RESEARCH PAPER | Environment | Volume : 3 | Issue : 7 | July 2013 | ISSN - 2249-555X

Impact Of Zinc Electroplating Industry Effluent Residue On Growth, Biochemical Characteristics And Yield Of Black Gram

KEYWORDS: Electroplating, effluent, residue, growth, black gram

M.R.Rajan
Department of Biology, Gandhigram Rural Institute – Deemed University Gandhigram-624 302, Tamil Nadu, India

S.David Noel
Department of Biology, Gandhigram Rural Institute – Deemed University Gandhigram-624 302, Tamil Nadu, India

V.Kalaiselvi
Department of Biology, Gandhigram Rural Institute – Deemed University Gandhigram-624 302, Tamil Nadu, India

ABSTRACT *For the present study different quantities of zinc electroplating industry effluent residue(0,250,500,750,1000 and 1250) for treatment 0(control), 1,2,3, 4 and 5 on growth, biochemical characteristics and yield of black gram Phaseolus mungo was used. Growth parameters such as seed germination percentage, shoot and root length, fresh and dry weight, leaf area index and vigour index, biochemical characteristics such as chlorophyll a, b, total chlorophyll and carotinoid and yield of black gram were estimated after 60th day. From the results it is inferred that the growth parameters such as shoot and root length, dry weight, leaf area index, vigour index, biochemical characteristics such as chlorophyll a, b, total chlorophyll and carotinoid and yield were higher in T4.*

INTRODUCTION:
Large amount of industrial effluents discharged due to rapid industrialization is a serious threat to our country. Industrial effluents are rich in organic and inorganic matter including heavy metals (Kumawat et al., 2001). Pollution of water and soil by heavy metals is one of the serious environmental problems in urbo-industrialized countries. Heavy metal pollution not only affects the production and quality of crops but also influences the quality of atmosphere and water bodies, and there by threatens the health and life of animals and human beings (Vijayaraman et al., 2007). Major contributors of heavy metals into the environment are leather and textile industries, automobiles, paints, electroplating and metallurgical industries etc. Among the major polluting industries, electroplating industries releases large quantities of heavy metals such as zinc, copper, chromium and nickel. Some of the heavy metals act as micronutrients for plant growth. Zinc is a major micronutrient for plant growth. The studies related to the impact of zinc electroplating industry effluent residue on growth, biochemical characteristics and yield of black gram Phaseolus mungo is totally wanting. Hence the present study was carried out.

MATERIALS AND METHODS:
For the present study zinc electroplating industry effluent was collected from Madurai, Tamil Nadu, India, in 20 L plastic containers. After collection, the effluent was immediately transported to the laboratory for analysis. The physic- chemical characteristics such as pH, electrical conductivity, total solids, total dissolved solids, total suspended solids, hardness, sodium, potassium, calcium, sulphate, chloride, dissolved oxygen, COD and zinc were analysed(APHA 2012). Vegetable crop Black gram Phaseolus mungo was selected for the present study. Healthy, uniform and dried seeds were collected from Horticultural College and Research Institute, Tamil Nadu Agriculture University, Periyakulam, Tamil Nadu, India for pot culture studies.

The electroplating industry effluent was evaporated in a glass tray(3 litre) in order to collect residue . Residue was standardized for the present study with various weight ranges from 100 to 5000 mg. From the pilot study it was found that the zinc electroplating industry effluent residue beyond 2000 mg was not suitable for germination and hence weight range from 250 to 1250 mg was used for the present study.

For pot culture studies Garden soil and sand were collected from the Nursery, Department of Biology, Gandhigram Rural Institute- Deemed University, Gandhigram. The seeds were soaked in ground water and kept as control. Both control and experimental seeds were allowed to grow in plastic pots(25 cm dia and 25 cm height) containing a mixture of red soil, sand and cowdung manure in the ratio of 1:1:1. All the pots are kept in Green house. The experimental plants were supplied with different quantities of electroplating industry effluent residue such as 0, 250, 500, 750, 1000 and 1250 mg for treatment 0(control), 1, 2, 3, 4 and 5 respectively. For each treatment triplicates were maintained. The growth, biochemical characteristics and yield of Black gram Phaseolus mungo were analysed on 60th day.

