DOKUZ EYLÜL ÜNİVERSİTESİ

METALS ACCUMULATION AND TRANSFER IN *Portulaca oleracea L.* SAMPLES AS EDIBLE WILD PLANTS IN AEGEAN REGION OF MEDITERRANEAN AREA

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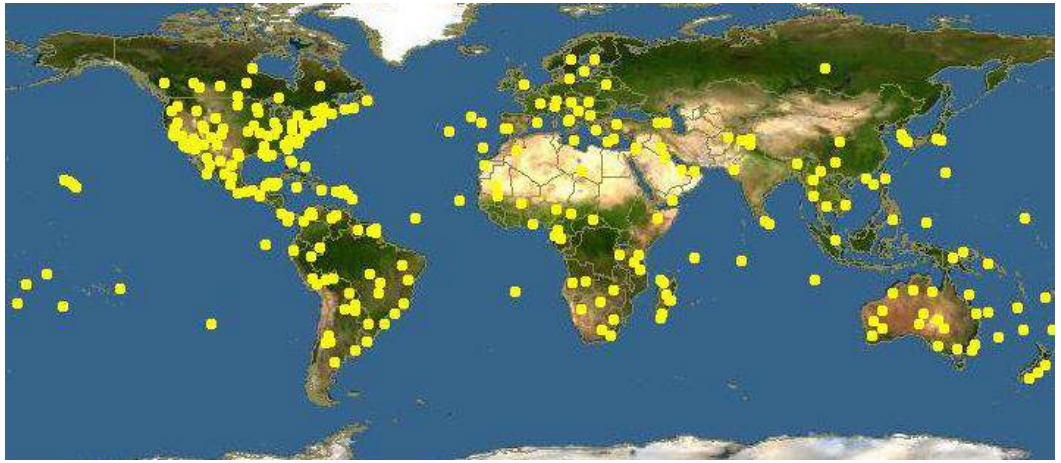
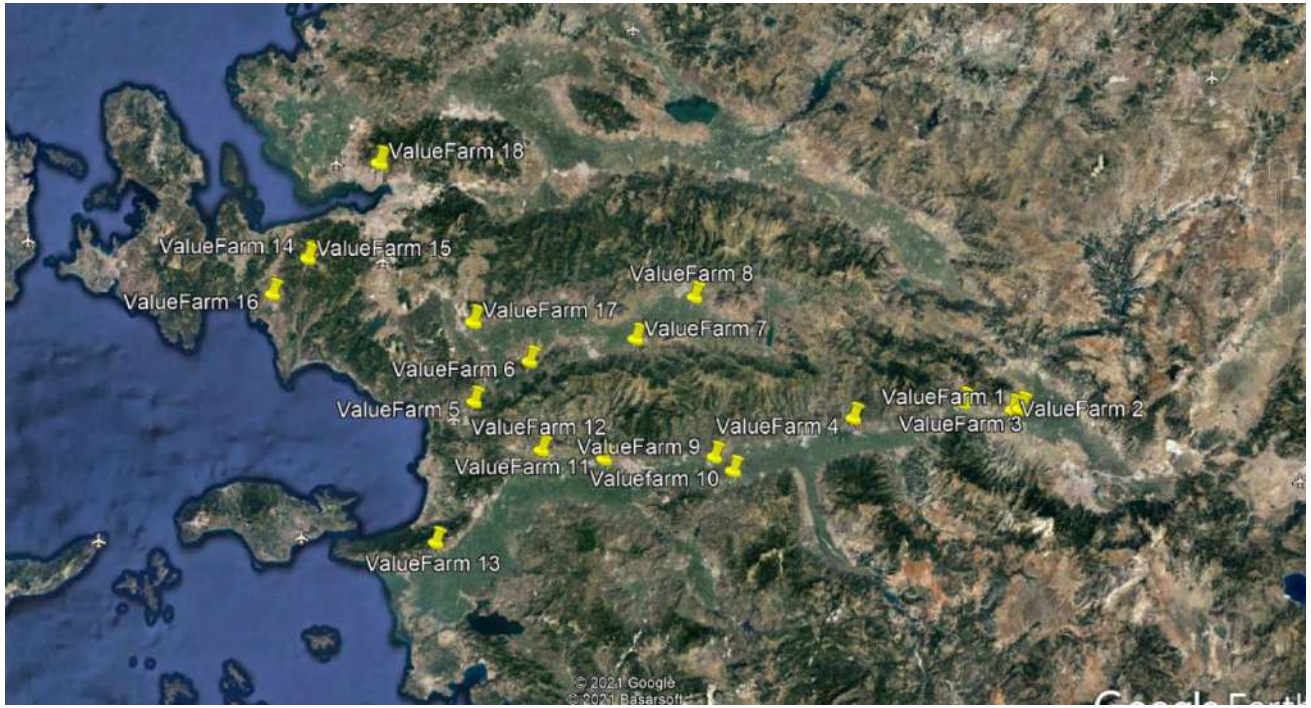
Portulaca oleracea L.

