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Research Article

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Evaluation of treated wastewater irrigation on the productivity of wheat

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ABSTRACT

The major objective of this research work is to propose the initial environmental impact assessment concerning the utilization of treated wastewater for two different varieties of wheat production. The study analyzed the soil chemical composition before and after irrigation at two different depths (0-30 cm & 30-60 cm). Water chemical composition is also analyzed for controlled water, treated water of Abu Dhabi and Al Ain. Wheat plant chemical composition present in the head, root, and shoot for both the varieties is analyzed. The levels of Ca, Mg, Na and CI in soil have increased after irrigation with controlled water. The presence of cations and anions in the soil are slightly higher in the treated water of Abu Dhabi. Ca, Na, CI and SO_4 are found to be significantly higher after irrigation with treated wastewater of Al Ain. The plant chemical composition of head, root and shoot ND fiber, AD fiber, Crude protein and Macro elements have shown no significant differences across the three types of water and two varieties of wheat production. The correlations between RBS limits and the three types of water considered in the study are negative. The results revealed that the differences in chemical composition between RBS limits, controlled, treated wastewater of Abu Dhabi and Al Ain are statistically significant with particular reference to trace and heavy metals. Concerning water chemical composition, the study concludes that the correlation between controlled water and treated wastewater of Al Ain is strong when compared to Abu Dhabi.

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INTRODUCTION

Climate conditions around the globe face a variety of problems, including water shortages in many nations. Climate change greatly affects the balance of demand and the availability of natural resources in many ways. Growth in population, socio-economic impacts are having an effect on water supplies in the Arab region. Climate change and climate instability bring more complexities. Increased temperatures can lead to rapid evaporating water throughout the Arab region, including the UAE. [1]. Ensuring the optimal supply of water for drinking, agriculture and other uses has truly become a challenge. Reuse of wastewater can be an effective response to water scarcity by implementing the concepts of integrated water management[2].

Wastewater use in agriculture without the appropriate precautions can influence the accumulation of microbiological and chemical pollutants in crops and soil conditions. Interestingly, urban wastewater has the largest share of wastewater used for agricultural purposes, as it can lead to better crop nutrition. Municipal wastewater use for agricultural purposes is a common practice in the MENA region. [3]. While treated wastewater is a cheap resource that is accessible all year round, it has many hazards if not handled properly. Wastewater and treated wastewater have become viable and effective water supplies that can complement the freshwater resources of a nation. By 2050, urban areas will grow dramatically and about 70% of the world's population is projected to reside in cities that ensure reliable wastewater supply [4]. However, it is vital to use wastewater for irrigation by safeguarding the health of important stakeholders, such as farmers and customers at large, while mitigating negative environmental impacts.

There are a number of restrictions on the treatment and re-use of treated wastewater in agriculture, including insufficient knowledge on the environmental and health effects of re-use, limited economic analysis, including financial viability and government-benefits, government participation in the processing and treatment of wastewater [5]. Analysis of the benefits and associated risks associated with the use of treated wastewater has shown that not only are soil health conditions economic but also increased, while at the same time reducing fertilizer requirements. It is important to understand that salts, nitrogen and bacteria are the major sources of risk associated with the use of recycled water for irrigation and, surprisingly, the risks associated with heavy metals are relatively low [6]. The main purpose of this research paper is to suggest an initial environmental impact assessment with respect to the use of treated wastewater for wheat production. The research involves an analysis of the chemical composition of the wheat plant present in the head, root and shoot of two varieties of wheat.

MATERIALS AND METHODS

Two varieties of wheat were cultivated using three different types of water, such as freshwater Controlled (C), Abu Dhabi Treated Wastewater (T1) and Al Ain Treated Wastewater (T2). The experiments were performed at the Al-Foah Research Farm of UAE University located in Al Ain City, UAE. The experiments were performed during the rising season between November to March. A surface area of 318 m^2 (20.5 m × 15.5 m) was used to carry out the experiments. Five replications were made for each form of wheat within a plot area of 2 x 2.5 m^2 using three separate water treatments. Drip irrigation system has been used for all water treatments. Chemical fertilizers were used once a week by irrigation at rates of 200 kg N / ha, 120 kg P_2O_5 / ha and 80 kg K_2O / ha.

