INTERNATIONAL JOURNAL OF PLANT, ANIMAL AND ENVIRONMENTAL SCIENCES
IJPAES
VOLUME-2, ISSUE-1, JAN-MAR-2012 ISSN 2231-4490
Accepted: Dec-2011 *Short Communication*

CHROMIUM TOXICITY IN MUNG BEAN, *VIGNA RADIATA* AND BIOREMEDIATION BY *PSEUDOMONAS FLUORESCENCE*

Abbasi*, Hisamuddin, M.I .Robab, Ambreen Akhtar and Rushda Sharf

Department of Botany, Aligarh Muslim University, Aligarh-202002

Email:*abbasisyed222@gmail.com*

ABSTRACT : A pot experiment was conducted in the net house of Department of Botany, AMU, Aligarh to evaluate the effect of chromium applied as $K_2Cr_2O_7$ at different concentrations @ 5, 10, 15, 20, 25 and 30 mg/kg soil on the growth parameters including shoot length, root length, nodule number, fresh weight and dry weight alone and along with *Pseudomonas fluorescence*. There was significant reduction in all the growth parameters at 30 mg/kg soil of $K_2Cr_2O_7$ while non significant reduction was observed at different concentration levels below 30 mg/kg soil. When bacterium was applied simultaneously with metal, there was a prominent but non significant improvement in growth parameters at the lower level of metal application. This may be attributed resistant nature of *Pseudomonas fluorescence* towards the metal.

Key words: Bioremediation, chromium toxicity, mung bean, *Pseudomonas fluorescence*.

INTRODUCTION

Heavy metal pollution is one of the current and most troublesome environmental problem due to mismanagement of effluents coming out from industries that contribute significantly to soil contamination. At elevated levels, these toxic substances may pose considerable loss to human and animal health as well as enormous loss in yield.

Chromium is one of the important pollutant among other pollutants like cadmium, lead, mercury and aluminium. Leather industry is the major cause for the high influx of chromium to the biosphere accounting for 40% of the total industrial use (J. Barnhart, 1997). Chromium (vi) is considered the most toxic form which usually occurs, associated with oxygen as chromate (CrO_4^{-2}) or dichromate ($Cr_2O_7^{-2}$) oxyanions. Chromium (iii) is less toxic, less mobile and is mainly found bound to organic matter in soil and aquatic environments (T. Bacquer et al., 2003). Until now, methods used for their remediation such as excavation & landfill, thermal treatment, acid leaching and electroclamation are not suitable for practical applications, because of their high cost, low efficiency, large destruction of soil structure and fertility. Thus the development of bioremediation strategies for heavy metal contamination is necessary (S. Cheng et al., 2002).

MATERIALS AND METHODS

In a pot experiment mung bean var. PDM 139 was taken as test plant and potassium dichromate and *Pseudomonas fluorescence* were taken for the treatment. Healthy seeds of mung bean were surface sterilized by using NaOCl and rinsed twice with sterilized distilled water and sown in 15 cm pots filled with steam sterilized soil @ 1 kg soil per pot. Pure culture of *Pseudomonas fluorescence* was obtained from IARI, New Delhi and sub cultured on tryptic broth medium and incubated at 37 ± 1^0C until, reaching the concentration of 1.5×10^8 cfu/ml . 10 ml of this suspension was poured into each pot around the seedling. At the same time, plants were treated with $K_2Cr_2O_7$ @ 5, 10, 15, 20, 25 and 30 mg/kg soil and the same experiment was conducted without the application of bacteria. Each treatment was replicated three times and pots were kept in randomized complete block design in green house.

Plants were uprooted after 35 days of sowing. Length of shoot and root was measured with the help of meter scale. Fresh weight was measured by physical balance. Plants were kept separately in paper envelops and kept in incubator maintained at 72^0C for five days thus dry weight was determined. Nodule number was counted by visual observation.

RESULTS AND DISCUSSION

Table 1 revealed that shoot length was significantly decreased by 26.4 cm as compared to 30.4 cm in control. Similarly significant reduction was observed in root length by 7.6 cm, nodule number was reduced by 14.0, fresh weight was 3.3 gm and dry weight was decreased by 1.0 gm in comparison to control at (p=0.05) @ 30 mg/kg of $K_2Cr_2O_7$ (S. Samantray et al, 1999) in a study with chromite mine soil in five cultivars of mung bean, noted that root growth was significantly affected after 28 days of root emergence. The non significant reduction was recorded at all the concentrations below 30 mg/kg of metal application. Least reduction was observed in all the growth parameters at 5 mg/kg of $K_2Cr_2O_7$. Some crops are not affected by lower concentration (3.8×10^{-4} µM) (Jr. Huffman and allaway 1973 a, b).

