RESEARCH PAPER | Environment | Volume : 4 | Issue : 12 | Dec 2014 | ISSN - 2249-555X

Field Level Study on The Impact of Zinc Electroplating Industry Effluent Residue on Growth, Biochemical Characteristics and Yield of Black Gram Vigna Mungo

KEYWORDS: Field level study,impact,Zinc Electroplating industry effluent residue, growth, biochemical, yield, black gram

* M.R.Rajan	S.David Noel	V.Palaniselvi
Department of Biology, Gandhigram Rural Institute- Deemed University, Gandhigram- 624 302, Tamil Nadu, India. *Corresponding Author	Department of Biology, Gandhigram Rural Institute- Deemed University, Gandhigram- 624 302, Tamil Nadu, India	Department of Biology, Gandhigram Rural Institute- Deemed University, Gandhigram- 624 302, Tamil Nadu, India

ABSTRACT *The present study deals with the field level study on the impact of different quantities of electroplating industry effluent residue(250, 500, 750, 1000 and 1250mg) on growth, biochemical characteristics and yield of Black gram Vigna mungo . Germination percentage of the Black gram was higher(100%) in T1 and T3 and lower in T5 (80%).Shoot and root length of the Black gram were higher in T3 with 750 mg and lower in T5 with 1250 mg of zinc electroplating industry effluent residue on 60th day. Total fresh and dry weight of Black gram were higher in T3 and lower in T5. Chlorophyll a,b, total chlorophyll, anthocyanin total sugar and total protein was higher in T3 and lower in T5.Free amino acids, L- proline, leaf nitrate and yield of Black gram was higher in T4 and lower in T1. Length and weight of Black gram was higher in T3 and lower in T5.*

INTRODUCTION:

Environmental pollution has become a buzz world-wide and is accentuated by rapid industrialization which is fast transforming the natural resources like air, water and soil into big reservoirs of dangerous pollutants(Khan et al.,1984). Among the various kinds of pollution the problem of water pollution due to discharge of both industrial and domestic effluents has attained serious dimensions in India (Lakshmi and Sundaramoorthy,2001).

Employing industrial effluent in agriculture would be a meaningful way of addressing the problem. Application of waste water to crop land is an attractive option for disposal because it can improve physical properties and nutrient contents to soils (Kiziloglu et al, 2007). Among the major industries, electroplating industry effluent contains large amount of heavy metals such as zinc, chromium and nickel. Zinc act as micronutrient for the growth of plants. The work related to the impact of zinc electroplating industry effluent residue on growth, biochemical characteristics and yield of Black gram Vigna mungo under field level is totally wanting. Hence the present study was carried out.

MATERIALS AND METHODS

For the present study, zinc electroplating industry effluent was collected from Sundararajpuram, Madurai, Tamil Nadu, India, in plastic containers (20L),transported to the laboratory and evaporated in the plastic tray (10 L) in order to collect residue . After evaporation the residue was scratched and collected for the field studies. 1gm of residue was taken in a boiling tube and digested using 10ml triple acid solution (HNO_3,H_2SO_4 and $HClO_4$ in 9:2:1 proportion respectively) till the sample became colorless. The digested sample was filtered using Whatman No.1 filter paper two times and was made up to 50ml and it was subjected to analysis of zinc using Atomic Absorption Spectrophotometer (AAS). The residue was standardized for the present study by a pilot study with various weight ranges from 250 to 5000 mg. From the pilot study it was observed that the electroplating industry effluent residue beyond 1250mg is not suitable for germination. Hence, in the present study, the weight ranged between 250 and 1250mg of zinc electroplating industry effluent residue was chosen. Both control and experimental plants of black gram were grown for a period of 60 days. Growth, biochemical characteristics and yield were estimated finally.

The experimental field is located at KVK (Krishi Vigyan Kendra), Gandhigram, Dindigul district and is situated in the central region of Tamilnadu at 10° 3'N latitude and 77 ° 15'E longitudes. The field experiment was laid out in Randomized block design. The field was ploughed three times and brought to a fine tilth at the last ploughing. The experimental plants in field trial had six treatments supplied with different quantities of zinc electroplating industry effluent residue such as 0, 250, 500, 750, 1000 and 1250mg for treatment 0 (control), 1, 2, 3, 4 and 5 respectively and had three replications in the field layout. The experimental field was irrigated by well water. Ten plants were raised in each microplot with appropriate spacing between rows and plants.

