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Onion Production as influenced by the application of cobalt with Different Doses of Nitrogen

Nadia Gad, M.R. Abdel-Moez and M.E. Fekry Ali

Plant Nutrition Dept., National Research Centre, El Buhouth St., Dokki, Giza, Egypt, P.O. Box, 12622.

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ABSTRACT

Two field experiments were carried out to evaluate onion productivity as affected by cobalt under different rates of nitrogen fertilizer. The experiments were conducted at Research and Production Station, National Research Centre, El-Nubarya Site, Beheara Governorate, Delta Egypt under drip irrigation system during 2018 and 2019 seasons. The obtained results are summarized in the following: Cobalt at 10 ppm with 100% N resulted the highest growth and yield parameters followed by 80% N followed by 60%N while 40% N gave the lowest values. Cobalt gave the greatest values of all growth and yield parameters as well as bulb mineral composition and chemical constituents especially with all nitrogen doses. Cobalt with 80% nitrogen significantly onion yield compared with the rate of 100%N alone. Cobalt save 20% from requiremen.t Cobalt increased the efficiency of the nitrogen fertilization amendment reduce the recommended dose of about by 40%

Keywords: Cobalt-Onion productivity- Nitrogen fertilizer.

1. Introduction

Onion (*Allium cepa L.*) is one of the most important field crops whose leaf protion as vegetable and bulbs as salad and spice are used daily (IzadKhan *et al.,* 2010). Plant nutrition is one of the most important factors that the increase plant production. Balanced use of fertilizer especially nitrogen could resulted in an increase in bulb yield of onion (*El-Gizawy et al.,* 2013).

Nitrogen is most recognized in plants for its presence in the structure of the protein molecule. In addition, nitrogen is found in such important molecules as pureness, pyrimidines are found in the nucleic acids RNA and DNA which are essential for protein synthesis (Abu-Rayyan and Al-Hadidin, 2005)

Cobalt is considered to be a beneficial element for higher plants in spite of the absence of evidence for direct role in their metabolism. This is true in spite of essentiality for Photosynthetic activities of lower plants such a euglena gracilis; it was frequently reported to be localized in various sub-cellular fractions as in chloroplasts (Jolly, 2004), Cobalt is an essential element for the synthesis of vitamin B_{12} which is required for human and animal nutrition, Cobalt does not accumulate in human body as the other heavy metals with the increase in age (Young, 1983). Nadia Gad and Abd El-Moez (2011) found that the cobalt addition significantly increased the broccoli growth, head yield, mineral composition as well as heads chemical contents compared to control plants. Cobalt at 6ppm had a greatest values. Nadia Gad and Nagwa Hassan (2013) reported that all Cobalt rates (2.5; 5.0, 7.5 and 10.0 ppm) significantly increased sweet pepper growth yield parameters compared with untreated plants. Cobalt at 5 ppm resulted the vegetative growth, yield and quality measurements. Holah *et al.,* (2019) showed that all cobalt levels (from 2.5 to 20.0ppm) significantly increased tomato plants growth, yield, nutritional-status and chemical contents compared with control plants. Cobalt at 7.5ppm gave the highest values. Nadia Gad and Fekry Ali (2020) revealed that all cobalt concentrations (from 5to10 ppm) significant increase in the growth as well as potato tubers yield and its quality compared with control. Cobalt at 10 ppm resulted the greatest values. As cobalt level increasing in plant growth media over than 10 ppm, the favourable effects of cobalt was e reduced.

Corresponding Author: Nadia Gad, Plant Nutrition Dept., National Research Centre, El Buhouth St., Dokki, Giza, Egypt, P.O. Box, 12622. E-mail: drnadiagad@yahoo.com

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2. Materials and Methods

I. Soil analysis

Soil samples were taken from Research and production Station, Nobaria, Behera Governorate, Delta Egypt. Such samples were air dried and then prepared for analyses using conventional techniques.

