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Effect of Zinc Electroplating Industry Effluent Residue on Growth and Certain Biochemical Characteristics of Cluster Bean (Cyamopsis Tetragonoloba) L. Taub

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Abstract: ***The present study deals with the effect of Zinc electroplating industry effluent residue on growth and certain biochemical characteristics of cluster bean the physico chemical characteristics such as pH, Electrical conductivity, Total dissolved solids Total suspended solids , Chloride , Sulphate , Dissolved oxygen , BOD , COD , Sodium , Zinc , were estimated .Growth parameters shoot and root length , and fresh & dry weight and Biochemical characteristics chlorophyll a, chlorophyll b, Total chlorophyll, Carotinoides were measured after 60 days. Germination percentage of Cluster bean was higher in treatment 1 (100) and lower in (84) in treatment 6 with 2500 mg of Zinc electroplating industry effluent residue. Shoot and root length and fresh and dry weight of cluster bean was higher in treatment 1 and lower in treatment 6. Like growth parameters biochemical characteristics are higher in treatment 1 and lower in treatment 6.***

Keywords: Zinc, Electroplating Industry Effluent, Residue, Growth, Biochemical characteristics, Cluster bean

1. Introduction

Untreated or partially treated waste water pose a serious problem to the ecosystem and the life forms. The indiscriminate disposal of industrial, municipal and agricultural wastes into aquatic systems is responsible for the environmental pollution. Pollution of water and soil by heavy metal is one of the serious environmental problems in urbo-industrialized countries. The release of waste waters into the water bodies affects the flora and fauna (Nampoothery and Sasidharan, 1976 and Singh et al., 2002).

Industrial effluents have been regarded as a source of pollution because of the lack of efficient treatment and disposal (Srivastava and Pandey, 1999). These wastes contain toxic chemicals and radio nuclides, there by entering into the food chain beyond their permissible limits, directly or indirectly affect the entire life on the planet earth. Among the major industries, electroplating industries release large quantities of heavy metals such as Zn, Cr, Cu, N. Some of the heavy metals act as micronutrients for the growth of plants. The work related to the effect of zinc electroplating industry effluent residue on growth and some biochemical characteristics of Cluster bean Cyamopsis tetragonoloba (L.) Taub. is totally wanting.

2. Materials and Methods

For the present study Zinc electroplating industry effluent was collected from an electroplating industry located at Sundararajapuram, Madurai, Tamil Nadu, India, in plastic containers (20L). After collection, the effluent was immediately transported to the laboratory for analysis The Physico-chemical characteristics such as pH, electrical conductivity, total solids, total dissolved solids, total suspended solids, hardness, sodium, potassium, calcium, magnesium, sulphate, chloride, nitrogen, dissolved oxygen, BOD, COD and zinc were estimated using standard methods (APHA, 1990).

Pot culture Studies

The design of experiments is presented table (1). The seeds were sown in various pots containing red soil and sand (control), red soil, sand and chemical fertilizers (chemical fertilizers control), red soil, sand and FYM (farmyard manure control), residue alone and in combination with various amendments viz., residue plus FYM, residue plus FYM and chemical fertilizers. The details of the combinations (design of the experiments). The seedlings were allowed to grow in the respective pots. The growth and biochemical parameters were measured after 60th day.

Table 1: Design of experiments

Sr. No.	Treatment	Red soil	Sand	Electroplating industry Effluent residue	Farmyard manure	Chemical Fertilizers
1.	T_0	3kg	3kg	_	_	_
2.	T_1	3kg	3kg	_	_	Full dose*
3.	T_2	3kg	3kg	500mg	_	_
4.	T_3	3kg	3kg	1000mg	_	_
5.	T_4	3kg	3kg	1500mg	_	_
6.	T_5	3kg	3kg	2000mg	_	_
7.	T_6	3kg	3kg	2500mg	_	_
8.	T_7	2kg	2kg	_	31.2g	_
9.	T_8	2kg	2kg	500mg	31.2g	_
10.	T_9	2kg	2kg	1000mg	31.2g	_
11.	T_{10}	2kg	2kg	1500mg	31.2g	_
12.	T_{11}	2kg	2kg	2000mg	31.2g	_
13.	T_{12}	2kg	2kg	2500mg	31.2g	_

14.	T_{13}	2kg	2kg	250mg	15.6g	Half dose**
15.	T_{14}	2kg	2kg	500mg	15.6g	”
16.	T_{15}	2kg	2kg	750mg	15.6g	”
17.	T_{16}	2kg	2kg	1000mg	15.6g	”
18.	T_{17}	2kg	2kg	1250mg	15.6g	”

3. Results and Discussion

A Physico-chemical characteristic of zinc electroplating industry effluent is presented in Table 2. pH the effluent was 2. Periyasamy and Rajan (2009) reported lower pH value (3) in electroplating industry effluent. The BIS permits pH value of 6.0 – 9.0 for industrial effluent disposal in to the environment .the EC of effluent was 8900 mS/cm. and it was well about the value recommended by BSI (400 ms/cm) indicating high concentration of ionic substances. Balamurugan (2000) also reported high value of electrical conductivity in tannery effluent. The total dissolved solids in the effluent was 14600mg/l. Rajan et al.,(2010) reported higher value of total dissolved solids (9700 mg/l) in electroplating industry effluent. The BIS permits only 2100 mg/l of total dissolved solids for disposal in to the environment. The total hardness level was comparatively high in effluent (1120 mg /l) than the permissible limit (BIS 250mg/l). However the higher hardness level may be due to the absence of dissolved carbonate and non-carbonate hardness. Mariappan (2002) reported higher value of total hardness (1912 mg/l) in tannery industry effluent. The growth parameter of cluster bean grown in different treatment is presented in table 3.

