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Effect of Co Level and FYM on Growth and Yield of Fodder Sorghum

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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 sorghum 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 Ustrochrepts) 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 sorghum were found in 40 and 80 mg kg^{-1} levels of Co. The higher plant height, green forage yield anddry matter yield was obtained in FYM application at 1 % over no FYM application.

Key words: *Cobalt, FYM, Yield, Sorghum, Growth*

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[2].

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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.

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 sorghum crop (variety S- 1049) was sown in pot. The observations including plant height, green forage yield and dry weight of leaves, stem and root were recorded. Plants were harvested at 60 DAS. Experimental data were analyzed using standard statistical procedure Steel and Torrie[11].

RESULTS AND DISCUSSION

Effect of FYM

The plant height (87.17 and 129.34 cm) of sorghum crop were also increased significantly due to application of FYM @ 1% at 30 DAS and at harvest and were 18.00 and 21.70 per cent higher than control, respectively. The green forage yield of sorghum (142.90 g pot^{-1}) increased due to application of FYM @ 1 % and it was 20.60 per cent higher over control (F0). Effect of FYM was also shown in dry matter yield of sorghum. The higher dry matter yield (leaves, stem and root) of 26.82, 19.32 and 7.28 g pot^{-1} were recorded with application of FYM @ 1 % (F1) over control, which was 23.94, 24.89 and 43.03 per cent higher than control, respectively. The dry matter yield of sorghum is in order as under:

Leaves> stem> root

In general, the plant height, green forage yield and dry matter yield 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[12], Oad *et al*[9]., Verma *et al*[13]., and Puri and Tiwari[10] also reported similar results in different crops.

Effect of cobalt

The highest plant height (90.29 and 130.51 cm) of sorghum was noted with the application of Co @ 20 mg kg^{-1} at 30 DAS and at harvest however, it was at par with 10 mg kg^{-1} at 30 DAS. While lowest plant height of sorghum at 30 DAS and at harvest was noted in the application of maximum level of Co (80 mg kg^{-1}).The results revealed that the application of Co significantly increased green forage yield of sorghum due to application of cobalt up to 20 mg Co kg^{-1} soil, which noticed significantly the highest green forage yield (140.56 g pot^{-1}), it was at par with 10 mg kg^{-1} Co level. Significantly the lowest green forage yield of sorghum were noticed due to application of 80 mg kg^{-1} Co level, which was 5.19 per cent lower than control.Significantly the highest dry matter of leaves (27.36 g pot^{-1}), stem (19.36 g pot^{-1}) and root (7.08 g pot^{-1}) of sorghum were recorded with the application of 20 mg kg^{-1} level, which was 13.25, 12.36 and 14.94 per cent higher than control, respectively. While, significantly the lowest dry matter yield of leaves (22.11 g pot^{-1}), stem (15.55 g pot^{-1}) and root (5.21 g pot^{-1}) were noted with the application of maximum level of Co (80 mg Co kg^{-1} soil).

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. Moreover, low cobalt levels being with positive effect due to several induced effects in hormonal synthesis and metabolic activity, while the higher cobalt levels were found to increase the activity of some enzymes such as peroxidase and catalase in plant and hence increasing the catabolism rather than the anabolism. The similar results were also found by the Gad *et al*[6]., for maize crop and Kandil *et al*[8]., for soybean crop. It was also observed that the detrimental effect of application of high amount of cobalt resulted in the reduction in total dry matter yield due to partly owing to its toxic effect and partly due to its ionic imbalance[3]. Several workers[1,7] also reported decrease in dry matter yield due to higher application of cobalt.

