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ORIGINAL RESEARCH ARTICLE

# Phytotoxicity Analysis of Untreated and Bacterial Consortium Treated Textile Dye Effluent

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**ABSTRACT**

In the present study, phytotoxicity analysis of untreated and bacterial consortium treated (*Bacillus odyssey* + *Bacillus thuringiensis* + *Bacillus subtilis*) textile dye effluent was carried out in five different agricultural crops *viz*., Paddy, Groundnut, Maize, Blackgram & Greengram. The germination percentage was less with untreated textile dye effluent treatment when compared to bacterial consortium treated textile dye effluent and water. The untreated textile dye effluent affected the length of plumule and radical significantly. It was observed that, maximum germination percentage, length of plumule and length of radical was noticed by the control treatment containing water alone followed by the bacterial consortium treated textile dye effluent. Minimum germination percentage, length of plumule and length of radical was noticed in untreated textile dye effluent.

**Key words**: Textile dye effluent, Bacterial consortium, Phytotoxicity analysis and Agricultural crops.

## 1. INTRODUCTION

Environmental pollution has been recognized as one of the major problems of the modern world [1, 2]. The increasing demand for water and dwindling supply has made the treatment and reuse of industrial effluents an attractive option [3]. One of the most important environmental pollution problems is the color in water courses, although some of this color is normally present and of "natural" origins (e.g. the color originates from the activity of some microorganisms in ponds), a considerable proportion, especially in the lower reaches of rivers draining large industrial conurbations, originates from industrial effluents [4]. Some colored effluents are associated with the production and use of dyestuff [5, 6].

Pollution problems due to textile industry effluents have increased in recent years. From the available literature it can be estimated that approximately 75% of the dyes discharged by textile processing industries belong to the classes of reactive (36%), acid (25%) and direct (15%) dyes [7]. In these classes, the azo dyes are the most important chemical class of synthetic dyes and pigments, representing between 60% and 80% of the organic dyes used in industries such as the textile, leather, plastic, cosmetic and food industries [8]. Recent studies have shown that azo dyes contribute to the mutagenic activity of ground and surface waters polluted by textile effluents [9, 10]. Furthermore, their discharge into surface water leads to aesthetic problems and obstructs light penetration and oxygen transfer into bodies of water, hence affecting aquatic life. Moreover, it is very difficult to treat textile industry effluents because of their high BOD, COD, heat, colour, pH and the presence of metal ions [11]. In recent years, new processes for dye degradation and wastewater reutilization have been developed [12]. In particular, systems based on biological processes using a large variety of bacterial strains, allow for degradation and mineralization with a low environmental impact and without the use of potentially toxic chemical substances, under mild pH and temperature conditions [13, 14].

Several physico-chemical decolorization techniques have been reported, few of them were accepted by the textile industries [15]. The physical and chemical methods have disadvantages of being highly expensive, coupled with the formation of large amount of sludge and the emission of toxic substances. In addition, the

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accumulation of concentrated sludge creates a disposal problem. The general approach of bioremediation is to improve the natural degradation capacity of the native organism. Several microorganisms have been reported by number of investigators, having the capacity to decolorize various textile azo dyes [16, 17] in addition to azo dyes some have ability to metabolize other classes of dyes [18]. The degradation of azo dyes produces aromatic amines, which are carcinogenic, and mutagenic. Recently, several reports appeared showing that the microorganism has ability, not only to decolorize dyes but also detoxify it [19, 20, 21].

## 2. MATERIALS AND METHODS

### 2.1. Collection of Textile dye effluent

The dye house effluent was collected from a dyeing unit in Theco Silks, Thirubhuvanam region, Kumbakonam district, Tamil Nadu, India. It was refrigerated at 4°C and used without any preliminary treatment.

### 2.2. Phytotoxicity analysis of untreated and bacterial consortium treated Textile dye effluent

Phytotoxicity tests were performed in order to assess the toxicity of the untreated and bacterial consortium (*Bacillus odyssey* + *Bacillus thuringiensis* + *Bacillus subtilis*) treated textile dye effluent. The phytotoxicity study was carried out at room temperature on five kind of seeds commonly used in the Indian agriculture. Seeds of paddy (*Oryza sativa* L.), groundnut (*Arachis hypogoea* L.), maize (*Zea mays* L.), blackgram (*Vigna mungo* L.) and greengram (*Vigna radiata* L.) (10 seeds) were sprayed separately with 10 ml of untreated textile dye effluent and bacterial consortium treated textile dye effluent per day. Control set was carried out using distilled water at the same time. Germination (%) as well as the length of plumule and radical was recorded after 7 days.

## 3. RESULTS AND DISCUSSION

The phytotoxicity analysis of untreated and bacterial consortium treated textile dye effluent was carried out in five different agricultural crops *viz*., Paddy (*Oryza sativa* L.), Groundnut (*Arachis hypogoea* L.), Maize (*Zea mays* L.), Blackgram (*Vigna mungo* L.) & Greengram (*Vigna radiata* L.) and the results were tabulated in (**Table 1- 5**).

