Effect of cobalt, and nitrogen forms on nitrate accumulation in Jew's mallow plant as affected by a nitrification inhibitor

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Abstract: A pot experiment was established in the green house of National Research Centre to evaluate the effect addition of cobalt element at a rate 10 ppm, different rates of nitrogen (100 and 200) ppm N and forms of nitrogen as a Sodium Nitrate Na NO_3, Ammonium Sulphate $(NH_4)_2$ SO_4 and Urea $(NH_2)_2$ CO as others two treatments with and / or without a nitrification inhibitor (N-serve) on mineral composition and nitrate accumulation in Jew's mallow plant in alluvial soil of type clay loam. The results revealed that a positive contact was found between nitrogen rates and each of fresh, dry weight and plant contents of Cobalt, Nitrogen, Phosphorus, Potassium, Nitrate and residual effect of inorganic Nitrogen. While, a negative relation with trace elements contents (Fe, Mn, Zn and Cu) was observed Treatments of (Ammonium sulphate and Urea) with Cobalt and (N-serve) as a nitrification inhibitor registered the highest value of all the determinations studied, except a nitrate accumulation in plant which recorded the highest values with (Sodium Nitrate, Ammonium Sulphate and Urea) with cobalt and without inhibitor respectively. Residual effect of inorganic nitrogen registered the highest values with (ammonium sulphate and urea) treatments with cobalt and (N-serve) inhibitor respectively. Results concluded that.

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1. Introduction

People one continuously exposed to nitrate and nitrite through drugs, water and food, fresh vegetables are often rich source of nitrate and nitrite intake Egyptians consume great quantities of nitrate in Egyptian vegetables all over the year. Tests of nitrate accumulation in Egyptian vegetables showed considerable high values as compared to those found in vegetables grown in several Europian countries (Hanafy *et al.*, 1991) and (Blom-Zandstra, 1989) in spite of the high intensity and long duration of light in Egypt which favour nitrate reduction in plants. This Could be mainly due to intensive application of nitrogen fertilizers alone by Egyptian formers which results imbalanced nutritional status of the plants and consequently high nitrate accumulation. Source of nitrogen effect on nitrate accumulation of nitrate contents of lettuce can also be reduced by the partial replacement of nitrate with ammonium in the nutrient solution culture (NFt) (Van der Boon *et al.*, 1990). In soil grown crops, however, applied ammonium is relatively quickly converted to nitrate at moderate of high soil temperatures. The application of a nitrification inhibitor can however, effectively suppress the oxidation of ammonium by Nitrozomonas bacteria (Amberger, 1979) and can therefore increase the effectiveness of ammonium application in reducing of nitrate content of lettuce (Roorda VanEy singa, 1984).

Nitrate levels can go up and down rapidly in plants. It accumulates only in the vegetative parts of plants , not in the grain or fruit. Lately some studies indicated that cobalt element has beneficial effect at nitrogen assimilation and transformations in plant, this may be cause of accumulation least of nitrate, and using little of nitrogen fertilizers. (Youssef *et al.*, 2001 and Youssef. 1997) revealed that Cobalt remarkably increased fresh and dry weight where it glorify advantage of nitrogen fertilizer in tomato plant. (Abd Flafatha, 2008) showed that a positive effect with rates of cobalt and nitrogen uptake were found that's reflected on dry matter weight to plant. Seemed that cobalt element encourage of plant uptake for nutrients which reflect on the dry matter production in lettuce plant.

The objective of the present study were to examine the effect of nitrogen form and application of cobalt with nitrogen on yield and nitrate content of grown of Jew's mallow plant. The necessity of a nitrification inhibitor when nitrogen is continually applied in ammonium form was also examined.

2. Materials and Methods

A green house experiment was conducted at National Research Centre, during of May to July

2008 to evaluate different rates and forms of nitrogen fertilizers effect with cobalt addition on mineral composition and nitrate accumulation in Jew's mallow plant (Corchorus olitorius. L.) C.V. Balady. Experimental soil was alluvial of type clay loam texture from Giza governorate at south Egypt, Table (1) indicated that some chemical and physical characteristics of the experimental soil.

The experiment include three factors were, different forms of nitrogen as $NaNO_3$, $(NH_4)_2$ SO_4 and $(NH_2)_2CO$ (100 and 200) ppm N. Cobalt element at a rate 10 ppm, a nitrification inhibitor namely (N-serve) applied as a chemical compound, 2-chloro-6 (trichloro methyl pyridine) added at a rate 1% of N-fertilization. (N-serve) was introduced in combination with ammonium sulphate and urea and / or without. Nitrogen fertilization was added after 10 days of emergence.

Pot filled with ten kg soil were used and 300 ppm of dihydrogen potassium phosphate KH_2 PO_4 / pot as a source of P and K at before sowing was added. A control treatment receiving no addition was established. The experiment was laid out in randomized complete block design with three replicates. All pots were irrigated in a way to maintain soil moisture level at 80% of the water holding capacity during the growing season. Plant samples of experiment were collected after 40 days of sowing, fresh and dry weights of leaves and stems were recorded and dried in an oven at 70°C ground and prepared for analysis. Nitrate was determined in fresh plant leaves nitrate was extracted with warm water and shaking for two hours, it was determined by using devarda alloy according to (Cottenie *et al.*, 1982).

Table 1: Some chemical and physical characteristics of the experimental soil.