Two different treated wastewater (TWW) from Al Wathba, Abu Dhabi and Al SAAD, Al Ain were used for experimental water. Normal local well water was used as control. The experimental plan used was factorial based and completely randomised. Wheat seeds were germinated for 10 days, and then 13 seedlings were transplanted into each pot.

Crop and Management

Two different genotypic advanced lines derived from the international trial 33rd ESWYT (V1) and 20th SAWYT (V2) were used as targets for this research and these wheat varieties were obtained from the CIMMYT Genetic Resource Centre, El Batan, Mexico. Temperature, pH, and EC of the different kinds of water were monitored using combined portable pH/EC/TDS/Temperature meter (Hanna instrument, USA).

Analysis of Agronomical Parameters

After 12 weeks of planting, wheat plant samples were harvested to evaluate the agronomical parameters such us plant length, root length, plant weight, dry weight, flag length and area, number of heads and head length.

Estimation of Crude Protein

The Kjeldahl method was followed by the AOAC International [7] method. Approximately 1 g of raw material was hydrolyzed with 15 mL of H_2SO_4 containing two copper catalytic tablets in a heat of 420°C for 2 hours. After cooling, 50 ml of 4 percent boric acid solution in the receiving flask added 3-5 drops of the mixed indicator and placed it under the Kjeldahl condenser. The distillation machine ensures that the condenser tube reaches below the acid surface in the flask and now applies 50 ml of water and 60 ml of 32% of NaOH solution to the Kjeldahl flask. Take 0.1 N HCl in the burette and titrate the contents of the flask against it.

Procedure for NDF Determination (Neutral detergent fiber)

The content of neutral detergent fiber was calculated by the Waldern [8] process. 1 g of fine powder was weighed in a crucible and 100 ml of neutral detergent solution, 0.5 g of sodium sulphite and a few drops of n-octanol were added. The reaction mixture was purified and the extract was washed three times with hot water and two times with acetone. The resulting mixture was allowed to stand dry for 8 hours incubated at 105° C and then in a desiccator.

Acid detergent Fiber

The content of acid detergent fiber was calculated by the Dong and Rasco [9] process. Exactly 1 g of fine powder was weighed in a crucible and 100 ml of acid detergent solution and a few drops of n-octanol were added. The reaction mixture was allowed to stand for 60 minutes in boiling conditions. The reaction mixture was filtered and the extract was washed with hot water for three times and acetone for two times. The resulting mixture was permitted to stand dry for 8 hours incubated at 105 °C and then in a desiccator. Weight of the content was articulated in gms.

Microelements and Macroelements

Mineral elements were measured in the dry head, shoot and root tissue at the end of the harvest. The samples were air-dried then oven-dried at 105°C for 3 hours and the samples were grinded and deposited in the desiccators for further analysis. Samples were appropriately prepared by measuring 0.5 grams of sample in microwave digestion vessels and adding 10 ml of concentrated nitric acid (HNO_3) and 2 ml of hydrochloric acid (HCL) [10]. The vessels were capped and place in the microwave digestion system. The analysis was conducted using ICP-OES - Agilent Technologies, 710-ES - Agilent Technologies. The percentages of different elements in this sample was determined by the corresponding standard calibration curves obtained by using standard AR grade solutions of the elements, for example K, Mg, Ca, Na, Fe, Mn, Zn, P and S. The blank reagents were carried out using the complete procedure and contain the same acid concentration in the final solution as the sample solution used for the investigation.

Statistical Analysis

Statistical analysis was performed using one way analysis of variance followed by Duncan's Multiple Range Test using Statistical Package for the Social Science software (SPSS) package version 12.00. Results were expressed as mean±standard deviation for six replicates in each group. P values < 0.05 were considered statistically significant.