The germination percentage of five different agricultural crop seeds (Paddy, Groundnut, Maize, Blackgram and Greengram) was less with untreated textile dye effluent treatment when compared to bacterial consortium (*Bacillus odyssey* + *Bacillus thuringiensis* + *Bacillus subtilis*) treated textile dye effluent and water. The untreated textile dye effluent affected the length of plumule and radical significantly. It was observed that, maximum germination percentage, length of plumule and length of radical was noticed by the control treatment containing water alone followed by the bacterial consortium (*Bacillus odyssey* + *Bacillus thuringiensis* + *Bacillus subtilis*) treated textile dye effluent. Minimum germination percentage, length of plumule and length of radical was noticed in untreated textile dye effluent.

**Table 1: Phytotoxicity assay of treated and untreated textile dye effluent against Paddy (*Oryza sativa* L.)**

| S. No | Treatments | Paddy (*Oryza sativa* L.) | | |
|---|---|---|---|---|
| | | Germination (%) | Length of plumule (cm) | Length of radicals (cm) |
| 1 | Control (Water alone) | 100 | 19.90±0.5 | 10.01±0.8 |
| 2 | Effluent alone | 50 | 10.55±0.6 | 4.06±0.2 |
| 3 | Bacterial consortium treated textile dye effluent | 90 | 16.70±0.3 | 7.13±0.4 |

*Values are mean of three experiments ± SEM, significantly different from the control (Seed germination in water) by one – way analysis of variance (ANOVA) with Tukey – Kramer comparison test.

**Table 2: Phytotoxicity assay of treated and untreated textile dye effluent against Groundnut (*Arachis hypogoea* L.)**

| S. No | Treatments | Groundnut (*Arachis hypogoea* L.) | | |
|---|---|---|---|---|
| | | Germination (%) | Length of plumule (cm) | Length of radicals (cm) |
| 1 | Control (Water alone) | 100 | 19.90±0.5 | 10.01±0.8 |
| 2 | Effluent alone | 64 | 10.55±0.6 | 4.06±0.2 |
| 3 | Bacterial consortium treated textile dye effluent | 92 | 16.70±0.3 | 7.13±0.4 |

*Values are mean of three experiments ± SEM, significantly different from the control (Seed germination in water) by one – way analysis of variance (ANOVA) with Tukey – Kramer comparison test.

**Table 3: Phytotoxicity assay of treated and untreated textile dye effluent against Maize (*Zea mays* L.)**

| S. No | Treatments | Maize (*Zea mays* L.) | | |
|---|---|---|---|---|
| | | Germination (%) | Length of plumule (cm) | Length of radicals (cm) |
| 1 | Control (Water alone) | 100 | 19.90±0.5 | 10.01±0.8 |
| 2 | Effluent alone | 60 | 10.05±0.2 | 4.00±0.5 |
| 3 | Bacterial consortium treated textile dye effluent | 84 | 16.35±0.7 | 7.01±0.2 |

*Values are mean of three experiments ± SEM, significantly different from the control (Seed germination in water) by one – way analysis of variance (ANOVA) with Tukey – Kramer comparison test.

**Table 4: Phytotoxicity assay of treated and untreated textile dye effluent against Blackgram (*Vigna mungo* L.)**

| S. No | Treatments | Blackgram (*Vigna mungo* L.) | | |
|---|---|---|---|---|
| | | Germination (%) | Length of plumule (cm) | Length of radicals (cm) |
| 1 | Control (Water alone) | 100 | 19.90±0.5 | 10.01±0.8 |
| 2 | Effluent alone | 52 | 9.90±0.4 | 3.95±0.2 |
| 3 | Bacterial consortium treated textile dye effluent | 80 | 16.03±0.5 | 6.92±0.7 |

*Values are mean of three experiments ± SEM, significantly different from the control (Seed germination in water) by one – way analysis of variance (ANOVA) with Tukey – Kramer comparison test.

**Table 5: Phytotoxicity assay of treated and untreated textile dye effluent against Greengram (*Vigna radiata* L.)**

| S. No | Treatments | Greengram (*Vigna radiata* L.) | | |
|---|---|---|---|---|
| | | Germination (%) | Length of plumule (cm) | Length of radicals (cm) |
| 1 | Control (Water alone) | 100 | 19.90±0.5 | 10.01±0.8 |
| 2 | Effluent alone | 46 | 7.97±0.4 | 2.70±0.2 |
| 3 | Bacterial consortium treated textile dye effluent | 72 | 14.47±0.5 | 4.60±0.7 |

*Values are mean of three experiments ± SEM, significantly different from the control (Seed germination in water) by one – way analysis of variance (ANOVA) with Tukey – Kramer comparison test.

Khan *et al*. [22] have already reported the adverse effects of these waters on the growth of *Triticum aestivum*. Parshetti *et al*. [23] also showed that germination of *Triticum aestivum* was less with Malachite green treatment compared to its degradation product. Hence, phytotoxicity studies revealed that biodegradation of dyes by a microbial culture, resulted in its detoxification. Thus, treated effluent can be used for ferti-irrigation. Saratale *et al*. [24] showed the phytotoxic effect of Navy Blue HER on the germination of *Phaseolus mungo* and *Sorghum vulgare*. Both the plant seeds inhibited 90% germination when seeds were treated with 1500ppm concentration of Navy blue HER. On the contrary, no phytotoxic effect (100% germination) was observed at the same concentration of degradation products.

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