Research Paper

Volume : 3 | Issue : 6 | June 2014 • ISSN No 2277 - 8179

Field Level Study on the Impact of Zinc Electroplating Industry Effluent Residue on Growth, Biochemical Characteristics and Yield of Cluster Bean Cyamopsis Tetragonoloba

Environment

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

M.R.Rajan*	Department of Biology, Gandhigram Rural Institute- Deemed University Gandhigram- 624 302, Tamil Nadu, India. *Corresponding Author
M.Prema	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

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 Cluster bean Cyamopsis tetragonoloba . Germination percentage of the Cluster bean was higher in T3 (98 %) and lower in T5 (88%). Shoot and root length of the Cluster bean were higher in T3 with 750 mg and lower in T1 with 250 mg of zinc electroplating industry effluent residue on 60th day. Total fresh and dry weight of Cluster bean were higher in T3 and lower in T4.Leaf area index and vigour index of Cluster bean was higher in T3. Chlorophyll a,b, total chlorophyll, anthocyanin total sugar, total protein, free amino acids, L-proline, leaf nitrate and yield of Cluster bean was higher in T3 and lower in T5.

INTRODUCTION

Among industries, electroplating industries plays a important role in causing the water pollution. Electroplating industrial effluent contains high amount of total dissolved solids, total solids, hardness, large quantities of inorganic pollutants like Chloride, sulphate, nitrate, organic compounds and heavy metals like Zinc, Copper, Nickel and Chromium contaminate soil and water and have deleterious effect on human health and planktons. The use of industrial effluents for irrigation has emerged in the recent past as an important way of utilizing waste water, taking the advantage of the presence of considerable quantities of N, P, K and Ca along with other essential nutrients. Due to high cost and scarcity of chemical fertilizers, the land disposal of agricultural, municipal and industrial waste is widely practiced as a major and economic source of nutrients and organic matter for growing cereal crops by poor farmers (Younas & Shahzad, 1998; Jamal et al., 2002). It not only prevents the waste water from being an environmental hazard, but also serves as an additional potential source of fertilizer for agricultural use. Some of the heavy metals when present within the permissible limit act as micronutrients for plant growth. The work related to the impact of Zinc electroplating industry effluent residue on growth, biochemical characteristics and yield of Cluster bean Cyamopsis tetragonoloba [L] Taub. 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 (HNO3,H2SO4 and HCIO4 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 cluster bean 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 10º 3'N latitude and 77 º 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 growth characteristics of Cluster bean Cyamopsis tetragonoloba is presented in Table 1. In the present study the germination percentage of Cluster bean was higher in T0 (100%) followed by T3 (98%) and lower in T5 (88%) 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. Shoot length, root length, total fresh weight and total dry weight was higher in T3 (750 mg). Ram Chandra et al., (2004) reported that raw distillery effluent was more toxic than treated effluent and inhibited the growth (root length and shoot length) of Phaseolus aureus. Rani and Alikhan (2007) reported that the lower concentration (25%) of distillery effluent showed higher rate of root length, shoot length, total fresh weight, and total dry weight. The vigour index was higher in T3 (7039.6%). Mariappan (2002) reported that the vigour index decreased with increasing concentration of treated tannery effluent in tree species.

Table 1 Impact of different quantities of zinc electroplating industry effluent residue on growth

Parameters	Treatments					
	T_0	T_1	T_2	T_3	T_4	T_5
Germination(%)	100	96	94	98	90	88
Shoot length (cm)	21.6±1.04	21.16±1.89	45.3±2.08	71.9±16.07	32.5±0.55	33.83±0.76
Root length (cm)	8.6±0.763	8±0.05	10±1.541	16.5±0.763	15.5±1.527	12.3±0.54
Total Fresh weight (g)	2.12±0.182	3.12±0.182	4.2±0.264	5.22±0.425	1.23±0.03	2.135±0.03
Total Dry weight (g)	1.86±0.182	2.02±0.025	2.36±0.130	5.11±0.348	4.33±0.406	1.91±0.104
Leaf area index (cm^2)	3±0.44	4±0.43	3±0.57	10±0.88	9±0.60	8±0.53
Vigour index (%)	2856±0.96	2799±0.36	5201±0.02	7039±0.18	4275±0.80	4074±0.04

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

Impact of different quantities of zinc electroplating industry effluent residue on biochemical characteristics of Cluster bean Cyamopsis tetragonoloba is presented in Table 2. Chlorophyll a, total chlorophyll, chlorophyll b, carotenoids and total soluble sugar were higher in T3 (750 mg). The result showed an increase in the total chlorophyll and carotenoid contents is increased and beyond this concentration, level of pigments gradually decreased. Various reports showed the same result. (Pandey et al, 2008).Anthocyanin was higher in T5 (1250 mg). Free amino acids, L- proline, and leaf nitrate were higher in T3 (750 mg). Total protein and leaf nitrate were higher in T3 (750 mg). Elayarajan (2002) reported that highest amount of protein content was recorded at 10% effluent concentration and the lowest content was recorded at 75%. Karunyal et al (1994) reported that the chlorophyll and protein contents of Oriza sativa were found to decrease with the effluent concentration of 75 and 100%.

