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HEAVY METALS CONTENT OF SOME COTTON GENOTYPES AND SOIL PROPERTES AS AFFECTED BY WATER QUALITY

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ABSTRACT

Plant uptake is one of the major pathways by which toxic metals enter to human food chain. The irrigation water, important source of toxic metals, is contaminated with effluent and other pollutants due to the widespread industrialization. Two lyzimeter experiments were conducted at Sakha Agric. Res. Station, Kafr El-sheikh, Egypt, for two successive seasons, 2010 and 2011.It aimed to study the effect of irrigation water quality for long –term on productivity of four cotton genotypes; Giza86, Giza87, Giza88 and Giza89 in the two seasons were to study the content of their root, stem, leaves, and seed cotton of heavy metals; Cd, Ni and Pb as affected by irrigation water quality. Lyzimeters (100\ 70/ 90 cm) were filled with clayey soil was irrigated with three water qualities since 1987. They were $_{W1}$, Nile water, W_3, drainage water and W_2, mixed water, 50% W_1+50%W_3. A split –plot design with four replicates were used where, irrigation water quality and cotton genotype were allocated to main and sub-plots, respectively .The obtained results showed that using drainage water quality for irrigation increased ECe, SAR, soluble Na^+, Mg^{++}, $So4^=$and Cl^- in soil paste extract, total and available Pb,Cd and Ni than that of mixed or Nile water. The results show also that the effect of genotypes were different significantly for all studied cotton yield and same characters of tested genotypes .The effect of drainage water on studied genotypes were significantly different on most studied characters; the highest values for seed cotton yield , seed and plant high were obtained from Nile water followed by mixed water mean while drainage water gave the lowest values for this characters .The interaction between water qualities and cotton genotypes were significant in some studied characters. In general, stem cotton of the studied heavy metals were higher than that of root, leaves, and seed cotton for all water quality treatments .Cotton root, stem, leaves, and seed cotton contents of Pb ,Cd and Ni greater when drainage water (W_3) was applied than that of the mixed or Nile water.

Keywords: cotton, water qualities, heavy metals.

INTRODUCTION

Heavy metal toxicity is one of major current environmental health problems, and potentially dangerous due to bioaccumulation through the food chain and in plant products for human consumption. Therefore, heavy metal contamination of soils and plants has become an increasing problem.

A number of factors including climate, atmospheric deposition, the nature of soil on which the plant is grown and the maturity degree of plant at time of harvesting influence the concentration of heavy metals on and within plants (voutsa *et al*. 1996 and Lake *et al*.1984). Heavy metal contents of food plants can be affected by the anthropogenic factors such as the application of fertilizers, sewage sludge or irrigation with waste waters (Devkota and Schmidt, 2000 and frost and ketchum 2000). Heavy metal contamination of agricultural soils can pose long – term environmental problems and are not without health implications (**Ferguson 1990**). In conclusion, increasing industrialization and urbanization have not only degradation but also caused the contamination of our precious food resources. During recent years, studies on toxic effects of heavy metals especially Cd, on crop plants are being received considerable attention (Boussamo *et al*, 1999). Translocation of Cd from root to shoot has been studied in several plant species, showing that it is likely to occur via the xylem and to be driven by leaf transpiration (Hart *et al*.1998). The studies on the determination of metal concentration in plant species are not important only for their translocation to food chain, but also examination of the soil remediation by phytoextraction of toxic metals. Cotton is a major world cash crop; however, limited information is available on genotypic variation regarding the impact of Cd toxicity on growth and yield (WU *et al*, 2004). Throughout all countries, the extent of contamination of irrigation water with Cd Pb and Ni were not being able to be determined due to its increasing usage as well as production.

The current study aims to study the effect of water quality for long –term, on crop, quality and their heavy metals content in addition to soil chemical characteristics and productivity of four cotton genotypes.

