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

KEYWORDS: Impact, dye industry effluent residue, growth, biochemical characteristics, yield, lady's finger *Abelmoschus esculentus*

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ABSTRACT *The present study deals with the impact of Dye industry effluent residue on growth, biochemical characteristics and yield of Lady's Finger Abelmoschus esculentus grown for a period of 60 days. The Dye industry effluent was collected from Chinnalapatti, Dindigul District, Tamil Nadu, India. Physico – chemical characteristics such as pH, electrical conductivity, total solids, total dissolved solids, total suspended solids, hardness, sodium, potassium, calcium, magnesium, chloride, dissolved oxygen, Biological Oxygen Demand and copper were estimated. Different quantities of dye industry effluent residue such as 500, 1000, 1500, 2000 and 2500 mg were used for growth studies. Growth parameters such as seed germination shoot and root length, fresh and dry weight, biochemical characteristics such as chlorophyll a, b, total chlorophyll and carotenoide and yield performance such as number of fruits, weight and size were carried out on 20th, 40th and 60th day. Germination of Lady's finger is higher (86%) in treatment 1 with 500 mg of dye industry effluent residue and lower in treatment 2 with 1000 mg of residue. Shoot length, fresh and dry weight; chlorophyll a, b and total chlorophyll were higher in treatment 1 and lower in treatment 5. Carotenoid content is higher in treatment 1 and lower in treatment 5. The yield performance is higher in treatment 5 with 2500 mg of dye industry effluent residue.*

INTRODUCTION:

Waste water from textile industries has a strong effect on aquatic and terrestrial environment because it is discharged in high quantity and may contain many biocalcirant contaminations (Schonberger and Kaps, 1994). The coloured effluent damages the aesthetic quality of water and reduces light penetration and photosynthesis and some of the dyes are toxic, mutagenic, carcinogenic and allergic (Aksu and Cagastay, 2006). The effluents contains high concentration of metal based dyes, phenols, aromatics, amines etc. The presence of metal based coloured dyes and foaming chemicals in textile waste water not only retards biological activity but also cause metal toxicity to the aquatic and terrestrial life (Sarnaik and Kanekar, 1995). Moreover, mobilization of toxic metals from these sites leads to spread of metal contamination via ground and surface water posing health and environmental problems. Dye industries releases large quantity of heavy metals like copper, chromium, nickel and zinc. Lower concentration of metals is needed as nutrients for plants. The work related to the impact of dye industry effluent residue on growth, biochemical characteristics and yield performance of Lady's finger Abelmoschus esculentus is totally wanting. Hence the present study was carried out.

MATERIALS AND METHODS:

For the present study, dye industry effluent was collected from dye industry, Chinnalapati, Tamil Nadu, India, in plastic containers (20 liters). 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, sulphate, chloride, dissolved oxygen, Biological Oxygen Demand and Chemical Oxygen Demand were estimated(APHA, 1990).

Vegetable crop Lady's Finger Abelmoschus esculentus was selected for pot culture study based on surviving capacity, growth capabilities and economic value. Healthy, uniform, dried and pretreated quality seeds were procured from Horticultural College and Research Institute, Tamil Nadu Agricultural University, Periyakulam, Tamil Nadu, India and used for the present study.

Dye industry effluent was evaporated in the glass tray (3 lit) in order to collect residue. Residue was standardized for the present study by a pilot study with various weight ranges from 500 to 5000 mg. From the pilot study it was found that the dye industry effluent residue up to 2500 mg was suitable for germination and growth. For the present study the weight range of dye industry effluent residue was kept between 500 and 2500 mg (i.e 500, 1000, 1500, 2000 &2500). The seeds were sown in plastic pots (25 cm dia, 20 cm height) containing red soil, sand and cow dung in the ratio of 1: 1: 1. All the pots were kept in green house. In each treatment triplicates were maintained and regularly watered. The seedlings were allowed to grow in the respective pots for a period of 60 days with an interval of 20 days. The growth, biochemical and yield performance was carried out. The procedure adopted for the analysis of growth and biochemical characteristics and yield of vegetable crop is presented in table 1.

Table 1. Procedure followed for growth and biochemical characteristics and yield of vegetable crop

S. No.	Parameters	References
1.	Germination efficiency (%)	Carley and Watson (1969)
2.	Shoot length (cm)	Arts and Marks(1969)
3.	Root length "	Buris et al (1969)
4.	Total fresh weight (g)	"
5.	Total dry weight "	"
6.	Chlorophyll a (mg / g fw)	Arnon (1949)
7.	Chlorophyll b (mg / g fw)	"
8.	Total chlorophyll (mg / g fw)	"
9.	Carotenoides (M mole/g fw)	"
10.	Number of fruits	Panse and Sukhatme (1978)
11.	Weight	"
12.	Size	"

RESULTS AND DISCUSSION:

The physico- chemical characteristics of dye industry effluent is presented in Table 1. The pH of dye industry effluent was 8.2. Khobragade et al.,(2001) reported higher value of pH (9.1) in sugar industry effluent. The electrical conductivity was 3800 mS/ cm. Mariappan and Rajan (2002) reported higher value of electrical conductivity (11,575 mS/ cm) in tannery industry effluent. The BIS (Bureau of Indian Standards) permits only 400 mS/ cm) for electrical conductivity for the disposal

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of effluent in to the environment. The total dissolved solids of the dye industry effluent was 14950 mg/ l. Periyasamy and Rajan(2009) 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 of effluent into the environment.