II. Physical analysis

Particle size distribution, saturation percentage curve, moisture characteristics curve, bulk density, hydraulic conductivity, total prosity and texture class were determined according to Blackmore (1972).

III. Chemical analysis

Electrical conductivity (ds/m^{-1}), pH in soil- water suspension (1:2.5), organic matter content (%), $CaCO_3$ (%), cation exchange capacity, Exchangeable sodium (%), cations and anions in meq/liter (in soil paste), macro and micronutrients were determined according to Black *et al.,* (1982).

IV. Cobalt analysis

Total cobalt were determined in Aqua regain extract (Cottanie, 1982). The water soluble cobalt as well as available cobalt (DTPA extractable) was assayed according to Black *et al.* (1982). Determination of cobalt was carried out using Atomic Absorption Spectrophotometer, Varian AA-20.

Table 1: Physical and chemical analysis of the experimental soils in EL- Nubaria Station.

Physical properties											
Particle size distribution %								**Soil moisture constant %**			
Sand		Silt	Clay	Soil texture		Saturation		FC	WP		AW
70.8		25.6	3.6	Sandy loam		32.0		19.2	6.1		13.1
Chemical properties											
				Soluble cations (meq^{-1}L)				**Soluble anions (meq^{-1}L)**			
pH 1:2.5	**EC (dS m^{-1})**	**$CaCO_3$ %**	**OM %**	**Ca^{++}**	**Mg^{++}**	**K^+**	**Na^+**	**HCO_3^-**	**CO_3**	**Cl^-**	**$SO_4^=$**
8.49	1.74	3.4	0.20	0.8	0.5	1.6	1.80	0.3	-	1.9	0.5
Cobalt				**Total**		**Available**		**Available micronutriments**			
ppm				**mg 100 g^{-1} soil**				**ppm**			
Soluble	**Available**	**Total**		**N**	**P**	**K**		**Fe**	**Mn**	**Zn**	**Cu**
0.35	4.88	9.88		15.1	13.3	4.49		4.46	2.71	4.52	5.2

V. Plant material and experimental design

A preliminary experiment was carried out at Wire-house, National Research Centre at 2017. Onion Seeds cv. Giza Red were sown in soil. Samples which taken from Nubaria farm in pots 40 cm on 8 September 2017. According to the preliminary experiment results the concentrations range of cobalt which gave to growth and yield parameters were used in two field experiments carried out at Research and production Station, National Research Centre, Al-Nubaria Site, Beheara Governorate, Delta Egypt under drip irrigation system at 2018 and 2019 successive seasons.

Onion seedlings were transplanting on 22 and 25 December 2018/2019 and 2019/ 2020 respectively. The experimental plot size was 10.5 m^2 (1/400 fed). Each plot consisted of five ridges. Each ridge was 3.5 m long and 50 cm wide.

According to the preliminary experiment results, the concentration to 10 ppm cobalt which gave the greatest growth and yield values of onion.

Eight treatments were concluded:

1. (NH_4) SO_4 (100 %) recommended doses control
2. (NH_4) SO_4 (80 %)
3. (NH_4) SO_4 (60 %)
4. (NH_4) SO_4 (40%)

5. (NH_4) SO_4 (100 %) + Cobalt at 10 ppm
6. (NH_4) SO_4 (80 %) + Cobalt at 10 ppm
7. (NH_4) SO_4 (60%) + Cobalt at 10 ppm
8. (NH_4) SO_4 (40%) + Cobalt at 10 ppm

The experimental design was a piece of splinter once with three replications for each treatment, the seedlings (at third true leaves) were irrigated once with cobalt at 10 ppm, as cobalt sulphate form. All required agricultural managements for plants growth and production were carried out as recommended by Ministry of Agriculture (2015).

VI. Measurement of vegetative growth

After 60 days from transplanting, plant height, leaves number per plant, leaves fresh and dry weights along with leaf area per plant were recorded according to FAO (1980).

VII. Measurement of plant yield

After 130 days from transplanting, bulb diameter, bulb fresh and dry weights as well as bulb yield (Ton/ fed) were determined according to Gabal *et al.* (1984).

