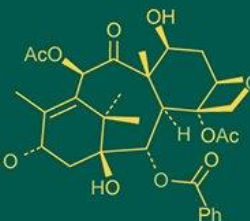
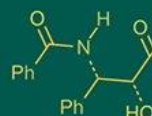
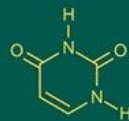
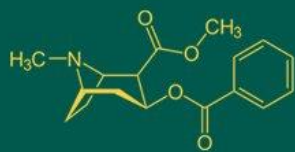


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
NAAS Rating (2026): 5.29
IJABR 2026; SP-10(7): 569-576
www.biochemjournal.com
Received: 07-05-2026
Accepted: 09-06-2026

Poonam Ranga
Department of Microbiology,
CCS Haryana Agricultural
University, Hisar, Haryana,
India

Shikha Mehta
Department of Microbiology,
CCS Haryana Agricultural
University, Hisar, Haryana,
India

Meena Sindhu
Department of Microbiology,
CCS Haryana Agricultural
University, Hisar, Haryana,
India

Microbial mediated decolorization of textile dye: A bioremediation approach

Poonam Ranga, Shikha Mehta and Meena Sindhu

DOI: <https://www.doi.org/10.33545/26174693.2026.v10.i7Sg.9042>

Abstract

The textile industry generates large volumes of dye-containing wastewater that poses serious environmental and agricultural challenges due to the presence of recalcitrant azo dyes. The present study was undertaken to isolate indigenous bacteria from textile dye-contaminated sites and evaluate their potential for decolourization of Coractive Blue dye and textile effluent, along with assessing the phytotoxicity of treated effluent. A total of 34 bacterial isolates were obtained from Haryana, India. Primary and secondary screening identified three efficient bacterial isolates, TCB8, TCB17 and TCB30, for dye decolourization. Among these, isolate TCB17 exhibited the highest decolourization efficiency, achieving 44.5% decolourization of Coractive Blue dye (10 mg L^{-1}) after 96 h. TCB17 also demonstrated maximum textile effluent decolourization (36%) in 50% effluent after 120 h under optimized conditions of 35°C , pH 8.0 and static incubation. Biological treatment significantly reduced the phytotoxicity of textile effluent. Treated effluent enhanced seed germination and seedling growth of chickpea and mungbean compared with untreated effluent, with germination increasing to 40.2% and 62.6%, respectively. Pot-house evaluation on wheat revealed that untreated effluent severely reduced plant height, biomass and grain yield, whereas treated effluent significantly improved all growth parameters. The study demonstrates that bacterial isolate TCB17 possesses promising potential for the biological treatment of textile wastewater and effectively reduces its phytotoxicity.

Keywords: Textile effluent, decolourization, Coractive Blue, phytotoxicity, biological treatment

Introduction

Rapid industrialization has substantially contributed to economic development and employment generation worldwide. However, it has also led to the discharge of large quantities of industrial effluents into the environment. Among various industries, the textile industry is recognized as one of the major contributors to environmental pollution due to extensive use of synthetic dyes and chemicals during dyeing, printing and finishing processes (Sudarshan *et al.*, 2023) [14]. Approximately 80% of the dyes produced globally are utilized in the textile industry and nearly 10-30% of these dyes are released into the environment through wastewater generated during processing. The discharge of this untreated dye-containing effluent poses serious threats to the soil and aquatic ecosystem. Textile effluents are characterized by high chemical oxygen demand (COD), biological oxygen demand (BOD), and suspended solids (Bhatia *et al.*, 2018) [4]. Azo dyes constitute the largest and widely used class of textile dyes. These dyes are characterized by one or more azo bonds linked to aromatic structures that confer high color intensity and chemical stability (Ranga *et al.*, 2019) [12].

Furthermore, under reductive conditions, azo dyes can be transformed into aromatic amines that are toxic, mutagenic and potentially carcinogenic, posing serious ecological and public health risks (Aquino *et al.*, 2014, Khatri *et al.*, 2018) [2, 7]. The environmental and agricultural impact of azo dye contamination have received increasing attention in recent years. The discharge of dye-containing effluents into agricultural land alters the physicochemical properties of soil by affecting porosity, nutrient availability and microbial diversity. The intense coloration of contaminated water bodies reduces light penetration, thereby affecting photosynthetic activity in aquatic ecosystems ((Hassan & Carr, 2018) [6]. In agricultural ecosystems, azo dyes can interfere with soil microbial communities responsible for nutrient cycling and organic matter decomposition ultimately leading to reduced soil fertility.