RESULT AND DISCUSSION

Treated Wastewater Chemical Composition

In the current analysis, it was examined whether the treated wastewater chemical composition is within an appropriate safety range after irrigation with treated wastewater and the results were obtained in Table 1. The AD (T1) sample of water used for irrigation showed an acidic pH value of 4.93±0.28. Most plant tissues remain in active growth at a pH above seven [11]. The optimum pH of irrigation water approved by FAO is between 6.0 and 8.5. As can be seen from the pH calculation, the result indicates the existence of optimum pH values in the control and AA (T2) water samples. Based on the FAO guidelines, the pH of AD (T1) used in this study did not follow the limits set by FAO [12]. The other two samples control and AA (T2) are therefore ideal for irrigation. The use of high electrical conductivity (EC) effluents has some negative effects in that crops grown in a high EC medium may be characterized by the observation of the consumption of less ions resulting in poor growth [13]. The ideal EC values for waste water used for irrigation as set out in EPP (1995) were < 0.8 m S / cm. Wilcox [14] used the following table as an arbitrary guide to the quality of irrigation water based on EC principles. The mean mean EC value of AA (T2) was 0.95±.05 mS / cm. This confirms that it is appropriate for irrigation as it reaches the ideal limit range of 0-3.0 (ds / m).

The higher the electrical conductivity of the hydroponics medium, the higher the negative effects of Na Cl on crops [15]. The explanation for this is that the crops grown in AA (T2) effluent were less active than AD (T1) and control (Table 1). This is hazardous to reuse treated AA (T2) water in agriculture as it has high concentrations of potassium [16]. Two essential elements such as sodium and chlorine in excess concentration can harm the plants by reducing the absorption of potassium [17]. The acceptable limits of sodium and chloride values in treated water used for irrigation are<40 and <30 mg/L respectively. The elements of calcium (Ca) and Boron (B) are present within safe limits compared to FAO standards. The recommended values of Ca and B set by FAO are <400 ppm, and <2.0mg/L respectively. Previous literatures reported that high calcium is needed for optimum root growth of barley and cotton. The presence of ideal concentrations of sulphate, strontium (Sr), iron (Fe), nickel (Ni) Barium (Ba), and selenium (Se) justifies the efficiency of treated waste water in crop production [18].

Karl Pearson's Co-efficient of association between the three water varieties and the RBS limits has been determined and the results are shown in Table 2. The results indicate that the correlation between well (controlled) and treated water (T2) Al Ain is important, while the correlation between treated wastewater (T2) Al Ain and treated wastewater (T1) Abu Dhabi is moderate, and the correlations between the RBS

Table 1: Cations, anions, trace and heavy metals present in three types of water

Parameters	Control	Treated AD (T1)	Trated AA (T2)	Acceptable limits
pH	7.53±0.31	7.40±0.28	7.60±0.53	6.0-8.5
EC (ds/m)	0.31±0.05	0.33±0.05b	0.35±.05	0-.3.0
TDS ppm	211.40±32.45	212.40±21.25	220.11±3.41	<2000
SAR	2.23±0.45	2.23±0.45	3.19±0.52	41.25
Total N	3.83±14.80	2.63±4.81	2.30±0.19	<5mg/L
Nitrate NO3	0.00±.00	9.46±1.74	7.363±0.84	0-10.0 mg/L
Calcium (Ca) mg/L	17.94±1.70	17.94±1.70	15.94±2.01	0- 20.0
Magnesium (Mg)mg/L	2.62±0.50	2.62±0.50	3.26±0.25	0-5.0
Sodium (Na)mg/L	41.28±4.95	41.78±0.24	40.19±9.21	0-40.0
Potassium (K)mg/L	1.74±0.45	1.84±0.04	1.2±0.24	<2.0
Chloride (Cl)mg/L	25.85±22.17	29.81±0.24	25±10.2	0-30.0
Carbon trioxide (CO_3)	-	-	-	NA
Sulphate (SO_4) mg/L	4.32±0.14	4.32±0.27	5.51±6.24	0-20.0
Phosphate (PO_4) mg/L	0.31±0.02	0.31±0.14	0.31±0.02	<2.0
Aluminium (Al) mg/L	0.10±0.04	0.10±0.01	0.13±0.23	5.0
Arsenic (As) mg/L	0.08±0.01	0.07±0.01	0.06±0.05	0.10
Boron (B)mg/L	0.26±0.06	0.26±0.01		0-2.0
Barium (Ba)	-	-	0.01±0.00	-
Cadmium (Cd)	-	-	-	<0.01
Cobalt (Co)mg/L	-	-	-	0.05
Copper (Cu)	0.01±0.01	0.01±0.00	0.00±0.00	0.05-0.3
Iron (Fe) mg/L	-	-	-	20
Manganese (Mn)mg/L	0.01±0.01	0.01±0.001	0.01±0.00	0.2-10.0
Molybdenum (Mo)	0.02±0.02	0.03±0.003	0.02±0.01	0.01-0.05
Nickel (Ni) mg/L	-		0.08±0.00	<0.2
Lead (Pb) mg/L	0.02±0.01	0.02±0.001	0.03±0.00	<2
Selenium (Se)mg/L	0.18±0.01	0.18±0.01	0.15±0.00	0.02
Strontium (Sr)	0.01±0.02	0.01±0.001	0.08±0.01	-
Zinc (Zn)	0.19±0.08	0.19±0.002	0.02±0.01	0.1-0.5
pH	7.53±0.31	7.40±0.28	7.60±0.53	6.0-8.5

