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# Impact of Dyeing Industry Effluent Residue on Growth, Biochemical Characteristics and Yield of Bhendi Abelmoschus Esculentus

KEYWORDS: Dyeing industry effluent residue, growth, biochemical, yield, bhendi

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**ABSTRACT** *The present study deals with the impact of different quantities of dyeing industry effluent residue on growth, biochemical characteristics and yield of Bhendi Abelmoschus esculentus. Germination percentage, shoot length, root length, the total fresh weight, total dry weight and vigour index of Bhendi were higher in T1 (200 mg of residue). The chlorophyll a, total chlorophyll, carotenoid content and total soluble sugar of Bhendi were higher in T3.The anthocyanin, free amino acids L- proline, leaf nitrate, peroxidase and catalase of Bhendi were higher in T6.The total soluble protein of Bhendi was higher in T2 . The nitrate reductase content of Bhendi was higher in T1 .The length, weight and number of fruits of Bhendi were higher in T3 with 600 mg of dyeing industry effluent residue. From the results it is inferred that the growth parameters yield performance were higher in T1 (200 mg) and T3 (600 mg) respectively.*

## INTRODUCTION

Environmental pollution is one of the major problems of 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 release of organic compounds and heavy metals is one of the key factors that exert negative influence on man and environment causing toxicity to plants (Chandra *et al.*, 2010). Of the various sources of pollutants industrial effluents containing heavy metals pose a threat to the ecosystem. Among industries, the textile industry is considered to be one of the world's worst polluters because it uses a vast amount of chemicals and water during processing. Indian dyeing and dyestuff industries have grown over 50% during the last decade. India is now the second largest producer of dyes and dyestuffs in Asia after China. The use of dyeing effluents for irrigation may be an alternate for recycling if used rationally and in appropriate concentration (Kumawat *et al.*, 2001). The dyeing effluent is highly toxic in nature as it contains high suspended solids, COD, dye and chemicals along with concentration of heavy metals like Copper, Cadmium, Zinc, Nickel and Lead. Some of the heavy metals acts as micronutrients for the growth and development of plants. A novel strategy is the use of effluent residue containing heavy metals for growth of plants. The present study was conducted to evaluate the impact of dyeing industry effluent on growth, biochemical characteristics and yield of Bhendi *Abelmoschus esculentus.*

## 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. The dyeing Industry effluent was evaporated in the plastic tray (10 L) in order to collect residue. The residue was standardized for the present study by a pilot study with various weight ranges from 200 to 2000mg. From the pilot study it was found that the dyeing industry effluent residue beyond 1200mg is not suitable for germination. Hence, in the present study, the weight ranges of dyeing industry effluent residue were kept between 200 and 1200mg. Both control and experimental plants were grown for a period of 60 days.. Garden soil and sand were collected from the nursery, Department of Biology, Gandhigram Rural Institute - Deemed University, Gandhigram. For the collection of red soil a trench of 25cm depth was dug out and the red soil was taken from the trench. The seeds of Bhendi were soaked in ground water and kept as control. Both the control and seeds were allowed to grow in plastic pots, (25cm diameter, and 20 cm height) containing a mixture of red soil, sand and cow dung in the ratio 1:1:1. The experimental plants were supplied with different quantities of dyeing industry residue such as 0, 200, 400, 600, 800, 1000, and 1200mg for treatment 1 (control) 2, 3, 4, 5, 6 and 7 respectively.

The experimental results are presented in the form of tables using Microsoft Excel (Version 2007). Mean and Standard deviation were also calculated with the help of the same tool. Two-way ANOVA method was used for the analysis using MATLAB (Version R2008a). The data was input manually and computed. The output results obtained from the software indicate the differences between the treatments and days. Sum of square variations (SS). Degree of freedom (df). Variability of sample means (MS), critical probability (prob) were also obtained.

