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Transloeation of some Elements in Guar Plant *(Cyamopsis tetragonoloba* L.) as Affected by Npk-Fertilization and Compost of Town Refuse

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ABSTRACT

Heavy metals contamination indicates as one of the major threats to soil system. Technique of phytoremediation applied plants which are capable to transfer and accumulate metals into their tissues. In recent time it has been proposed that biofuel plants are more favorable for both remediation and utilization of polluted soil by metal. This study revealed heavy metals phytoremediation potential of guar plant in the framework of an experimental field. Plants were submitted to 10 treatments of T1: control (without fertilization), T2: compost town refuse (CTR, 10 m3.fed-1), T3: 50%NPK, T4: 50%NPK+CTR, T5: 75%NPK, T6: 75%NPK+CTR, T7: 100%NPK, T8: 100%NPK+CTR, T9: 125%NPK and T10: 125%NPK+CTR. Our results demonstrated that guar plant was able to tolerate Fe, Zn, Mn, Cu, Pb, Ni and Cr high concentrations, which set the plant capability to grow well in higher levels of heavy metals. Significant metal accumulation was observed in root along with reduced biomass for guar plant. Moreover, it could perhaps be used for phytostabilization, with success in marginally polluted soils where their growth would not be decline and decontamination of metals could be maintained at satisfying levels. However, translocation factor (TF) values suggested that guar plant is more efficient for phytoremediation at higher levels of heavy metals.

Keywords: Contamination, phytoremediation, heavy metals, compost town refuse, mineral fertilization, Guar plant

INTRODUCTION

Pollution of soil with harmful level trace metals and their accumulation in soil is of great concern in agricultural production due to the adverse effects on crop growth i.e., soil micro-organisms, and metal phytotoxicity (Nagajyoti*et al*., 2010). Heavy metals have gone into agricultural soils fristly because of inappropriate utilization, rapid industrialization, and disposal of toxic heavy metals containing wastes, pesticides and excessive use of fertilizers (Amel *et al*., 2016 and Bashmakov *et al.,* 2015), which become unsafe to environmental and human health. heavy metals, as Cd, Pb, Co, Ni, Zn, Fe, and Cr (Nagajyoti *et al*., 2010), are major environmental contaminants, especially in regions with high human activities.

Remediation of soil by a lot of physicochemical techniques has been well certified in literature. In any case, polluted soils remediation from heavy metal by chemical methods and traditional physical are not favorable for lands of agricultural, wanted technological resources and large investments (Oh *et al*., 2013). Along these lines, a plant-based technology has stand out as a continues treatment of elevated levels of different toxic metals in soils, which has received great attention during past years. Phytoextraction due to the effective use of plants metal-accumulation to transfer metals from soil through roots and shoots biomass then concentrate into the harvestable parts, (i.e. shoot and root) and seems to be a promising, cost-effective technology for the remediation of metal-contaminated soils (Amanullah*et al*., 2016).

Researcher has reported many various plant species for metal absorption from polluted soil. The uptake of trace metal, mechanism of its accumulation and concentration, exclusion as well as various species of plant and also between different parts of plant. However, the focus has been largely on the use of field crop plants for the management of long-term contaminated dispersion in this perspective to crop plants from Brassicaceae followed by Fabaceae, Asteraceae and Poaceae (Zaidi *et al*., 2012)

Guar (*Cyamopsistetragonoloba* L.) is one of the most important legume crops belongs to Fabaceae family. Itis an annual legume crop, grown as vegetable and feed for human and animal consumption, respectively, the endosperm of guar seeds contain gum, which is importance as food and non-nutritive item (Ashraf *et al.,*2002). Guar contains a lot of important mineral and phytochemicals such as flavonoids and saponin and is well-known traditional plant used in folklore medicine (Chavan*et al.,* 2014).

Abundant use of mineral fertilizers in agriculture caused a poor soil fertility and consumers health. The mineral fertilizers, town refuse and pesticide residues have created water pollution leading to carcinogenic effect on human body and caused damage to the important organs.