limits and three types of water vz., regulated, T1 and T2 are negative. Since the P-value (0.0060) of the ANOVA test performed at a 5 percent significance level is less than 0.5 and thus the discrepancy between the RBS limits, well, the T1 and T2 values obtained are statistically relevant on the basis of which it can be inferred that there is a substantial difference between RBS and well, T1 and T2 with respect to trace metals and heavy metals.

Plant Chemical Composition

The percentage of N.D fiber, A.D fiber, crude protein, macro elements, Sec elements, trace elements and heavy metals present in the wheat plant 's head, root and shoot have been investigated at all three sites for both the wheat varieties considered for the analysis (Tables 3-5). The essential elements affect the nutritional value of edible plants is their fiber and protein content. Daniz et al. [19] reported that the ADF content increased because of progress towards the grain-filling age, but cultivars may have different reactions. In our research, however, the ADF content was increased along with plant growth, as was the case with most cultivated crops.

Table 2: Correlation matrix for three varieties of water and RBS limits

Parameters	Well (Controlled)	Treated (T1) Abu Dhabi	Treated (T2) Al Ain	RSB limits
Well (Controlled)	1			
Treated (T1) Abu Dhabi	0.10523	1		
Treated (T2) Al Ain	0.771584	0.510581	1	
RBS limits	-0.00521	-0.00476	-0.01687	1

Nutritional composition has been observed that there is a great diversity of elemental contents studied in different parts of the wheat crop. Results of the elemental analysis obtained via the comparator process of the AAS techniques are seen in the results of the samples' mg/g dry weight. It should be noted that each result is an average of at least three independent measurements with accuracy of approximately ±1%. For most studies, the protein content is regarded as the key determinant of the form of food and less is known about the elemental composition of different wild edible organisms. As shown in the results, compared with the normal prescribed dietary allowance, the content of microelements in both variety and nutritional significance of the product.

The recommended protein dietary allowance (RDA) is 56 g for persons weighing 70 kg and 46 g for adults weighing 50 kg; children may consume 2kg / day [20]. According to Pamela et al. [21], plant-based proteins are of lower quality but their combination with many other protein sources such as animal protein can result in an adequate nutritional value. The concentrations of fibers and elements for plant products were found almost in line with the World Health Organizations standards [22].

The yields of plants like wheat were significantly higher when irrigated with treated wastewater compared with the use of saline well water. The increase in yield can mainly be attributed to plants obtaining 20 per cent higher water due to increased nitrogen supply while reducing the salinity level in their roots. In addition, water efficiency achieved at higher levels in plants receiving treated wastewater at an ETM level of 120

Table 3: Fiber, protein, macro and secondary elements present in both the varieties of wheat plant head