VIII. Measurement of Nutritional status

Onion bulbs sample either from the intact three plant for each treatment kept to chemical determinations for macronutrients (N, p and k) and micronutrient (Mn, Zn, Cu and Fe) according to Black *et al.,* (1982).

IX. Measurement cobalt content

Cobalt in onion bulbs were determined according to Cottenie *et al.* (1982).

X. Measurement chemical constituents

The present of total proteins, total soluble solids, stable oil per bull and volatile oil per bulb were determined according to A.O.A.C (1995).

Statistical analysis

All data were subjected to statistical analysis according to procedure outlined by SAS, (1996) Computer program and means were compared by LSD method according to Snedecor and Cochran (1980).

3. Results and Discussion

3.1. Vegetative growth and yield of onion plants which grown in Wire –house

Table (2) indicate that the different cobalt levels on the onion plant growth media significantly increase plant height, leaves number per plant, leaves fresh and dry weights, Bulb diameter, bulb fresh and dry weights, compared with control plants.

Table 2: Effect of cobalt on growth and yield parameters of onion plants which grown in wire house

Cobalt treatments (ppm)	Plant height (Cm)	Leaves number /plant	Leaves fresh weight (g)	Leaves dry weight (g)	Bulb Diameter (Cm)	Bulb fresh weight (g)	Bulb dry weight (g)
Control	56.40	5.45	35.2	8.67	4.11	113.5	38.2
5.0	58.0	6.92	36.1	9.71	4.23	115.2	38.9
7.5	59.7	8.83	38.4	10.90	4.84	118.7	40.0
10.0	62.0	11.4	40.0	11.84	5.39	121.8	41.7
12.5	61.1	11.4	39.7	11.75	5.35	120.0	41.0
15.0	59.3	10.9	39.1	11.30	5.24	118.9	40.6
17.5	56.8	10.5	32.6	10.91	5.11	118.1	39.5
20.0	54.7	9.6	37.5	10.36	4.89	117.7	39.1
LSD 5%	1.1	0.5	0.6	0.5	0.3	0.6	0.7

Cobalt at 10 ppm resulted the greatest values of the mentioned parameters of onion. Increasing cobalt above 10 ppm, the primitive effect was reduced. These results are in harmony with those obtained by Nadia Gad (2006), who found that cobalt at 7.5 ppm gave the highest growth and yield of tomato plants. Cobalt significantly to increase the endogenous hormones such as: Auxins, Gibberllins, and decrease of the activity of some enzymes such as peroxidase and catalase. Cobalt hence anabolism rather than catabolism, while increasing cobalt more than 7.5 ppm decrease cobalt promotive effect, Confirm these results (Yadav and Khanna, 1988; Holh *et al.,* 2019).

3.2. Vegetative growth

Data in Table (3) indicate that, all growth parameters i.e plant height, leaves number per plant, leaves fresh and dry weights as well as leaf area recorded the highest values with 100% N followed by 80% N followed by 60% N while the rate 40% gave the lowest figures. These results are in harmony with those obtained by Marschner (1995) who stated that the simulative effect of nitrogen on different plant growth parameters may owe much to that nitrogen is an essential element for building up protoplasm, amino acids and protein which promote cell division, Also nitrogen plays a vital contribution in several biochemical process related to plant growth. Confirm these results Erman *et al.,* (2009) who added that application of nitrogen significantly enhanced vegetative plant growth.

