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Zinc Electroplating Industry Effluent Residue on Growth, Biochemical Characteristics and Yield of Lady's Finger Abelmoschus Esculentus

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

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ABSTRACT *The present study deals with the impact of different quantities of zinc electroplating industry effluent residue on growth, biochemical characteristics and yield of Lady's finger Abelmoschus esculentus grown for a period of 60 days. Germination percentage is higher in treatment 3 and lower in treatment 5.Growth parameters such as shoot and root length, fresh and dry weight and leaf area index and vigour index and biochemical characteristics such as chlorophyll a, b, total chlorophyll and cartotenoid were higher in treatment 3. Fruit length and weight of lady's finger are higher in treatment 3.*

Introduction:

The widespread industrial activities and mismanagement of resources have resulted in dumping of solid and liquid wastes and thereby leading to the pollution of the ecosystem. Due to industrialization large amount of effluent was discharged in to the environment and leads to serious pollution (Pandey and Sharma, 1999). Among the major industries, electroplating industries releases large quantity of inorganic pollutants like chlorides and heavy metals (Akar et al., 2009). Various methods are used for the removal of toxic chemicals. Among the biological methods pytoremediation is a modern, recent, ecofriendly method for the removal of toxic chemicals to less harmful forms. Plants are capable of accumulating heavy metals and so play a significant role in cleaning up the environment. Metals such as zinc, nickel and copper are the best candidates for removal by phytoextraction because it has been shown that they are preferred by the majority of plants that uptake and absorb unusually large amounts of metals, some of the heavy metals acts 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). The work related to the impact of electroplating industry effluent residue on growth, biochemical characteristics and yield of Lady's finger Abelmoschus esculentus 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 Lady's finger Abelmoschus esculentus 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 Lady's finger Abelmoschus esculentus 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.Kumaravelu et al (2000) reported higher value of pH (8.81) in tannery 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. Vinod Sharma et al (2002) also reported higher value of electrical conductivity in the distillery effluent. The BIS permits only 400 ms/cm of Electrical conductivity for disposal of effluent in to the environment.The total dissolved solids of electroplating industry effluent was 4940 mg/l. Rajula and Padma Devi (2000) reported total dissolved solids 2200 mg/l in electroplating industry effluent. Chemical Oxygen Demand was 408 mg/l. Sandeep et al (2007) reported COD value of 2433 mg/l in distillery effluent. The chloride content of zinc electroplating industry effluent was 56 mg/l. Malavi and Prasad Rao (2003) reported higher chloride value (176 mg/l) in sugar industry 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.

Impact of different quantities of zinc electroplating industry effluent residue on growth characteristics of Lady's finger Abelmoschus esculentus is presented in Table 2.In the present study germination of Lady's finger was 100% in T0(control) followed by T1(96.6%) and T5(63.3%). Higher quantity of zinc electroplating industry effluent residue (1250 mg) inhibited the seed germination. Mariappan and Rajan (2002) reported that in the lower concentration (10%) of the tannery effluent the seed germination was higher in Parkinsonia aculeata and Caesaalpinia coriaria. Shoot and root length, vigour index,

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fresh and dry weight and leaf area index of Lady's finger was higher in Treatment 3(750 mg of residue). Vijayakumari (2005) reported the impact of Textile dyeing industry effluent on the growth parameters of Eleusine coracana.

Impact of different quantities of Electroplating industry effluent residue on biochemical characteristics of Lady's finger Abelmoschus esculentus is presented in Table 3.In the present study chlorophyll a, b, total and carotenoid were higher in treatment 3. Garg and Kaushik (2008) reported lower value on the effect of textile effluent along with organic amendments on Sorghum.

Impact of different quantities of Electroplating industry effluent residue on yield of Lady's finger Abelmoschus esculentus is presented in Table 4. Among the different treatments the fruit length and weight of Lady's finger is higher in treatment 3 and lower in treatment 1. Similar result was reported on the effect of dye industry effluent residue on yield of Lady's finger (Soundaravalli, 2011).

Conclusion:

From the results it was concluded that the growth parameters such as shoot and root length, fresh and dry weight, biochemical characteristics such as chlorophyll a,b, total chlorophyll and carotenoid and yield parameters of Lady's finger Abelmoschus esculentus were higher in treatment 3 with 750 mg of electroplating industry effluent residue.

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

*** Chemical Oxygen Demand**

Table 2. Impact of different quantities of zinc electroplating industry effluent residue on Growth characteristics of Lady's finger Abelmoschus esculentus

S. No.	Parameters	Treatment					
		T0 (Control)	T1	T2	T3	T4	T5
1.	Germination (%)	100	96.6	76.6	83.3	83.2	63.3
2.	Shoot Length(cm)	19±0.81	14±0.81	29.6±1.2	33±5.71	27.6±1.5	24.5±1
3.	Root Length (cm)	11.43±0.13	11.7±0.5	13.8±0.6	17.5±0.9	17.0±0.4	16.16±0.2
4.	Total fresh weight(g)	19.1±0.39	18.32±0.7	18.43±1.5	34.6±3.3	23.7±2.08	32.5±2.5
5.	Total dry weight (g)	16.9±1.3	16.2±1.4	17.6±1.59	32.6±3.34	20.5±2.49	26.3±4.4
6.	Leaf area index(cm^2)	54.9±0.16	41.93±1.5	44.3±4.24	109.8±0.2	76.21±0.9	74.7±1.2
7.	Vigour index (%)	156±0.28	240±0.09	250±1.18	290±0.4	220±0.3	230±0.5

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

Table 3. Impact of different quantities of zinc electroplating industry effluent residue on biochemical characteristics of Lady's finger Abelmoschus esculentus

S. No.	Parameters	Treatment					
		T0 (Control)	T1	T2	T3	T4	T5
1.	Chlorophyll a (mg/gfw)	5.26±0.8	4.83±1.6	5.07±0.8	5.91±.2.4	5.07±0.28	4.11±2.4
2.	Chlorophyll b "	1.96±1	1.75±1.0	1.67±1	9.32±1.03	1.68±1	1.2±1.02
3.	Total Chlorophyll "	7.24±0.9	6.5±0.8	6.7±0.8	8.0±0.25	6.7±2.43	5.3±2.1
4.	Carotinoid (µmole/gfw)	1.35±0.08	1.12±0.16	1.28±0.24	4.45±0.2	1.95±0.2	1.19±0.86

Table 4. Impact of different quantities of zinc electroplating industry effluent residue on yield of Lady's finger Abelmoschus esculentus

S. No.	Parameters	Treatment					
		T0 (control)	T1	T2	T3	T4	T5
1.	Fruit length(cm)	13.6±0.8	8.2±0.49	6.3±1.0	30.5±0.62	9.7±0.17	10.4±0.33
2.	Fruit weight(g)	230±0.6	200±0.5	275±0.2	340±0.9	320±0.8	335±0.7

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