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Accumulation of some heavy metals in the prevailing plants (*Alhagi mourorum* and *Suaeda vermiculata*) near the thermal power plant in Al-Nasiriyah city south of Iraq

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Abstract:

The present study aims to investigate the effect of Thermal power plant emissions upon two species of plant *Alhagi mourorum* and *Suaeda vermiculata* which growth in the region close to Thermal power plant. triplicater samples were collected seasonllys from autumn 2016 up to summer 2017 one time from each season. three station were selected in the study area to execute this study meters. The first station distances 400 meters from the thermal power station, The second station is located 800 meters from the thermal power plant . While, the third station distances 1200 meters from the thermal power plant . Three stations were with prevailing wind direction (north wind) , while control station situated far from the thermal power plant about 12 km. the concentratios of heavy metals Cd, Cu, Pb and Zn were estimate in root and shoot systems for both plants , their concentration in root system more higher than their concentrations in shoot system. its concluded from the present study that thermal electric power station emissions affected upon the plants which growth in the surrounding region with thermal power plant.

Keywords: heavy metals, thermal power plant, *Alhagi mourorum*, *Suaeda vermiculata*.

Introduction:

Thermal power plants are more preferable forelectricity production because of many reasons including their relatively low cost and their using to low quality coal as fuel (Cicek and Koparal, 2004).

Thermal power plants cause a sure ecological pollution.They emit large amount of ash with varying sizes. (Sengupta *et al*., 2011; Baba, 2002).

Excessive ash contamination can cause potential damage to the soil and the prevailing plants because of ahigher degree of chemical elements accumulation present in ash especially heavy metals. The essential heavy metals play a vital role in many physiological processes of the plants but in trace amounts. Several of these ions are necessary for growth, metabolism and development.when cells are confronted with either an elevated level of these vital ions or with non-essential ions, wide range of cellular damage can be noticed due to inactivation of bio-molecules by either blocking essential functional groups or by displacement of essential metal ions (Wood, 1974; Adriano *et al*., 1978; Shi and Sengupta, 1995; Singh and Yunus, 2000).

twigs. Leaves are about 1-2 cm in long, oblong *Alhagi mourorum*is a shrubby, perennial plant with a high about 0.4-1 m. Stems erect to ascending, much branched, with short, spinescent toobovate. Flowers are axillary, on spiny twigs, purple. Flowers are seen in April-August (Al-Oudat and Qadir, 2011).

Suaeda vermiculata is a succulent under-shrub, about 60-120 cm in high. It has a dark green colour. Leaves are short-petioled succulent, the lower leaves have an obovate-oblong shape while the upper leaves have ovoid to spherical shape.*S.vermiculata* is common in Saharo-Arabian and was grazed by large camel herds in this zone and was also used as fuel by the natives (Squires and Ayoub, 1994).

Because there are no more enough investigations about the effect of the thermal power plant in Nasiriyah city on the native plants, this study is designed to estimate the effect of the thermal power plant in Nasiriyah city on the accumulation of some heavy metals in two plant species native in this city. *A. mourorum* and *S. vermiculata*.

Materials and methods:

Study area: The study area was selected in the vicinity of the thermal power plant northwest of Nasiriyah city (south of Iraq) , and is about 3 km away from Nasiriyah center. Four stations were identified in the study area represented by the distances (400, 800, and 1200) m from the site of the thermal power plant in Nasiriyah which represented the stations (1, 2, and 3) respectively

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and with the direction of the prevailing wind in the city (North-westerly). The station 4 was used as control station which located near the shrine of Al-Sharif north-west of Nasiriyah city and away from the thermal power plant about 12 km. Table (1) and figure (1) show the location of study area and sampling stations.