Parameters	Plant head sample					
	CV1	CV2	T1V1	T1 V2	T2V1	T2V2
N.D.F	57.22±6.74	67.51±2.89	55.32±7.74	59.81±2.12	52.22±5.03	58.92±7.31
A.D.F	29.94±2.93	33.63±0.68	29.33±3.95	27.88±2.63	28.70±3.33	29.57±3.56
Crude Protein%"	10.72±0.97	10.27±0.32	13.22±3.58	12.33±2.70	9.96±0.78	10.20±0.99
N	1.72±0.16	1.64±0.05	2.12±0.57	1.97±0.43	1.59±0.12	1.63±0.16
P	0.50±0.02	0.53±0.02	0.49±0.04	0.49±0.03	0.45±0.03	0.51±0.06
k	0.94±0.13	1.05±0.09	0.98±0.14	1.06±0.13	0.83±0.13	0.97±0.16
Ca	0.25±0.03	0.21±0.02	0.24±0.03	0.21±0.01	0.23±0.01	0.22±0.01
Mg	0.24±0.02	0.20±0.02	0.24±0.03	0.22±0.02	0.24±0.02	0.23±0.02
S	0.19±0.02	0.43±0.52	0.20±0.02	0.27±0.17	0.20±0.01	0.20±0.01
Na	0.03±0.00	0.03±0.02	0.04±0.01	0.05±0.02	0.03±0.00	0.03±0.00
Fe	105.20±56.33	63.60±15.88	80.60±17.90	72.80±22.51	73.20±18.05	71.20±12.97
Cu	180.96±73.95	133.77±32.87	159.18±40.19	125.91±34.39	130.11±24.74	129.40±26.36
Mn	5.52±0.93	6.50±1.96	3.50±0.46	3.12±0.31	4.50±0.49	4.16±0.69
Zn	20.80±2.90	13.98±1.48	20.92±3.90	12.82±5.08	22.52±1.62	21.52±4.01
B	55.52±5.13	47.90±1.86	54.06±5.99	48.14±4.69	61.92±6.16	52.84±3.02
Mo	64.33±83.31	35.60±6.98	33.49±6.82	30.72±5.15	30.00±9.33	34.84±9.33
Ni	0.10±0.22	0.00±0.00	0.98±1.92	0.12±0.27	0.00±0.00	0.34±0.71
Pb	4.17±3.30	2.90±1.61	2.31±0.67	1.58±0.72	2.49±0.42	5.88±5.05
Sr	1.18±1.24	1.60±1.03	2.08±0.99	2.14±1.49	1.26±0.76	1.14±0.54
Al	33.40±2.79	32.20±6.14	28.20±3.70	26.80±2.17	30.80±2.05	32.40±7.37
Ba	15.24±1.13	14.12±4.37	8.45±1.99	7.01±1.20	13.05±2.13	12.96±3.59
Cd	0.15±0.21	0.24±0.19	0.41±0.25	0.34±0.20	0.18±0.14	0.27±0.06
Co	0.17±0.17	0.11±0.15	0.24±0.19	0.13±0.22	0.09±0.12	0.06±0.10
Cr	1.59±0.50	1.34±0.28	1.68±0.64	1.20±0.45	1.79±0.46	1.21±0.44
Se	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00

Data are averages of five replicates, with SD values (n = 5). ADF, acid detergent fiber; NDF, neutral detergent fiber

