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Field Level Study on the Impact of Zinc Electroplating Industry Effluent Residue on Growth, Biochemical Characteristics and Yield of Green Gram Phaselous Trilobatus

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

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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 1250 mg) on growth, biochemical characteristics and yield of Green gram Phaselous trilobatus . Germination percentage of the Green gram was higher in T_3 (100 %) and lower in T_5 (70%).Shoot and root length of the Green gram were higher in T_3 with 750 mg and lower in T_5 with 1250 mg of zinc electroplating industry effluent residue on 60th day. Total fresh and dry weight of Green gram were higher in T3 and lower in T_5.Leaf area index and vigour index of Green gram was higher in T_3. Chlorophyll a,b, total chlorophyll, anthocyanin,carotenoids,total sugar, total protein and yield of Green gram was higher in T_3 and lower in T_5.*

INTRODUCTION:

Pollution of the biosphere by heavy metals due to industrial, agricultural and domestic activities has created a serious problem for the safe and rational utilization of soils and water Heavy metal pollution is a serious threat to the environment due to the fact that it cannot be degraded, rather persist and are accumulated, hence pose severe effect on all life forms and can cause adverse toxic effects on the plants growing in the affected area leading to a decrease in agricultural productivity(Shweta &Tewari, 2007). Conventional methods being used for the removal of heavy metals such as precipitation as hydroxides, sulphides, oxidation, reduction and ion exchange. These methods are expensive. Moreover these are not eco-friendly in nature and result in the production of large amount of sludge. In this context biological methods have emerged as an eco-friendly and economic option. Plants capable of accumulating high levels and thus play a significant role in cleaning up of environment and made environment free from metals. Phytoremediation is a recent, eco-friendly and cost effective technology used for the removal of inorganic contaminants. A number of plant species are capable of high levels of organic compound degradation or heavy metal hyper accumulation. The use of effluent after treatment not only solves the disposal problem but also serve as an additional source of fertilizer in liquid form(Jolly et al ., 2010). Another advantage of effluent irrigation is that because of rapid industrialization significant amounts of heavy metals remain in soil due to long biological life and thus influence plant growth. Among the major industries, electroplating industry effluent contains large amount of heavy metals such as zinc, chromium and nickel. The work related to on the impact of Zinc electroplating industry effluent residue on growth, biochemical characteristics and yield of Green gram *Phaselous trilobatus* under field trail 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 green 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

The physico-chemical characteristics of zinc electroplating industry effluent is presented in Table 1. The pH of zinc electroplating industry effluent was 6. Periyasamy and Rajan(2009) reported a lower pH of 3 in electroplating industry effluent. The BIS permits pH of 6-9 for industrial effluent disposal into the environment. The electrical conductivity was 8700mS/cm, is well above the value recommended by BIS(400mS/cm) indicating high concentration

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of ionic substances. Balamurugan et al (2002) also reported higher value of electrical conductivity in tannery effluent. The total dissolved solids in the effluent was 4940mg/l. Rajan et al (2010) reported higher value of total dissolved solids(9700 mg/l) in electroplating industry effluent. The total hardness level was comparatively higher than the BIS permissible limit of 250mg/l. Mariappan (2002) also reported higher total hardness(1912 mg/l) in tannery industry effluent.

Table 1 Physico- chemical characteristics of electroplating industry effluent

S.No.	Parameters		Value
1.	pH		6.0
2.	Electrical Conductivity	mS/cm	8700
3.	Total Solids	mg/l	5640
4.	Total Dissolved Solids	"	4940
5.	Total Suspended Solids	"	700
6.	Total Hardness	"	420
7.	Chloride	"	56
8.	Dissolved Oxygen	"	13.72
9.	COD*	"	408
10.	Calcium	ppm	174.8
11.	Sodium	"	123.51
12.	Potassium	"	219.96
13.	Zinc	"	628.83

***Chemical Oxygen Demand**

Impact of different quantities of zinc electroplating industry effluent residue on growth characteristics of Green gram is presented in Table 2. In the present study the germination percentage of Green gram was higher in T_3 (100%) and lower in T_5 (70%) and these result showed that higher concentration of electroplating industry effluent residue (1250 mg) inhibited the seed germination. Kaushik *et al.*, (2005) reported that the direct dye industry effluent shows better results with 50% water diluted effluent samples than 100% effluent. Kalaiselvi *et al.*, (2009) reported that up to 10% concentration the distillery spent wash markedly improved the seed germination. The percentage reduction in shoot and root length and total fresh and dry weight were decreased after 30th and 60th day at higher quantities of zinc electroplating industry effluent residue. Rajan et al(2013) reported similar reduction in total fresh and dry weight of seedlings of brinjal was grown in dyeing industry effluent.