Table (1): Location of sampling stations

Stations	Latitude	Longitude
1	E=046°,11',47".51	N=31°,1',58".38
2	E=046°,12',2".14	N=31°,1',47".51
3	E=046°,12',16".80	N=31°,1',37".95
Control	E=046°,5',5".97	N=31°,5',53".12
Thermal power plant	E=046°,11',37".61	N=31°,2',13".03

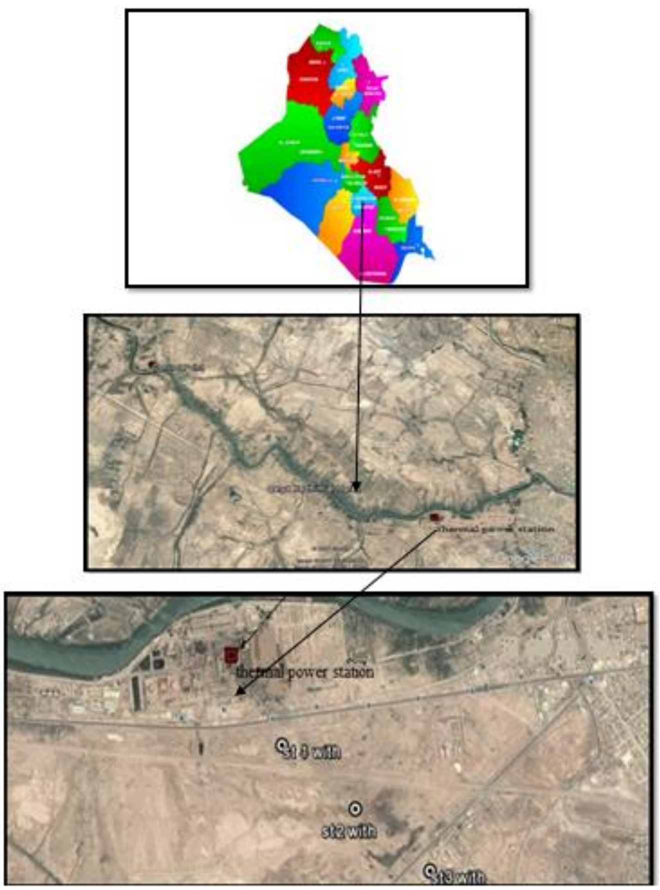

Figure (1) location of study area and sampling stations (Thi-Qar Environment Directorate)

Plants collections: Plant samples of the two species were randomly collected from each station seasonally in October, January, April and July . Each sample was divided into root and shoot systems, and then they treated according (Caselles, 1998; Caselles *et al.* , 2001) procedure. Plant samples of both shoot and root systems were washed with 2 liters of ion-free water, dried at room temperature, grinded well, sieved using a 0.63 µm sieve and then kept until heavy elements were estimated.

Extraction of heavy metals: 1g of plant powder was carefully digested with 4:1 (v/v) mixture of concentrated Nitric acid and Perchloric acid. The digestion was carried out on a hot plate at 80°C in digestion chamber (Barman *et al*., 2000). The obtained solution was analysed for Lead (Pb), Cadmium (Cd), Cupper (Cu), and Zinc (Zn) by atomic absorption spectrophotometry in Chemistry Department/ College of Science/ Thi-Qar University.

Statistical analysis: Statistical analysis was carried out using SPSS-10. Heavy metal distribution was tested by Analysis of Variance). Differences being considered significant at $P<0.05$.

Results and Discussion:

Accumulation of heavy metals in *A. mourorum* and *S.vermiculata*.

The seasonal variability of Cu, Pb, Cd and Zn in *A.mourorum* root system was showed in tables 2. Levels of Pb, Cu and Zn have the highest level at winter in the stations 1, 3 and 2 respectively, while Cd has the highest level at summer in the station 3 and in winter at station 2 . The statistical analysis showed a significant difference at $P< 0.05$ between the study stations for Pb, Cd and Zn accumulation. Seasonal accumulation is significant at $P< 0.05$ in the case of Pb and Zn only.

Accumulation of Pb and Cd in *A.mourorum* shoot system has a same pattern with that of root system. Zn accumulation in *A.mourorum* shoot system has its highest value in spring at station 1, while Cu has the highest value in autumn at station 2. The statistical analysis showed a significant difference at $P< 0.05$ between the study stations for accumulation of all studied metals. Seasonal accumulation is significant at $P< 0.05$ in the case of Pb only.Table (3).

