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Field Level Study on The Utilization of Dyeing Industry Effluent Residue on Growth of Brinjal *(Solanum melongena)*

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ABSTRACT

The present study deals with the field level study on the impact of different quantities of dyeing industry effluent residue(0,200, 400, 600, 800, 1000 and 1200 mg) on growth, biochemical characteristics and yield of Brinjal Solanum melongena. The growth characteristics of Brinjal Solanum melongena such as seed germination percentage, shoot length, root length, total fresh weight, total dry weight, leaf area index and vigour index were higher in T4 with 800mg and lower in T6 with 1200 mg of dyeing industry effluent residue on 45th day. The chlorophyll a,b, total chlorophyll ,carotenoid and total soluble protein content of Lady's finger was higher in T4 and lower in T6 . The total sugar of brinjal was higher in T4 and lower in T6. The length, weight and number of fruits of brinjal were higher in T4 with 800mg and lower in T6 with 1200mg of dyeing industry effluent residue.

KEYWORDS *Field level study, dyeing industry effluent residue, growth, brinjal.*

INTRODUCTION:

Environmental pollution is one of the major problems of the world and increasing day by day due to urbanization and industrialization. Over the last few decades large scale usage of chemicals in various human activities has grown very fast, particularly in a country like India which has to go for rapid industrialization in order to sustain growing population (Mustafa *et al*., 2010). The contamination of the environment has occurred through effluents of variety of industries like distilleries, paper, refineries, food, tannery and many more. The various toxic chemicals, heavy metals, acids, pesticides, persistent organic compounds and toxic salts discharged by these industries accumulated in the soil gradually, resulting in environmental contamination. Long term use of waste water on agricultural lands contributes significantly to the build up of the elevated levels of these metals in the soil and plants (Mapanda *et al*., 2005) which is of serious concern. Among Industries, textile dyeing industry releases toxic chemicals along with heavy metals like Copper, Cadmium, Zinc, Nickel and Lead. Some of the heavy metals acts as micronutrients for the growth and development of plants. It is well known fact that in the present context there is a limited availability of organic manure in agriculture due to population explosion, intensive agriculture, reduction in livestock population etc. Therefore, the judicious application of nutrients is essential to keep the soil fertile and to make the agriculture sustainable. Irrigating industrial effluent provides farmers with a nutrient enriched water supply and society with a reliable and inexpensive system for wastewater treatment and disposal (Feigin *et al.,* 1991). The work related to the utilization of dyeing industry effluent residue for growing crop plants under field trail is totally wanting. In this context the present study was carried out.

MATERIALS AND METHODS

For the present study, dyeing industry effluent was collected from Chinnalappatti, Dindigul, Tamil Nadu, India, in plastic containers (20L). After collection, the effluent was immediately transported to the laboratory for analysis 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 (HNO_3,H_2SO_4 and $HClO_4$ 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 different quantities from 200 to 2000 mg. From the pilot study it was observed that the dyeing industry effluent residue beyond 1200 mg is not suitable for germination. Hence, in the present study, the quantities between 200 and 1200 mg of dyeing industry effluent residue were chosen. 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 seven treatments supplied with different quantities of dyeing industry effluent residue such as 0, 200,400, 600, 800, 1000 and 1200 mg for treatment 0 (control), 1, 2, 3, 4, 5 and 6 respectively and had three replications in the field layout. The experimental field was irrigated by well water. Ten plants Brinjal S*olanum melongena* were raised in each micro plot with appropriate spacing between rows and plants. The growth parameter such as shoot and root length, fresh and dry weight, vigour and leaf area index, biochemical parameters such as chlorophyll a, chlorophyll b, total chlorophyll, carotenoides, anthocyanin, total soluble sugar, total soluble protein, L-proline, free amino acids and leaf nitrate and yield were estimated after 45 days.