MATERIALS AND METHODS

The trials were carried in above ground cement lyzimeter established and were irrigated with three water types since 1987.Two lyzimeter experiments were conducted at Sakha Agric. Res. Station, Kafr El-sheikh, Egypt, for two, successive seasons, 2010 and 2011 to study the effect of water quality for long –term, on crop, quality and their heavy metals content in addition to soil chemical characteristics. The productivity of four cotton genotypes; Giza86, Giza87, Giza88and Giza89 in the two seasons were studied to evaluate the content of their root, stem, leaves, and seed cotton of heavy metals; Cd, Ni and Pb; as affected by water qualities. Lyzimeters (100\ 70/ 90 cm) were filled with clay soil and irrigated with three water treatments since 1987. They were W_1, Nile water ,W_3, drainage water and W_2,mixed water ,50% w_1+50%W_3.A split –plot design with four replicates was used where , water quality treatments and cotton genotypes were allocated to main and sub main-plots, respectively.

Three irrigation treatments were used; Nile water(W_1), polluted drainage water (W_3) from drain No.7, which were analyzed for total soluble salts, soluble cations and anions and heavy metals content, Table (1). The treatments were incorporated in a split-plot design with four replicates. For all treatments, 22.5kg P_2O_5 /fed were applied as superphosphate, before planting. Plants were thinned to two plants per hill after 40 days from sowing. Nitrogen fertilizer at rate of 70kg N/fed was splitted in two equal doses. The first dose was added after thinning and the second dose was applied after 15 days later .The K fertilizer at rate of 48 kg k_2O /fed in the form of k_2SO_4 48% k_2O)was added with the second dose of nitrogen. The other agricultural practices were carried out as recommended. At harvesting representative root, stem, leaves, and seed cotton samples were collected for analysis; dry ashing technique was used for samples digestion as described by Chapman and pratt (1961). Before planting and after harvesting, soil samples were taken from each lyzimeter for chemical analysis; total soluble salts, soluble cations and anions in soil paste extract according to Page (1982). Available heavy metals in soil samples were also extracted by Diethylene Triamine Penta Acetic acid (DTPA), according to Lindsay and Norvall (1978). Total content of Cd, Pb and Ni in soil was extracted by Aqua Regia (Cottenie *et al*, 1982). Both total and available heavy metals were determined using the Atomic Absorption spectrophotometer technique using unit PERKIN ELIMER 3300.

Statistical analysis was carried out using IRTITSAT software, version3/93 (Biometric unit, International Rice Research Institute, Manila, Philippine).

RESULTS AND DISCSSION

1- Nile and drainage waters evaluation

Chemical characteristics of Nile and drainage waters used for irrigation of cotton plants , are shown in Table (1) .Data showed that the average of EC of Nile water was 0.43dS/m and its SAR value was 1.37.According to Richards (1969),Nile water is (C_2-S_1) ; medium salinity low sodicity (Richards,1969). While data of drainage water revealed that mean value of EC was 1.89 dS/m and SAR was 6.89. This water is high -salinity medium sodicity (C_3-S_2) according to (Richards1969), can not be used on soils with restricted drainage. Even with adequate drainage, special management for salinity control may be required and a crop with good salt tolerance should be selected .It can be concluded that Nile water is of good quality and drainage water is of poor quality for irrigation. The mixed water will be intermediate between them in relation to its chemical composition.

Table1. Chemical analysis and heavy metals content of Nile and drainage water.

Water qualities	Anions (meq/L)				Cations (meq/L)				EC dS/m	SAR	Water class**	PH
	$CO_3^{=}$	HCO_3^{-}	Cl^{-}	$SO_4^{=}$	Ca^{++}	Mg^{++}	Na^{+}	K^{+}				
Nile water	-	3.54	0.94	0.78	1.68	1.60	1.76	0.22	0.43	1.37	C_1-S_1	7.25
Drainage water	-	5.25	12.91	4.37	4.88	3.35	13.76	0.54	1.89	6.89	C_3-S_2	8.40
Heavy metals content (mg/l) in irrigation water												
Water qualities	Cd		Pb		Ni		Mn		Zn		Cu	
Nile water	0.004		0.30		0.021		0.011		0.010		0.012	
Drainage water	0.032		0.430		0.602		0.337		0.276		0.053	
Critical level (according FAO1985)	0.010		5.00		0.200		0. 200		2.00		0.200	