Corresponding Author:
Poonam Ranga
Department of Microbiology,
CCS Haryana Agricultural
University, Hisar, Haryana,
India

Such disturbances often result in poor seed germination, reduced root and shoot growth and decreased crop productivity.

To mitigate the adverse effects of textile dye pollution, several physicochemical treatment methods have been developed and implemented as well (Robinson *et al.*, 2001). These methods include coagulation, flocculation, adsorption, membrane filtration and oxidation processes (Mishra and Maiti 2018) ^[11, 13]. Although these technologies can effectively remove color from waste water, they are often associated with significant limitations such as high operational and maintenance costs, generation of secondary sludge, reduced effectiveness against structurally complex dyes etc. These limitations emphasize the need for more sustainable, economical and environmentally compatible treatment approaches.

Biological remediation has emerged as a promising alternative for the treatment of dye-contaminated environments. Microorganisms possess diverse metabolic activities that enable them to transform and detoxify complex pollutants. Among various microbial groups, bacteria have attracted considerable attention because of their rapid growth rates, adaptability to diverse environmental conditions and ability to produce extracellular and intracellular enzymes involved in dye degradation (Das *et al.*, 2023) ^[5]. Enzymes such as laccases, peroxidases, reductases and oxygenases play a crucial role in breaking azo bonds and in degrading aromatic intermediates into less toxic compounds. In addition to their biodegradation potential, several bacterial species possess plant growth promoting attributes including phosphate solubilization, zinc solubilization, phytohormone production etc. (Mathur *et al.*, 2023) ^[10]. Thus, bacterial bioremediation offers a dual advantage of environmental detoxification and enhancement of agricultural sustainability (Bera & Tank, 2021) ^[3]. In view of these concerns, the present study was undertaken to isolate and characterize indigenous bacteria from textile dye contaminated soil and to evaluate their potential for the textile dye as well as effluent decolorization.

Materials and methods

Sample collection and Bacterial Isolation

Soil and effluent samples contaminated with textile dye were collected from textile industrial sites in Panipat. The collected samples were brought to laboratory and processed for bacterial isolation. For the isolation of dye-tolerant bacteria, serial dilutions of the samples were prepared and inoculated onto mineral salt medium (MSM) supplemented with coractive blue dye (10mg/L). The inoculated plates were incubated under favourable growth conditions. The bacterial colonies exhibiting growth on the dye- containing medium were considered dye-tolerant and were selected for further studies. Pure cultures were obtained by repeated streaking on MSM plates.

Screening of bacterial isolates for dye decolorization

Bacterial isolates were screened for their ability to decolorize the dye at different concentrations (10, 20, 30 and 40 mg L⁻¹). The decolorization efficiency was assessed by measuring the absorbance of the dye solution at of dye by measuring absorbance at 620 nm using UV-Visible Spectrophotometer. Samples were collected at regular intervals, and the percent decolorization was calculated using the following formula:

$$\text{Decolorization (\%)}: (A_0 - A_t) / A_0 \times 100$$

where (A₀) is the initial absorbance of the dye solution and (A_t) is the absorbance at time (t)

Decolorization of textile effluent by selected bacterial isolates:

The decolorization potential of selected bacterial isolates was evaluated using textile effluent at different concentrations (50, 75 and 100%). Each isolate was inoculated into the effluent containing medium and incubated under suitable conditions. Decolorization efficiency was determined by measuring the reduction in absorbance of the effluent at 620 nm using UV-Visible Spectrophotometer. The percentage decolorization was calculated using the standard formula.

Optimization of culture conditions (temperature, pH and aeration) for decolorization of textile effluent by potent bacterial isolates:

The promising bacterial isolates, selected on the basis of decolourization performance, were subjected to optimization studies to determine the effect of various culture conditions on textile effluent decolorization. The effect of temperature (25, 30, 35 and 40 °C), pH (6, 7, 8, 9, and 10) and aeration (static and shaking) was studied using 50% effluent. Decolorization efficiency was assessed spectrophotometrically. The optimum conditions were determined based upon the maximum percentage decolorization achieved.