Parameters	Value	Parameters	Value
Soil pH (1:2.5)	7.48	Water holding capacity %	42.00
Ec dsm^{-1} (1:5)	0.47	Organic matter %	0.502
NH_4 ppm	3.0	Total CaCO3 %	1.25
NO_3 ppm	9.3	Mechanical composition %	
Total nitrogen %	0.012	Coarse sand	9.23
Available P ppm	31.0	Fine Sand	25.6
Available K ppm	64.0	Silt	22.6
Available Fe ppm	10.0	Clay	42.6
Available Mn ppm	17.0	Texture type clay loam	
Available Zn ppm	7.23		
Available Co ppm	2.33		
Available Cu ppm	1.67		

Total nitrogen was determined by using microkjeldahl technique according to (Jackson, 1967). Phosphorus was determined by colorimetrically according to (Cottenie *et al*., 1982). Potassium was determined by using flam photometer according to (Cottenie *et al.*, 1982). Fe, Mn, Zn, Cu and Cobalt were determined using the Atomic absorption as according to (Jackson, 1967).

Standard analysis of variance procedure of the completely randomized design was applied on data and the means were compared using duncan's multiple rang test and determined the L.S.D. test at 0.05 and 0.01 according to (Steel and Torrie, 1980).

3. Results and Discussion

*** Fresh matter Status:**

Fresh weight to Jew's mallow plant show that Cobalt, different rates and forms of nitrogen (100 and 200) ppm N under a nitrification inhibitor using in allovial soil of type clay loam and effect of harvesting time.

From data in table (2) noticed that 200 ppm N treatments were high fresh weight than it with 100 ppm N and that without cobalt. $(NH_4)_2$ SO_4+ NS at a rate 100 ppm N without cobalt treatment increased than other treatments also afternoon weights were increased than morning weights.

The same results were found with cobalt treatments with a rate of 100 ppm N except $NaNO_3$ treatment as recorded of head value in the afternoon time. All the differences between treatments were significantly under each two levels. On the other beside that 200 ppm N treatments without Cobalt showed that urea +NS treatment registered of highlight comparative with other treatments that's without cobalt and afternoon time, while $(NH_4)_2$ SO_4+NS with cobalt and a afternoon time as registered highest value comparative with other treatments Urea+NS treatment at section of 200 ppm N as cobalt and morning time recorded highest value comparative with other treatments and increasing in comparative with control respectively.

All differences between treatments were significantly under each of two levels. From previous results concluded that a nitrification inhibitor caused of increasing at fresh weight whereas all treatments which increased at fresh weight were with the inhibitor, cobalt and 200 ppm N where Urea+NS with 200ppm N and cobalt in the morning and (NH_4) SO_4+NS with cobalt with section of 200 ppm N in the afternoon may be data stoppage of light assimilation process through the night and tend the plant to storing of nourture matter and the growing plant tissues. Efficiency of the inhibitor stoppage of Nitrozomonas bacteria activity which convert of the ammonium to Nitrite then to nitrate which it was lost by the leaching during of soil irrigation and volatilization and denitrification processes also that nitrate carry of negative charge where was not kept on adsorption complex while the ammonium on was kept on (Abd El-Fattah, 1988) shown that fresh matter yield of the wheat plant was higher when fertilized with (NH_4), SO_4-N and Urea than NO_3-N. The nitrogen uptake by wheat plants was significantly higher for the $[(NH_4)_2SO_4$+urea] +N-serve than for the other treatments. (Nadia, 2006) applying cobalt in a suitable concentration for each crop gave a significant increase in the fresh and dry matter compared the control, she noticed that.

Table 2: Fresh weight (gm/pot) to Jew's mallow plant as affected by cobalt. Nitrogen forms and a nitrification inhibitor (N-serve).

Treatments	100 ppm N			
	Without Cobalt		With Cobalt	
	Morning	Afternoon	Morning	Afternoon
Control	12.0	11.2	13.0	11.5
$NaNO_3$	16.0	25.5	17.4	27.5
$(NH_4)_2SO_4$	18.0	22.0	20.5	24.00
$(NH_4)_2SO_4$+NS	24.5	24.7	25.6	27.0
Urea	15.6	24.0	23.0	25.6
Urea+NS	16.0	26.0	25.0	27.0
L.S.D 0.05	2.05	2.18	2.12	2.13
L.S.D. 0.01	2.90	3.05	2.97	2.98
200 ppm N				
$NaNO_3$	17.5	18.0	28.0	21.0
$(NH_4)_2SO_4$	22.6	25.7	23.0	28.0
$(NH_4)_2SO_4$+NS	28.8	29.7	28.0	32.0
Uea	18.0	26.0	27.0	28.0
Urea+NS	21.0	31.0	32.0	30.6
L.S.D. 0.05	2.08	2.17	2.18	2.17
L.S.D. 0.01	2.94	3.01	3.05	3.25

*** Dry Matter Status:**

Data in table (3) showed that dry weight to Jew's mallow plant as affected by cobalt addition 10 ppm and different rates of nitrogen N and forms with or without a nitrification inhibitor and harvesting time where were noticed at a section (100 ppm N) head values was recorded with $NaNO_3$, $(NH_2)_2$ CO and $(NH_4)_2$ SO_4 treatments with cobalt without inhibitor and afternoon time respectively following it, (Urea+NS), urea and $(NH_4)_2$ SO_4+NS with cobalt and morning and afternoon times respectively where were increasing rates in comparison with control as following (124, 121, 106, 94, 91 and 74)% respectively the greatest rate 124 % to sodium nitrate with cobalt in the afternoon time treatment. On the other beside at a section 200 ppm N treatments, head values were of urea +NS treatment with cobalt at morning time then $(NH_4)_2$ SO_4+NS treatment with cobalt at afternoon time, then Urea with cobalt without inhibitor at the morning time. The increasing rates in comparative with control as (62, 46 and 44)% respectively. The second order was found $(NH_4)_2SO_4$+NS with cobalt at the morning time then the same previous treatment but without cobalt at the afternoon time. The increasing rates in comparison control as (42, 63 and 63) % respectively.