2. Effect of the studied irrigation water qualities on some chemical properties of soil:

Changes in electrical conductivity of soil paste extract ECe (dS/m) , soluble cations; Ca^{++} , Mg^{++} , Na^{+} and K^{+}(meq /l) and soluble anions; $Co_3^{=}$,

Hco_3^- ,$Cl^-$and $SO_4^=$ (meq/l) are listed in Table 2.Comparing the mean ECe values of the studied soils, before planting and after harvesting ,they showed that they increased from 3.36, 5.79 and 6.89 dS/m to 3.67, 6.45 and7.99dS/m as affected by w_1,w_2 and w_3 water quality treatments , respectively. SAR mean value increased from 7.17 to 7.78 as affected by w_3 water treatment.

Table (2): Soil chemical analysis (soil paste extract) as affected by irrigation water quality (mean of 4replicalions)

Water quality	Anions(meq/L)				Cations(meq/L)				EC dS/m	pH*	SAR
	$CO_3^=$	HCO_3^-	Cl^-	SO_4^{--}	Ca^{++}	Mg^{++}	Na^+	K^+			
	Before planting										
W_1	-	3.19	11.91	18.50	14.00	9.11	10.11	0.39	3.36	8.00	2.96
W_2	-	2.91	24.36	30.63	20.25	12.85	25.35	0.46	5.79	8.10	6.34
W_3	-	2.81	29.21	36.84	23.21	17.12	0.98	0.55	6.89	8.20	7.17
	After harvesting										
W_1	-	4.48	11.36	20.85	15.11	8.68	11.40	0.30	3.67	8.10	3.23
W_2	-	4.86	27.10	32.55	22.25	16.80	28.14	0.32	6.45	8.18	6.62
W_3	-	5.14	34.68	40.08	25.82	13.65	36.00	0.44	7.99	8.22	7.78

PH In 1:2.50 soil: water suspension*

Data also showed, that utilization of drainage water for irrigation purposes tend to increase soluble Na^+, Mg^{++}, $So^{--}_4$and Cl^- than before planting .The data also showed that all soluble cations ,Cl^- and $So^=_4$ mean values ,were higher in soils irrigated with drainage water (W_3) than the other irrigation treatments. These results are in harmony with those obtained by Zein *et al*.(2002)

Effect of irrigation water qualities on the studied characters of the tested cotton genotypes in 2010-2011 seasons

Seed cotton yield:

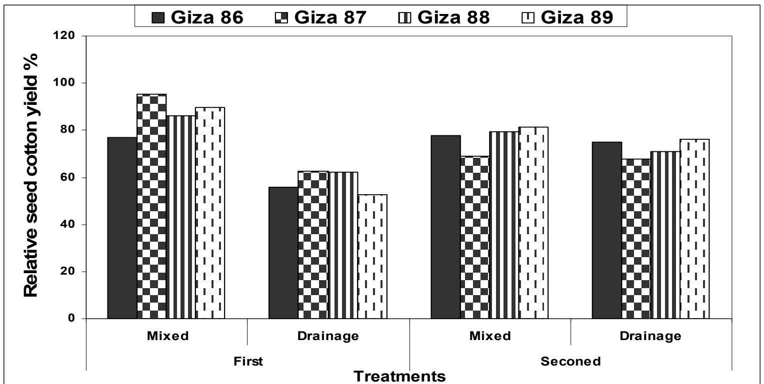
Data in Table (3) showed that the effect of different cotton Genotypes, irrigation water quality and their interactions exerted a significant on seed cotton yield, where Giza 86 gave the highest value in both seasons while Giza 87 gave the lowest value in both seasons. Cotton genotypes irrigated with Nile water produced the highest values of seed cotton yield which were 14.55 and 11.77 qaunter/fed in the first and second seasons respectively, using Nile water to irrigation Giza 86 genotypes gave the highest seed cotton yield (16.96 and 12.75 qaunter/fed) in first and second seasons, respectively while the lowest values (7.16 and 7.73 qaunter /fed) obtained using drainage water to irrigate Giza 87 in the both seasons respectively, Results presented in the same table 3 revealed that, in general, the increase of water salinity levels decreased the cotton yield of investigated genotypes. According to FAO (1973) scale for salinity tolerance relative Seed Cotton Yield % (S.C.Y.) ={(S.C.Y. for irrigation water quality/ S.C.Y. for Nile water)}× 100 depending on relative yield (75% of the control) where the data of the first season Fig(1) showed that all studied genotypes were sensitive to irrigation water quality , where their relative seed cotton yields decreased to be 62.6% for Giza 87 to 52.3% for Giza 89 under drainage water (W_3) but its, were higher than 75%