## RESULTS AND DISCUSSION

Effect of different quantities of dyeing industry effluent residue on growth characteristics of Bhendi *Abelmoschus esculentus* is presented in Table 1. In the present study the germination percentage of Bhendi was higher in $T_0$ (100%) followed by $T_1$ (93%) and lower in $T_6$ (70%) and these results showed that higher concentration of dyeing industry effluent residue (1200mg) inhibited the seed germination. Kaushik et al (2005) reported that the textile industry effluent did not show any inhibitory effect on seed germination at lower concentration (6.25%). Vijayakumari (2003) reported that soap factory was toxic to seed germination of finger and pearl millet, but when the effluent was diluted to 2.5 to 5.0% it enhanced the seed germination. Two way ANOVA (analysis of variance) of shoot length, root length, total fresh and dry weight and leaf area index of bhendi is presented in Table 2. In the present study the shoot length, root length, total fresh weight and total dry weight were higher in $T_1$ (200 mg). Behra and Mishra (1982) reported that the shoot and root length, total fresh and dry weight of the seedling showed a reverse relationship with effluent concentration. Muthalagi and Mala (2007)

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reported that 100% sewage concentration on *Trigonella Foenum* (Fenugrick) reduced the length of root and shoot from 42 – 32%, 2.10 to 1.49 cm and 2.08 to 1.49 cm, respectively. In the present study the leaf area index increases with increase in concentration. The leaf area index was higher in $T_6$ (43.25 $cm^2$). Wastewater supplies nutrients and enhances leaf area and chlorophyll content (Chandra et al 2009).The vigour index was higher in $T_1$ (5319.6%). Mariappan (2002) reported that the vigour index decreased with increasing concentration of treated tannery effluent in tree species. Rani and Alikhan (2007) reported that the lower concentration (25%) of distillery effluent showed higher vigour index in two cultivars of *Oryza sativa* L. Cv.Saka-4 and Pusa 44.

**Table 1 Effect of different quantities of Dyeing industry effluent residue on growth characteristics of Bhendi A*belmoschus esculentus* on 60th day.**

| Treatment | Parameters Germination (%) | Shoot Length (cm) | Root Length (cm) | Total Fresh Weight (g) | Total Dry Weight (g) | Leaf Area Index (cm²) | Vigour Index(%) |
|---|---|---|---|---|---|---|---|
| $T_0$ | 100 | 37.1±0.44 | 11.8±0.45 | 10.561±0.381 | 1.904±0.315 | 30.25±0.929 | 3400 |
| $T_1$ | 93 | 59±0.472 | 20.1±0.3 | 17.472±0.542 | 4.232±0.121 | 36.9±1.836 | 5319.6 |
| $T_2$ | 80 | 38.2±0.7 | 14.8±0.4 | 10.253±0.227 | 1.648±0.029 | 34.1±1.358 | 3088 |
| $T_3$ | 87 | 35.3±0.74 | 10.7±0.46 | 9.680±0.390 | 1.810±0.404 | 38.25±1.689 | 2827.5 |
| $T_4$ | 75 | 39.5±0.32 | 1.7±0.03 | 8.518±0.355 | 1.428±0.107 | 39.3±0.673 | 2757.5 |
| $T_5$ | 83 | 42.2±0.62 | 12.2±0.35 | 9.867±0.853 | 3.985±0.306 | 41.25±10.01 | 3444.5 |
| $T_6$ | 70 | 52.6±0.40 | 10.9±0.413 | 13.496±0.65 | 4.040±0.090 | 43.25±6.557 | 3304 |

The Values are averages of five observations. Mean±SE

T0-Red soil+ Sand+ Cow dung (1:1:1) T1- Red soil + Sand +Cow dung (1:1:1) + 200mg of dye industry effluent residue