From previous results show that cobalt and nitrogen is necessary to structure of dry matter for plant. (Richard and Byrd 1991 and Jan Zen *et al.,* 1996) studied the effect of urea applied with and without (N-serve) on grown in silty loam soil. They recommended that N application and N plus (N-serve) addition enhanced the plant growth and produced the highest yield.

(Youssef *et al*., 2001 and Youssef, 1997) revealed that cobalt remarkably increased fresh and dry weight of shoots and roots. The amounts of dry matter (shoots and roots) of tomato plants were the highest when Co was spotted in 1mm compartment compared with that of other soil compartments.

*** Cobalt Contents Status:**

Data in table (4) contents indicated that cobalt in Jew's mallow (ppm) as affected by cobalt addition and different rates, forms of nitrogen under effect a nitrification inhibitors nitrapyrin (N-serve). Treatments of nitrogen at a rate (100 ppm) Clear that head values was of $(NH_4)_2SO_4$ without cobalt at the afternoon time treatment then the same treatment but with cobalt and at the morning time.

Following it was of Urea+Co without inhibitor at the morning time treatment. Increasing rates in comparison control (207,124 and 61) % respectively, highest value was of $(NH_4)_2SO_4$ without cobalt and without inhibitor. All the differences between treatments were significant under each of two levels except little of values. Nitrogen treatments at a rate (200 ppm) reveal that, head values was of $(NH_4)_2SO_4$+NS without cobalt at the afternoon time, then $(NH_4)_2SO_4$ treatment without cobalt and inhibitor at the afternoon time treatment following it the same previous treatment but with cobalt at the morning time then the same treatment but at the afternoon time.

Increasing rates in comparison with control as (58,45,221 and 66)% respectively. Increasing highest rate was of $(NH_4)_2SO_4$ treatment with cobalt without inhibitor at the afternoon time. All the differences between treatments were significant under effect each of two levels.

From previous results conclusion that most of high values were registered of cobalt contents to Jew's mallow plants to treatments without inhibitor and without cobalt except $(NH_4)_2$ SO_4+NS at a rate 200 ppm N, and without cobalt at the afternoon time as it recorded highest value of where cobalt contents also most of high values were recorded without inhibitor treatments, seem that the inhibitor inhabitation to cobalt uptake but nitrogen incourage it. As increase cobalt uptake with increasing nitrogen was added. On the other hand indeed most of middle values was recorded with the inhibitor. Also most of high value at the afternoon time, therefore cobalt uptake associated with abundant nitrogen absorption regardless about the inhibitor (Mathers *et al.,* 2004) stated that nitrapyrine treatment decreased Co uptake. On the others hand, (Warren *et al.,* 1998) detected that nitrogen incourage cobalt uptake or other cations in their studies on corn and winter wheat forage.

Data in table (5) show some macronutrients as a percentage contents (N, P and K) in Jew's mallow plants as affected by cobalt addition , different rates of nitrogen and forms under effect a nitrification inhibitor application.

*** Nitrogen contents Status:**

Rate of nitrogen at (100 ppm) show that head value was of $(NaNO_3)$ without cobalt and without inhibitor at afternoon time treatment then [$(NH_4)_2SO_4$+NS] with cobalt and with inhibitor treatment following it $(NH_4)_2SO_4$ without cobalt, without inhibitor at the morning time treatment. Increasing rates as a percentage in comparison control (39, 36 and 21.5) respectively, highest rate was of $NaNO_3$ treatment without cobalt, without inhibitor at the afternoon time, may be mean of reason NO^-_3 ion is at soil solution solubility easy and available to plant uptake whereas was not kept on the soil surface particles. At the second part of table (5) as a rate of nitrogen 200 ppm was added. A Head value was of also $(NaNO_3)$ with cobalt and without inhibitor at afternoon time treatment. Following it (Urea) treatment without cobalt, without inhibitor at the afternoon time treatment then (Urea+NS) without cobalt, with inhibitor at afternoon time, increasing rates as a percentage in respectively (43.9 , 32.5 and 29). This may be due to NO_3^- ion is easy and available uptake than other forms of nitrogen.

Table 3: Dry weight (gm/Pot) to Jew's mallow plant as affected by Cobalt, nitrogen forms, a nitrification inhibitor (N-serve) and harvesting time.