RESULTS AND DISCUSSION

Impact of different quantities of zinc electroplating industry effluent residue on seed germination (%) and growth characteristics of Black gram *Vigna mungo* is presented in Table 1. Among the different treatments the germination percentage of the Black gram *Vigna mungo (L) Hepper* higher in T_1, T_3 (100%) and lower in T_5. In control (T_0) germination percentage was 98%. Among the different treatments the shoot length of the Black gram *Vigna mungo* was higher in T_3 and lower in T_5 on 60th day. In control (T_0) the shoot length was13.7cm. The root length of Black gram *Vigna mungo (L) Hepper* was higher in T_3 and lower in T_5 electroplating industry effluent residue of 750 mg and 1250 mg respectively on 60th day. In control (T_0) the root length was 10.3 cm . Among the different treatments the total fresh weight of Black gram Vigna mungo was higher in T_3 and lower in T_5. In control (T_0) the total fresh weight was 0.012 g on 60th day . The total dry weight of Black gram was higher in T_3 and lower in T_5 with zinc electroplating industry effluent residue of 750 mg and 1250 mg respectively. In control (T_0) the total dry weight was 0.004 g on 60th day. A decrease in total fresh and dry weight of

Volume : 4 | Issue : 12 | Dec 2014 | ISSN - 2249-555X

seedlings was observed when crop plant was grown in paper mill effluent(Gomathi and Oblisami, 1992)

Among the different treatments the leaf area index of Black gram was higher in T_3 and lower in T_5 with zinc electroplating industry effluent residue of 750 mg and 1250 mg respectively. In control (T_0) the leaf area index was 12cm^2 on 60th day. Among the different treatments the vigour index of Black gram is higher in T_3 and lower in T_5. In control (T_0) the vigour index is 1372%.

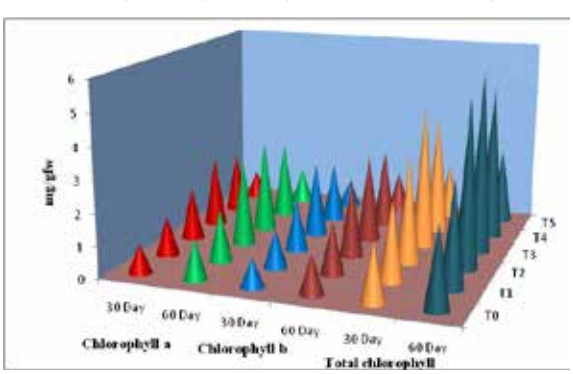
Table 1 Impact of different quantities of electroplating industry effluent residue on
Growth characteristics of Black gram Vigna mungo on 30th and 60thday (Field trial)

S.No.	Parameters	Treatment					
		T0(Control)	T1	T2	T3	T4	T5
1.	Germination (%)	100	100	100	100	100	100
2.	Shoot Length(cm)	5.5 ± 0.5	7.6±0.15	8.7±0.38	10.8±1.04	10.1±1.60	5.4±0.51
3.	Root Length (cm)	5.3±0.05	6.1±0.15	6.34±0.15	7.4±0.32	7.2±0.25	5.4±0.15
4.	Total fresh weight(g)	0.05±0.05	0.06±0.02	0.07±0.01	0.08±002	0.06±0.01	0.02±0.05
5.	Total dry weight (g)	0.01±0.01	0.02±0.02	0.002±0.1	0.03±0.07	0.003±0.2	0.001±0.1
6.	Leaf area index(cm^2)	5±0.04	6±0.58	7±0.51	9±0.12	0.003±0.2	0.001±0.1
7.	Vigour index (%)	1068±0.06	1370±0.10	1455±0.6	1840±0.01	1643±0.05	800±0.06

All the values are averages of five individual observations from triplicate. Mean±SE