Phytotoxicity analysis

Phytotoxic studies of untreated and bacterial treated effluent was evaluated using seeds of on seed of Mungbean and Chickpea. Healthy and surface sterilized seeds were used for the study. Seed germination percentage was recorded after incubation (24-72 h). The phytotoxic effect of the effluent was assessed by comparing the germination of treated and untreated effluent with that of control.

Effect of treated as well as untreated textile effluent on wheat crop under pot-house conditions

A pot-house experiment was conducted to evaluate the effect of treated as well as untreated textile effluent o the growth and performance of wheat (*Triticum aestivum* L.). the experiment consisted of seven as shown in Table 1.

Table 1: Treatments with different concentrations of textile effluent for pot-house study

Treatment	Description
T ₁	Control
T ₂	Untreated effluent (100%)
T ₃	Untreated effluent (75%)
T ₄	Untreated effluent (50%)
T ₅	Treated effluent (100%)
T ₆	Treated effluent (75%)
T ₇	Treated effluent (50%)

Statistical analysis

The experimental data was analysed by the application of completely randomised design (CRD) using Online Statistical Analysis Tools (OPSTAT) software.

Results and discussion

Soil and effluent samples contaminated with textile dye collected from textile industrial sites in Panipat were used for

isolation of bacteria. 34 bacterial isolates were retrieved from six samples (soil, sludge and effluent) collected from different sites (Table 2).

Primary screening of these isolates was done at 10mg/L of dye on the basis of change in colour (Fig 22.). Secondary

screening using different concentrations (10, 20, 30 and 40 mg/L) of coractive blue dye was performed for selected isolates obtained after primary screening (Table 3 and Fig 1) Three isolates (TCB 8, TCB 17 and TCB 30) were found to decolorize the dye efficiently (Fig 2).

Table 2: Bacterial isolates obtained from various sites of textile industry

Sr. No.	Samples	Location(s)/Site(s)	No. of Isolate(s)
1.	Fresh Sludge	ETP (Industry)	4
2.	15 Days old Sludge	Dumping	6
3.	Dry Soil (red)	Dumping	4
4.	Dry Soil (brown)	Dumping	10
5.	Dry Soil (white)	Dumping	7
6.	Textile Effluent	ETP (Industry)	3



Fig 1: Primary screening of bacteria for decolorization of Coractive Blue

Table 3: Primary screening for decolorization of Coractive Blue dye

Sr. No.	Isolate(s)	C. B Dye	Sr. No.	Isolate(s)	C. B Dye
1	TCB ₁	-	18	TCB ₁₈	-
2	TCB ₂	-	19	TCB ₁₉	-
3	TCB ₃	-	20	TCB ₂₀	-
4	TCB ₄	++	21	TCB ₂₁	++
5	TCB ₅	-	22	TCB ₂₂	-
6	TCB ₆	+	23	TCB ₂₃	-
7	TCB ₇	-	24	TCB ₂₄	+
8	TCB ₈	+++	25	TCB ₂₅	-
9	TCB ₉	-	26	TCB ₂₆	++
10	TCB ₁₀	-	27	TCB ₂₇	-
11	TCB ₁₁	++	28	TCB ₂₈	-
12	TCB ₁₂	+	29	TCB ₂₉	-
13	TCB ₁₃	-	30	TCB ₃₀	+++
14	TCB ₁₄	-	31	TCB ₃₁	-
15	TCB ₁₅	+	32	TCB ₃₂	-
16	TCB ₁₆	-	33	TCB ₃₃	++
17	TCB ₁₇	+++	34	TCB ₃₄	-