Treatments	100 ppmmN			
	Without Cobalt		With Cobalt	
	Morning	Afternoon	Morning	Afternoon
Control	3.4	3.3	3.4	3.4
$NaNO_3$	3.9	4.4	5.2	7.6
$(NH_4)_2SO_4$	4.2	3.8	5.6	7.0
$(NH4)_2SO_4$+NS	5.4	4.6	5.8	5.9
Urea	3.9	4.3	6.5	7.5
Urea+NS	3.8	4.8	6.6	6.5
L.S.D 0.05	1.45	1.48	1.53	1.51
L.S.D. 0.01	2.08	1.93	1.99	1.97
200 ppm N				
$NaNO_3$	3.8	3.8	4.5	4.6
$(NH_4)_2SO_4$	4.9	5.9	5.8	5.9
$(NH_4)_2SO_4$+NS	6.2	6.2	6.4	6.7
Urea	4.3	5.4	6.5	5.9
Urea+NS	4.6	6.5	7.3	6.5
L.S.D. 0.05	1.49	1.47	1.55	1.57
L.S.D. 0.01	1.59	1.94	1.98	2.07

*** Phosphours contents:**

Rate of nitrogen (100 ppm) at the first part of table (5) indicated that head values was of (Urea +NS) treatment as with cobalt at afternoon time following it (Urea) treatment with cobalt, without inhibitor at afternoon time treatment and [$NH_4)_2SO_4$+NS] treatment with cobalt, with inhibitor at afternoon recorded the same previous value. The following value common between the most treatments, it is 0.45% phosphorus contents increasing rates as the previous order in comparison control (100,66,66 and 50)%.

At the second part of table (5) as (200 ppm N) indicated to head values was of (Urea+NS) treatment as with cobalt, with inhibitor at afternoon time, following it $(NH_4)_2SO_4$+NS) and (Urea+NS) as with cobalt, only the latter with inhibitor treatments as it's the same values then (Urea) with cobalt, without inhibitor, (Urea without cobalt and inhibitor) and (Urea +NS) without cobalt, with inhibitor at afternoon time. In creasing rates at the previous order (30, 20, 20, 66 and 66) % respectively, highest rates were to only Urea at afternoon time and (Urea +NS) treatments without cobalt, that's mean it the inhibitor and cobalt were incourage phosphours absorption. All the differences between treatments were significant under each of two levels except some little values.

*** Potassium contents status:**

Data at the first section of table (5) as (100 ppm N) indicated to a head value was of ($NaNO_3$) treatment without cobalt , following it each of $(NH_4)_2SO_4$+NS) treatment without cobalt with inhibitor at the morning time and [$(NH_4)_2$ SO_4] treatment with cobalt, without inhibitor at the morning time as its recorded the same values. Then ($NaNO_3$) treatment with cobalt at the morning time. Increasing rates as a percentage in comparison control at the same treatments previous order as (24, 22, 22 and 18)% respectively.

Highest increasing rate was of ($NaNO_3$) treatment, without cobalt, without inhibitor. All the differences between treatments were significant under each of two levels except some little values. Data in the second section of table (5) as (200 ppm N) indicated to head values were of (Urea +NS) treatment as without cobalt, with inhibitor at morning time and [$(NH_4)_2$ SO_4+NS] treatment as with cobalt, with inhibitor at the morning time where it's the same value , following it $(NH_4)_2SO_4)$ and (Urea) treatments as with cobalt, without inhibitor at the morning time as it's the same value, then $(NaNO_3)$ treatment as without cobalt without inhibitor at afternoon time, increasing rates as a percentage in comparison control as the same treatments previous order (33,20,10,10 and 42.5) respectively, highest value of increasing rate was of $(NaNO_3)$ treatment as without cobalt at afternoon time. All the differences between treatments were significant under each of two levels except some little values.

Previous results indicated efficiency of the inhibitor as keep on nitrogen at form NH_4^+ and increase of NH_4/NO_3 ratio. This cause increasing of absorption of N, P and K. (Sullivan and Hovlin 2005) found that inhibit (N-serve) treatments whereas the effect of inhibition was stronger than one other whereas found that NH_4/NO_3 ratio is higher than one other and this difference continued until the experiment end. In the treatment Urea with inhibitor was NH_4/NO_3 ratio high as a result effect of N-serve alone. (Shehata Nadia *et al*, 2008) revealed that the addition of 10 ppm of cobalt had a significant primitive effect on nitrogen, phosphorus and potassium content in fruits, as compared with that of control and another cobalt levels increasing cobalt concentration up to 30.0 ppm , resulted in proportion significant reduction.

Table 4: Cobalt contents (ppm) in Jew's mallow plant as affected by addition of cobalt, nitrogen forms, a nitrification inhibitor (N-serve) and harvesting time.

Treatments	100 ppm N			
	Without Cobalt		With Cobalt	
	Morning	Afternoon	Morning	Afternoon
Control	68.0	74.0	98.0	79.0
$NaNO_3$	100	119	123	118
$(NH_4)_2SO_4$	124	227	220	118
$(NH4)_2SO_4$+NS	129	101	113	108
Urea	107	103	158	101
Urea+NS	133	103	117	166
L.S.D 0.05	8.55	9.15	11.9	9.44
L.S.D. 0.01	12.0	12.3	16.3	12.8
200 ppmN				
$NaNO_3$	174	182	178	117
$(NH_4)_2SO_4$	178	263	221	194
$(NH_4)_2SO_4$+NS	181	287	120	122
Urea	132	187	164	110
Urea+NS	162	202	140	95
L.S.D. 0.05	9.07	12.6	9.82	8.62
L.S.D. 0.01	12.4	17.6	13.5	11.8

Table 5 : Some macronutrients contents (%) in Jew's mallow plant as affected by cobalt, and nitrogen forms, rates and a nitrification inhibitor (N-serve) and harvesting time.