under mixed water to be 95.4% for Giza87 to 77% for Giza 86. These results are in harmony with data obtained by Zein *et al*.(2003)

Table (3): Effect of irrigation water quality on the studied character of tested genotypes in 2010-2011seasons.

Water quality	Cotton genotypes									
	Season 2010					Season 2011				
	Giza86	Giza87	Giza88	Giza89	Mean	Giza86	Giza87	Giza88	Giza89	Mean
	Seed cotton yield (qaunter /fed)									
W_1	16.96a	11.44a	15.34a	14.45a	14.55	12.75a	11.38a	12.36a	10.63a	11.77
W_2	13.08b	10.91a	13.33a	12.86a	12.54	9.94b	7.82b	9.80b	8.64b	9.04
W_3	9.49c	7.16b	9.62b	7.55b	8.45	9.53b	7.73b	9.75b	8.11b	8.53
Mean	13.18	9.65	12.60	11.58	11.58	10.74	8.98	10.30	9.12	9.78
	Seed index (g)									
W_1	10.21a	9.35a	10.98a	10.18a	9.92a	9.27a	8.46a	9.28a	9.21a	9.10
W_2	9.39b	8.62b	9.66a	9.55b	9.29b	8.58b	8.05b	8.55b	8.40a	8.40
W_3	8.67b	8.32b	8.92b	9.68b	8.74b	8.13b	7.69b	7.98b	8.22b	8.01
Mean	9.41	8.76	9.56	9.54	9.32	8.66	8.07	8.91	8.60	8.44
	Plant height (cm)									
W_1	98.00a	105.18a	82.50a	91.25a	93.40	87.90b	95.68a	87.08a	101.88a	93.12
W_2	95.15a	80.86b	73.75b	78.50b	82.76	96.88a	100.00a	81.75b	93.33b	92.94
W_3	92.66a	82.68b	82.58a	72.18b	82.53	84.40b	93.58b	84.43a	90.90b	88.33
Mean	95.28	89.51	79.61	80.64	86.26	89.66	96.42	84.42	95.35	91.40

Relative seed cotton yield% (S.C.Y.) = $\frac{\text{S.C.Y.for irrigation water quality}}{\text{S.C.Y. for Nile water}}$ x 100



Fig(1): Relative seed cotton yield % for studied genotypes under different water qualities during 2010 and 2011 seasons

Data of the second season in Fig (1) showed that under W_2 Giza 86, Giza88 and Giza89 were more tolerant than Giza 87, but under (W_3) Giza 86 and Giza 89 were tolerant than Giza 87 and Giza 88 .The former could select scale of relative seed cotton yield depending on cotton out put. It could be observed that seed cotton yield was significantly decreased under the application of mixed or drainage water qualities which have high salinity and sodicity levels than with Nile water treatment which have low salinity and sodicity level. These results are in harmony with data obtained by Abd Allah (1995), El-Mowelhi *et al*. (1995) and El-Hady (2001).