T2- Red soil + Sand +Cow dung (1:1:1) + 400mg of dye industry effluent residue

T3- Red soil + Sand +Cow dung (1:1:1) + 600mg of dye industry effluent residue

T4- Red soil + Sand +Cow dung (1:1:1) + 800mg of dye industry effluent residue

T5- Red soil + Sand +Cow dung (1:1:1) + 1000mg of dye industry effluent residue

T6- Red soil + Sand +Cow dung (1:1:1) + 1200mg of dye industry effluent residue

**Table 2 Two way ANOVA (Analysis of Variance) of shoot length, root length, total fresh and dry weight and leaf area index of Bhendi.**

| Parameters | Sources of variation | SS | df | MS | F | Prob>F |
|---|---|---|---|---|---|---|
| Shoot Length | Days | 2020.04 | 2 | 1010.02 | 119.52 | 1.19 |
| | Treatments | 812.78 | 6 | 135.46 | 16.03 | 4.27 |
| | Error | 101.41 | 12 | 8.45 | | |
| | Total | 2934.23 | 20 | | | |
| Root Length | Days | 130.27 | 2 | 65.1348 | 88.7 | 16.46 |
| | Treatments | 115.57 | 6 | 19.2616 | 26.23 | 3.12 |
| | Error | 8.81 | 12 | 0.7342 | | |
| | Total | 254.65 | 20 | | | |
| Total Fresh Weight | Days | 210.937 | 2 | 105.469 | 54.44 | 0 |
| | Treatments | 48.504 | 6 | 8.084 | 4.17 | 0.169 |
| | Error | 23.246 | 12 | 1.937 | | |
| | Total | 282.687 | 20 | | | |
| Total Dry Weight | Days | 17.3397 | 2 | 8.6698 | 20.06 | 0.0001 |
| | Treatments | 5.1545 | 6 | 0.8590 | 1.99 | 0.1465 |
| | Error | 5.1858 | 12 | 0.4321 | | |
| | Total | 27.68 | 20 | | | |
| Leaf Area Index | Days | 2906.69 | 2 | 1454.34 | 84.08 | 0 |
| | Treatments | 183.25 | 6 | 30.54 | 1.77 | 0.1892 |
| | Error | 207.57 | 12 | 17.3 | | |
| | Total | 3299.5 | 20 | | | |

SS-Sum of square Variation, df- Degree of Freedom MS- Variability of Sample Mean, F- Critical Probability Value Prob-Probability

Effect of different quantities of dyeing industry effluent residue on biochemical characteristics of *Abelmoschus esculentus* is presented in Table 3. In the present study the effect of different quantities of dyeing industry effluent on chlorophyll a, total chlorophyll, carotenoids and total soluble sugar were higher in $T_3$ (600 mg) whereas chlorophyll b was higher in $T_4$ (800 mg). Singh and Agarwal (2009) reported that total chlorophyll and carotene significantly increasing with sludge quantity. Anthocyanin, free amino acids L- proline, catalase and leaf nitrate were higher in $T_6$ (1200 mg). Total protein and nitrate reductase were higher in $T_2$ (400 mg) and $T_1$ (200 mg) respectively. Richa Marvari and Khan (2012) reported that total chlorophyll showed a reduction of 72.44% while protein showed a reduction of 71.65%. Karunyal *et al* (1994) reported that the chlorophyll and protein contents of *Oryza sativa* were found to decrease with the effluent concentration of 75 and 100%. Kaushik *et al* (2005) reported that the chlorophyll and carotenoid contents of three different cultivars of wheat did not show any inhibitory effect at low concentration (6.25%) of textile effluent. Rani and Shrivastava (1990) reported that the protein content in peas registered a decreasing trend with increasing concentration of spent wash.