Table 4: Fiber, protein, macro and secondary elements present in root

Parameters	Plant root sample					
	CV1	CV2	T1V1	T1 V2	T2V1	T2V2
N.DF	76.65±1.80	73.00±7.69	67.57±8.98	69.09±7.77	69.30±10.28	73.98±2.07
A.D.F	51.23±2.33	52.00±1.53	49.24±2.12	48.88±2.81	51.31±1.24	49.79±2.87
Crude Protein%"	2.18±0.98	1.75±1.10	4.10±0.78	4.09±0.69	2.99±0.93	3.23±1.05
N	0.35±0.16	0.28±0.17	0.66±0.12	0.65±0.11	0.48±0.15	0.52±0.17
P	0.12±0.04	0.10±0.03	0.17±0.06	0.15±0.05	0.11±0.01	0.14±0.05
k	0.59±0.15	0.49±0.16	0.60±0.09	0.51±0.10	0.64±0.18	0.64±0.27
Ca	2.74±0.55	3.20±0.81	2.25±0.32	2.39±0.49	3.16±0.74	2.92±0.84
Mg	1.62±0.30	1.90±0.42	1.25±0.21	1.49±0.26	1.77±0.33	1.68±0.52
S	0.10±0.02	0.11±0.02	0.21±0.05	0.33±0.33	0.19±0.10	0.18±0.08
Na	0.12±0.03	0.10±0.03	0.59±0.27	0.58±0.11	0.19±0.07	0.27±0.10
Fe	5189.00±1269.18	5773.80±847.21	4180.60±992.52	4988.60±1142.89	6132.00±888.13	5041.60±1412.17
Cu	8.54±2.29	9.00±1.91	6.92±1.00	6.81±0.51	6.61±0.63	6.74±1.05
Mn	113.38±30.85	130.88±17.88	98.24±15.21	104.68±16.20	129.34±22.83	121.14±29.78
Zn	47.08±8.79	39.68±9.74	72.30±20.90	59.96±24.34	59.58±18.74	59.22±19.80
B	37.34±1.62	30.32±3.59	45.82±9.35	39.06±6.31	34.96±3.62	36.54±4.74
Mo	0.97±0.91	0.69±0.55	1.92±1.02	0.94±1.55	0.51±0.74	1.25±1.29
Ni	168.96±43.25	198.18±42.64	127.84±28.41	148.66±40.23	186.72±31.47	173.92±62.08
Pb	3.56±2.98	1.98±1.29	1.91±1.68	2.54±1.76	2.84±2.04	0.64±0.63
Sr	122.26±37.14	152.62±43.50	126.94±14.75	127.06±19.28	170.88±47.19	157.48±41.85
Al	2041.40±543.52	2463.00±572.29	1714.00±384.86	1925.60±396.65	2520.80±417.18	2271.00±810.66
Ba	20.68±1.54	23.85±2.59	18.55±2.60	23.00±7.24	24.95±2.93	23.16±4.26
Cd	1.80±0.54	2.20±0.51	1.28±0.36	1.61±0.53	2.06±0.40	1.98±0.75
Co	7.97±1.92	9.98±1.81	6.09±1.40	7.09±1.73	9.14±1.61	8.23±2.70
Cr	41.51±12.72	48.39±7.40	31.57±6.25	37.77±10.34	46.17±8.45	44.84±15.56
Se	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00

Data are averages of five replicates, with SD values (n = 5). ADF, acid detergent fiber; NDF, neutral detergent fiber

Table 5: Fiber, protein, macro and secondary elements present in shoot

Parameters	Plant shoot sample					
	CV1	CV2	T1V1	T1 V2	T2V1	T2V2
N.D.F	52.29±13.42	60.76±2.32	60.46±3.80	59.94±2.52	59.36±2.01	60.69±1.01
A.D.F	32.92±8.04	40.02±2.75	31.10±5.54	33.62±5.08	39.82±2.00	40.49±1.46
Crude Protein%"	9.14±1.58	9.75±1.28	8.78±1.30	9.69±1.76	7.55±1.67	8.34±1.89
N	1.46±0.25	1.56±0.20	1.40±0.21	1.55±0.28	1.21±0.27	1.33±0.30
P	0.27±0.03	0.29±0.02	0.32±0.05	0.30±0.08	0.28±0.03	0.28±0.04
k	1.42±0.08	1.40±0.14	1.44±0.09	1.36±0.18	1.59±0.27	1.51±0.22
Ca	0.23±0.01	0.24±0.02	0.27±0.07	0.23±0.03	0.26±0.03	0.26±0.07
Mg	0.14±0.01	0.14±0.01	0.20±0.04	0.19±0.02	0.15±0.01	0.16±0.02
S	0.15±0.02	0.16±0.03	0.23±0.07	0.23±0.03	0.23±0.04	0.20±0.01
Na	0.02±0.04	0.02±0.04	0.28±0.16	0.48±0.13	0.05±0.01	0.10±0.12
Fe	143.85±21.38	146.35±12.58	149.48±43.92	136.20±22.53	185.00±51.77	155.20±65.67
Cu	2.85±0.35	2.66±0.31	1.84±0.35	1.75±0.40	2.48±0.56	1.98±0.59
Mn	9.95±3.84	9.60±2.80	11.74±1.04	10.57±1.77	10.78±4.18	9.50±4.41
Zn	28.18±3.62	27.26±4.03	35.30±3.83	34.24±8.87	40.36±8.55	30.74±5.57
B	32.44±5.60	35.42±4.87	32.67±5.73	40.33±6.03	40.20±9.93	33.48±3.00
Mo	0.73±1.03	0.94±1.40	2.70±1.29	2.51±0.67	0.77±1.16	1.18±0.57
Ni	2.14±1.02	1.60±0.57	2.23±0.83	1.64±1.35	2.94±1.26	2.18±1.27
Pb	2.36±1.44	0.92±0.88	1.86±1.38	1.96±1.70	1.24±1.35	0.48±0.57
Sr	35.59±1.96	37.80±3.27	36.62±6.27	33.16±4.52	37.70±6.55	42.48±6.36
Al	74.84±16.92	69.39±7.61	65.47±24.77	62.55±12.18	95.00±17.82	75.20±36.13
Ba	16.91±2.06	15.40±1.23	13.20±2.87	9.43±1.05	17.55±1.93	16.29±3.07
Cd	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
Co	0.15±0.17	0.29±0.13	0.19±0.11	0.19±0.18	0.21±0.21	0.18±0.17
Cr	1.33±0.30	1.47±0.28	0.93±0.21	1.04±0.51	2.13±0.90	1.25±0.53
Se	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00