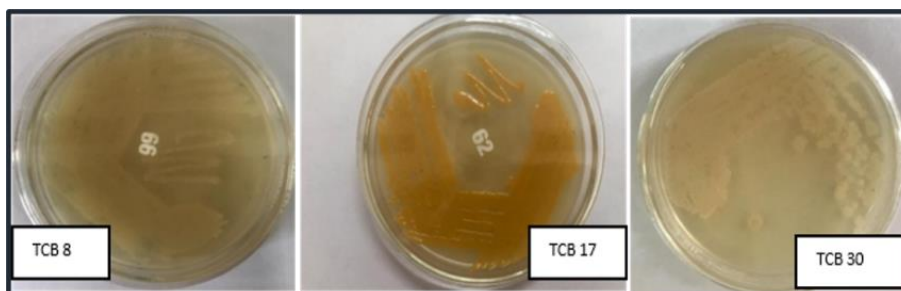


Fig 2: Selected bacterial isolates for Dye decolorization

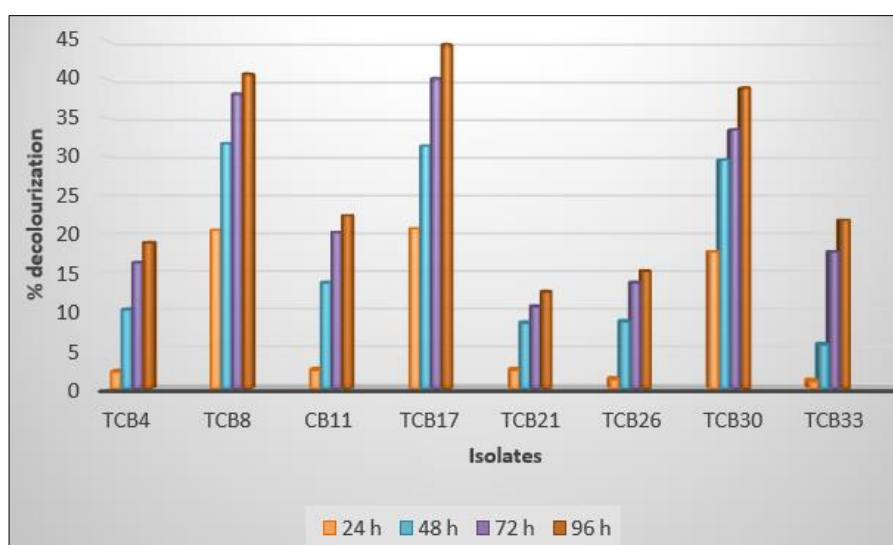
Table 4: Decolorization by various isolates at 10, 20 and 30 mgL⁻¹ of coractive blue dye

Isolate(s)	Decolourization (%)			
	Time period			
	24 h	48 h	72 h	96 h
10 mgL⁻¹, w/v				
TCB4	2.17±0.34	10.2±0.44	16.3±0.28	17.9±0.22
TCB8	20.5±0.38	31.7±0.44	38.1±0.41	40.7±0.33
CB11	2.42±0.88	13.7±0.51	20.2±0.29	20.8±0.31
TCB17	20.7±0.94	31.4±0.55	41.7±0.51	44.5±0.29
TCB21	2.41±0.88	8.49±0.43	10.6±0.41	12.5±0.20
TCB26	1.19±1.21	8.67±0.78	15.0±0.35	15.5±0.22
TCB30	17.7±0.49	29.6±0.39	33.5±0.35	38.0±0.27
TCB33	0.97±1.01	5.69±0.45	17.7±0.51	18.1±0.33
20 mgL⁻¹, w/v				
TCB4	-	6.31± 0.30	9.72±0.38	12.1±0.25
TCB8	11.6± 0.62	18.4± 0.33	26.6± 0.38	27.8± 0.33
CB11	1.89± 0.72	10.3± 0.50	16.4± 0.44	19.2± 0.40
TCB17	14.9± 0.55	23.4± 0.29	34.6± 0.35	35.6± 0.31
TCB21	-	2.23± 0.31	5.18± 0.30	8.14± 0.21
TCB26	-	3.78±0.27	8.82±0.31	13.7±0.23
TCB30	18.3± 0.57	21.2± 0.30	24.0± 0.27	26.8± 0.21
TCB33	-	3.89± 0.72	11.3± 0.50	15.4± 0.33
30 mgL⁻¹, w/v				
TCB4	-	-	3.12±0.32	8.7±0.24
TCB8	-	7.4± 0.31	10.6± 0.23	13.6± 0.33
CB11	-	-	5.4± 0.43	9.2± 0.41
TCB17	4.9± 0.41	12.4± 0.25	18.6± 0.33	18.9± 0.31
TCB21	-	-	7.18± 0.21	8.10± 0.23
TCB26	-	-	-	7.71±0.23
TCB30	-	10.2± 0.31	11.0± 0.21	14.8± 0.21
TCB33	-	2.89± 0.62	5.3± 0.21	9.4± 0.35