Table 2 Impact of different quantities of zinc electroplating industry effluent residue on growth characteristics of Green gram on 30th and 60th day

Growth Characteristics	Day	Treatment T_0 (Control)	T_1	T_2	T_3	T_4	T_5
Shoot Length(cm)	30th	10.3±0.40	11.8±0.76	14.3±0.60	17.1±0.23	15.8±0.45	9.9±0.52
	60th	20.8±0.65	22.4±0.4	23.4±0.1	23.8±0.7	30.5±0.30	18.1±0.66
Root Length (cm)	30th	4.02±0.21	5.02±0.12	6.62±0.1	8.5±0.12	7.3±0.16	3.8±0.32
	60th	8.06±0.51	9.2 ±0.26	11 ±0.3	16.1±0.34	13.1±0.36	7.9±0.65
Total Fresh Weight(g)	30th	0.007±0.002	0.008±0.001	0.009±0.002	0.015±0.004	0.011±0.004	0.003±0.001
	60th	0.019±0.02	0.011±0.001	0.021±0.005	0.034±0.011	0.025±0.001	0.007±0.001
Total Dry Weight(g)	30th	0.0025±0.02	0.0045±0.003	0.007±0.001	0.010±0.004	0.007±0.003	0.003±0.002
	60th	0.006±0.3	0.09±0.4	0.01±0.5	0.021 ±0.096	0.014±0.03	0.003±0.002
Leaf Area Index (cm2)	30th	6±0.12	7±1.68	8±1.03	10±0.32	9±0.51	5±0.35
	60th	14±0.53	15±0.59	16±0.49	18±0.57	17±0.41	12±0.46
Vigour Index(%)	30th	1202±0.05	1592±0.03	1763±0.04	2304±0.03	2029±0.04	959±0.05
	60th	2426±0.06	2844±0.03	2975±0.04	4491±0.05	3924±0.73	1976±0.34

Impact of different quantities of zinc electroplating industry effluent residue on biochemical characteristics of Green gram is presented in Table 3. Chlorophyll content of green gram was higher in T_3 and lower in T_5. Similar result was reported by Rajan et al (2014) in black gram treated with different quantities of electroplating industry effluent residue. The chlorophyll content reduces with the increased quantity of residue. Gupta and Bishwas Ray(2005) reported that the chlorophyll content in Withania somnifera plant exposed to higher metal concentration. The carotenoides content decreased with increase in zinc electroplating industry effluent residue. Kaushik et al (2005) reported that the chlorophyll and carotenoid contents of three different cultivars of wheat did not show any inhibitory effect at low concentration(6.25%) of textile effluent. The anthocyanin content increased with increasing quantities of electroplating industry effluent residue. At higher quantities of electroplating industry effluent residue anthocyanin accumulates as a stress response. The total soluble sugar and protein content was found to decrease with increasing quantities of electroplating industry effluent residue. A similar result was reported in rice seedlings with increase in effluent concentration(Behra and Mishra, 1983). The free amino acids content increased with increasing quantities of electroplating industry effluent residue. The free amino acids content increased more in Lady's finger(Sharma et al ., 1997). The degradation of protein may lead to increase in free amino acids content. Dhanam(2009) reported decreased level of protein in paddy seeds raised in lower concentrations of dairy effluent. The leaf nitrate content increased in treatment 4 with 1000 mg of effluent residue. Leaf nitrate content was increased with increasing concentration of colour match and sugar industrial effluents on Phaseolus mungo (Ahalya and Ramasubramanian, 2001) and Abelmoschus esculentus (Jeyarathi and Ramasubramanian, 2000).

Table 3 Impact of different quantities of zinc electroplating industry effluent residue on
biochemical characteristics of Green gram Phaseolus triolbatus on 60th day.

Parameters	Treatments T_0	T_1	T_2	T_3	T_4	T_5
Chlorophyll a (mg/gfw)	2.1±0.53	1.7±0.27	1.6±0.14	2.8±0.54	2.66±0.88	2.2±1.21
Chlorophyll b (mg/gfw)	2.2±0.05	2.0±0.20	3.0±0.89	5.1±0.73	4.3±0.31	2.2±0.08
Total Chlorophyll (mg/gfw)	11.1±0.41	13.2±0.47	16.42±0.94	19.22±0.09	18.46±0.12	11.71±0.82
Carotenoid (µmole/gfw)	1.5±0.42	2.5±0.14	2.4±0.16	3.51±0.01	3.09±0.02	2.04±0.10
Anthocyanin (µmole/gfw)	1.0±0.01	1.74±0.04	2.81±0.06	3.33±0.08	2.1±0.63	1.7±0.25
Total sugar (µmole/gfw)	0.9±0.09	1.14±0.14	1.5±0.04	1.81±0.12	1.5±0.09	1.02±0.24
Total protein (mg/gfw)	0.69±0.26	1.15±0.29	2.02±0.46	1.80±0.24	1.69±0.27	1.08±0.06
Free amino acid (mg/gfw)	2.02±0.01	2.42±0.23	3.16±0.07	3.42±0.09	3.56±0.02	3.10±0.02
L-proline (mg/gfw)	0.5±0.46	1.3±0.60	2.01±0.24	2.2±0.84	2.5 ±0.72	0.6±0.42
Leaf nitrate (mg/gfw)	8.10±0.10	9.45±0.09	9.93±0.66	10.8±0.03	12.42±0.02	10.82±0.01