The highest accumulation value for Pb, Cd and Zn in *S. vermiculata* root system was seen in the station 2 in winter, summer, spring and autumn respectively. While Cu has the highest accumulation value in station 1 at summer. A significant difference at $P< 0.05$ between the study stations for accumulation of all

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studied metals. Seasonal accumulation is significant at P< 0.05 in the case of Pb, Cd and Cu. Table (4).

Pb has found in the highest accumulation in *S. vermiculata* shoot system in station 1 in winter , while Cu and Zn in summer at station 3 while Cd recorded was ahighest in station 2 at summer . Table (5).

Heavy metals concentrations in the plants are highly associated with the chemical composition of the soil. Plant adaptation to the heavy metals may be related to several processes such as complexing and chelating of ions out sides the plant cells (especially root cells), binding of ions to plant cell wall and selective uptake of ions The absorption of trace metals by plant roots can be both passive and active , passive absorption is the diffusion of ions from soil into root endodermis while the active uptake needs metabolic energy and take place against chemical gradients (Alina , 2010).

Lead is present in soil due to anthropogenic activities. 90% of lead emission world-wide comes from burning of fossil oil and its derivatives (Treub, 1996; Thöni and Setler, 2004).The present study showed that the studied plants, especially S. vermiculata, accumulated lead higher than the other heavy elements identified in the study. This result is in agreement with (Cicek and Koparal , 2004 ; Delavar and Safari , 2015).In contrast to zinc is essential for organisms living. Zinc is a part of many enzymatic centres. It toxicity is noticed just in high concentration, this toxicity is expressed as yellowing of young plant leaves, plant death, and infertility and skin diseases in animals (Merian, 1984). Low accumulation of Zinc in the studied plant may be related to low Zinc concentration in the soil of study area.

Cadmium is non-essential metal that negatively affects the plant growth and development. It is recognized as an extremely pollutant due to its high toxicity and solubility in water (Pinto *et al*., 2004).

The results appeared that the studied plants have a high tolerance to Cadmium. Many plants species have to develop efficient and specific mechanism for heavy metal detoxification. One of the main mechanisms for Cd tolerance is depressing Cd bioavailability in soils, thus reducing the amount of Cd uptake (Punz and Sieghardt,1993).

Table (2): Accumulation of heavy metal in *A.mourorum* root system

Station	Season	Heavy metals µg/g dry weight			
		Pb	Cd	Zn	Cu
1	Autumn	34.61	1.40	13.60	14.20
	Spring	48.31	2.50	24.18	16.87
	Summer	56.09	2.90	21.60	20.61
	Mean	54.803	2.438	20.748	18.823
	SD	1911875	.72039	4.89181	4.13502
2	Autumn	49.30	2.70	14.10	25.30
	Winter	72.80	3.60	30.05	25.05
	Spring	50.61	2.91	22.09	17.34
	Summer	57.11	3.10	22.67	28.35
	Mean	57.455	3.078	22.228	24.010
	SD	10.78496	.38474	6.51824	4.69291
3	Autumn	48.11	3.01	17.31	22.11
	Winter	79.20	3.01	23.47	30.43
	Spring	48.36	2.47	20.30	18.91
	Summer	59.86	3.60	19.15	21.30
	Mean	58.883	3.023	20.058	23.188
	SD	1461194	.46155	2.58691	5.01579
4	Autumn	23.50	1.02	9.41	11.03
	Winter	23.50	1.02	9.41	11.03
	spring	23.50	1.02	9.41	11.03
	summer	23.50	1.02	9.41	11.03
	Mean	23.50	1.02	9.41	11.03
	SD	.0000	.0000	.0000	.0000