Application of chemical fertilizers leads to the loss of soil fertility due to imbalanced use of fertilizers which have adversely affected agricultural productivity and caused soil degradation (Wani and Lee, 1992). One of the most numerous organic substances, available in Egypt is organic town refuse, which can easily be recycled and used like sources of nutrients and organic substances. Many experiments on organic and mineral fertilization proved in sundry countries that organic fertilizer alone can maintain soil fertility under highly intensive farming systems (Singh and Jain, 2004), but it leads to heavy metals pollution.

MATERIALS AND METHODS

An experimental field on the effect of mineral fertilization was tested on guar plant (*Cyamopsistetragonolobus*) to cure the soil from heavy mental which polluted with town refuse as organic manure was layout at the Privet Farm of Fac. Agric., El-Mans, Univ., Egypt during season 2018. The experiment was laid out in randomized block design (RBD) consisting of 10 treatment combinations with 3 replicates with the different treatments allocated randomly in each replicate. Ten treatments *viz* T1: control (without fertilization), T2: compost town refuse (CTR, 10 $m^3.fed^{-1}$), T3: 50%NPK, T4: 50%NPK+CTR, T5: 75%NPK, T6: 75%NPK+CTR, T7: 100%NPK, T8: 100%NPK+CTR, T9: 125%NPK and T10: 125%NPK+CTR.

Seeds of guar were sown in line with the spacing of plant to plant 20 cm and row to row 45 cm and depth at 3-4 cm with plot area of 4 x 4.5 m in clay loam soil, the analysis of soil used was carried out following the methods described byHaluschak, (2006), coarse sand 3.66%, fine sand 17.05%, silt 41.17%, clay 38.12%, pH (1:2.5) 8.12, EC dSm^{-1} (1:5) 0.98, OM 1.78%, $CaCO_3$ 4.75, SP 62.5%

and available N, P and K were determined according to Reeuwijk, (2002) which were 53.62, 6.91 and 188.4 $mg.kg^{-1}$, respectively, iron, zinc, copper, manganese, nickel, lead and chromium were evaluated using atomic absorption spectrophotometer conferring to Mathieu and Pieltain (2003) which were, 5.13, 0.98, 0.13, 2.66, 1.08, 2.91 and 3.69 $mg.kg^{-1}$, respectively.

From Mansoura manufactory for organic manure, compost town refuse was taken, the chemical characteristics of compost town refuse were pH (1:5) 7.83, EC dSm^{-1} (1:10) 4.41, organic carbon 11.47%, OM 19.71%, total N 0.59%, C/N ratio 19.44, total P 0.38%, total K 0.69%, microelement and heavy metals as Fe, Mn, Zn, Cu, Pb, Ni and Cr were 44.15, 18.91, 9.06, 6.25, 7.44, 1.93 and 4.08 $mg.kg^{-1}$, respectively, then the surface layer of the soil was manured before seed sowing, mixed with 10 $m^3.fed^{-1}$ of CTR and irrigated until field capacity. Then, two weeks later for clarify the damage on seedlings and their roots produced by the heat of decomposition.

The natural agricultural practices were used for the guar plant, i.e. irrigation and fertilizers of NPK were added at rate of 50 kg N/fed and K_2O/fed for each as sulfate (20.5% N and 48 % K_2O, respectively) were added in two doses; after one month and the second dose during flowering stage, while 150 kg P_2O_5/fed as super phosphate (15.5% P_2O_5) was added to the soil before planting. According to the recommendation of the Egyptian Ministry of Agriculture these fertilizers were followed.