- Purslane, with the botanic name *Portulaca oleracea L.*, is known to be a common wild edible plant with highly rich nutritional and medicanal characteristics.
- It is the vegetable richest in Omega-3 fatty acids.
- Fresh purslane has high nutritional values, in terms of vitamins (A, B1 (thiamin), B2, B6, C, E, niacin, nicotinic acid, beta-carotene, riboflavin, folate etc.) and minerals (especially K, Ca, Fe, Mg, Na, P, Cu and Mn) which are beneficial for human health.
- In the Middle East, the plant is used in asthma, ulcer, diarrhea, dysentery and hemorrhoids, while it is used for antipyretic, muscle relaxant, antiseptic, antispasmodic, and diuretic purposes. Some studies have shown that purslane consumption helps reduce the occurrence of cancer and heart disease.

Purslane in Egyptian Tablets

Sampling





Küçükmenderes and Büyükmenderes Basins

Date	Sample No	Coordinate	Altitude, m	Habitat
14.11.20	PT 1	37.926710 28.905460	167.3	Olive trees- Cropland
14.11.20	PT 2	37.927390 28.883370	151.3	Okra cropland
14.11.20	PT 3	37.944750 28.747780	128.5	Eggplant Orchard - Okra cropland
14.11.20	PT 4	37.915260 28.440200	104.8	Orange Garden
15.11.20	PT 5	37.958580 27.385700	21.8	Peach- Orange Garden
15.11.20	PT 6	38.046580 27.540170	31.8	Peach Garden in green
15.11.20	PT 7	38.094610 27.836440	151	Onion, eggplant, tomato garden
15.11.20	PT 8	38.185060 28.001320	94.1	Potato cropland
17.11.20	PT 9	37.834150 28.052520	94	Cabbage Cropland
16.11.20	PT 10	37.803205 28.103941	39	Turnip Cropland
17.11.20	PT 11	37.831900 27.746350	41.5	Fennel and Cabbage Cropland
17.11.20	PT 12	37.851610 27.572580	47.5	Corn Cropland
17.11.20	PT 13	37.649854 27.277780	30	Orange Garden
20.11.20	PT 14	38.277633 26.922367	481	Olive and quince trees
20.11.20	PT 15	38.273217 26.921067	440	Garden
20.11.20	PT 16	38.194817 26.822167	16	Mandarin Garden
25.11.20	PT 17	38.1302750 27.383114	21	Garden
30.11.20	PT 18	38.479401 27.120571	29	Park/Public Garden

Methods

>The water contents in soil samples were determined gravimetrically by drying the soil according to TS EN ISO 11461 (ISO, 2001).
>The organic matter contents were determined on the basis of burning the dry sample according to ASTM D2974-13, TS 8336 standards (ASTM International, 2013) (TSE, 2008).
>The pH values of the soil samples were determined according to the ISO 10390 standard (TSE, 2013), and the electrical conductivity values were determined according to the ISO 11265 (ISO, 1994).
>The soil samples were treated based on acid digestion prior to the instrumental analysis of heavy metals samples. Perkin Elmer Sample Preparation Block 50-48 was used for lysis using the modified EPA 3050 Method B.
>Instrumental analysis of heavy metals in plant samples was carried out based on acid digestion. Perkin Elmer Sample Preparation Block 50-48 was used for this procedure.
>Heavy metal analyses of soil and plant sample extracts were performed with Thermo Scientific brand iCAP 6000 Series model ICP-OES.

