Effect of Different Rates of Cobalt on some Macro-Micronutrients and Heavy Metals Contents in Lettuce under Different Types of Recently Reclamation Soils

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Abstract: The main objective of this research work is to assess the influence of cobalt element addition on the uptake of some macronutrients (N, P and K) and some heavy metals (Cd, Ni and pb) in two different reclaimed soils. The first soil was sandy from (Abu- Rwash) region, the second soil was calcareous from (El Noboria) region. Cobalt was added with different rates (10, 15 and 20) ppm after plantation stage. Nitrogen was added by rate 100 ppm N at form amonium nitrate NH_4NO_3. Moreover, Dihydrogen potassium phosphate H_2KPO_4 at rate 200 ppm as source of phosphours and potassium was added at the same time. Lettuce plant of class (lactuca sativa var capitata). The obtained results can be summarized as follows: In sandy soil a positive connection between rates of cobalt and (N,P,K) contents, negative contact was found between cobalt concentrations and heavy metals contents (Cd, Ni, pb). Dry weight gave a positive contact with cobalt treatments, all differences were significantly to each of chlorophyll concentration and all trace elements contents except Mn were a positive relationship with cobalt treatments. All differences between treatments were significantly. In calcareous soil negative contact was found between rates of cobalt and nitrogen, while potassium a positive contact was found with phosphorus, concerning the heavy metals (Cd, Ni, pb) contents, positive contact was found with rates of cobalt. All this connections were significantly. Dry weight gave a negative connection with cobalt treatments but not significantly. Chlorophyll concentration and trace elements contents were in a positive relationship with cobalt treatments. All differences between treatments were significantly. Dry weight gave a negative connection with cobalt treatments but notsignificantly. Chlorophyll concentration and trace elements contents were in a positive relationship with cobalt treatments. All differences between treatments were significantly.

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Key words: Cobalt – lettuce plant – Sandy- Calcareous soil- Macronutrients – Heavy metals – Trace elements - Chlorophyll- Dry weight.

1. Introduction:

The need to determine the best practices for land use in regions with rigorous climates makes it necessary to recognize that any type of human use of land involves a chang in the natural ecosystems or their replacement by different artifical biological systems. The basis of decision making with respect to land use should be to maintain control of the anticipated transformation and to apply ecologicl principles so that the adverse effects on the environment will be minimum despite of introduction of permanent human use of the land resource.

The modern ecological term "ecosystem" describe show the biological community, functions as unit with extremely complex interactions. When crop growing and livestock raising are introduced and developed into highly specialized forms of land use, biological systems are created which differ greatly from natural ecosystems.

Nutrient availability in the soil differs in many aspects. Factors of major importance for the mineral nutrition of plants are root induced changes in rhizosphere, pH and amount and composition of root exudates (Uren and Reiseauer, 1988). The proximity, extent, and pattern of contact between soil and root are important factors in the absorption of heavy metals which are tightly bound to the soil colloids (Merckx et al., 1986). Many investigators reported a relationship between solubility of heavy metals in soil and soil pH. It is well established that concentration of most of heavy metals increases to various degree with the decrease in soil pH (smis, 1986 and förstner, 1988). Root – induced changes in the rhizosphere are important factors for the metal dynamics in this zone. However, little attention has been paid to the extent to which plant roots effect the ability and distribution of heavy metals (CO) in the vicinity of the roots.

In this work, it was found that applied Co at a different rate on some mineral and heavy metals contents in lettuce plant in different reclamation soils (sandy and calcareous).

2. Materials and methods

A pot experiment was conducted to study the availability of some macronutrients namely, nitrogen, phosphorus and potassium and some heavy metals as cadmium, nickel and lead contents in lettuce plants of class (lactuca sativa var capitata) as affected by the addition of cobalt element at different rates (10, 15 and 20) Ug/g soil and two different types of reclamation soils, sandy soil of (Abu-Rawash region) and calcareous soil (El Nobaria region). Table (1) indicat to some physical and chemical properties. Pot contents as 5 kg soil. Nitrogen was added at form ammonium nitrate NH_4No_3 at a rate 100ppm nitrogen, dihydrogen potassium phosphate H_2Kpo_4 as sources potassium and phosphours by rate 200 ppm was added.

All the fertilizers were added at one dose after plantation stage.

Three levels of cobalt were added as $CoSo_4.7H_2O$ at (10,15 and 20) ppm, urifornly mixed with soil. The moisture content of the pot was maintained at 80% of the water holding capacity along tim of the experiment. Plants were harvested on 50 day.

Plant samples were reweighed and dried to constant weight at 80°C in a ventilated oven. Dried samples material were analysed for total nitrogen a chieved determined by distillation using microkjeldahel distillation (Jackson 1985). Phosphours, potassium, heavy metals (Cd, Ni, pb) and tracelements as according (Jackson 1985) .