Five seedlings of guar were harvested randomly from each replicate to study the impact of compost town refuse treatment on the shoot length, leaves number, fresh weight, dry weight of (shoot & root), yield ton/fed and chlorophyll content (a, b and total chlorophyll) as well as minerals accumulation in shoot and root such as Fe, Zn, Mn, Cu, Pb, Ni and Cr $mg.kg^{-1}$were determined according to Kumpulainen *et al*., (1983) and Khazaei *et al*., (2017). The translocation factor (TF) was determined as a ratio of element in plant shoot to that in plant root as given in the following equation

$$Translocation\ factor\ (TF) = \frac{element\ content\ (shoot)}{element\ content\ (root)}$$

The pooled data were analyzed statistically by using CoSTATE Computer Software and the means of treatments were compared by using LSD test at levels of 5% probability conferring to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Growth parameters and yield:

Data presented in Table (1) indicate the effect of compost town refuse (CTR)and chemical fertilization treatmentson growth and yield of guar plant i.e. shoot length, leaves number, fresh weight, dry weight of (shoot & root) and yield(ton/fed).

It is clear from the data in Table (1) that using both CTR or mineral fertilization has promotive effect on plant morphological traits like, shoot length, leaves number, fresh weight, dry weight of (shoot & root) and yield, ton/fed. The application of 100%NPK+CTR exhibited the highest values of shoot length (89.61cm), leaves number (9.33), fresh weight of shoot (39.36g), fresh weight of root (13.27g), dry weight of shoot (19.83g), dry weight of root (6.97g) and yield, ton/fed (11.439). The maximum leaves number, fresh weight of shoot, fresh weight of rootwas achieved withapplication of 125%NPK+CTR and furtherincrease at the same application did not accounted a significant increase in shoot length, dry weight of soot, root and yield (ton/fed).The lowest values for all recorded parameters were achieved with control plant without fertilization.

Organic materials hold great promise due to their local availability as a source of multiple nutrients and ability to improve soil characteristics (Khaliq*et al.*, 2006). These results might be discussed by the findings of Mekki *et al.* (2016) who found that, increasing nutrient availability refer to integrated use of organic and mineral fertilizers increased nutrient uptake by the plant, which in turn lead to high vegetative growth and dry matter production then high faba bean yield. Also, its clearly indicated that increasing levels of elements helped in cell elongation of stem because of its development of cell and rapid cell division and elongation in meristematic region of plant, also, this perhaps refer to the remarkable part of N in plants. N is established in proteins, co-enzymes and nuclic acids, also P as mineral has a part in fixation of N_2, enhance nodulation of plant and increases photosynthesis of plant, while K activates some enzymes and ions of K^+ play a remarkable part in stomatal guard cells of leaves control and as well increment photosynthesis. Similar findings have also been reported by Ayub*et al*., (2012); ElHassan*et al*., (2014) and Mekki *et al.* (2016),

Table 1. Growth parameters and yield of guar crop as affected by different dosages of mineral and organic fertilization.

Treatments	Shoot length (cm)	No. of leaves /plant	fresh weight of shoot (g/plant)	fresh weight of root (g/plant)	dry weight of shoot (g/plant)	dry weight of root (g/plant)	yield (ton/fed)
Control	69.53	5.33	29.47	8.65	14.39	4.38	9.434
CTR (10 $m3.fed^{-1}$)	71.23	5.67	30.57	9.18	14.93	4.66	8.671
50%NPK	73.33	6.33	32.35	9.60	15.54	4.97	9.937
50%NPK+CTR	78.20	7.33	34.53	10.70	16.72	5.55	10.428
75%NPK	76.60	6.67	33.44	10.38	18.15	5.22	10.134
75%NPK+CTR	81.20	7.67	36.41	11.46	17.32	5.85	10.636
100%NPK	85.50	8.33	37.46	11.83	17.94	6.43	10.930
100%NPK+CTR	89.61	9.33	39.36	13.27	19.83	6.97	11.439
125%NPK	87.70	10.33	38.54	12.61	19.27	6.66	11.147
125%NPK+CTR	91.23	11.33	41.63	13.84	20.72	7.06	11.639
$LSD_{at\ 5\%}$	1.92	0.98	1.67	0.46	0.97	0.23	0.894

Chlorophyll content:

In the current investigation, chlorophyll content (a, b and total) increased significantly with gradual increase in NPK fertilization with compost of town refuse as tabulated in (Table 2). The maximum amount of chlorophyll content was measured at treatment 125%NPK+CTR, which recorded (0.849, 0.574 and 1.424 mg/g fresh weight, respectively for chlorophyll a, b and total chlorophyll), while the lowest concentration of chlorophyll was obtained with control.