Table 1. Effect of chromium at varying concentration levels on the growth parameters of mung bean.

Metal concentration (mg/kg) soil	Shoot length (cm)	Root length (cm)	Nodule Number	Fresh weight (gm)	Dry weight (gm)
Control	30.4	14.6	20.6	8.9	1.9
5	30.0	14.1	20.1	8.2	1.8
10	29.5	13.5	19.5	7.4	1.7
15	28.9	12.7	18.7	6.5	1.6
20	28.1	11.6	17.6	5.4	1.5
25	27.3	10.0	16.0	4.9	1.3
30	26.4	7.2	14.0	3.3	1.0
CD(p=0.05)	3.72	6.24	6.12	4.92	0.84

In table 2 non significant improvement was recorded in shoot length, root length, nodule number, fresh weight and dry weight when the bacterial suspension @ 10 ml was applied along with metal at different concentration levels. Root length was increased by 14.8 cm as compared to 14.6 at control. While nodule number was increased by 20.7 as compared to 20.6 at control while fresh weight was increased by 9 in comparison to 8.9 gm at control @ 5 mg/kg of metal application. It can be concluded that to survive under metal stressed conditions, bacteria have evolved several types of mechanisms to tolerate the uptake of heavy metal ions. These mechanisms include the efflux of metal outside the cell, accumulation and complexation of metal ions outside the cell and reduction of heavy metal ions to less toxic state (D.H. Nies, 1999). Different species of *Aspergillus*, *Pseudomonas*, *Sporophyticus*, *Bacillus*, *Phanerochaete* ctc. have been reported as efficient chromium and nickel reducers (G. Yan et al., 2003; R. Gopalan et al., 1994).

Table 2. Effect of chromium at varying concentration levels on mung bean in the presence of *Pseudomonas fluorescence* on growth parameters of mung bean.

Metal concentration (mg/kg soil)	Shoot length (cm)	Root length (cm)	Nodule number	Fresh weight (gm)	Dry weight (gm)
Control	30.4	14.6	20.6	8.9	1.9
5	30.4	14.8	20.7	9.0	1.9
10	29.9	14.1	20.0	7.8	1.8
15	29.2	13.1	19.1	6.8	1.7
20	28.3	11.9	17.9	5.6	1.6
25	27.4	10.2	16.2	5.0	1.4
30	26.5	7.6	14.1	3.4	1.1
CD (p=0.05)	3.84	6.84	6.24	5.16	0.98

ACKNOWLEDGEMENT

First Author is thankful to UGC for imparting financial assistance and chairman of the department for providing necessary facilities.

REFERENCES

1) D.H. Nies. Microbial heavy metal resistance. *Appl Microbial Biotechnol.,*1999, 51:730-750.

2) G.Yan, T. Virara. Heavy metal removal from aquous solution by fungus Mucor rouxii. *Water Res*., 2003, 37, 4486-4496.

3) Jr EWD Huffman, H.W. Allaway. Chromium in plants: distribution in tissues, organelles, and availability of bean leaf to animals. *J Agric Food Chem.,* 1973a, 21, 982-6.

4) Jr EWD Huffman, W.H. Allaway. Growth of plants in solution culture containing low levels of chromium. *Plant Physiol*.,1973b, 52, 72-5.

5) J. Barnhart. Occurrences, uses, and properties of chromium. Regul Toxicol Pharm., 1997, 26, 53-7.

6) R. Gopalan, H. Veeramani. Studies on microbial chromate reduction by Pseudomonas sp. in aerobic continuous suspended growth culture*., Biotech. Bioeng*., 1994, 43, 471-476.

7) S. Cheng, W. Crosse, F. Karrenbrock, M. Thoennessen. Efficacy of constructed wetlands in decontamination of water polluted by heavy metals. *Ecol Eng*., 2002, 18(3), 317-325.

8) S. Samantaray, G.R. Rout, P. Das. studies on differential tolarence of mung bean cultivars to metaliferous minewastes. *Agribiol Res.,* 1999, 52: 193-201.

9) T. Bacquer, C. Quantin, M. Sicot, J.P Boudot. Chromoum availability in ultramafic soils from New Calendonia. *Sci Total Environ.,* 2003, 301, 251-61.