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Impact of Zinc Electroplating Industry Effluent Residue on Growth and Biochemical Characteristics of Brinjal Solanum Melongena

KEYWORDS: Electroplating, effluent, residue, growth, biochemical, brinjal.

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ABSTRACT *The present study deals with the impact of electroplating industry effluent residue on growth and biochemical characteristics of Brinjal Solanum melongena grown for a period of 120 days. Various quantities of zinc electroplating industry effluent residue (0, 250, 500, 750, 1000 and 1250 mg) for various treatments such as 0(control), 1,2,3,4 and 5 were used in pot culture studies. Growth and biochemical characteristics of brinjal were estimated after 120 days. Germination percentage was higher (97) in treatment 2 and lower in treatment 1 and 5.Shoot and root length was higher in treatment 4 and lower in treatment 5. Fresh and dry weight was higher in treatment 2 and lower in treatment 4. Leaf area index and vigour index of brinjal was higher in treatment 4. Chlorophyll a and carotenoid content of brinjal was higher in treatment 3.Chlorophyll b and total chlorophyll was higher in treatment 3 and 5 respectively.*

Introduction:
Environmental pollution is one of the major problems all over the world. A number of countries including India have gone through dramatic industrial growth leading to considerable pollution problems. Industries release considerable amount of toxicants such as organic and inorganic compounds, acids, alkalis and suspended solids and thereby disturbing the fragile ecosystem. Industrial effluents with heavy metals adversely affect the growth and development when it is used for irrigation (Nagayjoti et al 2008 and Prasad, 1995). Among the major industries, electroplating industries releases large quantity of toxic substances including heavy metals such as zinc, copper, chromium and nickel. Some of these heavy metals act as micronutrients for the growth of plants. Zinc is one of the micronutrients essential for normal growth and development of plants as it is known to be required in several metabolic processes (Cakemake and Marschner, 1973). However presence of zinc at higher concentrations retarded growth and development of plant by interfering with certain important metabolic processes (Alia Prasad and Pardha Sardhi 1995 and Ebbs and Kochian, 1997). The work related to the impact of zinc electroplating industry effluent residue on growth and biochemical characteristics of Brinjal Solunam melongena 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 Brinjal Solanum melongena 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 cow dung 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 and biochemical characteristics of Brinjal Solanum melongena were analysed on 120th 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, TDS 4940 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. Mariappan and Rajan (2002) reported a COD of 272 mg/l in tannery 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

COD* Chemical Oxygen Demand

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Impact of different quantities of zinc electroplating industry effluent residue on growth characteristics of Brinjal is presented in Table 2. Germination percentage of Brinjal was higher in Treatment 2 (97) and lower in Treatment1 and Treatment 5 (90). In the present study higher quantity of effluent residue inhibited the seed germination. Mariappan and Rajan (2002) reported that in lower concentration (10%) of tannery effluent the seed germination was higher in Parkinsonia aculeata and Casalpinia coriaria. In the present study shoot and root length of Brinjal was higher in T4 (1000 mg) and fresh and dry weight was higher in T2(500 mg) of zinc electroplating industry effluent residue. The higher quantity of residue had negative effect on shoot length, fresh and dry weight. Similar study was reported in Parkinsonia aculeata and Casalpinia coriaria in 10% of tannery industry effluent (Mariappan and Rajan 2002).

Table 2. Impact of different quantities of zinc electroplating industry effluent residue on Growth characteristics of Brinjal Solanum melongena.

S.No.	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 zinc electroplating industry effluent residue on biochemical characteristics of Brinjal is presented in Table 3. Chlorophyll a and total chlorophyll was higher in T3(750 mg) and chlorophyll b and carotenoid was higher in T4(1000 mg of residue). The total chlorophyll content was the indicator in photosynthetic activities of plants. The total chlorophyll content was decreased with increasing quantity of electroplating industry effluent residue when compared to control. This may be due to increasing concentration of total dissolved solids, chloride, sulphate which diabolize the chlorophyll pigment, which in turn reduces the leaf chlorophyll content (Goswami and Naik, 1991).

Table 3. Impact of different quantities of zinc electroplating industry effluent residue on biochemical characteristics of Brinjal Solanum melongena.

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

Conclusion:

From the results it was concluded that the growth parameters such as shoot and root length, fresh and dry weight, leaf area index, vigour index and biochemical characteristics such as chlorophyll a, b, total chlorophyll and carotenoid of brinjal were higher in T4(1000 mg of residue).

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