Table 2. Chlorophyll content of guar crop as affected by different dosages of mineral and organic fertilization.

Treatments	Chlorophyll A (mg/g FW)	Chlorophyll B (mg/g FW)	Total chlorophyll (mg/g FW)
Control	0.741	0.493	1.234
CTR (10 m3.fed^{-1})	0.752	0.502	1.254
50%NPK	0.763	0.509	1.272
50%NPK+CTR	0.788	0.528	1.316
75%NPK	0.775	0.519	1.294
75%NPK+CTR	0.801	0.535	1.336
100%NPK	0.813	0.546	1.359
100%NPK+CTR	0.837	0.565	1.402
125%NPK	0.825	0.556	1.382
125%NPK+CTR	0.849	0.574	1.424
$LSD_{at\ 5\%}$	0.008	0.008	0.008

An increased was happened in photosynthetic pigment accumulation rate which association with 125%NPK+CTR treatment perhaps due to the effect of the chemical fertilization on the chlorophyll content could be refer to its prominent part in the chlorophyll molecule or chlorophyll pigment synthesis in the tissues plant. These findings are conformable to those reported byAmini*et al.,* (2016) and Fouda*et al.,* (2017), also, the same result was found by Abo El-Ezz, (2018) who mentioned that chlorophyll content was increased due to addition of compost of town refuse.

Mineral accumulation:

Beside concentrations, the most important parameter to evaluate the potential of phytoextraction in plants is the total amount of metals accumulated in the shoots and roots (Hanen*et al.,* 2010).

As for the effect of chemical fertilization levels under compost of town refuse on guar plant are presented in Table (3). It was found that microelements accumulation per plant in shoot and root of guar was rise significantly with respect to all treatments of additions to soil. In this study, guar plant accumulate more Fe, Zn, Mn and Cu mg.kg^{-1}in root than shoot. The highest values of microelements accumulation were found with using 125% NPK+CTR treatment in both shoot and root. The increase in element concentration of shoot and root related to increase of levels of mineral fertilization under compost of town refuse compared with control plants. So, it is needful to take biomass into account in order to evaluate the accumulation. Accumulation of nutrients in biomass of plant always depends on both their concentration and crop biomass (Vymazal, 2016).

Table 3. Microelement concentration of guar crop as affected by different dosages of mineral and organic fertilization.

Treatments	Fe (mg.kg^{-1})			Zn (mg.kg^{-1})			Mn (mg.kg^{-1})			Cu (mg.kg^{-1})		
	shoot	root	T.F	shoot	root	T.F	Shoot	root	T.F	shoot	root	T.F
Control	26.74	139.64	0.1915	14.95	78.16	0.1920	6.66	31.05	0.2145	0.99	4.88	0.2036
CTR (10 m3.fed^{-1})	59.66	316.22	0.1887	35.11	188.32	0.1864	14.65	77.13	0.1899	2.13	12.21	0.1741
50%NPK	27.00	139.85	0.1931	15.06	75.70	0.1990	6.79	31.24	0.2175	1.10	5.12	0.2156
50%NPK+CTR	59.97	316.47	0.1895	35.33	188.57	0.1873	14.87	77.35	0.1922	2.28	12.40	0.1839
75%NPK	27.18	140.06	0.1941	15.23	52.59	0.8345	6.94	31.46	0.2206	1.23	5.28	0.2338
75%NPK+CTR	60.22	316.66	0.1902	35.53	188.84	0.1882	15.10	77.64	0.1945	2.45	12.62	0.1941
100%NPK	27.41	140.34	0.1953	15.41	75.53	0.2040	7.11	31.74	0.2240	1.36	5.43	0.2497
100%NPK+CTR	60.45	316.85	0.1908	35.10	189.05	0.1857	15.32	77.95	0.1965	2.62	12.87	0.2036
125%NPK	27.64	140.57	0.1967	15.57	75.75	0.2055	7.27	31.96	0.2275	1.62	5.59	0.2896
125%NPK+CTR	60.75	317.05	0.1916	36.02	189.35	0.1903	15.47	78.17	0.1979	2.83	13.03	0.2169
$LSD_{at\ 5\%}$	0.19	0.24	0.0012	0.6	21.37	n.s	0.19	0.22	0.005	0.08	0.11	0.011