Results and Discussion

Sample No	Water content (%)	Organic matter content (% dw)	pH	EC, µS cm^{-1}
PT-1	12.81	6.63	7.86	445
PT-2	16.25	6.54	7.91	299.8
PT-3	19.26	3.24	8.26	877
PT-4	6.03	3.83	7.96	368
PT-5	4.61	3.55	7.29	252.5
PT-6	3.79	3.91	7.96	455
PT-7	4.23	4.37	7.13	275
PT-8	9.56	2.45	5.2	951
PT-9	10.82	2.80	7.87	362
PT-10	2.09	2.25	7.94	117.5
PT-11	8.52	3.92	7.76	429
PT-12	9.06	4.23	7.52	244.7
PT-13	11.42	4.21	7.8	239.7
PT-14	10.09	8.00	7.38	423
PT-15	4.24	5.29	7.5	340
PT-16	8.73	5.87	6.9	493

Element	Yerkabuğu Ortalaması mg/kg	PT1	PT2	PT3	PT4	PT5	PT6	PT7	PT8	PT9	PT10	PT11	PT12	PT13	PT14	PT15	PT16	PT17	PT18
Ag	0.075	ND	0.56	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**4.54**	ND
Al	82300	8,644.2	9,132.7	11,782.5	8,930.6	14,439.1	12,621.7	13,030.6	13,770.4	9,095.4	14,099.1	9,840.8	8,185.3	4,039.3	12,982.9	5,523.8	15,147.1	8,118.8	13,520.7
As	1.8	**9.48**	**6.59**	**14.55**	**4.90**	1.26	**16.01**	**2.44**	**16.26**	**7.06**	0.87	**7.09**	**6.82**	**10.33**	**4.18**	**9.25**	**3.45**	**7.59**	**16.47**
Ba	425	65.67	69.29	109.67	74.38	28.35	42.66	85.21	102.47	74.45	102.88	63.17	41.91	28.30	33.63	48.76	41.22	57.25	99.79
Cd	0.15	**1.35**	**1.26**	**1.25**	**1.82**	**1.86**	**1.83**	**2.39**	**1.81**	**1.91**	**1.83**	**2.06**	**1.09**	**1.71**	**1.68**	**0.74**	**2.48**	**1.26**	**1.53**
Co	25	13.87	12.77	10.40	12.92	21.67	15.72	15.99	13.05	12.06	14.70	13.57	8.00	10.27	15.80	6.56	20.09	8.97	12.80
Cr	102	59.01	57.02	40.60	33.32	154.24	84.38	42.10	39.77	30.55	42.69	49.88	42.55	13.34	26.50	26.17	97.78	**461.49**	42.25
Cu	60	24.61	23.88	28.08	32.36	70.34	37.63	37.34	26.80	29.82	21.21	25.81	15.95	38.07	**69.59**	23.00	**75.01**	23.15	25.86
Fe	56300	14,658.9	14,260.0	16,938.0	19,292.2	19,647.4	19,164.6	22,765.8	19,192.9	19,893.1	19,209.1	20,626.9	15,221.6	18,468.1	19,197.2	9,904.9	ND	14,890.4	17,007.1
Li	20	6.74	9.18	11.14	7.06	13.11	10.84	12.38	13.09	9.26	14.41	9.06	6.44	6.07	19.54	4.48	**23.93**	7.80	9.71
Mn	950	405.19	381.30	296.43	229.68	522.58	415.33	397.11	251.50	361.93	284.83	429.83	335.16	448.95	736.16	366.34	787.06	322.18	416.42
Ni	84	**132.99**	**123.61**	49.79	50.15	**167.68**	**84.32**	39.01	26.09	34.58	38.37	54.41	52.84	30.06	41.92	35.12	**124.32**	44.59	59.47
Pb	14	**14.71**	**14.07**	**43.13**	7.53	12.92	12.55	10.82	7.79	10.69	7.27	8.28	6.92	**21.70**	**23.12**	**18.29**	**34.44**	10.83	**15.03**
Sr	370	ND	ND	93.45	59.05	41.70	33.38	29.77	24.68	45.87	26.14	40.60	26.25	121.48	33.16	96.17	31.55	45.59	76.03
Zn	70	**71.30**	**84.51**	**90.98**	**100.68**	**108.13**	**85.97**	**163.60**	**82.31**	**84.44**	**86.05**	**89.17**	44.47	**74.54**	**89.48**	47.66	**112.16**	**78.80**	**75.66**