Table 3: Onion growth parameters as affected by cobalt under nitrogen rates after 115 days from transplanting (Mean of two seasons)

Nitrogen treatments (%)	Plant height (cm)	Leaves number per plant	Leaves weight/ Plant (g)		Leaf area Per plant (cm^3)
			Dry	Fresh	
		Without cobalt			
100	73.6	12.21	39.93	9.89	38.97
80	68.5	11.32	36.01	8.44	36.60
60	61.3	10.11	31.30	6.74	32.28
40	54.9	8.86	27.03	5.89	27.83
		With cobalt (10ppm)			
100	78.7	13.66	44.70	11.13	43.62
80	74.2	12.53	40.96	9.65	40.03
60	67,4	10.92	35.73	7.86	34.58
40	58.7	8.98	29.40	6.98	28.98
LSD 5%	**0.6**	**0.8**	**2.03**	**1.01**	**1.15**

Data also indicate that cobalt enhance onion growth parameters such as plant height, leaves number per plant, leaf area per plant as well as fresh and dry weights of leaves per plant with all nitrogen rates. These observation are consistent with previous report obtained by Hanson *et al.,* (2001) who found that cobalt is considered to be a beneficial element for higher plants and is kind of trace element and heavy metal in soil.

3.3. Yield characteristics

Data in Table (4) show that as nitrogen fertilizer rate in plant media decrease, the studies yield parameter of onion significantly decreased. These data are agree with those obtained by Danesh *et al*., (2018) who show that vegetative and yield characters can be improved under ideal nitrogen fertilization.

Data presented in Table (4) clearly indicate that cobalt significantly increased onion bulb yield parameters compared with control. Cobalt at 10 ppm the greatest values of yield parameters such as bulb diameter, per plant, bulb fresh and dry weights as well as bulb yield (ton/fed) in two seasons. Cobalt at 10 ppm significantly increased yield about 12.668 ton with %100 N while onion yield gave 11.566 ton per feddan with cobalt 80% N significantly increase onion bulb yield about 118.7% compared with 100% N alone. cobalt with 100% N significantly increase onion bulb up to 116.5%.Nitrogen rate 60% with cobalt significantly increase onion bulb yield up to 116.8%.Nitrogen at 40% gave the lowest bulb yield (112.5). These results are agree with those obtained by Nadia Gad and Fekry (2020) who found that cobalt at 10 ppm significantly promoted all summer squash yield parameters compared with control.

Table 4: Onion yield characteristics as affected by cobalt under nitrogen rates after 155 days from transplanting (Mean of two seasons).

Nitrogen treatments (%)	Bulb Diameter (cm)	Bulb weight(g)		Bulb yield (ton/fed)
		Fresh	Dry	
		Without cobalt		
100	4.94	127.0	38.44	11.046
80	4.08	109.5	35.84	10.314
60	3.78	98.4	31.26	8.469
40	2.25	86.7	26.88	6.726
		With cobalt (10ppm)		
100	5.83	132.8	42.2	12.686
80	5.70	128.6	39.89	11.966
60	4.46	111.8	36.02	9.895
40	3.40	95.6	31.85	7.572
LSD $_{5\%}$	0.8	3.0	2.2	1.519

3.4. Nutritional status

Data in Table (5) show that macronutrients (N, plant K) in onion bulb significantly increased with cobalt with all N doses compared with control in two seasons. As cobalt rate in plant media increasing above 10 ppm, the prometive effect reduced. These results are good agreement with those obtained by Boureto *et al.,* (2001) who stated that cobalt at 2.5 ppm in solution culture significantly increased the contents of N, P and K in tomato plants. Confirm these results Holah *et al.,* (2019) who pointed that cobalt at 7.5 ppm has positive effect on N, P and K contents in tomato fruits.

Table 5: Nutritional status in onion bulbs as affected by cobalt under nitrogen rates (Mean of two seasons).

Nitrogen Treatments (%)	Macronutrients%			Macronutrients (ppm)				
	N	P	K	Mn	Zn	Cu	Fe	Cobalt
					Without cobalt			
100	1.61	0.480	0.890	17.7	15.8	19.0	146	0.96
80	1.45	0.319	0.817	16.2	14.6	17.5	137	1.08
60	1.26	0.247	0.735	14.0	12.7	16.2	128	1.13
40	1.10	0.219	0.680	12.8	11.0	14.9	117	1.19
			With cobalt(10)					
100	1.72	0.560	1.530	18.9	16.7	20.8	133	6.87
80	1.60	0.408	1.481	16.9	15.3	19.1	125	6.59
60	1.31	0.323	0.982	15.6	13.2	17.5	117	6.21
40	1.18	0.278	0.787	13.3	11.9	16.0	109	5.78
LSD $_{5\%}$	0.8	0.12	0.5	0.6	0.7	1.1	208	0.6