Chlorophyll concentration in the fresh leaf was determined according to (licheloem and weil burn, 1983).

Table (1): Som physcial and chemical properties of the studied soils

Site	Texture	pH 1:2.5	EC Dsm^{-1} 1:5	Cations meq/L				Ppm	Anions meq/l			%	Heavy metalsmg μ g/g	Cations meq/L					
				Ca	Mg	Na	K	Fe	$SO_4^{=}$	HCO_3^{-}	Cl^{-}	CaCo3	OM	Available			Total		
														Cd	Ni	Cd	Ni	Cd	Ni
Abu-Rawash	Sandy	7.92	0.185	6.12	36.0	9.35	4.20	153	5.32	7.31	123	0.40	0.26	0.02	0.18	0.22	0.12	1.06	2.11
Nobaria	Calcareous	8.32	0.200	8.02	24.0	67.5	4.02	236	7.53	9.51	95	15.8	0.19	0.01	0.20	0.25	0.15	1.09	1.85

3. Results and Discussion

Sandy Soil:

The data presented in table (2) reveal that some macronutrients (N,p and k) contents in lettuce plant in different types of reclamation soils as affected by different rates of cobalt (10,15 and 20) ppm. N,P and K percentages contents in sandy soil was in positive relations with rates of cabalt as cobalt concentration increasing follow up (N,P,K) percentages contents in lettuce plant increased. Head values of (N,P,K) registered with rate of cobalt 20 ppm while among value came with rate of cobalt 15 ppm, the least values of (N,P,K) with cobalt concentration 10 ppm. Cobalt maybe enhance to rise representation of nutrients to plant as it important role in constitution of Co-enzymes and some hormons. (Youssef 1997).

It has been reported that cobalt increased the total dry matter and yield of pigeon pea and peanut (shehata 1989) found that cobalt significantly increased the percentage of stomatal closure and increase dramatically ABA which play a central role in some hormon of iso plant. (Anter and nadia 1999). Revealed that cobalt applicat ion[reduced transpi-ration rate and leaf water potential specially at low cobalt concentrations Abscisic Acid in contrary to both Auxine and Gibberelins was promotively affected by cobolt application. Root xylem and phloem were beneficially affected by cobalt specially at water deficit condition. Of what previously mention show that cobalt stimulate to the nutrients plant uptake.

Table (2): Macronutrients contents as percentage (%) in lettuce plant as affected by different rates of cobalt and soil types.

Cobalt treatment (ppm)	Sandy soil		
	N	**P**	**K**
Control	2.52	0.79	0.16
10	2.11	0.31	0.18
15	2.80	0.46	0.19
20	3.64	0.65	0.21
L.S.D 0.05	0.23	0.028	0.017
Calcareous soil			
Control	2.24	0.69	0.22
10	4.85	0.79	0.22
15	4.09	0.91	0.14
20	2.67	1.19	0.11
L.S.D 0.05	0.32	0.062	0.013

Calcareous soil:

Table (2) Concerning calcareous soil as lettuce plant uptake some macronutrients (N, P and K) as affected by different rates of cobalt show that a negative relation between (N,K) uptake and cobalt concentrations as increasing of cobalt rates decrease of (N, K) content in lettuce plant.

Head values of nitrogen and potassium (N and K) uptake were with cobalt rate 10 ppm and among values with 15 ppm, the least values of (N and K) content with 20ppm of cobalt rate, may be due to some properties of the studied calcareous soil such as rising of calcium carbonate rate thus rising rate of sodium cations and soil pH this is to lead to little of exchangeable sites. All differences between the treatments were significantly.

Phasphorus contents was in a positive relation with cobalt rates as it increasing phosphorus contents increase. Head value of P contents with 20 ppm of cobalt rate, among value with 15 ppm and the least value of P contents with 10 ppm of cobalt rate, it seems that the cobalt element stimulation to phosphorus uptake despite the phosphorus problems in calcareous soils such as the fixation it to make at form unavailable. All differences between the treatments were significantly (youssef et al 2001) show that cobalt addition by rate 40 ppm to cause decreasing soil pH almost 2 units in the rhizosphere compared to that of bulk soil, due to soluble and available phosphours increased in calcareous soil.

Date in table (3) showed that some heavy metals content (Cd, Ni and pb) in lettuce plant as affected by different rates addition of cobalt (10, 15 and 20) ppm and soil types (sandy and calcareous).

Sandy soil:

The data presented in table (3) reveal that entity negative relation between cobalt rates and (Cd, Ni and pb) content , head values of heavy metals were with rate of cobalt 10 then 15 ppm differences between them were slightly can be negligible.