Treatments	100 PPm N											
	Without cobalt						With cobalt					
	Morning			Afternoon			Morning			Afternoon		
	N	P	K	N	P	K	N	P	K	N	P	K
Control	3.30	0.30	4.51	3.81	0.30	3.65	3.31	0.22	4.50	3.82	0.31	3.51
$NaNO_3$	3.92	0.45	5.63	5.32	0.30	4.53	3.73	0.23	5.31	4.03	0.40	4.30
$(NH_4)_2SO_4$	4.01	0.22	4.33	3.21	0.30	3.95	3.43	0.32	5.55	3.85	0.45	5.01
$(NH_4)_2SO_4$+NS	3.95	0.31	5.54	3.70	0.45	3.93	4.54	0.35	5.06	4.02	0.53	4.53
Urea	3.75	0.32	4.07	3.92	0.45	4.62	3.56	0.30	5.08	3.57	0.55	4.56
Urea+NS	3.63	0.33	5.09	3.73	0.45	4.60	3.67	0.32	5.05	3.92	0.62	4.05
L.S.D 0.05	0.09	0.03	0.09	0.08	0.03	0.06	0.09	0.07	0.14	0.12	0.03	0.09
L.S.D. 0.01	0.12	0.04	0.12	0.11	0.04	0.08	0.12	0.09	0.19	0.17	0.04	0.12
200 pp m N												
$NaNO_3$	3.91	0.33	4.51	4.05	0.35	5.21	4.02	0.21	5.00	5.50	0.51	3.85
$(NH_4)_2SO_4$	4.33	0.35	4.51	4.32	0.45	4.41	4.25	0.30	5.52	4.31	0.67	5.02
$(NH_4)_2SO_4$+NS	4.20	0.31	5.08	4.13	0.43	4.71	4.11	0.42	6.08	3.98	0.66	4.11
Urea	4.31	0.30	5.08	5.05	0.54	5.10	3.71	0.45	5.53	4.13	0.53	4.81
Urea+NS	4.21	0.32	6.03	4.91	0.57	5.03	3.93	0.35	5.04	4.85	0.65	4.83
L.S.D. 0.05	0.11	0.010	0.14	0.08	0.02	0.09	0.012	0.006	0.12	0.08	0.06	0.13
L.S.D. 0.01	0.15	0.013	0.19	0.11	0.03	0.12	0.016	0.008	0.17	0.11	0.08	0.19

NS: as a nitrification inhibitor nitrapyrin (N-serve) at a rate 1% of nitrogen rates were added.

*** Nitrate contents status:**

Data in Table (6) indicated that the nitrate contents in Jew's mallow as affected by cobalt and different rates, forms of nitrogen (100, 200)ppm under effect a nitrification inhibitor, nitrapyrin (N-serve) application . At the first section of results where (100 ppm N) indicated, head values was of ($NaNO_3$) treatment as with cobalt at morning time, following it was of (Urea) treatment, with cobalt, without inhibitor at morning time, then ($NaNO_3$) treatment without cobalt without inhibitor at morning time. Increasing rates as a percentage in comparison control at the same treatments previous order (157, 153 and 145) respectively. At the second section of table as (200 ppm N) head values was of $(NH_4)_2SO_4$) treatment with cobalt, without inhibitor at morning time, following it ($NaNO_3$) treatment, with cobalt without inhibitor at afternoon time, then (Urea) treatment, with cobalt at morning time respectively. Increasing rates as a percentage at the same previous order in comparison control (229, 116 and 214) receptively.

At inclusive look on the previous results noticed that most of the treatments which it registered of high values of nitrate contents in Jew's mallow plants it not contain of inhibitor nitrapyin (N-Serve) but it contain cobalt element and at the morning time.

This indicated that the inhibitor inhibit of nitrate formation in soil from ammonium and urea fertilizers transformations and also that this treatments were with cobalt was added at a rate (10 ppm) in soil, this means it cobalt may retard of nitrate transformations to protein formation in plants also that most this treatments at morning time, may to reason stoppage of assimilation light during the night of what cause a nitrate accumulation during at night.

Also was found a positive contact between nitrogen rates were added and rate of nitrate in plants. (Maynard *et al*, 2006 and Mubashir, 2010) the concentration of nitrate in plant tissues is always in a dynamic state since it represents the difference between rates of absorption and rates of assimilation within the plant. For a particular plant part, translocation of absorbed nitrate to or form the part is also involved. (Yoon and Choi, 1999) found that accumulation of nitrate –N in the morning was greater than in the afternoon in the Jew's Mallow plant.

Table 6: Nitrate contents (ppm) in fresh leaves to Jew's mallow plant as affected by cobalt, nitrogen forms, nitrification inhibitor (N-Serve) and harvesting time.

