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Effect of Co level and FYM on growth and yield of fodder maize

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Abstract
A pot house experiment was carried out to study the effect of cobalt (Co) and farm yard manure (FYM) on growth and yield of maize at Department of Agricultural Chemistry and Soil Science, BACA, AAU, Anand with five levels of Co (0, 10, 20, 40 and 80 mg kg^{-1}) and two levels of FYM (0 and 1%) on loamy sand (*Typic Ustochrepts*) soil. The experiment was laid out in a CRD (factorial) with three replications. The experimental results indicated that an application of cobalt @ 20 mg kg^{-1} soil recorded the highest plant height, green forage yield and leaves, stem and root dry matter at harvest than other levels of cobalt. Decrease in plant height, green forage yield and dry weight of leaves, Stem and root of maize were found in 40 and 80 mg kg^{-1} levels of Co. The higher plant height, green forage yield and dry matter yield was obtained in FYM application at 1% over no FYM application.

Keywords: Cobalt, FYM, Yield, Maize, Growth

1. Introduction
In different part of the country, rapid growth of industries and increasing urbanization has created major problems with the disposal of sewage and industrial effluents. These industries generate huge quantity of solid and liquid wastes. They contain appreciable amount of metals besides beneficial nutrients. Therefore, their continuous application to soil may lead to accumulation of heavy metals which are likely to pose serious threat on soil health and plant growth as they depressed the yield and quality. Among the different polluting elements, the heavy metals create serious problems whenever they are accumulated in environment. The unwise use of row sewage water and industrial west water for irrigation continuously had elevated level of available heavy metals in the cultivated layer of the soil. This had caused serious problems concerning food chain and consequently, the health of organisms, including human being. Therefore the agriculturists are much worried about the pollution especially the entry of toxic elements in to food chain from soil to plant to animal/human beings. Cobalt is a trace element which can be a contaminant in soils due to agricultural additives or metal refineries (Bakkaus *et al*. 2005) [1].
Cobalt is one of the essential micronutrient elements which is needed by phytoplankton cell for the synthesis of cyanocobalamin (vitamin B_{12}) and is therefore considered as an important trace element (Sunda, 1989) [8]. Cobalt has been shown to be a biologically active metal directly associated with the health of several plant species, animals and human beings. Therefore, cobalt is a food concern and a concern for soil productivity, but the environmental hazards associated with excess cobalt is least among all the heavy metals in excess amounts.
Farm yard manure provides long-term immobilization of the metals because these minerals will not be degraded and so will bind the metals for much longer. Altogether an improved biological quality of the soil will be obtained by improved nutrient levels though the Farm yard manure as well as a reduced toxicity of the soil through immobilization of the metals.

2. Materials and Methods
A pot experiment was conducted during summer season of 2014 in the net house of the department of soil science and agricultural chemistry, Anand Agricultural University, Anand. The soil used in experiment was loamy sand in texture and alkali in reaction (pH 7.9), with 0.38% organic carbon, 220.37 kg ha^{-1} available N, 28.35 kg ha^{-1} available P_2O_5 and 252.57 kg ha^{-1} available K_2O. Micronutrients contain of soil 1.36, 8.62, 10.56 and 1.59 mg kg $^{-1}$ of Zn, Fe, Mn and Cu, respectively.

The treatments comprised of two levels of FYM (0 and 1%, henceforth referred to as F0 and F1), five levels of Co [0, 10, 20, 40 and 80 mg kg-1 (Co1, Co2, Co3 Co4 and Co5) in factorial combination in a complete randomized design with three replications. N and P were added uniformly in each plot. Different levels of Co were applied at the time of sowing through cobalt chloride. The seed of maize crop (variety African tall) was sown in pot. The observations including plant height, green forage yield and dry weight of leaves, stem and root were recorded. Maize was harvested at 60 DAS. Experimental data were analyzed using standard statistical procedure given by Steel and Torrie (1982) [9].

3. Results and Discussion

3.1 Effect of FYM

Application of FYM @ 1% (F_1) gave significantly higher plant height of 71.93 and 98.33 cm of maize as compared to treatment having no application of FYM (F_0) at 30 DAS and at harvest, respectively. The plant height of maize was 19.78 and 24.30 per cent higher than the control. The green forage yield of maize was significantly influenced due to application of FYM. The green forage yield of maize (206.39 g pot^{-1}) increased due to application of FYM @ 1% and it was 25.15 per cent higher over control (F_0). The dry weight of leaves, stem and roots (36.79, 4.49 and 4.38 g pot^{-1}) of maize crop were increased to 43.10, 49.17 and 36.02 per cent due to application of FYM @ 1% (F_1) over control (F_0), respectively.In general, the plant height was increased due to application of FYM might be due to beneficial effect of FYM which improved physical and chemical condition of soil, improved fertility status of soil and better utilization of nutrients. Results were conformity with finding of Sushila and Giri (2000) [10] who reported significant increase in plant height of wheat with application of FYM @ 10 t ha^{-1}. Oad *et al.* (2004) [6], Verma *et al.* (2006) [11] and Puri and Tiwari (2008) [7] also reported similar results in different crops.