In the present study the seed germination percentage was higher in T1, T7, T8 and T4 (100) and lower in T6 (84). As the level of Zn electroplating industry effluent residue increases the germination percentage decreases. The shoot and root length of cluster bean increased at lower quantity of residue. The percentage reduction in shoot & root length and total fresh and dry weight were decreased after 60 days at high quantities of electroplating industry effluent residue. Gomathi and Oblisamy (1992) observed such decrease in total fresh and dry weight of crop plant irrigated with paper mill effluent. Rajan et al., (2011) also reported such decrease in growth parameters when bendy was treated with different quantities of electroplating industry effluent residue.

The biochemical characteristic of cluster bean is presented in table 4. Chlorophyll a, b, total chlorophyll and carotinoides content were higher in treatment 1 and lower in treatment 6 Gupta and bishwas Ray (2005) also reported the lower content of chlorophyll in Withania somnifera plant exposed to higher concentration of metal. Anthocyanin content was higher in treatment 6 and lower in treatment 1.

In the present study the seed germination percentage shoot and root length, total fresh and dry weight and photosynthetic pigments like chlorophyll and carotinoides content increases gradually with increase in zinc electroplating industry effluent residue. These results coincide with the studies conducted on the influence of chromium and cadmium on germination, seedling growth and photosynthetic pigments of soybean Glycine max L.merr. Sankar Ganesh (2006).

Table 2: Physico-chemical characteristics of zinc electroplating industry effluent

S. No.	*Parameters*	*Value*
1	Ph	2
2	Electrical Conductivity (mS/cm)	8900
3	Total Solids (mg/l)	14,800
4	Total Dissolved Solids ”	14,600
5	Total Suspended Solids ”	200
6	Chloride ”	6390
7	Hardness ”	1120
8	Sulphate ”	1.646
9	Dissolved oxygen ”	56.56
10	BOD* ”	12.11
11	COD** ”	800
12	Calcium (ppm)	390
13	Magnesium ”	730
14	Sodium ”	375
15	Potassium ”	99
16	Zinc ”	7348

*BOD - Biological Oxygen Demand **COD - Chemical Oxygen Demand

Table 3: The Growth Parameter of cluster bean in different Treatment

		Treatment																
Parameters	Days	T0	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17
Germination	4	90	100	96	94	92	90	84	100	100	98	96	92	90	98	100	96	94	92
Shoot length	60	39.7	64	39.2	36.4	34.5	33.9	30.7	55.2	55.7	54.1	52.5	50.7	47.5	60.6	63.7	58.7	56.2	54
Root length	60	13.7	23.5	13.5	12.9	12.5	11.7	11.2	20.7	20.3	19.5	18.3	17.1	16.8	22.5	23.1	22.2	20.3	19.8
Fresh weight	60	9.6	19.3	9.3	9.0	8.7	8.6	8.1	16.5	16.4	16.3	16.1	15.8	15.4	19.0	19.2	18.7	18.1	17.8
Dry weight	60	1.5	4.0	1.5	1.4	1.3	1.3	1.1	3.4	3.3	3.1	3.0	3.0	2.9	3.8	3.9	3.6	3.5	3.3

Table 4: The Biochemical characteristic of cluster bean in different Treatment

		Treatment																
Parameters	Days	T0	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17
Chlorophyll a	60	2.2	5.1	2.2	1.9	1.8	1.1	1.6	3.6	3.5	3.6	3.2	2.9	2.8	4.8	5.0	4.8	4.4	4.3
Chlorophyll b	60	1.0	2.8	0.9	0.8	0.8	0.7	0.6	2.1	2.1	2.0	1.8	1.6	1.5	2.6	2.8	2.5	2.4	2.3
Total chlorophyll	60	3.3	7.9	3.2	2.8	2.6	2.4	2.3	5.7	5.6	5.6	5.0	4.6	4.3	7.5	7.8	7.3	6.9	6.6
Carotenoides	60	1.6	3.0	1.6	1.5	1.4	1.1	1.0	2.3	2.2	2.2	2.1	2.0	1.9	2.8	2.9	2.5	2.4	2.2
Anthocyanin	60	6.1	2.7	7.7	7.8	8.0	8.7	8.9	5.0	5.3	6.4	6.5	6.7	6.9	3.6	3.3	3.7	4.0	4.2

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