SOILS

SOILS

		Al	As	Ba	Cd	Co	Cr	Cu	Fe	Li	Mn	Ni	Pb	Sr	Zn
Al	r	1	-0.176	,500*	,727**	,853**	0.084	,563*	0.388	,827**	,552*	0.422	0.260	-0.198	,695**
	p		0.471	0.029	0.000	0.000	0.732	0.012	0.101	0.000	0.014	0.072	0.282	0.416	0.001
As	r		1	0.197	-0.353	-0.399	-0.123	-0.410	-0.046	-0.345	-0.337	-0.268	0.121	0.281	-0.414
	p			0.420	0.138	0.091	0.615	0.082	0.850	0.148	0.158	0.268	0.621	0.244	0.078
Ba	r			1	0.285	0.176	-0.073	-0.287	,468*	0.162	-0.188	-0.128	0.099	0.046	0.376
	p				0.237	0.472	0.766	0.234	0.043	0.508	0.442	0.601	0.686	0.850	0.113
Cd	r				1	,841**	0.005	,601**	0.434	,707**	,582**	0.279	0.135	-0.066	,850**
	p					0.000	0.985	0.006	0.063	0.001	0.009	0.248	0.581	0.788	0.000
Co	r					1	0.081	,776**	0.370	,783**	,722**	,672**	0.236	-0.198	,776**
	p						0.741	0.000	0.119	0.000	0.000	0.002	0.331	0.417	0.000
Cr	r						1	0.074	-0.015	0.048	0.071	0.195	-0.048	-0.076	0.106
	p							0.762	0.952	0.845	0.773	0.423	0.847	0.757	0.666
Cu	r							1	0.013	,788**	,853**	,508*	,470*	0.028	,549*
	p								0.959	0.000	0.000	0.026	0.042	0.908	0.015
Fe	r								1	0.039	0.032	-0.052	-0.206	0.126	,480*
	p									0.873	0.897	0.832	0.397	0.608	0.038
Li	r									1	,769**	0.343	,465*	-0.195	,609**
	p										0.000	0.151	0.045	0.424	0.006
Mn	r										1	,506*	,522*	0.026	,464*
	p											0.027	0.022	0.917	0.046
Ni	r											1	0.218	-0.338	0.306
	p												0.369	0.157	0.202
Pb	r												1	0.438	0.222
	p													0.061	0.362
Sr	r													1	-0.056
	p														0.819
Zn	r														1
	p														

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

	Initial Eigenvalues			Rotation Sums of Squared Loadings		
Bileşen	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
TB1	6.008	46.217	46.217	5.223	40.178	40.178
TB2	2.167	16.668	62.885	2.789	21.453	61.631
TB3	1.383	10.636	73.521	1.410	10.849	72.480
TB4	1.000	7.695	81.216	1.136	8.736	81.216

Extraction Method: Principal Component Analysis.

PC1-Natural Geochemistry

PC2-Agricultural Chemicals and PO_4^{-3} Fertilizers

PC3-Groundwater Irrigation

PC4- Ni&Cr from Mining Sites

	Component			
	TB1, %40.178	TB2, %21.453	TB3, %10.849	TB4, %8.216
Cu	**0.929**			
Mn	**0.912**			
Li	**0.882**			
Co	0.817	0.448		
Al	**0.673**	**0.628**		
Cd	0.650	0.598		
Pb	0.621		0.620	
Ni	0.583			0.455
Ba		**0.821**	0.429	
Fe		**0.806**		
Zn	0.583	0.646		
As			**0.761**	
Cr				0.931

Extraction Method: Principal Component Analysis.
a. Rotation converged in 8 iterations.