Concentration of heavy metals, Pb, Ni and Cr (mg.kg^{-1}) of guar plant are presented in Table (4), in guar plant the highest concentration of Pb, Ni and Cr (mg.kg^{-1}) were found in the root with small amount being translacated to shoot, which clearly related to the high level of NPK under CTR treatment. On accounted of strong binding of Pb, Ni and Cr with colloidal materials and/or organic, it is believed that only small amounts of the Pb are soluble in soil, and herewith are available for uptake of plant (Kopittke*et al.,* 2008).

Studies have shown the uptake of metals and their division as well as translocation to various parts of plant, its degree of tolerance to them are entrusted on the metal, its bioavailability, the plant kind and its metabolism (D'Souza *et al.* 2013).

T.F (Translocation factor):

The translocation factor (Tf) helps to recognize the fitness of plants for phytostabilzation or phytoextraction by demonstrate the characteristics of accumulation and displacement of metals in plants. Plants with translocation factor < 1 are good phytostablisor, suitable for phytostabilziation, (Rohan *et al.,* 2013 and Varun *et al.,* 2017). In general, data in Tables (3 and 4) of elements in guar plant have ability to be used for phytoextraction purpose. Between tested plant the translocation factor values < 1 with all treatments, So, guar plant being a high efficient plant for element transfer from root to the shoot would be a great accumulator and a possible candidate suitable for elements phytoextraction.

Table 4. Heavy metals concentration in shoot and root of guar crop as affected by different dosages of mineral and organic fertilization,and also T.F.values.

Treatments	Pb (mg.kg^{-1})			Ni (mg.kg^{-1})			Cr (mg.kg^{-1})		
	shoot	root	T.F	shoot	Root	T.F	shoot	root	T.F
Control	21.14	81.87	0.2582	2.73	12.45	0.2190	3.65	16.73	0.2183
CTR (10 m3.fed^{-1})	49.10	205.33	0.2391	6.18	30.13	0.2052	8.25	41.33	0.1997
50%NPK	21.35	82.12	0.2600	2.89	12.67	0.2279	3.86	17.04	0.2264
50%NPK+CTR	49.32	205.64	0.2398	6.28	30.38	0.2066	8.53	41.54	0.2053
75%NPK	21.60	82.36	0.2623	3.05	12.88	0.2371	4.22	17.32	0.2435
75%NPK+CTR	49.57	205.93	0.2407	6.46	30.66	0.2108	8.76	41.84	0.2094
100%NPK	21.83	82.67	0.2640	3.24	13.10	0.2476	4.46	17.53	0.2545
100%NPK+CTR	49.78	206.13	0.2415	6.71	30.93	0.2169	9.04	42.05	0.2151
125%NPK	22.09	82.91	0.2664	3.38	13.32	0.2540	4.67	17.82	0.2621
125%NPK+CTR	50.05	206.41	0.2425	6.92	31.14	0.2224	9.27	42.31	0.2191
LSD $_{at\ 5\%}$	0.11	0.15	0.0011	0.12	0.12	0.005	0.16	0.16	0.0072