The table 4 presents the percentage decolourization achieved by different bacterial isolates (TCB4, TCB8, CB11, TCB17, TCB21, TCB26, TCB30, and TCB33) over a period of 24, 48, 72, and 96 hours at three different concentrations (10, 20, and 30 mg L⁻¹). The results are expressed as mean ± standard deviation, indicating the reproducibility of the experiments. At the lowest concentration (10 mg L⁻¹), all isolates exhibited an increase in decolourization efficiency with increasing incubation time (Fig 3). Among the isolates, TCB17 demonstrated the highest decolourization activity, increasing from 20.7% at 24 h to 44.5% at 96 h. Similarly, TCB8 showed

40.7% decolourization after 96 h. TCB30 also showed decolourization, 38.0% at 96 h.

When the concentration was increased to 20 mg L⁻¹ (Fig 4), the decolourization efficiency of all isolates decreased compared with the 10 mg L⁻¹ treatment. Several isolates showed no measurable decolourization at 24 h (represented by “-”), suggesting an adaptation or lag phase before active degradation. Thus, increasing the dye concentration reduced the decolourization capability of the isolates. At the highest concentration (30 mg L⁻¹), decolourization efficiencies declined significantly, indicating an inhibitory effect of the higher dye concentration on microbial activity.

**Fig 3:** Decolorization of Coractive Blue dye (10 mgL⁻¹, w/v)

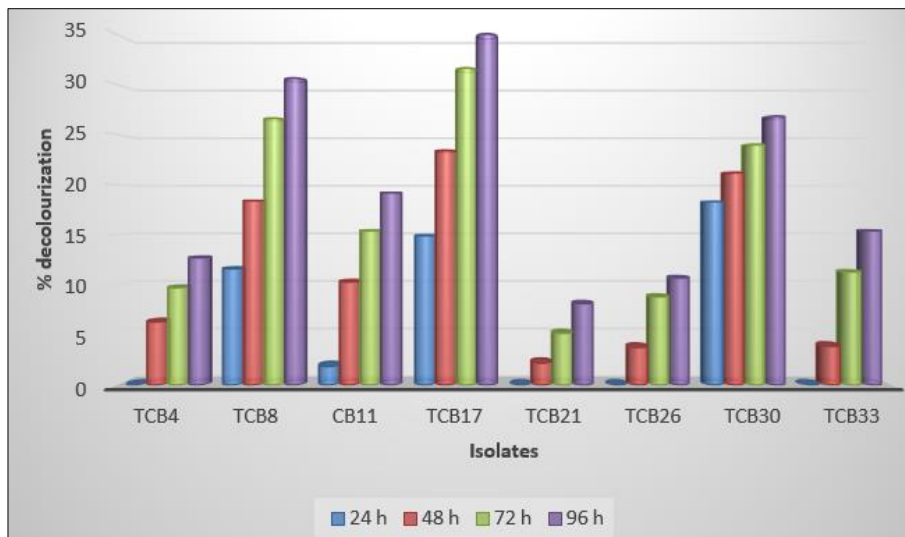


Fig 4: Decolorization of Coractive Blue dye (20 mgL^{-1} , w/v)



Fig 5: Decolorization of Coractive blue dye by selected isolates at different concentrations A: 10 mg/L, B: 20 mg/L and C: 30 mg/L

Bacterial isolates TCB8, TCB17 and TCB30 showed 20, 34 and 26% decolorization of textile effluent, respectively at 50% concentration whereas 11, 18 and 12% decolorization

was observed on raw textile effluent (100%), respectively (Fig 5).

Textile effluent (75%) was decolorized up to 16, 28 and 17% by isolates TCB8, TCB17 and TCB30 respectively. Potent

bacterial isolate TCB17 showed maximum decolorization (36%) of textile effluent (50%) at optimized temperature 35

$^{\circ}\text{C}$ and pH 8.0 (Fig. 6) under static conditions (Fig. 7) after 120h of incubation.