PLANTS

Element	Average, ppm dw			Range in plants ppm dw (Pais and Jones, 1997)	
	Root	Stem	Leaf	Min	Max
Al	367.6	53.7	346.9	10	1000
As	0.2	0.2	1.2	0.009	1.7
B	23.7	27.5	29.7	na	na
Ba	150.2	134.0	134.6	na	na
Cd	0.1	0.1	0.0	0.1	1
Co	0.1	0.1	0.1	0.3	0.57
Cr	2.3	0.6	2.3	0.2	0.2
Cu	26.4	22.4	37.0	1	10
Fe	796.8	164.8	750.7	20	100
Li	0.2	0.2	0.4	na	na
Mn	36.0	23.5	85.9	10	500
Ni	2.4	1.2	4.8	0.3	3.5
Pb	1.3	1.9	18.0	1	1
Sr	107.4	140.6	151.6	na	na
Zn	59.3	55.5	102.3	10	100

Metals	BCF Range in plants (Pais and Jones, 1997)		BCF Range in the samples		
	Min	Max	Max	Min	Ave
Al	na	na	0.111	0.000	0.034
As	0.01	0.1	0.377	0.000	0.034
Ba	na	na	4.358	0.664	2.450
Cd	1	10	0.275	0.000	0.033
Co	0.01	0.1	0.086	0.000	0.010
Cr	0.01	0.1	0.397	0.000	0.044
Cu	1	10	1.573	0.411	0.841
Fe	na	na	0.131	0.000	0.045
Li	na	na	0.164	0.000	0.019
Mn	na	na	0.313	0.017	0.093
Ni	0.1	1	0.204	0.000	0.042
Pb	0.01	0.1	1.053	0.000	0.113
Sr	na	na	4.896	0.731	2.305
Zn	1	10	1.125	0.197	0.707

BCF<2 indicates a range from deficiency to minimal enrichment of the element in question, 2<BCF<5 indicates moderate enrichment, 5<BCF<20 indicates significant enrichment, 20<BCF<40 indicates very high enrichment, and BCF>50 is indicator of high enrichment in the point.

PLANTS

Metals	Root-Stem TF			Root-Leaf TF		
	Max	Min	Ave	Max	Min	Ave
Al	1.645	0.000	0.291	1.645	0.000	0.348
As	1.971	0.134	0.829	1.971	0.134	0.928
B	1.645	0.692	1.192	1.645	0.692	1.201
Ba	1.704	0.238	0.978	1.704	0.238	0.989
Cd	1.523	0.665	0.959	1.523	0.665	1.019
Co	2.506	0.387	1.112	2.506	0.387	1.261
Cr	0.808	0.000	0.227	0.808	0.000	0.382
Cu	1.320	0.589	0.870	1.320	0.589	0.941
Fe	1.946	0.000	0.391	1.946	0.000	0.468
Li	1.528	0.555	0.985	1.528	0.555	1.010
Mn	1.733	0.257	0.708	1.733	0.257	0.731
Ni	3.069	0.000	0.584	3.069	0.000	1.039
Pb	3.359	0.000	0.933	3.359	0.000	1.418
Sr	2.514	0.934	1.343	2.514	0.934	1.409
Zn	1.630	0.610	0.980	1.630	0.610	1.021

Plants exhibit TF < 1 when under stress due to the metal level. However, in the case of TF > 1, the plants tolerate the metal concentration and also use the metals in their systems. Therefore, there is a potential for metal accumulation in plants with TF > 1.