RESULTS AND DISCUSSION

Impact of different quantities of dyeing industry effluent residue on growth characteristics of Brinjal Solanum melangena is presented in Table 1. It was observed that the germination efficiency was higher in T4 (100%) and lower in T6 (40%).Rajan et al(2015) reported similar germination efficiency of Lady's finger Abelmoschus esculentus when treated with different quantities of dyeing industry effluent. Kaushik *et al*.,(2005) reported that the dyeing industry effluent shows better result with 50% water diluted effluent samples then 100%effluent. It clearly in that the decreased load of the concentration in the effluent leads to improved germination and growth of the plants. Vijayakumari (2003) reported that soap factory effluent was toxic to seed germination of finger and pearl millet, but when the effluent was diluted to 2.5 to 5.0% it enchanced the seed germination. In the present study, the shoot length, root length, total fresh weight and total dry weight was higher in T4 (20.14cm), followed by T3 (19.17cm) and lower in T0 (8.21cm) in Brinjal. The higher concentration of effluent residue had negative effect on growth characteristics. Mariappan and Rajan (2002) was reported similar results in *Acacia Ferruginea* treated with 10% of tannery effluent. Sreya Basu (2013) reported that the shoot and root length decreased with increasing concentration of treated chrome plating industry effluent on Cow pea. Behra and Misra (1982) reported the distillery effluents on rice seedlings, showed that the fresh and dry weight of seedlings have reverse relationship with effluent concentration. Rajan *et al.,* (2013) also reported that the both weight parameters increased in zinc electroplating industry effluent residue (500 and 750mg) on Brinjal. In the present study, the leaf area and vigour index increases with increase in concentration T4 (37 cm2) and lower in T6 (15 cm2). Vijayaragavan *et al.,* (2011) showed that the leaf area index gradually decreased with higher concentration of sugar mill effluent. The vigour index area was higher in T4 (6790%) and lower in T3 (1344%). Sandeep *et al.,* (2008) reported that the leaf area and vigour index higher was in 50% treated distillery effluent but higher concentration of effluent inhibited the leaf area and vigour index.

Table 1 Impact of different quantities of dyeing industry effluent residue on growth

Parameters	Treatments						
	T_0	T_1	T_2	T_3	T_4	T_5	T_6
Germination(%)	80	80	90	90	100	50	40
Shoot length (cm)	32.0 ± 0.01	39.0 ± 0.06	43.5 ± 0.10	48.4 ± 0.01	49.0 ± 0.11	33.1 ± 0.09	27.1 ± 0.01
Root length (cm)	7.0 ± 0.02	8.8 ± 0.06	14.5 ± 0.01	15.8 ± 0.1	18.9 ± 0.6	11.3 ± 0.1	9.0 ± 0.6
Total Fresh weight(g)	8.21 ± 0.5	13.68 ± 0.1	15.01 ± 0.6	19.70 ± 0.1	20.14 ± 0.7	13.59 ± 0.7	10.70 ± 0.1
Total Dry weight (g)	0.62 ± 0.1	0.88 ± 0.6	1.12 ± 0.1	1.28 ± 0.7	1.49 ± 0.2	1.21 ± 0.5	1.10 ± 0.1
Leaf area index (cm^2)	15.0 ± 0.02	23.0 ± 0.01	28.0 ± 0.06	31.0 ± 0.01	37.0 ± 0.01	30.0 ± 0.07	21.0 ± 0.01
Vigour index (%)	3120 ± 0.07	3824 ± 0.02	5130 ± 0.06	5778 ± 0.05	6790 ± 0.80	2060 ± 0.06	1344 ± 0.03

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

In the present study, the effect of various quantities of dyeing industry effluent on chlorophyll *a, b* and total soluble sugar, total soluble protein and L-proline were higher in T4. Dhanam *et al,. (*2009) reported that the biochemical parameters *viz.,* chlorophyll, carotenoids, total sugars, starch, protein and amino acid contents increased at lower concentrations, maximum increase at 25% concentration. Enhancement of chlorophyll could due to high nutrient uptake, synthesis of amino acids and translocation probably facilitated by optimum availability of iron and magnesium and also due to reduction in phenol content in the treated dairy effluent. In present study L-proline content was higher at T6 (5.34 µmole g fw) and lower in T4 (1.14 µmole g fw). The leaf nitrate of Brinjal was higher in T6 (5.82 mg). Dilshadatabassum *et al.,* (2013) reported that higher concentration (100%) of industry effluent increased leaf nitrogen in Mustard.