Treatments	100 ppm N			
	Without Cobalt		With Cobalt	
	Morning	Afternoon	Morning	Afternoon
Control	147	126	147	221
$NaNO_3$	360	231	378	342
$(NH_4)_2SO_4$	336	281	284	243
$(NH4)_2SO_4$+NS	212	226	318	204
Urea	259	245	372	255
Urea+NS	240	221	314	229
L.S.D 0.05	15.9	15.2	18.9	16.7
L.S.D. 0.01	21.8	20.8	25.9	22.9
200 ppm N				
$NaNO_3$	377	270	511	478
$(NH_4)_2SO_4$	382	294	484	387
$(NH_4)_2SO_4$+NS	276	242	388	394
Urea	317	250	462	365
Urea+NS	253	219	420	362
L.S.D. 0.05	18.3	16.4	22.2	21.1
L.S.D. 0.01	25.1	22.5	30.4	28.9

*** Micronutrients contents status:**

Data in table (7) indicated that micronutrients contents (Fe, Mn,Zn and Cu) ppm in Jew's mallow as affected by the treatments under studied.

*** Iron contents status :**

The first section as nitrogen at a rate (100 ppm N). Fe contents indicated that head values were of $(NH_4)_2SO_4$ and (Urea) treatments as with cobalt, without inhibitor and the last without cobalt, this values it (4000 and 3375) ppm respectively. Following it were of (Urea) and ($NaNO_3$) treatments as with cobalt and without inhibitor values it (3175 and 3125). Increasing rates as a percentage in comparison control (150, 180, 98 and 95) respectively as according to the previous order treatments. As for the second section of table (7) as 200 ppm N. whereas head values were of (Urea +NS) and (Urea) treatments with cobalt with inhibitor and without, its values (3775, 3500), ppm respectively. Following it were of $(NH_4)_2$ SO_4) and (Urea) treatments as with cobalt and without inhibitor its values (3298 and 3204) ppm respectively then $(NH_4)_2$ SO_4 + NS) treatment as with cobalt and with inhibitor and [$(NH_4)_2$ SO_4] treatment as without cobalt and without inhibitor. It's values (2684 and 2574) ppm respectively increasing rates as a percentage in comparison control (136, 191, 106, 100, 68 and 114) respectively as according to the previous treatments order. Highest increasing rate was to [$NH_4)_2$ SO_4] as with cobalt without inhibitor to a rate of nitrogen 100 ppm while with 200 ppm N was (Urea +NS) treatment as with cobalt and with inhibitor. That's means it that cobalt and inhibitor incourage iron uptake especially with ammonium or Urea fertilization may be due to increasing of assimilation process to enzymes and hormones formation and growth of plants.

*** Manganese contents status:**

The first section of table (7) as (100 ppm N) indicated that, head value were of $(NH_4)_2$ SO_4) treatment as without cobalt, without inhibitor and (Urea) treatment as with cobalt, without inhibitor and (Urea+NS) treatment as with Cobalt, with inhibitor it's values (186 and 132) ppm respectively. Following it were of $(NH_4)_2SO_4$ +NS) treatment as without cobalt, with inhibitor, and (Urea + NS) treatment as with cobalt, with inhibitor, it's values (120 and 112). of Mn contents. Then ($NaNO_3$) treatment as without cobalt, without inhibitor it's values (186,132,120, 112 and 94) ppm of Mn contents respectively. Increasing rates as a percentage in comparison control at previous treatments order as (166,25,71,6 and 34). At the second section as 200 ppm N show that head values were of ($NaNo_3$) as without cobalt, without inhibitor and [$(NH_4)_2SO_4$+NS] treatment as without cobalt, with inhibitor respectively its values (304 and 192) ppm respectively. Following it ($NaNO_3$) and [$(NH_4)_2SO_4$)] as without cobalt, without inhibitor and [$(NH_4)_2SO_4$]) as with cobalt, without inhibitor, it's values (183 and 162) ppm respectively, then (Urea) treatment as without cobalt, without inhibitor and (Urea +NS) treatments as without cobalt, without inhibitor and (Urea +NS) treatment as with cobalt, with inhibitor it's values (148 and 143) ppm respectively, highest value was of $NONO_3$ treatment as a result NO_3^- ion not adsorption on clay surface because it carry of a negative charge and consequently there a bigger chance to cations exchangeable on clay surface therefore the plant there more uptake of manganese (Mn) element.

On the other beside the inhibitor inhibition transformation of ammonium and Urea to NO_3 as a result a nitrification process therefore competition occur between NH_4^+ ion and Mn^{++} on the clay surface of what cause lesser a chance to Mn adsorption.

Table 7: Micronutrients content (ppm) in Jew's mallow as affected by cobalt and different rates, forms of nitrogen and a nitrification inhibitor.

Treatments	100 ppmN							
	Without Cobalt				With Cobalt			
	Fe	Mn	Zn	Cu	Fe	Mn	Zn	Cu
Control	1204	70.0	212	29.0	1600	106	220	54.0
$NaNO_3$	1533	94.0	250	42.0	3125	70.0	156	33.0
$(NH_4)_2SO_4$	2500	186.0	300	62.0	4000	65.5	154	36.5
$(NH_4)_2SO_4$+NS	1125	120.0	243	43.0	3000	65.0	119	26.5
Urea	3375	66.0	166	108	3175	132.0	188	37.8
Urea+NS	2340	53.0	155	31.5	3002	112.0	250	50.8
L.S.D 0.05	44.9	9.45	14.9	7.25	54.6	7.92	13.5	5.61
L.S.D. 0.01	61.5	12.9	19.6	9.39	74.8	10.9	18.4	7.68
200 ppm N								
$NaNO_3$	1600	304	159	52.5	2507	183	267	56.0
$(NH_4)_2SO_4$	2574	125	224	73.5	3298	162	209	47.5
$(NH_4)_2SO_4$+NS	1308	192	231	51.0	2684	121	178	39.0
Urea	3500	148	180	33.5	3204	138	206	56.5
Urea+NS	1895	123	110	42.5	3775	143	221	45.0
L.S.D. 0.05	42.6	12.2	12.3	6.49	50.8	10.7	11.3	5.98
L.S.D. 0.01	58.3	16.7	16.8	8.92	69.6	14.7	15.5	8.19