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

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 %	73.87	106.28	118.49	21.64	15.47	5.09
F_1 : 1 %	87.17	129.34	142.90	26.82	19.32	7.28
SEm ±	**1.20**	**1.11**	**1.61**	**0.38**	**0.19**	**0.08**
CD (P=0.05)	**3.55**	**3.27**	**4.76**	**1.13**	**0.57**	**0.24**
Levels of Co						
Co_1 : 0 mg kg^{-1}	81.29	120.30	128.72	24.16	17.23	6.16
Co_2 : 10 mg kg^{-1}	87.63	122.12	135.22	24.75	17.84	6.43
Co_3 : 20 mg kg^{-1}	90.29	130.51	140.56	27.36	19.36	7.08
Co_4 : 40 mg kg^{-1}	73.63	113.69	126.94	22.78	17.00	6.04
Co_5 : 80 mg kg^{-1}	69.76	102.43	122.04	22.11	15.55	5.21
SEm ±	**1.90**	**1.75**	**2.55**	**0.61**	**0.31**	**0.13**
CD (P=0.05)	**5.61**	**5.17**	**7.53**	**1.79**	**0.90**	**0.38**
CV %	**5.78**	**3.64**	**4.79**	**6.13**	**4.30**	**5.05**
Interaction	**Sig.**	**Sig.**	**NS**	**Sig.**	**Sig.**	**Sig.**

Effect of F × Co interaction

Significantly the highest dry matter yield of leaves, stem and root of 31.84, 22.71 and 8.81 g pot^{-1} of sorghum were noted with the application of 20 mg Co kg^{-1} along with FYM @1 % higher than rest of the combinations of FYM and cobalt levels. Significantly the lowest dry matter yield of leaves (20.27 g pot^{-1}), stem (14.98 g pot^{-1}) and root (4.81 g pot^{-1}) were noted with the application of 80 mg Co kg^{-1} soil without FYM treatment combination than rest of the combination except F_0Co_4 combination in leaves. Similar results were also found due to interaction effect of FYM and cobalt on plant height of sorghum. The application of Co @ 20 mg kg^{-1} with the incorporation of FYM @ 1% recorded significantly highest plant height of 101.2 and 146.72 cm at 30 DAS and at harvest, respectively, however it was at par with the Co @ 10 mg kg^{-1} along with FYM @ 1% application at 30 DAS. While significant the lowest plant height of 67.64 and 91.25 cm were recorded due to application of 80 mg Co kg^{-1} without FYM at 30 DAS and at harvest, respectively.

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[4] in pea. Gad Nadia[5] 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 and on dry matter yield of sorghum

Treatment	Plant height (cm)				Dry matter yield (g pot^{-1})					
	30 DAS		at harvest		Leaves		Stem		Root	
	F_0	F_1	F_0	F_1	F_0	F_1	F_0	F_1	F_0	F_1
Co_1	75.80	86.78	21.95	26.37	21.95	26.37	15.44	19.02	5.09	7.23
Co_2	76.94	98.33	22.32	27.18	22.32	27.18	15.57	20.11	5.19	7.67
Co_3	79.39	101.2	22.87	31.84	22.87	31.84	16.01	22.71	5.35	8.81
Co_4	69.58	77.68	20.78	24.78	20.78	24.78	15.32	18.67	5.01	7.08
Co_5	67.64	71.87	20.27	23.95	20.27	23.95	14.98	16.11	4.81	5.61
SEm ±	**1.28**		**2.48**		**0.86**		**0.43**		**0.18**	
CD (P=0.05)	**3.76**		**7.31**		**2.53**		**1.27**		**0.53**	

CONCLUSION

From the above results, it is concluded that application of FYM increased the plant height, green forage yield as well as dry matter yield of leaves, stems and roots. Plant height, green forage yield, dry matter of leaves, stem and root were increased up to 20 mg cobalt kg^{-1} soil application, but further increased in Co levels values give negative results. In general, the increased in the dry matter of sorghum leaves, stem and root biomass in cobalt application of 20 mg kg^{-1} level were 25.89, 31.14 and 24.50 per cent higher than control. The plant height, green forage yield, dry matter yield of leaves, stem and root were noticed significantly the lowest in the treatment combination of maximum level of Co (80 mg kg^{-1}). The highest reduction of 13.24, 2.99 and 9.97 per cent were noticed in 80 mg kg^{-1} level of cobalt in dry matter yield of leaves, stem and root of sorghum as compared to respective control.

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