These results could be illustrated on the basis of; chemical fertilizers are available nutrients forms of soil, which can be transported and to be much more mobilized and readily than organic manure. Organic manures like compost of town refuse release nutrients very slowly to the plants. As long as, are incapable for supply excess of required amount of nutrients in the critical period of plant growth. Also, These results perhaps due to the fact that uptake of metals by plant is administered by many factors such as organic matter, soil pH (Eriksson, 1996) soil microorganism, temperature, the content of metal itself, and plant species. Many researches have illustrated that pH is the most influential factor to control absorption of trace element in soils and seems to be the first factor affecting the metals phyto-availability (Filius *et al.*,1998). On the same line, the compost positive effect on physico-chemical and biological characteristics properties of soil, where organic matter increase soil drainage, ventilation and improve the soil ability to retain water. It is known that compost is used as a soil amendment which increase holding capacity of soils and increment nutrient available, which in reflected on impact the growth and improve plant production. Our findings are in agreement with those obtained byMekki, (2016); Abo El-Ezz, (2018) and Amin *et al*., (2018)

CONCLUSION

Considering to the fast growth, biomass, accumulation of metals, tolerance, adaptive properties, restoration potential towards elements, and being leguminous and fast growing crop, guar in fast and successive flushes. Likewise, the translocation factor values suggest that this plant was remarkable for metal phyto-stabilization and guar is considered as more potency candidates for phytoremediation. Furthermore, this plant has ecological and economic values. This plant can both remediate metal-polluted regions and manufacture value-able biomass, which can increase income for the owners of the regions. Then burned and neat off, the harvested biomass.

REFERENCES

Abo El-Ezz, S. F. (2018). Yield and quality parameters of sweet pepper fruits as affected by p-fertilization and compost town refuse. J. Soil Sci. and Agric. Eng. Mans. Univ., 9 (12): 715-721.

Amanullah, M.; W. Ping, A. Amjad, K. A. Mukesh, H. L. Altaf, W. Quan and Z. Zengqiang (2016). Challenges and opportunities in the phytoremediation of heavy metals contaminated soils: A review. Ecotoxicology and Environ. Safety, 126: 111–121.

Amel, S. B.; M. Nabil, A. Nadia, G. Hocine, L. Hakim and D. Nadjib (2016). Phytoremediation of soil contaminated with Zn using Canola (*Brassica napus* L.). Ecological Eng., 95: 43–49.

Amin, H.; B. A. Arain, T. M. Jahangir, M. S. Abbasi and F. Amin (2018).Accumulation and distribution of lead (Pb) in plant tissues of guar (*Cyamopsistetragonoloba* L.) and sesame (*Sesamumindicum* L.) : profitable phytoremediation with biofuel crops.Geology, Ecology, and Landscapes, 2 : 1, 51 – 60 , DOI : 10. 1080 / 24749508.2018.1452464.

Amini, R.; S. Sakhavi, M. R. Shakiba and A. D. Mohammadi-Nassab (2016). Effect of different intercropping patterns and fertilizers on some growth characteristics of faba bean *(Viciafaba L.)*. Intl. J. Agro. And Agri. Res., 9 (1): 9-15.

Ashraf, M. Y.; K. Akhtar, G. Sarwar and M. Ashraf (2002).Evaluation of arid and semi arid ecotypes of guar (*Cyamopsistetragonoloba*) for salinity tolerance. J. Arid Environ., 52: 473-482.

Ayub, M.; M. A. Nadeem, M. Naeem, M. Tahir, M. Tariq and W. Ahmad (2012).Effect of different levels of P and K on growth, forage yield and quality of cluster bean (*Cyamopsistetragonolobus* l.).J. Animal & Plant Sci., 22(2): 479-483.

Bashmakov, D. I.; A. S. Lukatkin, N. A. Anjum, I. Ahmad and E. Pereira (2015). Evaluation of zinc accumulation, allocation, and tolerance in *Zea mays* L. seedlings: Implication for zinc phytoextraction. Environ. Sci. and Pollution Res., 22 (20): 15443–15448.