PLANTS- Roots

Correlations

		Al (ppm)	As (ppm)	B (ppm)	Ba (ppm)	Cd (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	Fe (ppm)	Li (ppm)	Mn (ppm)	Ni (ppm)	Pb (ppm)	Sr (ppm)	Zn (ppm)
Al (ppm)	r	1	0.213	-0.401	0.024	0.034	0.173	,509*	0.027	,956**	0.192	0.240	,635**	0.161	-0.046	,475*
	p		0.396	0.099	0.926	0.894	0.493	0.031	0.915	0.000	0.445	0.337	0.005	0.524	0.855	0.047
As (ppm)	r		1	0.059	-0.137	,845**	,985**	,845**	0.166	0.045	,995**	0.019	0.380	,694**	-0.038	,470*
	p			0.816	0.589	0.000	0.000	0.000	0.511	0.860	0.000	0.940	0.120	0.001	0.880	0.049
B (ppm)	r			1	0.343	0.210	0.060	-0.156	,517*	-0.437	0.089	0.461	-0.213	0.102	0.180	0.184
	p				0.164	0.402	0.812	0.536	0.028	0.070	0.727	0.054	0.396	0.687	0.476	0.465
Ba (ppm)	r				1	-0.191	-0.172	-0.074	-0.162	-0.019	-0.142	0.032	0.102	0.050	0.359	-0.101
	p					0.447	0.495	0.771	0.519	0.941	0.574	0.900	0.688	0.844	0.144	0.690
Cd (ppm)	r					1	,847**	,542*	,490*	-0.044	,891**	0.083	0.233	,480*	0.118	0.459
	p						0.000	0.020	0.039	0.861	0.000	0.744	0.351	0.044	0.641	0.056
Co (ppm)	r						1	,803**	0.168	0.026	,976**	0.021	0.293	,622**	-0.045	,497*
	p							0.000	0.506	0.917	0.000	0.935	0.238	0.006	0.860	0.036
Cr (ppm)	r							1	0.006	0.360	,814**	0.006	,627**	,666**	-0.027	0.322
	p								0.980	0.142	0.000	0.981	0.005	0.003	0.915	0.193
Cu (ppm)	r								1	0.065	0.230	,495*	0.132	-0.101	0.018	0.366
	p									0.797	0.359	0.037	0.600	0.689	0.945	0.135
Fe (ppm)	r									1	0.033	0.263	,528*	-0.004	-0.066	0.409
	p										0.897	0.292	0.024	0.987	0.796	0.092
Li (ppm)	r										1	0.031	0.379	,684**	-0.008	,472*
	p											0.902	0.121	0.002	0.975	0.048
Mn (ppm)	r											1	-0.118	-0.102	-0.278	,703**
	p												0.641	0.687	0.263	0.001
Ni (ppm)	r												1	0.385	0.353	0.121
	p													0.114	0.150	0.631
Pb (ppm)	r													1	-0.156	0.213
	p														0.535	0.395
Sr (ppm)	r														1	-0.254
	p															0.309
Zn (ppm)	r															1
	p															

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Total Variance Explained

	Initial Eigenvalues			Loadings			Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.647	47.060	47.060	5.647	47.060	47.060	5.073	42.279	42.279
2	2.468	20.564	67.623	2.468	20.564	67.623	2.739	22.825	65.104
3	1.946	16.218	83.841	1.946	16.218	83.841	2.248	18.737	83.841

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component		
	1	2	3
Li (ppm)	**0.978**		
As (ppm)	**0.978**		
Co (ppm)	**0.957**		
Cd (ppm)	0.851		
Cr (ppm)	0.805	0.487	
Pb (ppm)	0.763		
Al (ppm)		**0.966**	
Fe (ppm)		**0.936**	
Ni (ppm)		0.717	
Mn (ppm)			0.879
Zn (ppm)			0.767
Cu (ppm)			0.749

Extraction Method: Principal Component
a. Rotation converged in 4 iterations.

PC1- 42.3% Fertilizer and groundwater irrigation

PC2- 22.8% Earth's crust geochemistry

PC3- 18.7% agricultural chemicals Burgundy solution, $CuSO_4$, $ZnSO_4$

PLANTS- Stems

Correlations

		Al (ppm)	As (ppm)	B (ppm)	Ba (ppm)	Cd (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	Fe (ppm)	Li (ppm)	Mn (ppm)	Ni (ppm)	Pb (ppm)	Sr (ppm)	Zn (ppm)
Al (ppm)	r	1	0.184	0.393	0.081	0.275	0.273	0.316	0.207	,864**	0.315	0.439	0.414	-0.160	0.141	0.292
	p		0.464	0.107	0.750	0.270	0.273	0.201	0.410	0.000	0.203	0.068	0.088	0.525	0.577	0.240
As (ppm)	r		1	0.426	-0.224	,936**	,939**	,742**	,822**	,594**	,884**	0.276	,654**	0.374	-0.028	,534*
	p			0.078	0.372	0.000	0.000	0.000	0.000	0.009	0.000	0.268	0.003	0.126	0.912	0.022
B (ppm)	r			1	0.178	,574*	,585*	,685**	0.389	0.409	,657**	0.404	0.406	-0.229	0.257	0.430
	p				0.479	0.013	0.011	0.002	0.110	0.092	0.003	0.097	0.095	0.362	0.303	0.075
Ba (ppm)	r				1	-0.286	-0.285	-0.078	-,468*	-0.041	-0.193	-0.432	-0.099	0.196	,611**	-0.286
	p					0.250	0.252	0.758	0.050	0.871	0.444	0.073	0.697	0.435	0.007	0.250
Cd (ppm)	r					1	,997**	,811**	,818**	,617**	,960**	0.305	,702**	0.052	0.035	,567*
	p						0.000	0.000	0.000	0.006	0.000	0.218	0.001	0.838	0.891	0.014
Co (ppm)	r						1	,833**	,810**	,616**	,966**	0.314	,698**	0.052	0.034	,595**
	p							0.000	0.000	0.006	0.000	0.205	0.001	0.838	0.894	0.009
Cr (ppm)	r							1	,488*	,499*	,940**	0.223	0.446	0.052	-0.039	,740**
	p								0.040	0.035	0.000	0.373	0.064	0.836	0.877	0.000
Cu (ppm)	r								1	,542*	,696**	,522*	,678**	0.163	-0.199	0.438
	p									0.020	0.001	0.026	0.002	0.519	0.430	0.069
Fe (ppm)	r									1	,590**	,474*	,644**	0.052	0.181	0.418
	p										0.010	0.047	0.004	0.837	0.473	0.084
Li (ppm)	r										1	0.271	,610**	0.055	-0.002	,667**
	p											0.277	0.007	0.828	0.993	0.002
Mn (ppm)	r											1	0.337	-0.096	-0.250	0.458
	p												0.171	0.705	0.316	0.056
Ni (ppm)	r												1	-0.045	0.281	0.452
	p													0.859	0.259	0.060
Pb (ppm)	r													1	-0.249	0.042
	p														0.320	0.868
Sr (ppm)	r														1	-0.252
	p															0.313
Zn (ppm)	r															1
	p															