*** Zinc contents status:**

At the first section of table (7) as (100 ppm N) indicated to head value were of $(NH_4)_2SO_4$ and ($NaNO_3$) treatments as without cobalt, without inhibitor and (Urea + NS) treatment as with cobalt, with inhibitor it's values (300 , 250 and 250) ppm respectively. Following it $(NH_4)_2SO_4$+NS) treatment as without cobalt, with inhibitor. All the differences between treatments were significant under each of two levels except some little values. Data in the second section as 200 ppm N indicated to head values to Zinc contents were of ($NaNO_3$) treatment as with cobalt, without inhibitor and [$(NH_4)SO_4$+NS] treatment as without cobalt, with inhibitor, it's values (267 and 231) ppm. Following it [$(NH_4)_2SO_4$] treatment as without cobalt, without inhibitor and (Urea +NS) treatment as with cobalt, with inhibitor it's values (224 and 221) ppm of Zinc content. Then [$(NH_4)_2SO_4$] and (Urea) treatments as with cobalt, without inhibitor, it's values (209 and 206) ppm . increasing rates as a percentage in comparison control as (21,9, 6, 0.5, 0 and 0) respectively as the previous treatments order. All the differences between treatments were significant under each of two levels except some little values. Highest value was of (NaNO3) treatments as without inhibitor of what give a bigger chance on clay surface to cations exchangeable of what lead to more uptake of zinc uptake.

*** Copper contens status:**

Data in the first section of table (7) as (100 ppm N) indicated to head values were of (Urea) and [$(NH_4)_2$ SO_4] treatments as without cobalt, without inhibitor, it's values (108 and 62) ppm of copper (Cu) contents. Following it (Urea+NS) treatments as with cobalt and with inhibitor. Then [$(NH_4)_2SO_4$+NS] treatment as without cobalt, with inhibitor and (Urea) treatment as with cobalt, without inhibitor it's values (43 and 37.8) ppm respectively. All the differences between treatments were significantly under each of two levels except some little value. Highest value was of urea treatment as without cobalt, without inhibitor, at the second section of data as (200 ppm N) head values were of [$(NH_4)_2SO_4$] treatment as without cobalt, without inhibitor and (Urea) treatment as with cobalt, without inhibitor it's values (73,5 and 56.5) ppm of Cu Contents following it ($NaNO_3$) treatment as with cobalt, without inhibitor and ($NaNO_3$) treatment without cobalt, without inhibitor it's values (56.0 and 52.5) ppm. Then [$(NH_4)_2SO_4$+NS] treatment as without cobalt, with inhibitor and [$(NH_4)_2SO_4$] treatment as with cobalt, without inhibitor it's values (51.0 and 47.5) ppm of Cu contents. Increasing rates as a percentage in comparison control as (153, 5.0, 4.0, 81, 76.0 and 0) respectively, as according to the previous treatments order. Highest value of increasing rates was of $(NH_4)_2SO_4$ treatment as without cobalt, without inhibitor. That's give a bigger chance for others cations exchangeable because the inhibitor incourage continuously of ammonium ion $(NH_4)^+$ as not transformation to (NO_3^-) ion, thus at absence of cobalt element (Selim, 1987) reported that the effect of the inhibitor was more pronounced at low rather at high N-doses. On the other hand, its decrease of other cations. The effect on micronutrient elements is not noticeable since the plant requirements of such elements are quite low. (Kafakafi and Neumann, 1985) shown that Fe-content seemed to be affected by different N-sources and a nitrification inhibitor. Data revealed that application of sodium nitrate increased concentration of Fe by 34% as compared to control concluded that supplying the plant with as in present of nitropyrin (N-serve) for preventing nitrification reduced Fe chlorosis. Even when ammonium was less than 20% of total mineral N in the soil. Suggesting that NH_4 uptake by plant and consequence of hydrogen (H^+) efflux occurs from the root soulbilizing enough Fe near the root to-overcome the chlorosis. (Kagawa *et al.*, 2001) showed that , cobalt level of 2.5 ppm in solution culture increasing Mn, Zn and Cu content in cucumber fruits. These results are in harmony with those of (Liala and Nadia, 2002) clear indicated that, the addition of cobalt resulted in a reduction of Fe which was more or less proportion with the concentration of added cobalt. This indicates the competition between Fe and Co in apsorbtion. This may be explained on the basis of results reported by (Bisht, 1991) and (Blaylock, 1995) that showed certain antagonistic relationships between two elements.