Chavan, B. L.; M. M. Vedpathak and B. R. Pirgonde (2014). AB of National Seminar on ‘Environmental issues & Social exclusion’ 11 & 12 Feb 2014, Centre for the Study of Social Exclusion and Inclusive Policy, (Shivaji University, Kolhapur), 52.

D’Souza, R.; M. Varun, J. Pratas and M. S. Paul (2013). Spatial distribution of heavy metals in soil and flora associated with the glass industry in North Central India: Implications for phytoremediation. Soil and Sediment Contamination: An Intel. J., 22: 1–20.

ElHassan, H. E.; E. E. E. Diab and G. A. M. Osman (2014). Growth and metals accumulation in guar (*cyamopsistetragonoloba*) irrigated with treated wastewater. Intl. J. Scientific & Tech. Res., 3: 36-40.

Eriksson, J.; I. Oborn, G. Jansson, and A. Andersson (1996). Factors influencing Cd-content in crops—Results from Swedish field investigations. Swed. J. Agric. Res. 26: 125–133.

Filius, A.; T. Streck, and J. Richter (1998). Cadmium sorption and desorption in limed topsoils as influenced by pH: Isotherms and simulated leaching. J. Environ. Qual. 27:12–18.

Fouda, K. F.; A. M. El-Ghamry, Z. M. El-Sirafy and I. H. A. Klwet (2017). Integrated Effect of Fertilizers on Beans Cultivated in Alluvial Soil. Egypt. J. Soil Sci., 57 (3): 303 – 312.

Gomez, K. A. and A. A. Gomez (1984). "Statistical Procedures for Agricultural Research". John Wiley and Sons, Inc., New York.pp:680.

Haluschak, P. (2006). Laboratory Methods of Soil Analysis. Canada-Manitoba Soil Survey. April

Hanen, Z.; G. Tahar, L. Abelbasset, B. Rawdha, G. Rim, M. Majda and A. Chedly (2010). Comparative study of Pb-phytoextraction potential in *Sesuviumportulacastrum* and *Brassica juncea*: Tolerance and accumulation. J. Hazardous Materials, 183: 609–615.

Khaliq, A.; M. K. Abbasi and T. Hussain (2006). Effects of integrated use of organic and inorganic nutrient sources with effective microorganisms (EM) on seed cotton yield in Pakistan. Bioresour. Tech., 97 (8): 967-972.

Khazaei, H.; R. Podder, C. T. Caron, S. S. Kundu, M. Diapari, A. Vandenberg, and K. E. Bett (2017). Marker–Trait Association Analysis of Iron and Zinc Concentration in Lentil *(Lens culinaris*Medik.) Seeds. The plant genome, 10 (2): 1-8.

Kopittke, P. M.; C. J. Asher, R. A. Kopittke and N. W. Menzies (2008). Prediction of Pb speciation in concentrated and dilute nutrient solutions. Environ. Pollution, 153(3): 548–554.

Kumpulainen, I.; A. M. Raittila; I. Lehto, and P. Koiristoinen, (1983). Electro thermal Atomic Absorbtion spectrometric determination of heavy metals in foods and diets. J. Associ. Off. Anal. Chem., 66: 1129-1135.

Mathieu, C., and F. Pieltain, (2003). Chemical Analysis of Soils. Selected methods, France, pp; 387.

Mekki, B. E. (2016).Effect of bio-organic, chemical fertilizers and their combination on growth, yield and some macro and micronutrients contents of faba bean (*Viciafaba* L.).Bioscience Res., 13(1): 08-14.

Nagajyoti, P. C.; K. D. Lee and T. V. M. Sreekanth (2010). Heavy metals, occurrence and toxicity for plants: A review. Environ. Chemistry Letters, 8: 199–216.