Results and Discussion:
Physico-chemical characteristics of zinc electroplating industry effluent are presented in Table 1. The pH of the effluent was 6.55, TDS4940 mg/l, chloride 56 mg/l and COD 408 mg/l. Piyush Malaviya and Anuradha Sharma (2011) reported a pH of 4, COD of 2496 mg/l, TDS of 799.7 mg/l and chloride of 1408 mg/l in distillery effluent. The calcium, sodium potassium of the effluent was 174.8, 123.15 and 219.96 ppm respectively. Baskaran et al (2009) reported higher amount of calcium, sodium and potassium in sugar mill effluent. The electrical conductivity was 8700 ms/cm. Mariappan and Rajan (2002) reported higher value of electrical conductivity (11, 575 ms/cm) in tannery effluent. The BIS permits only 400 ms/cm of Electrical conductivity for disposal of effluent in to the environment.

Table 1. Physico- chemical characteristics of zinc electroplating industry effluent

S.No.	Parameters	Value
1.	pH	6.55
2.	Electrical Conductivity ms/cm	8700
3.	Total Solids mg/l	5640
4.	Total Dissolved Solids "	4940
5.	Total Suspended Solids "	700
6.	Chloride "	56
7.	Dissolved Oxygen "	13.72
8.	COD* "	408
9.	Calcium ppm	174.8
10.	Sodium "	123.51
11.	Potassium "	219.96
12.	Zinc "	628.83

Volume : 3 | Issue : 7 | July 2013 | ISSN - 2249-555X

Impact of different quantities of zinc electroplating industry effluent residue on growth characteristics of Black gram is presented in Table 2. In the present study the germination percentage of Black gram was 100% in all the treatments. Mariappan and Rajan (2002) reported that in lower concentration (10%) of the tannery effluent the seed germination was 100% in Parkinsonia aculeata and Caeslpinia coriaria. Dhanam (2009) documented increased percentage of germination of paddy in low concentration of dairy effluent. Enhanced seed germination of Vigna mungo is also documented at 25% of textile effluent (Wins and Murugan, 2010). The shoot and root length was higher in T4, followed by T3 (750 mg of residue) in Black gram. The higher concentration of effluent residue had negative effect on shoot and root length. Similar study was reported in Parkinsonia aculeate and Caesalpinia coriaria treated with 10% of tannery industry effluent (Mariappan and Rajan, 2002). Rani and Akilan (2007) also reported that the shoot and root length decreased with increasing concentration of treated distillery effluent on two cultivars of Oryza Sativa. Fresh and dry weight and vigour index was higher in T4 followed by T1 and T5. Higher concentration of zinc electroplating industry effluent residue had negative effect on fresh and dry weight and vigour index. Similar study was reported in Parkinsonia aculeate and Caesalpinia coriaria treated with 10% of tannery effluent (Mariappan and Rajan 2002). Vijayakumari (2005) reported that the lower concentration of textile dyeing industry showed high fresh and dry weight of Eleusine coracana. Faiz Hussain et al (2010) reported that fresh and dry weight decreased with increasing concentration of tannery effluent on two cultivars of Sun flower.