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared			Rotation Sums of Squared		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.021	58.512	58.512	7.021	58.512	58.512	5.797	48.312	48.312
2	1.657	13.809	72.321	1.657	13.809	72.321	2.667	22.223	70.534
3	1.035	8.624	80.944	1.035	8.624	80.944	1.249	10.410	80.944
4	0.833	6.941	87.886						

Extraction Method: Principal Component Analysis.

PC1- 48.3% Agricultural chemicals and fertilizers

PC2- 22.2% Earth's crust geochemistry

PC3- 10.4% Groundwater irrigation

Rotated Component Matrix[a]

	Component		
	1	2	3
Li (ppm)	**0.964**		
Co (ppm)	**0.952**		
Cd (ppm)	**0.942**		
Cr (ppm)	0.897		
As (ppm)	0.873		0.422
Cu (ppm)	0.693		
Zn (ppm)	0.677		
Ni (ppm)	0.596	0.501	
Al (ppm)		**0.892**	
Fe (ppm)	0.414	**0.837**	
Mn (ppm)		0.704	
Pb (ppm)			**0.921**

Extraction Method: Principal Component

a. Rotation converged in 5 iterations.

PLANTS- Leaves

Correlations

		Al (ppm)	As (ppm)	B (ppm)	Ba (ppm)	Cd (ppm)	Co (ppm)	Cr (ppm)	Cu (ppm)	Fe (ppm)	Li (ppm)	Mn (ppm)	Ni (ppm)	Pb (ppm)	Sr (ppm)	Zn (ppm)
Al (ppm)	r	1	0.093	-0.419	-0.307	0.130	0.141	,515*	0.327	,989**	0.072	0.431	,557*	0.053	-0.299	-0.005
	p		0.715	0.084	0.216	0.606	0.577	0.029	0.186	0.000	0.775	0.074	0.016	0.836	0.227	0.986
As (ppm)	r		1	0.394	-0.005	,684**	,777**	,796**	0.041	0.154	,725**	-0.081	-0.073	,996**	-0.235	,745**
	p			0.106	0.984	0.002	0.000	0.000	0.873	0.541	0.001	0.750	0.775	0.000	0.348	0.000
B (ppm)	r			1	0.264	0.134	0.194	0.114	-0.234	-0.405	0.242	-0.141	-0.381	0.414	0.030	0.149
	p				0.290	0.595	0.441	0.654	0.351	0.095	0.333	0.577	0.118	0.088	0.905	0.555
Ba (ppm)	r				1	-0.298	-0.333	-0.331	-,543*	-0.322	-0.095	-,518*	0.109	-0.008	,544*	-0.182
	p					0.230	0.177	0.179	0.020	0.193	0.707	0.028	0.666	0.975	0.020	0.469
Cd (ppm)	r					1	,929**	,626**	,662**	0.191	,937**	-0.037	0.039	,658**	-0.214	,546*
	p						0.000	0.005	0.003	0.448	0.000	0.884	0.879	0.003	0.394	0.019
Co (ppm)	r						1	,812**	,548*	0.228	,807**	-0.040	-0.033	,780**	-0.241	,668**
	p							0.000	0.019	0.363	0.000	0.874	0.896	0.000	0.335	0.002
Cr (ppm)	r							1	0.290	,587*	,514*	0.147	0.126	,804**	-0.325	,632**
	p								0.242	0.010	0.029	0.562	0.618	0.000	0.188	0.005
Cu (ppm)	r								1	0.336	,493*	0.333	0.285	0.014	-0.271	0.212
	p									0.173	0.038	0.176	0.251	0.955	0.277	0.398
Fe (ppm)	r									1	0.111	0.394	,521*	0.120	-0.310	0.047
	p										0.660	0.105	0.027	0.634	0.211	0.853
Li (ppm)	r										1	-0.093	0.022	,683**	-0.108	,496*
	p											0.715	0.930	0.002	0.670	0.036
Mn (ppm)	r											1	0.267	-0.087	-0.397	0.226
	p												0.285	0.730	0.103	0.367
Ni (ppm)	r												1	-0.105	0.059	0.158
	p													0.678	0.816	0.532
Pb (ppm)	r													1	-0.228	,765**
	p														0.362	0.000
Sr (ppm)	r														1	-0.242
	p															0.334
Zn (ppm)	r															1
	p															