Data in Table (5) also indicate that all the used levels of cobalt gave the significant beneficial effect on the contents of micronutrients (Mn, Zn and Cu) of onion bulb compared with untreated plants. These results agrees with those obtained with James (2005) who found that cobalt significantly increased Mn, Zn and Cu content of tomato fruits.

Also Table (5) clearly indicate that the addition of cobalt in plant media resulted in a reduction in Fe content in tomatoes. The reduction rate of Fe was more or less proportion with the concentration of added cobalt. This indicates, again, the competition between Fe and Co in absorption. This may be explained on the basis of results reported by Blaylock (1986) who showed certain antagonistic relationships between the two elements (iron and cobalt). While the content of cobalt in onion bulb significantly increased with the increasing cobalt rate in plant media. These results are agrees with those obtained by Nadia Gad and Nagwa Hassan (2013) who stated that as increasing cobalt level in plant media above 10 ppm significantly, cobalt sweet increase concentration in pepper fruits. Young (1983) reported that the daily cobalt.

Requirement for human nutrition could reach 8 ppm depending on cobalt levels in the local supply of drinking water without health hazard. Levels of 8.22 ppm in the highest cobalt treatment (15 ppm) is below the dangerous level, since the daily consumption of tomato fruits does not exceed a few grams.

3.5. Chemical constituents

Data concerning effect of cobalt on chemical contents of onion bulb are given in Table (6). The results reveal that, cobalt has a significant favorable effect in all chemical constituents in onion such as total proteins, total soluble solids as well as stable and volatile oil compared with control (N rates alone). These results are agree with those obtained by Nadia Gad and Fekry Ali (2020) who reported that cobalt is hence all chemical content in potato tubers.

Table 6: Chemical constituents in onion bulb as affected by cobalt under nitrogen rates (Mean of two seasons).

Nitrogen treatments (%)	Total proteins	Total soluble solids (%)	Stable oil	Volatile oil
		Without cobalt		
100	10.1	14.86	14.80	0.292
80	9.06	13.52	13.66	0.221
60	7.88	12.24	12.79	0.198
40	6.89	11.46	11.56	0.171
		With cobalt(10 ppm)		
100	1.08	16.27	16.26	0.322
80	10.0	14.70	14.83	0.271
60	8.19	13.19	13.59	0.209
40	7.38	12.06	12.6	0.183
LSD $_{5\%}$	0.5	0.4	0.48	0.12

4. Conclusion

Cobalt promising element in the newly reclaimed soils in Egypt. Cobalt help plants to tolerate the harmful weathering in this soils. Also it has a primitive effect of onion growth, yield quantity and its quality. Therefore, considerable attention should be taken concerning applying this element (cobalt) as a fertilizer.

References

A.O.A.C. 1995. Method of analysis. Association of Official Agriculture Chemists. 16th Ed., Washington, D.C.USA.

Abu-Rayyan, A.M. and N.A. Al-Hadidi, 2005. Onion production and nitrogen uptake in response to different doses of urea fertilizer at two different plant populations. J. King Saud Univ.,18(1): 19-34.

Black, C.A., D.D. Evans, L.E. Ensminger, G.L. White and F.E. Clarck, 1982. "Methods of Soil Analysis", Part 2. Agron. Inc. Madispn Wise.

Blackmore, A.D., Jolly and R.H. Walser, 1972. Methods of Chemical Analisis of Soils. Newzealand. Soil Dureau. P A2.1, Dep. No. 10.

Blaylock, A.D., T.D. Davis, V.D. Jolley and R.H. Walse, 1986. Influence of cobalt and iron on photosynthesis, chlorophyll, and nutrient content in regreening chlorotic tomatoes and soybeans. J. of plant Nutrition, 9(3-7):813-838.