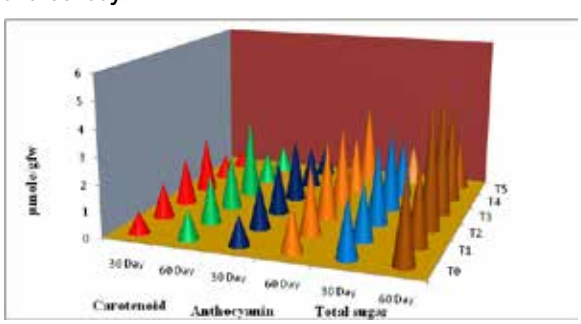
Impact of different quantities of electroplating industry effluent residue on biochemical characteristics of Black gram Vigna mungo is presented from Figure 1-4.Among the different treatments the chlorophyll a of Black gram is higher in T_3 with 750 mg of electroplating industry effluent residue and lower in T_5 with 1250 mg of electroplating industry effluent residue. In control (T_0) the chlorophyll a is 1.28 mg/gfw on 60th day . The chlorophyll b of Black gram is higher in T_3 and lower in T_5. In control (T_0) the chlorophyll b is 1.27mg/gfw on 60th day. Among the different treatments the total chlorophyll of Black gram is higher in T_3(5.70mg/gfw) and lower in T_5 (2.40 mg/gfw). In control (T_0) the total chlorophyll is 3.42 mg/gfw on 60th day(Figure1).Gupta and Bishwas Ray(2005) also reported that the lower chlorophyll content in Withania somnifera esposed to high concentration of metal.

Figure1.Impact of different quantities (250, 500, 750, 1000 and 1250mg) of electroplating industry effluent residue on Chlorophyll a,Chlorophyll b and Total Chlorophyll (mg/gfw) of of Black gram Vigna mungo on 30th and 60thday.



Impact of different quantities of electroplating industry effluent residue on carotenoid content of Black gram is higher in T_3 and lower in T_5(figure 2). In control (T_0) the carotenoid content is 1.26 mg/gfw on 60th day. Among the different treatments the anthocyanin content of Black gram is higher in T_5 and lower in T_3. In control (T_0) the anthocyanin content is 1.78 µmole/gfw on 60th day (Figure 22). Among the different treatments the total soluble sugar of Black gram is higher in T_3 (5.01µmole/gfw) and lower in T_5(2.02 µmole/gfw). In control (T_0) the total soluble sugar is 3.47 µmole/gfwon 60th day (Figure 2).

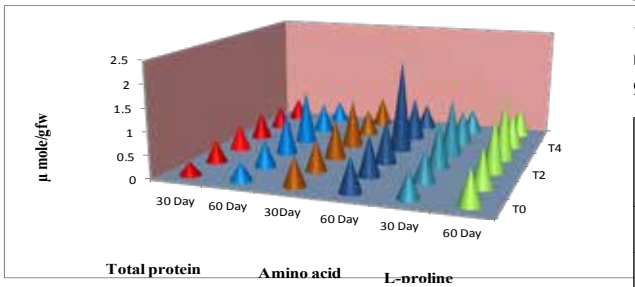
Figure 2. Impact of different quantities (250, 500, 750, 1000 and 1250mg) of electroplating industry effluent residue on Carotenoid, Anthocyanin and Total sugar (µmole/gfw) of Black gram Vigna mungo on 30th and 60thday.



Among the different treatments the total soluble protein of Black gram is higher in T_3 (1.208 mg/gfw) and lower in T_5 (0.508 mg/gfw). In control (T_0) the total protein is 0.429 mg/gfw on 60th day(Figure 3). Rani and Srivastava(1990) reported that the protein content in peas registered a decreasing trend with increasing concentration of spent wash. Among the different treatments the free amino acids of Black gram is higher in T_3(0.604 mg/gfw) and lower in T_5(0.604 mg/gfw). In control (T_0) the free amino acid is 0.762 mg/gfw on 60th day(Figure3).Free amino acids increased more in treated Lady's finger than in control plants(Sharma et al 1996). Among the different treatments the L- proline of Black gram is higher in T_3(1.362 mg/gfw) and lower in T_5(0.694 mg/gfw). In control (T_0) the L- proline is 0.758 mg/gfw on 60th day(Figure3).

Figure 3. Impact of different quantities (250, 500, 750, 1000 and 1250mg) of electroplating industry effluent residue on Total protein, Amino acid and L-proline (mg/gfw) of Black gram Vigna mungo on 30th and 60thday.