3.2 Effect of cobalt

Significantly the highest plant height of 71.38 and 98.90 cm were noticed due to application of Co @ 20 mg kg^{-1}at 30 DAS and at harvest of maize crop, respectively. While, significantly the lowest plant height of maize (61.18 and 80.78 cm) was recorded in the maximum level of cobalt (80 mg kg^{-1}) at 30 DAS and at harvest. It was 5.80 and 7.45 per cent lower than control (0 mg kg^{-1} Co). The results revealed that the application of Co significantly increased green forage yield of maize due to application of cobalt up to 20 mg Co kg^{-1} soil, which noticed significantly the highest green forage yield (222.73 g pot^{-1}). The dry weight of leaves (36.23 g pot^{-1}), stem (4.38 g pot^{-1}) and root (4.37 g pot^{-1}) of maize were increased to 25.89, 31.14 and 24.50 per cent with application of Co 20 mg kg^{-1} to the soils as compared to control, respectively. The dry weight of leaves (27.97 g pot^{-1}), stem (3.24 g pot^{-1}) and root (3.16 g pot^{-1}) were decreased to 13.24, 2.99 and 9.97 per cent when 80 mg kg^{-1} Co was added to the soils as compared to control, respectively. The results indicated that the lower doses of cobalt resulted in maximum growth and yield of plants as compared to higher both the levels. The responses associated with low cobalt levels may be attributed to catalase and peroxidase activities which were found to decrease with low levels of cobalt and increase with the higher ones. These enzymes are known to induce plant respiration, so superior resulting in successive consumption for products of photosynthesis and consequently reduced in plant growth. The similar results were also found by the Gad *et al*. (2012) [4] for maize crop and Kandil *et al.* (2013) [5] for soybean crop.

Table 1: Effect of cobalt and FYM on plant height (cm), green forage yield (g pot^{-1}) and dry matter yield (g pot^{-1}) maize

Treatment	Plant height (cm)		green forage yield (g pot^{-1})	Dry matter yield (g pot^{-1})		
	30 DAS	at harvest		Leaves	Stem	Root
Levels of FYM						
F_0 : 0 %	60.05	79.11	164.92	25.71	3.01	3.22
F_1 : 1 %	71.93	98.33	206.39	36.79	4.49	4.38
SEm ±	0.57	0.64	2.42	0.34	0.07	0.06
CD (P=0.05)	1.68	1.89	7.15	0.99	0.21	0.16
Levels of Co						
Co_1: 0 mg kg^{-1}	64.95	87.29	179.73	28.78	3.34	3.51
Co_2 : 10 mg kg^{-1}	67.95	90.71	184.20	33.78	4.03	4.11
Co_3 : 20 mg kg^{-1}	71.38	98.90	222.73	36.23	4.38	4.37
Co_4 : 40 mg kg^{-1}	64.48	85.93	175.57	32.51	3.76	3.86
Co_5 : 80 mg kg^{-1}	61.18	80.78	166.03	24.97	3.24	3.16
SEm ±	0.90	1.01	3.83	0.53	0.11	0.09
CD (P=0.05)	2.66	2.99	11.31	1.57	0.32	0.26
CV %	3.35	2.80	5.06	4.16	7.19	5.61
Interaction	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.

3.3 Effect of F × Co interaction

The interaction effect of Co X FYM was found to be significant in respect of plant height, green forage yield and leaves, stem and root dry matter yield recorded at harvest of maize (Table 2). The data pertaining to these interactions are presented in Table 2.

The application of Co @ 20 mg kg^{-1} with the incorporation of FYM @ 1% noted significantly the highest plant height (79.46 and 110.18 cm) of maize at 30 DAS and at harvest, respectively and it was significantly the highest than all other treatment combinations. Whereas, significant the lowest plant height of 55.89 and 69.07 cm were recorded due to application of 80 mg Co kg^{-1} without FYM at 30 DAS and at harvest, respectively. Among the different interactions, application of Co (20 mg kg^{-1} soil) along with FYM @1% significantly increased green forage yield of 263.40 g pot^{-1}. While significantly lower green forage yield of 152.73 g pot^{-1} was recorded with application of Co 80 mg kg^{-1} soil which was at par with application of cobalt at 40 mg kg^{-1} soil. Among all treatment combinations, F_1Co_3 (20 mg Co kg^{-1} along with FYM @1%) recorded significantly the highest dry matter yield of leaves (43.11 g pot^{-1}), stem (5.14 g pot^{-1}) and root (5.12 g pot^{-1}) of maize than rest of the combination, whereas significantly the lowest yield (18.89, 2.63 and 2.53 g pot^{-1}) were noted under F_0Co_5 (80 mg Co kg^{-1} without FYM) treatment combination.