Seed index (g):

Results presented in Table(3) showed that seed index was responded significantly to genotype (G), irrigation water (W) and their three genotypes surpassed Giza87 for seed index during first and second seasons , the highest value of seed index (9.92g) was obtained from cotton genotypes irrigated with Nile water than both irrigated with the mixed or drainage water , while ,in the second season seed index was affected significantly when there were significant differences among the three water qualities : Nile water gave the highest seed index (9.10g) while under drainage water the lowest value was obtained (8.01g) .All the genotypes under study showed significant differences between Nile water and both mixed and drainage water for seed index . These results are in harmony with those of Abd El-Rehim and Abd El-Hady (1998).

Plant height

Data in Table (3) show that plant height of cotton genotypes were generally significantly affected by genotypes. Where Giza 86 and Giza 87 gave the highest values (95.00 and 89.51cm). While Giza 88 gave the lowest values in the both seasons (79.61 and 84.42cm), while in the second season, the highest plants were obtained from Giza 87 (96.42cm) and Giza 89 (95.32cm) .The irrigation water qualities exerted a significant effect on plant height during the first season only, Nile water gave the highest values for plant height (93.40cm) than the mixed and drainage water. The effect of the genotype x water quality interaction was significant for this character where Giza 87 under Nile water gave the highest plants (105.2cm) than under mixed and drainage water, Giza 89 under Nile water gave the highest value (91.30 cm) than under drainage water. While Giza 86 and Giza 88 were not significantly affected by the irrigation water quality. The observed results showed that plant height decreased by the application of mixed and drainage water in the first season .This reduction in the plant highest might be attributed to the salinity and sodicity under the mixed and drainage water. Similar results, were reported by Zein and Bader (2003), who found that plant height of cotton decreased with increasing soil salinity.

Heavy metals accumulation in cotton:

Once the ions have been absorbed through the roots and have been transported to the xylem vessels, there is possibility of movement throughout the whole plant. The rate and extent of movement within plants depends on the metal concerned, the plant organ and the age of plant (Alloway, 1995).

Statistical analysis in Table (4) revealed that significant effect of water quality (W_1, W_2 and W_3) on each of all studied heavy metals concentration in cotton genotypes.

The concentration of studied heavy metals in the cotton tissues Table (4) being in the follow order: root> stems>leaves>seed>lint under all water qualities.

Data in Table (4) showed that the studied heavy metals Cd, Ni and Pb content of cotton genotypes under drainage water were the greatest than that of Nile and mixed water .This could be attributed to the pollution sources of industrial and municipal wastes discharged to the drainage system .These results are in agreement with those obtained by Zein *et al*. (2009, 2002) and El-Mowelhi *et al*. (1995).

Table (4): Effect of water qualities on the heavy metals concentration in cotton plant organs (root, stem, leaves, seed and lint) ugkg^{-1}

Cotton genotypes	Water qualities								
	W_1			W_2			W_3		
	Cd	Pb	Ni	Cd	Pb	Ni	Cd	Pb	Ni
	Root								
Giza86	182 c	958 b	190 c	204 b	963 c	202 c	212 b	1266 a	216 b
Giza87	202 a	969 a	202 b	210 a	1039 b	206 b	216 a	1118 d	218 b
Giza88	192 b	932 c	192 c	204 b	958 c	200 c	216 a	1245 c	218 c
Giza89	175 d	853 d	210 a	199 c	1204 a	222 a	210 b	1253b	232 a
	Stem								
Giza86	186 b	1048 d	377 c	199 b	1392 c	393 d	226 c	1443 c	420 d
Giza87	200 a	1440 a	357 d	222 a	1443 b	668 a	290 a	1506 a	726 a
Giza88	152 c	1422 b	508 b	200 b	1463 a	563 b	234 b	1476 b	636 b
Giza89	142 d	1254 c	519 a	152 c	1276 d	528 c	182 d	1360 d	610 c
	Leaves								
Giza86	57 c	591 d	45 b	100 a	627d	52 a	116 b	758 d	68 a
Giza87	52 d	650 c	44 b	92 b	715 b	46 b	112 c	778 b	62 c
Giza88	70 b	682 b	44 b	82 c	798 a	52 a	110 c	863 a	66 b
Giza89	80 a	576 a	46 a	83 c	674 c	52 a	122 a	774 c	59 d
	Seed without lint								
Giza86	30 b	414 c	41a	40 d	418 d	44 c	78 b	488 c	54 a
Giza87	33 b	410 d	41 a	48 c	442 c	46 b	70 d	482 d	52 b
Giza88	32 b	510 a	41 a	70 a	526 a	48 a	74 c	538 b	50 c
Giza89	38 a	440 b	40 b	66 b	516 b	44 c	84 a	574 a	54 a
	Lint								
Giza86	54 a	332 c	52 d	56 a	386 a	60d	67 b	448 a	72 d
Giza87	47 b	342 a	58 c	50 b	378 b	69c	74 a	414 d	80 b
Giza88	44 b	336 b	68 a	50 b	356 d	76b	65 b	432 c	78 c
Giza89	56 a	443 a	64 b	58 a	360 c	78a	60 c	442 b	90 a