Table 2 Physico- chemical characteristics of dye industry effluent

S. No.	Parameters		Average Values
1.	Colour		Reddish brown
2.	pH		8.2
3.	Electrical conductivity	m S / cm	3800
4.	Total Solids	mg / l	16000
5.	Total Dissolved Solids	"	14950
6.	Total Suspended Solids	"	1050
7.	Hardness	"	560
8.	Alkalinity	"	6400
9.	Chloride	"	630
10.	Dissolved Oxygen	"	3.232
11.	Dissolved Carbon dioxide	"	44
12.	Biological Oxygen Demand	"	65
13.	Chemical Oxygen Demand	"	744
14.	Sodium	ppm	9.29
15.	Potassium	"	0.21
16.	Calcium	"	5.34

The Chemical Oxygen Demand (COD) of dye industry effluent was 744 mg/l. Mariappan and Rajan (2002) reported the COD value of 272 mg/l. The BIS permits 100 mg/l for disposal of effluents in to the environment. The chloride content of the dye industry effluent was 630 mg/l. Khobragrade et al (2001) reported lower chloride (197mg/l) content in sugar industry effluent. The BIS permits up to 600 mg/l.

Effect of different quantities of dye industry effluent residue on seed germination (%), shoot and root length, total fresh and dry weight, chlorophyll a, b, total chlorophyll and carotenoides of Lady's finger Abelmoschus esculentus is presented in table 3. In the present study the germination percentage of Lady's finger was higher in T0 (96) (control) followed by T1 (86) and lower in T2 (58). Higher concentration of dye industry effluent 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 Caesalpinia coriaria.

Table 3 Effect of different quantities of dye industry effluent residue on Seed Germination, shoot and root length, total fresh and dry weight, chlorophyll a, b, total chlorophyll and carotenoides of Lady's finger Abelmoschus esculentus

Parameter	Days	Treatment					
		T_0	T_1	T_2	T_3	T_4	T_5
Germination (%)		96	86	58	68	69	72
Shoot length (cm)	20	5.5	5.4	4.9	4.4	4.2	3.9
	40	28.5	20.3	19.3	16.1	15.8	14.3
	60	34	29	28.2	24.1	26.4	25.3
Root length (cm)	20	4.2	5.2	4.7	3.8	4.4	5.3
	40	9.5	6.5	6.8	6.7	6.2	7.8
	60	10.7	8.0	9.5	18.5	10.5	15.5
Total fresh weight (g)	20	21.42	18.27	17.02	15.81	12.53	11.2
	40	31.23	34.63	30.4	26.43	20.26	18.56
	60	38.66	56.00	45.2	42.31	41.3	37.32
Total dry weight (g)	20	2.68	2.94	3.25	2.87	2.63	2.41
	40	3.71	4.93	5.43	4.79	4.39	3.83
	60	8.3	7.8	7.23	5.64	6.87	4.72
Chlorophyll a (mg / g fw)	20	0.382	1.967	1.704	1.565	1.414	1.198
	40	5.628	6.120	4.762	3.435	2.642	2.010
	60	2.023	9.532	5.432	5.362	4.324	3.708
Chlorophyll b(mg / g fw)	20	1.299	4.872	4.389	3.756	2.057	1.762
	40	5.324	5.823	6.037	5.037	3.012	2.004
	60	4.473	10.418	8.724	7.523	5.291	4.195
Total chlorophyll(mg/g fw)	20	1.681	6.839	6.093	5.954	3.471	2.96
	40	10.952	11.943	10.799	8.472	5.654	4.014
	60	6.402	19.95	14.156	12.885	9.615	7.903
Carotenoides(Mmole/gfw)	20	3.487	3.168	3.082	2.946	2.478	1.965
	40	25.760	24.921	23.643	23.173	20.844	19.304
	60	48.287	47.875	47.531	45.048	43.756	41.189

T_0 – Red soil +Sand + Cow dung (1:1:1) (control)
T_1 - Red soil +Sand + Cow dung (1:1:1) + 500 mg of dye industry effluent residue
T_2 - Red soil +Sand + Cow dung (1:1:1) +1000 mg of dye industry effluent residue
T_3 - Red soil +Sand + Cow dung (1:1:1) +1500 mg of dye industry effluent residue
T_4 - Red soil +Sand + Cow dung (1:1:1) + 2000 mg of dye industry effluent residue
T_5 - Red soil +Sand + Cow dung (1:1:1) + 2500 mg of dye industry effluent residue

In the present study shoot length, fresh and dry weight of lady's finger was higher in T_0 followed by T_1 (500 mg of dye industry effluent residue).Higher concentration of the dye industry effluent residue had negative effect on shoot length, fresh and dry weight. Similar study was reported in Parkinsonia aculeata and Caesalpinia coriaria treated with 10% of tannery effluent (Mariappan and Rajan, 2002).Chlorophyll a, b, total chlorophyll and carotenoides content were higher in T_0 followed by T_1.The total chlorophyll content is the indicator of photosynthetic activities of plants. The total chlorophyll content was decreased with increasing concentration of dye industry effluent residue when compared to control. This may be due to the increasing concentration of total dissolved solids, chloride, sulphate and nitrate which destabilize the chlorophyll pigment, which in turn reduces the leaf chlorophyll content (Khan and Jain, 1995). Effect of different quantities of dye industry effluent residue on yield performance of Lady's finger is presented in Table 4. Among the different treatments the yield performance of Lady's finger such as number of fruits, weight and size were higher in T_5 and lower in T_1.

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Table 4. Effect of different quantities of Dye industry effluent Residue in relation to yield performance of Lady's finger
Abelmoschus *esculentus*.

S. No.	Parameter	Treatment					
		T0	T1	T2	T3	T4	T5
1.	Number of fruits	13	10	11	15	16	17
2.	Weight (g)	230	200	275	320	335	350
3.	Size (cm)	12.5	13.7	14.2	15.6	16.4	18.7

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