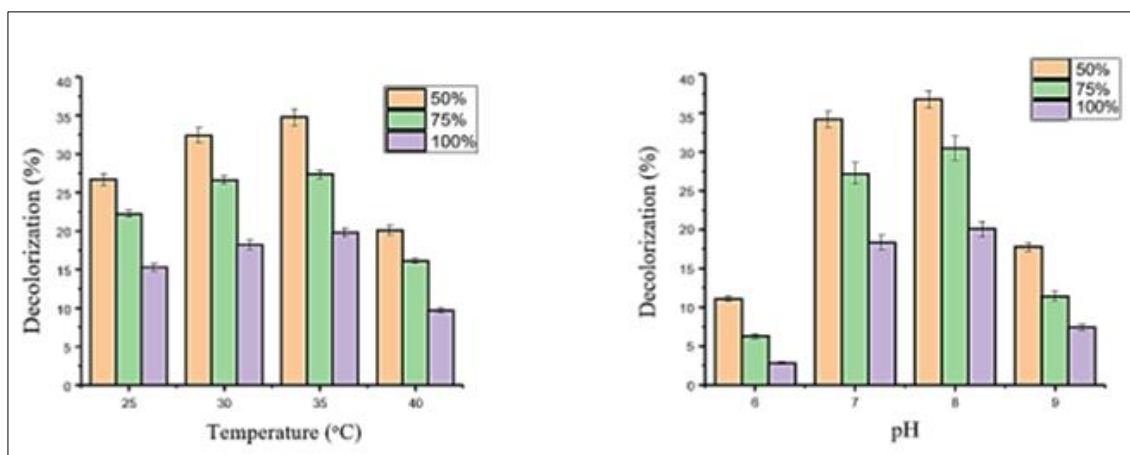


Fig 6: Effect of temperature (A) and pH (B) on decolorization of textile effluent by bacterial isolate TCB 17 at 120h

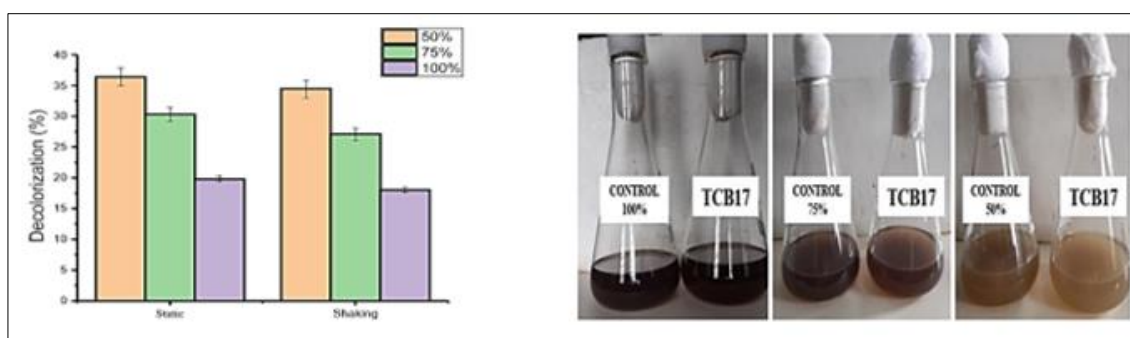


Fig 7: Effect of aeration on decolorization of textile effluent by bacterial isolate TCB 17 after 120h at temperature 35°C and pH 7

Untreated (Raw) textile effluent showed 8% and 12% germination of chickpea and mungbean seeds whereas treated effluent (100%) showed 15% and 21% germination of chickpea and mungbean after 72h, respectively (Table 5).

Textile effluent (50%) treated with TCB 17 showed 40%, and 62% seed germination in chickpea and mungbean respectively.