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Total Variance Explained

	Initial Eigenvalues			Loadings			Rotation Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.743	47.861	47.861	5.743	47.861	47.861	4.681	39.010	39.010
2	2.808	23.403	71.265	2.808	23.403	71.265	2.908	24.230	63.240
3	1.339	11.155	82.420	1.339	11.155	82.420	2.302	19.179	82.420

PC1- 39.0% Fertilizers and groundwater irrigation

PC2- 24.2 % Earth's crust geochemistry

PC3- 19.2% Agricultural chemicals -$CuSO_4$

Rotated Component Matrix[a]

	Component 1	2	3
Pb (ppm)	**0.989**		
As (ppm)	**0.980**		
Cr (ppm)	0.851	0.406	
Zn (ppm)	0.771		
Co (ppm)	0.769		0.589
Al (ppm)		**0.949**	
Fe (ppm)		**0.927**	
Ni (ppm)		0.691	
Mn (ppm)		0.605	
Cu (ppm)			**0.904**
Cd (ppm)	0.614		0.774
Li (ppm)	0.621		0.675

Extraction Method: Principal Component
a. Rotation converged in 5 iterations.

Conclusions

- Soil Organic Matter
- Soil pH
- Soil EC
- In Soil Samples:
  - As, Cd, Ni, Zn and Pb were generally found above the Earth's Crust Average Levels, where Cu was detected above ECAL in some sampling points
  - Natural Geochemistry was the major factor influencing soil HM levels, while agricultural chemicals and fertilizers have considerable impacts.

Conclusions

- In Plant Samples:
  - Cr, Cu, Fe and Pb levels in plant root, stem and leaves were found above the ranges defined for plants, while Ni and Zn levels were only exceeding the corresponding ranges for the leaves.
  - The BCFs calculated for As, Cr and Pb were above the defined bioconcentration factors in the literature. However, only Ba and Sr showed “moderate enrichment” in plants and the rest of the metals did not show a significant enrichment according to BCF values.
  - TF calculated for Root to Stems resulted with >1 values for B, Co and Sr, where Cd, Ni, Li, Cu, and Zn were added to these elements in TF values calculated for Root to Leaves

Conclusions

- Therefore, B, Cd, Co, Ni, Li, Cu and Zn has a potential of being accumulated in *Portulaca* organs
- Statistical analysis showed that;
  - Earth crust geochemistry is the second major factor on metals levels in all *Portulaca* organs (22.2%-24.2%)
  - Fertilizers and ground water irrigation were the major factors on HM levels in the roots(42.3%)
  - In aerial parts of *Portulaca*;
    - **In stems; agricultural chemicals and fertilizers (48.3%)**
    - **In leaves; fertilizers and groundwater irrigation (39.0%)**

    were the most affecting factors on HM levels.

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