In the present study the effect of different quantities of electroplating industry effluent on performance such as number, weight and length of fruits were higher in T_3(750 mg).(Table 4). Mahimairaja and Bolan(2004) reported that low doses of distillery spent wash remarkably improve the yield of dry land crops(ragi, ground nut, sorghum and green gram). Singh et al (2011) reported that tannery waste at lower concentration promotes the yield of Chrysanthemum cuttings.

Table 4.Impact of different quantities (250, 500, 700, 1000 and 1250mg) of electroplating Industry effluent residue on length, weight and number of Green gram *Phaseolus trilobatus on* 60thday

Treatment	No. of pods/plant	Wt. of the pods/plant(g)	Length of the pods/plant(cm)
T_0(Control)	6.2	1.2	6
T_1	6.4	1.4	7
T_2	6.8	1.7	7
T_3	7.8	2.2	10
T_4	7.4	2.0	8

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T_5	6.0	1.1	3

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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. | | Balamurugan, T., Rajan, M.R and Mariappan, V.2002. Development of a low cost technology for the treatment of tannery effluent. Recent trends in Biotechnology, Agrobios (India), Jodhpur.pp.241-244 | . | Behra, B.K and B.M.Mishra.1983. Analysis of the effect of industrial effluent on growth and development of rice seedlings. Environ. Res., 28: 10-20. | | Dhanam, S.2009. Effect of dairy effluent on seed germination, seedling growth and biochemical parameters of paddy. Bot. Res. Int., 2:61-63. | | Gupta, A.K and Bishwas Ray 2005. Bioaccumulation of cadmium, zinc, copper and chromium by Withania somnifera. Nature Environment and Pollution Technology, 4(110:131-135. | | Jeyarathi, K.P. & Ramasubramanian, V.2000. Analysis of sugar cane mill effluent and its impact on the growth and biochemical characteristics of Abelmoschus esculentus. Proc. of Natl. Conf. On Recent Trends in Biotechnology. Allapuzha, Kerala, pp. 97-99. | Jolly, Y.N., Islam,A and Mustaba, A.I. 2010. Impact of dyeing industry effluent on soil and crop. Universal Journal of Envir. Res. And Tech., 2(6): 560-568. | Kalaiselvi, P., S. Shenbagavalli., S. Mahimairaja and P. Srimathi. 2009. Impact of post biomethanated distillery spentwash on seed germination and seedling growth of dry land crops. Madras Agric. J., 96:331-334. | | Kaushik, P., V.K. Garg and B. Singh .2005. Effect of textile effluents on growth performance of wheat cultivars. Bioresour. Technol., 96: 1189-1193. | | Mahimairaja, S and Bolan, N.S(2004) Problems and prospects of agricultural use of distillery spent wash in India. Super Soil: 3rd Austalian, New Zealand Soils Conference, 5-9 December, University of Sydney, Austalia,pp.1-6. | | 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. | | Periyasamy, M and Rajan, M.R.2009. Physico- chemical characteristics of electroplating industry effluent and water quality index. J.of Industrial Pollution Control, 25(1): 29-32. | | Rajan, M.R., Periyasamy, M and Menakadevi, V.2010. Absorption of chloride from electroplating industry effluent using fungi. Asian J. of Microbiol. Biotech. Env. Sci.,12(4): 785-787. | | Rajan, M.R., U.Nizath Fathima and S.David Noel 2013.Impact of Dyeing Industry Effluent Residue on Growth, Biochemical characteristics and yield of Brinjal Solanum melogena, Journal of Applied Research, 3(10): 84-86. | | Rajan, M.R.., S.David Noel and V.Palaniselvi 2014. Field Level Study on The Impact of Zinc | Electroplating Industry Effluent Residue on Growth, Biochemical Characteristics and Yield of Black GramVigna Mungo. Indian J.of Applied Research,4(12):556-558. | | Sharma, S.K., Srivastava, A & Singh, V.P.1997. Effect of rubber factory effluent on growth in Vigna mungo. Journal of Environ.Poll., 4(30: 175-177. | Shweta,S and S. Tewari. 2007. Impact of brass and electroplating industry effluent on some physic- chemical and biological properties of soil. J. of Scientific and Industrial Res., 66: 957-962. | 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.