Oh, K.; T. Li, H. Y. Cheng, Y. Xie and S. Yonemochi (2013). Development of profitable phytoremediation of contaminated soils with biofuel crops. J. Enviro. Protection, 4: 58–64.

Reeuwijk, L. P. (2002). Procedures For Soil Analysis. Inter. Soil Ref. and Info. Center. Food and Agric. Organization of the United Nations.

Rohan, D.; V. Mayank, P. João and M. S. Paul (2013). Spatial distribution of heavy metals in soil and flora associated with the glass industry in North Central India: Implications for phytoremediation. Soil and Sediment Contamination: An Intel. J., 22: 1–20.

Singh, D. K. and S. K. Jain (2004).Interaction effect of nitrogen and phosphorus on yield and economics of chilli (*Capsicum annum* L.), cv. Pant C-1. Department of Vegetable Science, College of Agriculture, G. B. Pant University of Agriculture& Technology, Pantnagar - 263 148, India. Scientific Horti., 9: 97-100.

Varun, M.; C. O. Ogunkunle, R. D'Souza, P. Favas and M. Paul (2017). Identification of *Sesbaniasesban* (L.) Merr. as an efficient and well adapted phytoremediation tool for Cd polluted soils. Bulletin of Environmental Contamination and Toxicology.doi: 10.1007/s00128-017-2094-6.

Vymazal, J. (2016). Concentration is not enough to evaluate accumulation of heavy metals and nutrients in plants. Science of the Total Enviro., 544: 495–498.

Wani, S. P. and K. K. Lee (1992). Fertilizers, organic manures, recyclable wastes and biofertilisers (Tandon HLS, Ed.). New Delhi.

Zaidi, A.; P. A. Wani and M. S. Khan (2012). Toxicity of heavy metals to legumes and bioremediation. Dordrecht: Springer. doi:10.1007/978-3-7091-0730-0

إنتقاليه بعض العناصر فى نبات الجوار تحت تأثير التسميد المعدنى و سماد قمامة المدن

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يعتبر التلوث بالمعادن الثقيله أحد التهديدات الرئيسيه التى تواجه التربه فى الفتره الاخيره. ويمكن استخدام التقنيه الحيويه النباتيه فى المعالجه حيث ان لها القدره على تحمل وتراكم المعادن داخل أنسجتها. وقد أقترح مؤخرا أن استخدام النباتات كان أكثر ملائمه لمعالجه التربه من العناصر الثقيله و التخلص منها. ومن خلال التجربه تحت الدراسه لمعالجه التربه من العناصر الثقيله بإستخدام نبات الجوار فى إطار التجربه تم إستخدام 10 معاملات هى (كنترول، سماد قمامه المدن، 50% من التسميد المعدنى، 50% تسميد معدنى + سماد قمامه المدن، 75% تسميد معدنى ، 75% تسميد معدنى + سماد قمامه المدن، 100% تسميد معدنى ، 100% تسميد معدنى+سماد قمامه المدن، 125% تسميد معدنى ، 125% تسميد معدنى+ سماد قمامه المدن). أظهرت النتائج تحت الدراسه أن نبات الجوار له القدره على تحمل التركيزات العاليه من المعادن الصغرى و الثقيله مثل الحديد، زنك، نحاس، منجنيز، رصاص، نيكل ، كروم وقد أكد ذلك قدرته على النمو فى بيئه ذات تركيز عالى من تراكم المعادن و قد لوحظ تراكم كبير للمعادن فى الجذر مع انخفاض الكتله الحيويه علاوه على ذلك يمكن استخدام نبات الجوار للتحلص من تلك المعادن بشكل هامشي حيث لن يقوم بإعاقه نمو نبات أخر معه مع الحفاظ على مستويات المعادن فى التربه ومن هنا كان معامل الازاحه الاقل دليل على قدره نبات الجوار على استخدامه فى المعالجه النباتيه للتربه الملوثه بالمعادن الثقيله.