Table 2. Impact of different quantities of zinc electroplating industry effluent residue on Growth characteristics of Black gram Phaseolus mungo

S.	Parameters	Treatment					
		T0 (Control)	T1	T2	T3	T4	T5
1.	Germination (%)	100	100	100	100	100	100
2.	Shoot Length(cm)	23.1±0.24	26.8±0.17	24.2±0.37	31.9±0.2	32.3±0.2	29.9±0.26
3.	Root Length (cm)	9.63±0.17	6.46±0.28	8.03±0.1	15.23±0.36	16.9±0.2	9.46±0.28
4.	Total fresh weight(g)	13.9±0.13	16.8±0.13	18.6±0.18	19.5±0.10	22.1±0.20	19.8±0.20
5.	Total dry weight (g)	5.43±0.46	6.47±0.27	5.62±0.30	6.16±0.16	7.65±0.21	6.16±0.17
6.	Leaf area index(cm2)	6.58±1.6	9.42±1.6	11.68±1.4	15.67±1.4	19.5±1.9	14.7±1.7
7.	Vigour index (%)	399±0.56	486±0.63	449±0.71	493±0.76	569±0.78	506±0.8

T0 – Red soil+sand+cowdung manure (1:1:1)

T1 - Red soil+sand+cowdung manure (1:1:1) + 250mg zinc electroplating industry effluent residue

T2 - Red soil+sand+cowdung manure(1:1:1) + 500mg zinc electroplating industry effluent residue

T3 - Red soil+sand+cowdung manure (1:1:1) + 750mg zinc electroplating industry effluent residue

T4 - Red soil+sand+cowdung manure(1:1:1) + 1000mg zinc electroplating industry effluent residue

T5 - Red soil+sand+cowdung manure(1:1:1) + 1250mg zinc electroplating industry effluent residue

Impact of different quantities of Electroplating industry effluent residue on biochemical characteristics of Black gram Phaseolus mungo is presented in Table 3. Chlorophyll a,b and total chlorophyll of Black gram were higher in T4, followed by T1. The total chlorophyll content is the indicator of the photosynthetic activities of plants. The total chlorophyll content was increased with increasing quantity of zinc electroplating industry effluent residue when compared to control. But Baskaran et al(2009) reported that the pigments chlorophyll a, b and total chlorophyll were found to increase from 25% of sugar mill effluent and decreased in 10%. Carotenoid content was higher in T2 followed by T3.Caroteniods are known to protect the chlorophyll from photo bleeching and damage(Ramasubramanian et al 1993). The carotenoid content was decreased with increasing quantity of zinc electroplating industry effluent residue. Mariappan (2002) reported that the carotenoid content decreased with increasing concentration of treated tannery effluent in Acacia auriculiformis, A.holosericea, A. Excels and Dalbergia sissoo. Kaushik et al(2005) reported that the lower concentration of textile effluent did not show any inhibitory on carotenoids content of three different cultivars of wheat.

Table 3. Impact of different quantities of zinc electroplating industry effluent residue on biochemical characteristics of Black gram Phaseolus mungo

S. No.	Parameters	Treatment					
		T0 (Control)	T1	T2	T3	T4	T5
1.	Chlorophyll a (mg/gfw)	10.5±0.12	21.8±0.18	15.4±0.20	15.7±0.24	21.9±0.28	9.7±0.28
2.	Chlorophyll b "	7.5±0.05	14.3±0.24	0.5±0.12	6.1±0.24	14.5±0.48	4.9±0.48
3.	Total Chlorophyll "	18.06±0.08	36.1±0.2	16.0±0.1	21.9±0.2	36.5±0.3	14.7±0.3
4.	Carotinoid (µmole/gfw)	1.83±0.16	3.55±0.07	5.98±0.32	4.43±0.12	3.74±0.16	3.34±0.6

Impact of zinc electroplating industry effluent residue on pod length and weight of Black gram Phaseolus mungo is presented in Table 4. Pod length and weight of black gram was higher in T4 and lower in T3. The higher quantity of effluent residue had positive effect on pod length and weight. Suguna et al (2005) reported that the yield and weight of Cow Pea was better in Viscous industry effluent. Rashmi Varma (2008) studied the effect of zinc stress on Triticum aestivum variety and reported that the lower concentration is beneficial for the yield of wheat plant, but higher concentration has inhibitory effect.