Table 2 Impact of different quantities of zinc electroplating industry effluent residue on
biochemical characteristics of Cluster bean Cyamopsis tetragonoloba

Parameters	Treatments					
	T_0	T_1	T_2	T_3	T_4	T_5
Germination(%)	100	96	94	98	90	88
Shoot length (cm)	21.6±1.04	21.16±1.89	45.3±2.08	71.9±16.07	32.5±0.55	33.83±0.76
Root length (cm)	8.6±0.763	8±0.05	10±1.541	16.5±0.763	15.5±1.527	12.3±0.54
Total Fresh weight (g)	2.12±0.182	3.12±0.182	4.2±0.264	5.22±0.425	1.23±0.03	2.135±0.03
Total Dry weight (g)	1.86±0.182	2.02±0.025	2.36±0.130	5.11±0.348	4.33±0.406	1.91±0.104
Leaf area index (cm^2)	3±0.44	4±0.43	3±0.57	10±0.88	9±0.60	8±0.53
Vigour index (%)	2856±0.96	2799±0.36	5201±0.02	7039±0.18	4275±0.80	4074±0.04

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

Impact of different quantities of zinc electroplating industry effluent residue on yield of Cluster bean Cyamopsis tetragonoloba is presented in Table 3. Yield performance such as, length, weight and number of pods were higher in T3 (750 mg). Medhi et al., (2005) reported that diluted paper mill effluent increased the height of plant, number of pods per plant, and weight of pods in pea and rice. These findings were similar with earliar reports (Rajannan et al, 1998 and Kumar et al., 2006).

Table 3 Impact of different quantities of zinc electroplating industry effluent residue on

Treatment	Length of the pods/plant(cm)	Wt. of the pods/plant(g)	No. of pods/plant
T_0(Control)	3.86	14.2	35
T_1	4.56	10.3	42
T_2	4.38	10.7	44
T_3	5.93	11.65	51
T_4	4.23	10.95	34
T_5	3.71	10.6	30

REFERENCE

Elayarajan. M .2002. Land application of treated paper board mill effluent on soil, water and plant ecosystem. World Journal of Environmental Biosciences, 1:38-41. | Jamal, A., N. Ayub, M.Usman and A.G.Khan .2002. Arbuscular mycorrhiza fungai enhance Zn and Ni uptake from contaminated soil by Soybean and lentil. Int. J. Phytorem, 4:205-221. | 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. | Karunyal, S., G.Renuga and Paliwal .1994. Effects of tannery effluent on seed germination, leaf area, biomass and mineral content of some plants. Bioresour. Technol., 47:215-218. | Kaushik, P., V.K. Garg and B. Singh .2005. Effect of textile effluents on growth performance of wheat cultivars. Bioresour. Technol., 96: 1189-1193. | Kumar, G., Sharmila Banu.G and V.Kannan .2006. Effects of textile mill effluent on seed germination, seedling growth and pigment content of Arachis hypogeal. Journal of Ecobiology, 19(1): 19-22. | 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. | Medhi, U.J., A.K. Talukdar and S.Deka .2005. Effect of pulp and paper mill effluent on seed germination and seedling growth of mustard (Brassica campestris), pea (Pisum sativam) and rice (Oryza sativa) seeds. Poll Res., 27:437-442. | Pandey, S. N., B.D. Nautiyal and C.P. Sharma .2008. Pollution level in distillery effluent and its phytotoxic effect on seed germination and early growth of maize and rice. J. Environ. Biol., 29: 267-270. | Rajannan, G., Devarajan, L and Oblisami, G.1998. Impact of distillery effluent irrigation on | growth of banana crop. Proceedings of National Seminar on Application of Treated | effluents for irrigation, March 23, Thiruchirapalli, pp. 56- 59. | | Rani, R and Alikhan, M.A .2007. Utilization of distillery effluent and its effect on growth and physiology of Oryza sativa L. Proc. of the Natl. Conf. on Eco-friendly Utili. of Recyclable org. Res. from Sugar and Distillery Industries for Sus. Agri., 6-7 March, Trichy. pp.1-9. | Ram Chandra., Kishan Kumar and Jaswant Singh .2004. Impact of anaerobically treated and untreated (raw) distillery effluent irrigation on soil microflora, growth, total chlorophyll and protein contents of Phaseolus aureus L. J. Environ. Biol., 25:381-385. | Younas, M. and F.Shahzad .1998. Assessment of Cd,Ni,Cu sand Pb pollution in Lahore, Pak. J. Environ., 24:761-766. |