Table 5: Seed germination at different concentration of treated and untreated textile effluent

Time (h)	Seed germination (%)									
	Textile effluent concentration (%)									
	Chickpea					Mungbean				
	Control	Raw Effluent	Treated Effluent			Control	Raw Effluent	Treated Effluent		
			50%	75%	100%			50%	75%	100%
24	45.6 $\pm$ 0.20	0	7.1 $\pm$ 0.23	0	0	53.8 $\pm$ 0.41	0	21.5 $\pm$ 0.32	13.1 $\pm$ 0.41	8.3 $\pm$ 0.41
48	69.3 $\pm$ 0.21	3.1 $\pm$ 0.13	24.5 $\pm$ 0.31	14.2 $\pm$ 0.21	7.1 $\pm$ 0.22	75.7 $\pm$ 0.23	5.7 $\pm$ 0.31	48.2 $\pm$ 0.12	21.6 $\pm$ 0.35	12.4 $\pm$ 0.42
72	86.5 $\pm$ 0.16	8.4 $\pm$ 0.21	40.1 $\pm$ 0.39	20.3 $\pm$ 0.34	15.2 $\pm$ 0.33	91.1 $\pm$ 0.21	12.1 $\pm$ 0.41	62.9 $\pm$ 0.35	34.4 $\pm$ 0.31	21.1 $\pm$ 0.38

Table 6: Effect of untreated and treated effluent on seed germination parameters

Parameters	Chickpea		Mungbean	
	Treated	Untreated	Treated	Untreated
Germination (%)	40.2 $\pm$ 0.21	18.2 $\pm$ 0.25	62.6 $\pm$ 0.23	24.4 $\pm$ 0.25
Plumule (mm)	2.01 $\pm$ 0.13	0.24 $\pm$ 0.11	3.07 $\pm$ 0.12	1.21 $\pm$ 0.21
Radicle (mm)	2.36 $\pm$ 0.16	0.51 $\pm$ 0.13	4.17 $\pm$ 0.23	1.34 $\pm$ 0.16

The effect of treated and untreated effluent on the seed germination characteristics of chickpea and mungbean was studied. The parameters evaluated include germination percentage, plumule length, and radicle length (Table 6). It has been observed that treated effluent had a significantly more favorable effect on seed germination and early seedling growth than untreated effluent. In chickpea, seeds irrigated with treated effluent showed germination percentage of 40.2%. Similarly, the plumule length increased from 0.24 mm

under untreated effluent to 2.01 mm with treated effluent. The radicle length also increased from 0.51 mm in untreated effluent to 2.36 mm following treatment. These findings suggest that the treatment process effectively reduced the phytotoxic effects of the effluent, thus, promoting better seed germination. A similar trend was observed in mungbean, which showed greater tolerance and response to treated effluent. The germination percentage was 62.6% under treated effluent, compared to only 24.4% with untreated

effluent. The plumule length increased from 1.21 mm in untreated effluent to 3.07 mm with treated effluent, while the radicle length increased from 1.34 mm to 4.17 mm, respectively. Treated effluent significantly enhanced germination percentage, plumule growth, and radicle development in both chickpea and mungbean compared with untreated effluent. Among the two crops, mungbean exhibited higher germination and better seedling growth than chickpea under both treated and untreated conditions, suggesting greater tolerance to residual contaminants.

Table 7 presents the effect of different concentrations of treated and untreated textile effluent on the growth and yield attributes of wheat (variety WH 1105) under pot-house conditions. The parameters evaluated included plant height, dry shoot weight, and grain weight per plant. The results indicate that both treated and untreated textile effluent adversely affected wheat growth compared to the control, although treated effluent was considerably less toxic than untreated effluent. The control treatment (T₁) showed the highest values for all growth and yield parameters, with a plant height of 45.93 cm, dry shoot weight of 4.864 g per plant, and grain weight of 4.21 g per plant. This reflects the optimum growth of wheat under normal irrigation conditions without textile effluent.

Irrigation with 100% untreated effluent (T₂) resulted in lowest plant height (23.96 cm), dry shoot weight (1.135 g per plant), and grain weight (1.01 g per plant). Slight improvements were observed with dilution of the untreated effluent. Plants with 75% untreated effluent (T₃) attained a

plant height of 24.89 cm, dry shoot weight of 1.216 g per plant, and grain weight of 1.13 g per plant followed by 50% untreated effluent (T₄).