*** Residual effect inorganic nitrogen in soil status:**

Residual effect inorganic nitrogen in soil as affected by cobalt, different rates and forms of nitrogen and a nitrification inhibitor nitrapyrin (N-serve) were added under effect of Jew's mallow cultivation in a alluvial soil of type clay loam. Data in table (8) indicated that at the first section as (100 ppm N) . Head values of total N were of (Urea +NS) and [$(NH_4)_2SO_4$+NS] treatments, this efficiency of inhibitor as ammonium ion NH_4^+ more than nitrate anion No_3^- at each of two treatments where as its with inhibitor,

Table 8: Residual inorganic nitrogen (ppm) in soil after Jew's mallow harvesting as affected by cobalt, different rates, forms of nitrogen and a nitrification inhibitor.

Treatments	100 ppm N					
	Without Cobalt			With Cobalt		
	NH_4^+	NO_3^-	Total	NH_4^+	NO_3^-	Total
$NaNO_3$	7.0	13.0	20.0	7.6	12.0	19.6
$(NH_4)_2SO_4$	8.9	14.1	23.0	9.8	14.3	24.1
$(NH_4)_2SO_4$+NS	22.0	16.0	38.0	26.0	13.2	39.2
Urea	11.0	14.0	25.0	12.3	12.0	24.3
Urea+NS	30.3	7.7	38.0	30.6	11.1	41.7
L.S.D 0.05	1.83	1.89	2.31	2.03	1.15	2.33
L.S.D. 0.01	2.51	2.21	3.17	2.79	1.57	3.28
200 ppm N						
$NaNO_3$	8.0	32.5	40.5	7.20	32.8	40.0
$(NH_4)_2SO_4$	12.0	30.0	42.0	15.0	28.3	43.3
$(NH_4)_2SO_4$+NS	35.0	17.0	52.0	29.6	21.6	51.2
Urea	20.6	27.9	48.5	18.3	27.6	45.9
Urea+NS	38.0	17.0	55.0	37.0	20.2	57.2
L.S.D. 0.05	2.18	2.23	2.66	2.63	2.69	3.25
L.S.D. 0.01	3.42	3.06	3.65	3.35	3.97	4.38

Following were of [$(NH_4)_2$ SO_4+NS], (Urea +NS) as without cobalt with inhibitor and (Urea) treatment as without cobalt without inhibitor, values it's (41,7,39,38,38 and 25) ppm respectively of total nitrogen. The lowest values were of ($NaNO_3$) treatment without cobalt or with cobalt it's values (20 and 19.6) ppm of total N respectively. From the previous results noticed that the inhibitor protected of soil nitrogen of the loss at form nitrate $(NO_3)^-$ by the leaching, denitrifcaiton and volatilization processes whereas the inhibitor is keeping of nitrogen at form ammonium (NH_4^+) ion and inhibition transformation its to (NO_3^-) form. At the second section of table (8) as (200 ppm N). Head values of total nitrogen were of (Urea +NS) treatment as without or with cobalt and with inhibitor it's values (57.2 and 55) ppm respectively. Following it were of [$(NH_4)_2SO_4$+NS] treatment as without or with cobalt and with inhibitor its values (52 and 51.2) ppm respectively. Then (Urea) treatment as without or with cobalt and without inhibitor respectively. Form the previous results at a inclusive look noticed that presence a positive connection between nitrogen rates was added and residual effect of total nitrogen in soil . all the treatments with inhibitor (N-serve) the residual of total nitrogen in soil was more than the other treatments. Also amounts of nitrogen as form ammonium (NH_4^+) was higher with inhibitor treatments than amount of nitrate (NO_3^+) that's as a result the inhibitor effect and it's alon or with cobalt element as was found increasing of total nitrogen at a slight rates than the other treatments which without cobalt treatments. (Abd El Fattah, 1988) showed that the soil treated with $(NH_4)_2SO_4$ and Urea with (N-serve) inhibitor contained 67.6% of the added N, the corresponding values for the $(NH_4)_2SO_4$ and $NaNO_3$ treatments are 25 and 22%, respectively.

Residual effect of N fertilizer was very high in the former treatment clearly show the economical benefits from using the nitrification inhibitor. (Abd El Fattah, 2008) showed that cobalt element encourage of plnat uptake for nitrogen which inter in constitution of dry matter. (Youssef *et al.,* 2001 and Abde EL sabour and Rabie, 2004) reported that cobalt had a stimulating effect on plant growth, cobalt is involved in Co-enzyme and hence is essential for several enzymatic reaction (Khattab and liala, 2002) found that the protein ratio content and

N,P,K and Fe composition of parsley and coriander increased with increasing cobalt concentration up to 25 mg co/kg soil.

*** Comment and conclusion:**

Indeed the cobalt element using with suitable rates support at improvement of the quantities and qualities properties to the plants especially with nitrogen us fertilizations as increases of plant uptake of macro-micronutrients where contribute increasing of nutrition assimilation and motivates enzymatics hormones plants formation as reflected on the dry matter plants where increase of economic and nutrition value it, on the other beside that the nitrification inhibitor nitrapyrin (N-serve) efficiency at the protection of nitrogen at form ammonium (NH_4) fertilizer of the losses. Also the inhibitor had decreases of nitrate accumulation in the plants of through keeping on the nitrogen at form (NH_4^+) ammonium as it inhibition transformation to (NO_3) nitrate which exposes to the losses from soil at the several methods. Therefore, results was recommended that using of nitrogen fertilizer at form ammonium (NH_4^+) or urea with (N-serve) inhibitor and cobalt element at the suitable concentrations according to soil type and plant was cultivated.

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