Table 2 Effect of different quantities of Dyeing industry effluent residue on Biochemical

Parameters	Treatments						
	T_0(Control)	T_1	T_2	T_3	T_4	T_5	T_6
Chlorophyll a	1.0± 0.106	2.0±0.14	3.9± 24.64	5.0± 1.26	6.02± 0.42	3.90± 0.21	2.1± 0.11
Chlorophyll b	1.2± 2.16	2.3±2.14	3.8± 0.02	4.92± 0.24	5.91± 0.11	4.50± 0.42	2.01±0 .11
Total Chlorophyll	2.12± 2.6	3.51±0.23	6.13± 1.03	8.19± 0.23	9.8± 0.43	7.1± 1.11	7.3± 0.24
Carotenoid	2.84± 0.44	2.50±1.21	3.80± 0.14	3.98± 0.01	4.23± 0.13	3.8± 0.14	3.5± 0.24
Anthocyanin	3.5± 0.42	3.41±0.06	3.3± 0.15	3.98± 0.02	1.86± 0.94	4.2±0.73	4.78±0.46
Total soluble Sugar	6.54± 0.01	9.01±0.41	11.00± 0.41	11.14±0.32	11.56± 1.09	9.5±0.41	6.5 ± 0.43
Total protein	6.2± 0.03	7.20±0.19	8.52± 0.14	10.124±0.2	10.91± 0.01	8.21±0.24	5.13 ± 0.42
L-Proline	3.04± 0.49	2.9±0.42	2.85± 0.12	2.67±0.25	1.14± 0.01	5.24±0.04	5.34± 0.04
Free amino acids	3.5± 0.04	3.04±0.01	2.71± 0.42	5.15±0.42	2.35± 0.43	4.51±0.01	5.82± 0.01
Leaf Nitrate	6.81± 1.09	6.5± 0.10	6.15±1.21	5.8±1.20	5.50± 0.24	8.51±0.91	8.94±2.62

All the values are mg/gfw except carotenoid, anthocynin, Total soluble sugar, Total protein and L-Proline (µmole/gfw)

All the values are averages of 5 individual observations (Mean±SE)

In the present study, the impact of dyeing industrial effluent on yield performance such as length of fruits, weight of fruits, number of fruits were higher in T4. Wastewater application increased the yield characteristics like 1000 seed weight and seed yield, where an increase of 12.59% and 3.89% was shown respectively and among different doses of nitrogen proved optimum, The processes involved in seed production like vegetative growth , formation of storage organs and seed filling help in determining the seed yield (Yoshida 1972). Mahimairaja and Bolan (2004) reported that low doses of distillery spent wash remarkably improved the yield of dry land crops (ragi, ground nut, sorghum and green gram).

Table 3 Effect of various quantities (200,400,600,800, 1000 and 1200) of dyeing industry effluent residue on Length, weight and number of Brinjal Solanum melongena on 90th day(Field trail)

Treatment	Length	Weight	Number
T0	9.70 ± 0.50	5.994 ± 0.02	5.0 ± 0.09
T1	10.2 ± 0.08	6.021 ± 0.80	7.0 ± 0.06
T2	10.9 ± 0.03	6.573 ± 0.07	8.0 ± 0.90
T3	11.6 ± 0.07	7.862 ± 0.04	7.0 ± 0.02
T4	14.2 ± 0.02	9.474 ± 0.08	9.0 ± 0.20
T5	7.10 ± 0.80	5.527 ± 0.90	5.0 ± 0.09
T6	5.40 ± 0.04	5.422 ± 0.40	4.0 ± 0.04

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