Boureto, A. E.; M. C. Castro and J. N. Kagawa, 2001. Effect of cobalt on sugar beet growth and mineral content. Revistra Brasileira Sementes. 18-63-68.

Cottenie, A., M. Verloo, L. Kiekens, G. Velgh and R. Camerlynck, 1982. Chemical analysis of plant and soil. Chemical Analysis of Plants and Soils. PP 44-45. State Univ. Ghent Belgium.

Danesh, R.K., S. Bidaring, E. Azarpour, M. Moraditochaee and H.R. Bozorgi, 2012. Study effects of nitrogen fertilizer management and foliar spraying of marine plant Ascophyllu-Int.J.Agri.Crop.Sci., 4(20):1492-1495.

El-Gizawy, E.S.A., L.S.M. Geries and E.K. Mahmoud, 2013. Onion productivity and soil fertility status as influenced by integrated use of fertility status as influenced by integrated use of inorganic, compost tea and N2-fixing bacterial fertilizers. J. plant production, Mansoura Univ., 4(2):249-270.

Erman, M.E. Ari, Y. Togay and F. Cig, 2009. Response of field pea (*Pisum sativum* sp. Arvense L.) to rhizobium inoculation and nitrogen application in Eastern Anadolia. J. Animal and Veterinary Advances, 8(4):616.

FAO, 1980. Soil and plant testing as a basis of fertilizer recommendation. Soil Bull., 3812.

Gabal, M.R., I.M. Abd-Allah, F.M. Hass and S. Hassannen, 1984. Evaluation of some American tomato cultivars grown for early summer production in Egypt, Annals of Agriculture Science Moshtohor., 22: 487-500.

Hanson, H.T. Larsen, H.M. Seip and R.D. Vogt, 2001. Trace metals in soils at four sites in N Southern China. Water, Air, and Soil Pollution 130: 1721-1726, 2001.

Holah, Sh. Sh., S.T. Aou Zeid, Nadia Gad and M.M. Abbas 2019. Response of Tomato (*Lycopersicum esculentum*) to Cobalt Supplement. Plant Archives, 19(1): 817-822.

IzadKhan, M., M. Tajbakhsh, M.R. Zardoshty and G. Hasanzadeh 2010. Evaluation effects of different planting systems on water use efficiency relative water content and some plant growth parameters in onion (*Allium cepa* L). Notulae Scientia Biologicae, 2(1):88-93. DOI: https://doi.org/10.15835/nsb213565

James, D.B., 2005. Interrelation between minerals plant tissues. J. Plant Nutr., 11:1236.

Marschner, H., 1995. Mineral Nutrition of higher plant. 2nd (ed.) Academic press limited text Book, 864.

Ministry of Agriculture, 2015. Statistical Yearbook, Egypt

Nadia Gad and M.R. Abdel-Moez, 2011. Broccoli growth, yield quantity and quality as affected by cobalt nutrition. Agriculture and Biological J. of North America, 2(2): 226-231.

Nadia Gad and Nagwa Hassan, 2013. Response of growth and yield of sweet pepper (*Capsicum annuum* L.) to cobalt nutrition. World Applied Sciences Journal, 2(5): 760-765.

Nadia Gad, 2006. Increasing the efficiency of nitrogen fertilization.

SAS. 1996. Statistical analysis system, SAS users guide: statistics. SAS Institute Inc., Edition, Cary, NC.

Snedecor, G.W. and W.G. Cochran, 1980. Statistical Analysis Methods. 6th Ed. Iowa State Univ. Press. Ames., Iowa, USA.

Yadav, D.V. and S.S. Khanna, 1988. Role of cobalt in nitrogen fixation: A review. Agric. Rev., 9:180–182.

Young, S. R., 1983. Recent advances of cobalt in human nutrition. Victoria B.C. Canada. Micronutri. News Inform. 3(3): 2-5.