**Table 3 Effect of different quantities of Dyeing industry effluent residue on Biochemical characteristics of Bhendi *A.esculentus* on 60th day (pot culture).**

| Parameters | Treatments $T_0$(Control) | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ |
|---|---|---|---|---|---|---|---|
| Chlorophyll a | 25±0.100 | 66.10±0.14 | 64.06±.24.64 | 77.57±1.20 | 67.22±0.42 | 72.97±0.21 | 68.80±.111 |
| Chlorophyll b | 28.63±2.15 | 25.05±2.14 | 22.46±0.02 | 20.92±0.24 | 30.71±0.11 | 21.70±0.42 | 13.99±2.11 |
| Total Chlorophyll | 46.62±2.6 | 89.21±0.23 | 87.12±1.03 | 98.49±0.23 | 97.93±0.43 | 94.56±1.11 | 82.84±0.24 |
| Carotenoid | 0.93±0.44 | 1.10±1.21 | 61.20±0.14 | 1.34±0.01 | 1.106±0.13 | 0.99±0.14 | 0.73±0.24 |
| Anthocyanin | 5.08±0.42 | 5.81±0.05 | 55.07±0.15 | 6.35±0.02 | 7.28±0.94 | 6.59±0.73 | 9.12±0.46 |
| Total soluble Sugar | 10.64±0.01 | 11.41±0.41 | 11.19±0.41 | 11.42±0.32 | 9.14±1.09 | 8.25±0.41 | 5.17±0.43 |
| Total protein | 1.43±0.03 | 1.50±0.19 | 1.79±0.14 | 1.614±0.27 | 1.69±0.01 | 1.421±0.24 | 1.35±0.42 |
| Free amino acids | 1.68±0.04 | 1.74±0.01 | 1.41±0.42 | 2.15±0.42 | 2.35±0.43 | 2.61±0.01 | 2.95±0.01 |
| L-Proline | 1.14±0.49 | 1.26±0.42 | 1.35±0.12 | 1.47±0.23 | 1.59±0.01 | 1.84±0.04 | 1.89±0.04 |
| Catalase | 3.92±2.41 | 3.95±0.26 | 3.96±0.09 | 4.12±0.94 | 4.36±1.00 | 4.52±0.14 | 4.79±0.46 |
| Peroxidase | 0.95±0.02 | 1.01±0.26 | 1.03±0.26 | 1.22±0.14 | 1.34±1.29 | 1.57±0.29 | 1.64±0.94 |
| Nitrate Reductase | 12.46±0.19 | 11.09±0.44 | 10.24±0.64 | 10.03±0.41 | 9.42±0.24 | 8.64±0.42 | 8.12±0.20 |
| Leaf Nitrate | 15.01±1.09 | 15.15±0.10 | 15.25±1.21 | 15.64±1.20 | 15.70±0.24 | 15.81±0.91 | 15.91±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)

Effect of different quantities of dyeing industry effluent residue on yield of Bhendi *Abelmoschus esculentus* is presented in Table 4. In the present study the effect of different quantities of dyeing industry effluent on yield performance such as number of fruits, length of fruits and weight of fruits were higher in $T_3$ (600 mg). Mahimairaja and Bolan (2004) reported that low doses of distillery spent wash remarkably improve the yield of dry land crops (ragi, ground nut, sorghum and green gram). Rajannan *et al* (1998) reported that the application of spent wash with 50 times dilution in rice resulted in normal yield. Singh *et al* (2011) reported that tannery waste at lower concentration promotes the yield of *Chrysanthemum* cuttings.

**Table 4 Effects of different quantities of Dyeing industry effluent residue on Length, Weight and Number of Bhendi A*.esculentus* on 60th day (pot culture).**

| Treatment | Length | Weight | Number |
|---|---|---|---|
| $T_0$ (control) | 10.9 | 5.994 | 8 |
| $T_1$ | 9.7 | 6.021 | 5 |
| $T_2$ | 10.2 | 5.573 | 8 |
| $T_3$ | 12.4 | 6.862 | 11 |
| $T_4$ | 7.6 | 4.474 | 6 |
| $T_5$ | 5.1 | 5.527 | 5 |
| $T_6$ | 5 | 5.422 | 4 |

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