Data are averages of fivereplicates, with SD values (n = 5). ADF, acid detergent fiber; NDF, neutral detergent fiber

per cent [23] and Atef Hamdy, 2002). Sodium and potassium are major cations of both intracellular and extracellular nature. Sodium is involved in controlling plasma volume, acid-base balance, contraction of the nerves and muscles. Manganese is an antioxidant nutrient which is important for the breakdown of fats and cholesterol and also helps nervous and brain nourishment [24]. Magnesium deficiency may be responsible for tetany, tuberculosis, diabetes , cancer and all nerve diseases [25]. Zinc is a part of many metalloenzymes and is used as an astringent and antifungal agent in its organic compounds. Helps wound healing and nucleic acid and insulin metabolism. Zinc in excess induces anemia, which can lead to dermatitis if deficient in the body. The zinc level per 10 g of plant species was no greater than 4950 μg, thus lower than the maximum permissible amount and considered healthy [26].

Wastewater irrigation can have no major effect on soil heavy metals such as Pb and Cd regardless of irrigation period [27]. In plants which were grown in waste irrigation, the essential nutrients of plants such as N, NO_3, P , and K are higher. However, the plant's Pb and Cd can increase if the irrigation time is two years, whereas they can decrease over a longer period. The presence of metals in wastewater may have an adverse effect on the nutritional value of the crops other than on the environment. It is found that in many cases the treatment plants do not extract the chemicals and metals adequately from the wastewater and thus adequate controls should be developed for removal processes [28], and the treated water should be used for agricultural purposes.

CONCLUSION

It has been concluded that there is significant variation in the macro-and micronutrient quality of wheat crops and cultivars. The levels of Ca, Mg, Na, and CI in soil have increased significantly after irrigation, regardless of depth, when irrigated with managed water. However, the presence of cations and anions after irrigation with Abu Dhabi treated wastewater is slightly higher compared to before irrigation, although statistically no significant. In the case of Al Ain, Ca, Na, CI and SO4 after irrigation are significantly higher. With reference to the chemical composition of plants present in the head, root and shoot of wheat plants, the percentages of ND fiber, AD fiber, crude protein, Macro and Sec elements showed no major variations across the three locations and two varieties of wheat as evidenced by ANOVA test results. The chemical composition of treated wastewater concluded that there is a clear correlation between controlled water and treated Al Ain wastewater while the correlation between the treated Al Ain wastewater and Abu Dhabi wastewater is moderate. It is important to note that the associations between RBS limits and the three water types are negative. ANOVA findings indicate that the differences between the RBS maximum, regulated, treated Abu Dhabi wastewater and treated Al Ain wastewater are statistically important in terms of trace and heavy metals. The usage of wastewater would lead to substantial improvements in both grain production and biomass production.

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