Data in same Table illustrate the influence of water qualities on the studied heavy metals concentration in roots , stems, leaves, seeds and lint of cotton plant especially which irrigated by drainage water,it were in the following order for: Roots, stem, seed and lint : Pb> Ni> Cd ; while for leaves the order is :Pb>Cd> Ni . The main concentrations of Pb in plant tissues of cotton irrigated with drainage water were 1220, 1446, 793, 520and 434 ugkg^{-1} for root, stems, leaves, seeds and lint, respectively. El-sanafawy (2002) found that the main sources of Pb in water, soil and plants are mainly related to the waste water of some factories as oil and soap factories. They also added that the most amount of Pb was associated with soluble, exchangeable carbonate specifically and hydroxides fractions. In the present study the input of Pb with drainage water, which polluted from oil & soap wastes of Kafr El-sheikh, absorbed by plant tissues from the drainage water.

Studied cotton genotypes:

Data of heavy metals concentration in root, stem, leaves, seed and lint of studied cotton genotypes and coefficient of their translocation (TC) are presented in Table (4).Where as: TC = (Content of heavy metal in organ / Content of the same heavy metal in another) ×100. Data revealed generally that the studied heavy metal contents; Cd, Pb and Ni ug/kg dry matter increased in all organs of four studied cotton genotypes using drainage water (W_3) for irrigation compared to that irrigated with mixed (W_2) and that irrigated with Nile water (W_1).The data in the same Table showed the sequence of heavy metals concentration in the plant organs ug/kg as follows: stem> root>leaves>seed>lint.

Table (5):Effect of water qualities on the heavy metal translocation coefficient in cotton plants (root, stem, leaves, seed and lint) %

Cotton genotypes	Water qualities								
	W_1			W_2			W_3		
	Cd	Pb	Ni	Cd	Pb	Ni	Cd	Pb	Ni
	Translocation coefficient from Root to stem								
Giza86	102.20	106.40	198.42	97.55	144.55	194.55	106.60	113.98	194.44
Giza87	99.00	148.61	176.73	105.71	138.88	227.18	134.26	134.70	241.28
Giza88	79.17	152.58	217.50	98.05	152.71	231.50	108.33	118.55	245.87
Giza89	81.14	147.00	199.52	76.38	105.98	192.79	86.88	108.54	219.83
	Translocation coefficient from stem to leaves								
Giza86	30.65	56.39	1.94١	5 50.2	45.04	13.23	51.33	52.53	16.19
Giza87	26.00	45.14	12.32	41.44	49.55	9.83	38.62	51.66	11.28
Giza88	46.00	47.96	10.78	41.00	54.55	11.23	47.01	58.46	12.31
Giza89	56.33	45.94	10.98	54.61	52.82	12.15	67.03	56.91	11.57
	Translocation coefficient from leaves to seed								
Giza86	52.63	70.05	91.11	40.00	66.66	84.62	67.24	64.38	82.35
Giza87	63.46	63.08	90.41	52.17	61.82	95.83	62.50	61.95	83.87
Giza88	45.71	74.78	90.91	85.37	65.91	92.31	67.27	62.34	75.75
Giza89	47.50	76.39	86.96	78.52	76.56	84.62	68.85	74.16	91.53
	Translocation coefficient from leaves to lint								
Giza86	94.47	56.18	115.56	56.00	61.56	115.38	57.76	59.10	105.88
Giza87	90.38	52.62	131.82	54.00	52.87	150.00	66.07	53.21	129.03
Giza88	62.86	49.27	154.55	60.98	44.61	146.00	59.09	50.05	118.00
Giza89	55.00	79.91	139.13	69.88	53.41	150.00	49.18	57.11	152.54