Volume : 3 | Issue : 7 | July 2013 | ISSN - 2249-555X

Table 4. Impact of different quantities of zinc electroplating industry effluent residue on yield of Black gram Phaseolus mungo

S. No.	Parameters	Treatment					
		T0 (control)	T1	T2	T3	T4	T5
1.	Pod length(cm)	3.9±0.28	4.1±0.7	3.8±0.1	4.3±0.2	4.4±0.1	4.2±0.3
2.	Pod weight(cm)	8.6±0.17	17.5±0.2	17.5±0.2	18.3±0.2	21.6±0.5	10.5±0.2

CONCLUSION:

From the results it is concluded that the growth parameters such as shoot and root length, dry weight, leaf area index, vigour index, biochemical characteristics such as chlorophyll a, b, total chlorophyll and carotinoid and yield were higher in T4.

Acknowledgement: Authors are thankful to University Grants Commission for offering financial assistance to carry out this study

REFERENCE

APHA. 2012. Standard methods for examination of water and waste water. 21st Edition. American Public Health Association, Washington, DC. | Baskaran, L., Sundaramoorthy, P., Chidambaram, A.L.A and K.Sankar Ganesh., 2009 Growth and physiological activity of Green gram (Vigna radiata) under effluent stress. Bot. Res. Internat.,2(2), 107-114. | Dhanam,S.,2009. Effect of dairy effluent on seed germination, seedling growth and biochemical parameters of paddy. Bot. Res. Int., 2,61-63. | Faiz Hussain., Saeed A.Malik., Mohammad Azhar., Nahidah Bashir., Uzma Younis., Mahamood-ul- Hassan., Seema Mahamood.,2010. Effect of tannery effluent on seed germination and growth of two sunflower cultivars. African J. Biotech., 9(3), 5113-5120. | Kaushik, P., Gary, V.K., Singh, B., 2005. Effect of textile effluent on growth performance of wheat cultivars. Bioresource Technol., 96, 1189-1193. | Kumawat, D.M.K., Tuli P. Singh and Gupta, V,.2001. Effect of dye industry effluent on germination and growth performance of two Rabi crops. J. Ecobiol., 13(2), 89-95. | Mariappan, V.,2002. Evaluation of treated tannery effluent and soil amendment studies for growing certain tree species. Ph.D thesis submitted to Gandhigram Rural Institute- Deemed University, Gandhigram, Tamil Nadu,India. | Mariappan, V., Rajan, M.R.., 2002. Effect of tannery effluent on seed germination and seedling growth of Parkinsonia aculeate and Caesalpinia coriaria.J.Ecobiol.,14(4), 241-246. | Piyush Malaviya., Anuradha Sharma., 2011. Impact of distillery effluent on germination behaviour of Brassica napus. J.Environ. Biol.,32, 91-94. | Ramasubram anian,V.,Ravichandran,V., Kannan,S.,1993. Analysis of industrial effluent and their impact on the growth and metabolism of Phaseolus mungo Commun. Soil Sci. Plant Analysis,24(17&18),2241-2249. | Rashmi Varma., 2008.Studies on the effect of zinc stress on growth parameters of Triticum aestivum. Asian J. of Microbiol.Biotech. Env. Sci.,10(4), 811-812. | Suguna,D.M.,Rupavathi, P.S., Aruna Devi,K.,2005.Impact of Viscose pulp industry effluent and seed inoculants on Cow pea yield and quality. Madras Agric. J.,92(4-6),244-247. | Vijayakumari, B.,2005. Response of Eleusine coracana to textile dyeing industry effluent. J. Ecobiol.,17(1),79-82. | Vijayaraman, K., George John., Sivakumar, M.,2007. Phytoremediation of textile dyeing effluents containing heavy metals copper and cadmium. J.Ecotoxicol. Environ. Monit.,17(5), 473-478. | Wins, J.A., Murugan,M.,2010. Effect of textile mill effluent on growth and germination of black gram Vigna mungo. Int.J.Pharma. Bio. Sci., 1,1-7. |