The least values of heavy metals content with 20 ppm of cobalt rate. That's meaning , cobalt inhibition effect on heavy metals content especially with the rising of cobalt rates in sandy soil.

(Zhang, M; and zixia, ke 2009) showed that in the polluted soils by heavy metals may be enhance entity of cobalt element with the fertilization in the little levels of heavy metals contents.

Calcareous soil:

Head values of some heavy metals (Cd, Ni, pb) were with 20 ppm of cobalt rate, among values with 15 ppm of cobalt concentration, the least values was with 10 ppm of cobalt rate.

This results meaning entity positive contact between cobalt rates and heavy metals content in lettuce plant. May be due to properties of calcareous soils such rise of soil pH, calcium carbonate highly rate and sodium cations rising concentration in soil studied. All the differences between the treatments were significantly.

Table (3): Heavy metals contents in lettuce plant (ppm) as affected by different rates of cobalt and soil type.

Cobalt treatment (ppm)	**Sandy soil**		
	Cd	**Ni**	**Pb**
Control	10	141	653
10	34.2	230	420
15	33.3	229	415
20	14.6	150	133
L.S.D 0.05	1.48	13.7	184
Calcareous soil			
Control	42.5	269	446
10	17.5	117	173
15	40.0	231	376
20	45.0	278	455
L.S.D 0.05	1.57	11.9	16.2

Table (4) Dry weight, chlorophyll and micronutrients content in lettuce plant as affected by different rates of cobalt and different types of soils.

Cobalt Treatments (ppm)	**Sandy Soil**					
	Dry. W	Chlorophyll	**Ppm**			
Ppm	Gm	Mg/g	Fe	Mn	Zn	Co
Control	10.3	0.22	85	110	18.9	17.5
10	15.5	0.35	126	135	22.3	31.6
15	17.8	0.78	175	117	29.7	46.5
20	25.8	1.1	215	118	35.2	67.3
L.S.D. 0.05	2.04	0.15	12.3	10.9	2.69	10.2
Calcareous soil						
Control	11.8	0.32	114	146	15.4	25.3
10	21.4	0.65	208	158	19.7	34.7
15	18.7	0.94	203	173	25.8	59.8
20	17.3	1.21	255	167	30.7	66.3
L.S.D. 0.05	2.03	0.20	10.8	10.7	2.18	11.6

Sandy soil:

Data in table (4) shows that a positive contact between for each iron, manganese zinc and cobalt in lettuce plant uptake and dry weight (gm) where as its increased with increasing of this micronutrients with increasing of cobalt treatments in a sandy soil where Fe uptake with a rate comparison with control (48, 106 and 153) % with cobalt treatments increasing respectively. May be cobalt nutrient stimulate Fe, zin and co.

Behavior Mn was in contrary relation with dry weight to lettuce plant. May be Mn at form unavailable for uptake in sandy soil or it competition with Fe on granulars surface in sandy soil where, as a little surface specific specially.

Chlorophylle concentration to be have same of relationships with cobalt treatments and it gave similar results with (Fe, Mn, Zn and Co) contents in lettuce plant. My be that find a positive effect between dry weight and chlorophylle concentration in lettuce plant.

Calcareous soil:

It was found opposite contact between cobalt treatments and dry weight but the differences were negligible may be cause soil pH rising which due to limited hinder to cobalt available. Positive contact between cobalt treatments and all nutrients conten in lettuce plant under study (Fe, Mn, Zn and Co, all the differences between nutrients content and cobalt tseatments were significantly, where that (Fe) absorption percentage comparison control (82, 78, 123) % respectively.

Chlorophyll concentration in lettuce plant was at a positive contact with cobalt treatments where as percentage comparison control (103, 194, 278) respectively.May be due to increasing of (Fe) in plant.

(Perez, et al, 2008) revealed that cobalt remarkably increased fresh and dry weight, of shoots and roots. The amounts of dry matter of tomato plants were the highest when Co was spotted in 1mm compartment compared with that of other soil compartments. The influence of Co placements on plant growth was most pronounced in roots than shoots. It has been reported that low concentration of Co had favorable effect on plant growth.(Takahashi and satio, 2007) found that the trace elements were increased under cobalt treatments wich to follow increasing chlorophyll concentration in tomato plant (Sposito, 2003) got a general conclusion that activities of the micromutrients in solution rather than concentrations per shops would be more meaning ful.

In this study.

The reduction in trace elements extractability was accompanied by Co placements.

4. Summary and Conclusion:

In sandy soil cobalt treatments gave a positive effect with most of the previously results at all cobalt concentrations, therefore were recommended to using it with example this soils.

In Calcareous soil cobalt element gave a negative effect with high concentrations, while it gave a positive effect with low concentrations, therefore were recommended to using it where not more cobalt concentration of (10 ppm) in example this soils.

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