Heavy metals content in Nile and drainage waters (mg/l)

Data in Table (1) showed that the studied heavy metals Cd, Pb and Ni content of drainage water were greater than that of Nile water by about 8, 1.4 and 263 times. The mean values of studied heavy metals ; Cd, Pb and Ni concentration in Nile water were 0.004 ,0.30and 0.021mg/l for Cd, Pb and Ni ,respectively .According to the Guidelines of water quality criterion Nat .Acod .of sci., (1972) Nile has good water quality is considered safe for irrigation .However , the concentration of heavy metals in drainage water were 0.032,0.43 and 5.526 ppm for Cd,Pb and Ni ,respectively .The mean value of heavy metal concentration in drainage water indicate that the values of available Cd, Pb and Ni surpassed the critical levels to cause phytotoxicity, Zein *et al*.(2002).

Total heavy metals content and DTPA soil extract from studied soil.

Data in Table (6) showed that all values of the total and DTPA-extractable heavy metals of soil can be discendingly arranged according to the effect of water qualities treatments as follows: W_3 > W_2 > W_1 before cotton planting and after harvesting .It seems that soil of total and available studied heavy metals has followed this sequence Pb >Ni >Cd. These findings and conclusions are in agreement with those of Aboulroos *et al*.(1991) and Zein *et al*.(2002) .Aboulroos *et al*. (1991) found that the behaviour of Fe, Mn, Zn, Cu and Pb differs from that Cd , Co and Ni in soils irrigated with sewage effluent , they added that in Cd, Co and Ni metals ,the percentage held in primarily minerals fraction were increased with time on the expense of the percentage of other fraction , especially that organically complexed. Although the studied soils were still beyond the critical levels, it could be reached these levels upon the continuous using of drainage water.

Table (6): Total and DTPA extractable heavy metal concentration in soil from 2010-2011(mg/kg) before planting and after harvesting cotton plants

Water quality	Cd		Ni		Pb	
	Total	Available	Total	Available	Total	Available
	Before planting					
Nile water	0.15	0.099	3.02	1.77	6.50	3.61
Mixed water	0.19	0.131	8.11	2.00	38.12	8.99
Drainage water	0.40	0.151	10.06	2.36	٧٩.٥٥	11.01
	After harvesting					
Nile water	2.61	0.80	23.36	1.32	54.40	3.56
Mixed water	3.21	0.92	27.27	2.00	69.94	4.76
Drainage water	3.54	1.11	30.46	2.32	94.20	5.02

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تأثيرنوعية مياه الرى على خواص التربة وعلى انتاجية بعض أصناف القطن ومحتواهما من العناصر الثقيلة

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أقيمت تجربتين بمحطة البحوث الزراعية بسخا – كفر الشيخ – مصر لموسمى٢٠١٠ و٢٠١١ تهدف إلى دراسة تأثير نوعية مياه الرى للمدى البعيد على إنتاجية اربعة أصناف من القطن هى جيزة ٨٦ وجيزة٨٧ وجيزة٨٨وجيزة ٨٩وخواص التربةالكيمائية وكذلك على محتوى التربة واجزاء النبات من العناصر الثقيلة وهى الرصاص والكادميوم، النيكل .