In general, the results showed that the application of FYM may reduce the toxicity of Co through stabilization of Co in soil and thus increased plant height. Similar result found by Gad Nadia (2006) [2] in pea. Gad Nadia (2011) [3] reported enhanced plant height of roselle due to application of cobalt with organic fertilization as compared to fertilized with organic manures alone.

Table 2: Interaction effect of FYM and cobalt on plant height (cm) and on dry matter yield (g pot^{-1}) of maize

Treatment	Plant height (cm)				Green forage yield (g pot^{-1})		Dry matter yield (g pot^{-1})					
	30 DAS		at harvest				Leaves		Stem		Root	
	F_0	F_1	F_0	F_1	F_1	F_0	F_0	F_1	F_0	F_1	F_0	F_1
Co_1	58.21	71.70	58.21	26.67	30.89	2.86	26.67	30.89	2.86	19.02	5.09	7.23
Co_2	62.15	73.76	62.15	27.94	39.62	3.15	27.94	39.62	3.15	20.11	5.19	7.67
Co_3	63.30	79.46	63.30	29.34	43.11	3.61	29.34	43.11	3.61	22.71	5.35	8.81
Co_4	60.68	68.27	60.68	25.73	39.29	2.78	25.73	39.29	2.78	18.67	5.01	7.08
Co_5	55.89	66.47	55.89	18.89	31.04	2.63	18.89	31.04	2.63	16.11	4.81	5.61
SEm ±	1.28		1.43		1.28		0.75		0.16		0.12	
CD (P=0.05)	3.76		4.23		3.76		2.21		0.46		0.36	

4. Conclusion

From the result of this experiment we can concluded that application of Co @ 20 mg kg^{-1} level increased maximum growth and yield of fodder maize and detrimental effect were seen at higher Co level. Whereas, highest reduction in plant height, green forage yield dry matter yield of leaves, stem and root of maize was observed at Co @ 80 mg kg^{-1} level.

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6. References

1. Bakkaus E, Gouget B, Gallien JP, Khodja H, Carrot F, Morel JL *et al*. Concentration and distribution of cobalt in higher plants: The use of micro-PIXE spectroscopy. Nuclear Physics Research, 2005; 231: 350-356.
2. Gad Nadia. Increasing the efficiency of nitrogen fertilization through cobalt application to pea plant. Research Journal of Agriculture and Biological Sciences. 2006; 2(6):433-442.
3. Gad Nadia. Productivity of Roselle (*Hibiscus Sabdariffa* L.) Plant as affected by Cobalt and Organic Fertilizers. Journal of Applied Sciences Research, 2011; 7(12):1785-1792.
4. Gad Nadia, Abdel-Moez MR, Kandil Hala. Influence of cobalt and mycorrhizae mediated phosphorus on some higher plants growth and yield. Journal of Basic Applied Sciences Research. 2012; 2(11):11942-11951.
5. Kandil Hala, Ihab MF, El-Maghraby Amal. Effect of cobalt level and nitrogen source on quantity and quality of soybean plant. Journal Basic Applied Science Research. 2013; 3(12):185-192.
6. Oad FC, Buriro UA, Agha SK. Effect of organic and inorganic fertilizer on the yield and quality of fodder maize, (Zea mays L.). Research on Crops, 2004; 8(1):99-103.
7. Puri KP, Tiwana US. Effect of organic and inorganic sources of nitrogen in forage maize. Forage Research, 2008; 34(1):62-63.
8. Sunda WG. Trace metal interactions with marine phytoplankton. Journal of Biol. Oceanogr. 1989; 6:411-442.
9. Steel RG, Torrie JH. Principles and procedures of statistics. McGraw Hill Book Company, 1982, New Delhi- 110001.
10. Sushila R, Giri G. Influence of FYM, nitrogen and biofertilizers on growth, yield attributes and yield of wheat (*Triticum aestivum*) under limited water supply. Indian journal of agronomy. 2000; 45(3):590-595.
11. Verma A, Nepalia V, Kanthaliya PC. Effect of integrated nutrient supply on growth, yield and nutrient uptake by maize-wheat cropping system. Indian journal of agronomy. 2006; 51(1):3-6.