمياه الصرف الصحى على الخواص الفسيولوجية لنبات القمح

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تم دراسة تأثير رى نباتات القمح بمياه مصرف نمرة ٧ بمحافظة كفر الشيخ وقدرت مقاييس النمو والمحتوى الصبغى ونظام مضادات الأكسدة لنبات القمح بالإضافة إلى ذلك قدر محتوى عينات التربة والنبات من العناصر الثقيلة .

ولتحقيق هذا الغرض تم أخذ مجموعتان من عينات القمح : المجموعة الأولى أخذت من حقول تروى بماء عذب بينما المجموعة الأخرى تروى بمياه مصرف نمرة ٧ من الخمس مواقع المختاره وقد أظهرت النتائج ان مياه المصرف تحتوى على كميات من العناصر الثقيلة (كادميوم ورصاص ونحاس) مما يتسبب فى مشكلة التلوث إذا ما تعدت الكميات الموجودة فى مياة الرى الحدود الموصى بها حسب إرشادات منظمة الأغذية والزراعة.

وقد تجمعت كميات ملحوظة من العناصر الثقيلة فى كل من الجزء الخضرى وقش وحبوب القمح مما أدى إلى نقص ملحوظ فى الوزن الرطب والوزن الجاف لكل من الجذور والجزء الخضرى مصحوبة بنقص فى المحتوى الصبغى وكذلك زيادة ملحوظة فى نشاط الإنزيمات المضادة للأكسدة وكذا المحتوى الكلى للكربوهيدرات إستجابة للرى بمياه المصرف.

سجل عنصر الكادميوم فى عينات المياه نتائج أعلى من الحد الحرج فى كل المواقع بينما كان مستوى النحاس والكادميوم والرصاص فى التربة أقل من الحد الحرج وزاد تركيز النحاس والكادميوم والرصاص فى حبوب وقش نبات القمح تدريجياً من الموقع (١) الى الموقع (٥).

كان أعلى العناصر تركيزاً هو الرصاص وأقلها الكادميوم فى كل من الحبوب والقش وكان الرصاص فى القش أعلى من الحبوب.

بالنسبة للحبوب كان تركيز النحاس والكادميوم والرصاص أقل من الحد الحرج وفى القش كان تركيز النحاس والكادميوم أقل من الحد الحرج بينما تركيز الرصاص كان أعلى من الحد الحرج.