وقد أجريت الدراسة فى أحواض أسمنتية (١٠٠ × ٧٠ × ٩٠ سم) وضعت بها تربة طينية وتروى الأحواض بثلاثة نوعيات من المياه منذ عام ١٩٨٧ وهذه النوعيات هى مياه النيل (مياه ذات نوعية جيده" W_1) مياه صرف (ذات نوعية رديئة W_3) ومياه مخلوطة (٥٠ % W_1 + ٥٠% W_2) W_3 وزعت المعاملات فى قطع منشقة فى أربع مكررات حيث وضع الرى فى القطع الرئيسية والأصناف فى القطع الشقية.

وأوضحت النتائج مايلى :

- زاد إستخدام مياه الصرف فى الرى من قيم التوصيل الكهربى ECe ، SAR والكاتيونات والأنيونات الذائبة فى مستخلص عجينة التربة المشبعة وكذلك محتوى التربة الكلى والمستخلص ب DTPA من العناصر الثقيلة عن تلك المستخدم فيها المياه المخلوطة أو مياه النيل فى الرى .
- وجد أن هناك تأثير عالى المعنوية لنوعية المياه المستخدمة فى الرى على المحصول ومكونات المحصول وكذلك محتوى بعض أصناف االقطن من العناصر الثقيلة المدروسة.
- كان محتوى أجزاء النبات من العناصر الثقيلة تبع الرتبة الساق>الجذور > الأوراق> الحبوب > الشعر .
- أوضحت النتائج أن جيزة ٨٩ كان أكثر الأصناف تحملا لإستخدام المياه المخلوطة، ومياه الصرف وكان الاقل في محتواه من الرصاص ، النيكل، ولايوجد هناك فروق معنوية مع عنصر الكادميوم لكل الأصناف تحت الدراسة .
- أظهرت النتائج أن قلة محتوى الأصناف من العناصر الثقيلة أخذ الترتيب التالى :

مع الرصاص للجذور : جـ٨٧> جـ٨٦> جـ٨٨> جـ٨٩
ومع النيكل للجذور : جـ٨٩> جـ٨٧> جـ٨٨>جـ ٨٦

- أوضحت النتائج أن الرى بمياه النيل أعطت أعلى إنتاجية فى أصناف القطن ومكونات المحصول وكان لتاثيرالتركيب الوراثى (الصنف) معنويا على جميع الصفات التى تم دراستها خلال موسمى الزراعية وتفوق جيزة ٨٦على جيزة ٨٩ من طبقة طويل التيلة فى معظم الصفات كما تفوق جيزة ٨٨ على جيزة ٨٧ من طبقة فائق الطول فى معظم الصفات التى تم دراستها.
- كان تاثير نوعية مياه الرى معنويا على الصفات التى تم دراستها فقد أوضحت النتائج أن معاملات الرى بمياه النيل سجلت أفضل النتائج يليها المياه المخلوطة ثم مياه الصرف التى اعطت أقل القيم للصفات المدروسة .
- كان تاثير التفاعل بين التركيب الوراثى ونوعية مياه الرى معنويا على الصفات التى تم دراستها وبدراسة تاثير نوعيات المياه على كل صنف أوضحت النتائج أن الاصناف التى تم دراستها تاثر كل منها معنويا بنوعية مياه الرى فى صفات محصول القطن الزهر وطول النبات ووزن الألف حبة حيث كانت أفضل النتائج عند الرى بمياه النيل وأقلها عندالرى بالمياه المخلوطة اومياه الصرف.
- سجلت كل الأصناف التى تم دراستها درجة مقاومة لملوحة مياه الرى المخلوطة فى صفة محصول القطن الزهر وعلية يمكن التوصية بزراعة أى منها بالمناطق التى تستخدم المياه المخلوطة فى الرى. أتضح أن العناصر الثقيلة المدروسة وهى النيكل والرصاص والكادميوم تتراكم فى نبات القطن بكميات كبيرة وهذا يجعلة أن يكون دليل مفيد للدلالة على مدى جاهزية العناصر فى الأراضى الملوثة بالعناصر الثقيلة ويمكن أستخدامة فى استخلاص هذه العناصرمن الأراضى الملوثة بها .

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