Table (3): Accumulation of heavy metal in *A.mourorum* shoot systems

Station	Season	Heavy metals µg/g dry weight			
		Pb	Cd	Zn	Cu
1	Autumn	32.10	1.08	8.35	10.21
	Winter	64.05	1.40	16.56	12.67
	Spring	45.06	2.25	21.30	12.30
	Summer	36.10	2.01	11.20	13.45
	Mean	44.328	1.658	14.353	12.158
	SD	14.221	.53917	5.74773	1.38399
2	autumn	44.50	2.40	18.50	17.30
	winter	60.32	2.00	15.11	13.01
	spring	47.35	2.30	18.20	12.50
	summer	48.50	2.28	13.50	15.30
	Mean	50.168	2.245	16.328	14.528
	SD	6.974	.17156	2.42920	2.21337
3	autumn	42.20	2.61	19.89	16.18
	winter	61.44	2.09	12.40	10.11
	spring	46.21	2.20	14.20	13.20
	summer	53.06	3.19	12.10	14.10
	Mean	50.728	2.523	14.648	13.398
	SD	8.433	.49809	3.61594	2.52207
4	autumn	20.09	0.91	5.13	7.10
	winter	20.09	0.91	5.13	7.10
	spring	20.09	0.91	5.13	7.10
	summer	20.09	0.91	5.13	7.10
	Mean	20.09	0.91	5.13	7.10
	SD	0.00000	.00000	.00000	.0000

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Table (4): Accumulation of heavy metal in *S.vermiculata* root systems

Station	Season	Heavy metals µg/g dry weight			
		Pb	Cd	Zn	Cu
1	autumn	39. 90	2.91	19.03	12.51
	Winter	83.05	2.03	22.04	18.30
	Spring	61 .31	2.80	22.10	16.91
	summer	65.12	4.70	25.21	68.10
	Mean	62.345	3.110	22.095	28.955
	SD	17.71296	1.12999	2.52326	26.21310
2	autumn	51.10	3.60	30.05	20.20
	Winter	87.03	2.90	26.21	20.80
	Spring	62.07	2.90	23.17	18.36
	summer	68.70	5.90	27.44	62.67
	Mean	67.228	3.825	26.718	30.508
	SD	15.06688	1.42215	2.85598	2146678
3	autumn	47.51	4.20	24.09	22.80
	Winter	75.10	2.20	19.91	22.20
	Spring	59.80	3.06	26.90	20.07
	summer	62.61	5.20	29.11	66.32
	Mean	61.25	3.665	25.003	32.848
	SD	11.32199	1.31081	3.96813	22.34572
4	autumn	24.30	1.30	9.80	10.03
	Winter	24.30	1.30	9.80	10.03
	Spring	24.30	1.30	9.80	10.03
	summer	24.30	1.30	9.80	10.03
	Mean	24.30	1.30	9.80	10.03
	SD	.0000	.0000	.0000	.0000

Table (5): Accumulation of heavy metal in *S.vermiculata* shoot systems

Station	season	Heavy metals µg/g dry weight			
		Pb	Cd	Zn	Cu
1	autumn	35.01	2.15	17.01	9.30
	winter	70.66	1.68	14.31	15.20
	spring	49.16	2.30	19.50	15.30
	summer	53.09	4.20	21.05	15.19
	Mean	51.980	2.583	17.968	23.748
	SD	14.67546	1.11021	2.95209	21.14853
2	Autumn	41.50	3.10	21.31	15.10
	Winter	66.10	2.25	15.70	18.47
	Spring	50.30	2.35	19.55	16.10
	Summer	55.50	5.01	22.31	53.20
	Mean	53.350	3.178	19.718	25.718
	SD	10.27797	1.27920	2.91121	18.37609
3	Autumn	39.75	3.25	16.09	19.70
	Winter	67.20	1.90	16.82	18.50
	Spring	51.60	2.40	23.11	17.83
	Summer	55.60	4.50	25.50	54.10
	Mean	53.538	3.013	20.380	27.533
	SD	11.32500	1.13752	4.64561	17.72855
4	autumn	21.55	1.03	6.70	7.90
	winter	21.55	1.03	6.70	7.90
	spring	21.55	1.03	6.70	7.90
	summer	21.55	1.03	6.70	7.90
	Mean	21.55	1.03	6.70	7.90
	SD	.0000	.0000	.0000	.0000

Concolutions:

1. It concluted from the presented study. their high amount of studied metals were found inthe root and shoot system for both plants .

2. Higher concentration of heavy metals was found in the root system more than in the shoot system for both plants.

3. The plant of *S.vermiculata* concentrated heavy metals (Cd, Cu, Pb, Zn) more than it,s in *A.maurorum* plant for shoot and root system.

4. The study area affected by the emissions of thermal electric power station particular with wind direction.

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