Volume : 4 | Issue : 12 | Dec 2014 | ISSN - 2249-555X



Among the different treatment the leaf nitrate of Black gram is higher in T_3(6.58 mg/gfw) and lower in T_1 (3.92mg/gfw). In control (T_0) the leaf nitrate is 4.29 mg/gfw on 60th day(Figure 4).Leaf nitrate content was increased with increasing concentration of colour match industry effluents on Phaseolus mungo(Ahalya and Ramasubramanian, 2001).

Figure 4 .Impact of different quantities (250, 500, 750, 1000 and 1250mg) of electroplating industry effluent residue on Leaf nitrate (mg/gfw) of Black gram Vigna mungo on 30thand 60thday.

Impact of different quantities of zinc electroplating industry effluent residue on yield of Black gram is presented in Table 2. Among the different treatments the length of Black gram is higher in T_3 with 750 mg of electroplating industry effluent residue and lower in T_5 with 1250 mg of electroplating industry effluent residue. In control (T_0) the length of Black gram is 5.0 cm on 60th day. Like length the weight of Black gram is also higher in T_3 (2.3g) with 750mg of electroplating industry effluent residue and lower in T_5 with 1250mg of electroplating industry effluent residue. In control (T_0) the weight of Black gram is 1.4 g on 60th day. Among the different treatment the number of Black gram is higher in T_3 (14) and lower in T_5 (6). In control (T_0) the number of Black gram is 8.Mahimairaja and Bolan(2004) reported that low doses of distillery spent wash remarkably improve the yield of dry land crops such as ragi, ground nut, sorghum and green gram.Singh et al (2011) reported that tannery waste at lower concentration promotes the yield of Chrysanthenum cuttings.

Table 2. Impact of various quantities (250, 500, 700, 1000 and 1250mg) of electroplating industry effluent residue on length, weight and number of Black gram Vigna mungo on 30th and 60thday.

Treatment	No. of pods/ plant	Wt. of the pods/ plant(g)	Length of the pods/ plant(cm)
T0(Control)	8	1.4	5.0
T1	7	1.5	5.1
T2	10	1.9	5.3
T3	14	2.3	5.5
T4	12	1.4	4.2
T5	6	1.0	3.6

REFERENCE

Ahalya, M and Ramasubramanian, V.2001.Analysis of colour match industrial effluent and its impact on some biochemical characteristics of Phaseolus mungo. Proc. of State Level Seminar on Biodiversity – the present and the future scenario. Ayya Nadar Janaki Ammal College, Sivakasi, Tamil Nadu,pp.82-85. | Gomathi, V and Oblisami, G. 1992. Effect of pulp mill effluent on germination of tree crops. Indian Journal Environmental Health,34(4): 326-328. | | Gupta and Bishwas Ray (2005) Bioaccumulation of Cadmium, Zinc, Copper and Chromium by Withania somnifera. Nature Environment and Pollution Technology, 4:131-135. | Khan, A.M., Mujahid, A and Azhar, A.N.1984. Effect of industrial dairy processing effluent on soil and crop plants. Environmental Pollution Series, A. 33: 97-106. | Kizilglu, F.M., Turan, M., Sahin, U., Angin, I., Anapali, O and Okuroglu, M.2007. Effect of waste water irrigation on soil and cabbage plant Brassica olerecea var. capitates. Journal Plant Nutrition and Soil Sciences, 170: 166-172. | Lakshmi, S and Sundaramoorthy, P. 2001.Biochemical and mineral content changes of the paddy seedlings under tannery effluent treatment. Journal of Environmental Pollution, 8(1):13-17. | Mahimairaja, S and Bolan, N.S.2004. Problems and prospects of Agricultural use of distillery spent wash in India. Super Soil 2004: Australia.pp.1-6. | Rani, R and Srivastava, M.M.1990.Ecophysiological response of Pisum sativum and Citrus maxima to distillery effluents. Int. Econ. Environ. Sci., 16:126-132. | Sharma, B.K andIgbal Habib.1996. Irrigational impact of rubber factory effluent on elemental bioaccumulation and metabolite concentration of component parts of Pisum sativum. Geophysiology, 26(1): 13-18. | Singh, P.K.,Kumar, V and Singh, S.2011. Management of Tannery waste: Its use as planting medium for Chrysanthenum plants. Journal of Enviromental Science and Management, 4:560-567. |