In contrast, the treated effluent treatments showed comparatively better growth and yield, indicating that microbial treatment effectively reduced the phytotoxicity of the textile wastewater. Wheat irrigated with 100% treated effluent (T₅) showed a plant height of 28.48 cm, dry shoot weight of 1.320 g per plant, and grain weight of 1.72 g per plant. Further improvement was observed with 75% treated effluent (T₆), where plant height increased to 30.03 cm, dry shoot weight to 1.972 g per plant, and grain weight to 1.96 g per plant. The 50% treated effluent treatment (T₇) performed best among all effluent treatments, producing a plant height of 35.93 cm, dry shoot weight of 2.086 g per plant, and grain weight of 2.21 g per plant.

The results demonstrate microbial treatment of the textile effluent resulted in improved plant height, biomass accumulation, and grain production as compared to untreated effluent. Furthermore, dilution of the treated effluent (50%) proved to be the most suitable among the effluent treatments, suggesting that a combination of biological treatment and appropriate dilution can reduce the harmful impact of textile wastewater on wheat cultivation. These findings highlight the importance of treating textile effluent before its agricultural reuse and indicate that treated effluent, particularly at lower concentrations, has greater potential for safe irrigation than untreated wastewater.

Table 7: Effect of treated and untreated effluent on yield attributes of Wheat

Treatments		Plant height (cm)	Dry shoot weight (g/plant)	Grain weight (g/plant)
T ₁	Control	45.93	4.864	4.21
T ₂	Untreated Effluent (100%)	23.96	1.135	1.01
T ₃	Untreated effluent (75%)	24.89	1.216	1.13
T ₄	Untreated effluent (50%)	27.27	1.196	1.39
T ₅	Treated effluent (100%)	28.48	1.320	1.72
T ₆	Treated effluent (75%)	30.03	1.972	1.96
T ₇	Treated effluent(50%)	35.93	2.086	2.21

Conclusion

The research findings highlight that the indigenous bacterial isolate TCB17 proves to be a potential candidate for eco-friendly bioremediation of textile effluent. The study highlights the potential of bacterial treatment as a sustainable and cost-effective alternative to the conventional methods for reducing dye pollution and facilitating the safe reuse of textile wastewater in agriculture.

References

1. Ajaz M, Shakeel S, Rehman A. Microbial use for azo dye degradation: A strategy for dye bioremediation. *International Microbiology*. 2020;23(2):149-159.
2. Aquino JM, Rocha-Filho RC, Ruotolo LA, Bocchi N, Biaggio SR. Electrochemical degradation of a real textile wastewater using β -PbO₂ and DSA® anodes. *Chemical Engineering Journal*. 2014;251:138-145.
3. Bera SP, Tank SK. Microbial degradation of Procion Red by *Pseudomonas stutzeri*. *Scientific Reports*. 2021;11(1):3075.
4. Bhatia D, Sharma NR, Kanwar R, Singh J. Physicochemical assessment of industrial textile effluents of Punjab, India. *Applied Water Science*. 2018;8(3):83.
5. Das S, Cherwoo L, Singh R. Decoding dye degradation: Microbial remediation of textile industry effluents. *Biotechnology Notes*. 2023;4:64-76.
6. Hassan MM, Carr CM. A critical review on recent advancements in the removal of reactive dyes from dyehouse effluent by ion-exchange adsorbents. *Chemosphere*. 2018;209:201-219.
7. Khatri J, Nidheesh PV, Singh TA, Kumar MS. Advanced oxidation processes based on zero-valent aluminium for treating textile wastewater. *Chemical Engineering Journal*. 2018;348:67-73.
8. Lellis B, Fávaro-Polonio CZ, Pamphile JA, Polonio JC. Effects of textile dyes on health and the environment and bioremediation potential of living organisms. *Biotechnology Research and Innovation*. 2019;3(2):275-290.
9. Lellis B, Fávaro-Polonio CZ, Pamphile JA, Polonio JC. Effects of textile dyes on health and the environment and bioremediation potential of living organisms. *Biotechnology Research and Innovation*. 2019;3(2):275-290.

10. Mathur H, Joshi N, Khaturia S. Microbial community profiling in wastewater of effluent treatment plant. In: Genomics Approach to Bioremediation: Principles, Tools, and Emerging Technologies. 2023. p. 157-181.
11. Mishra S, Maiti A. The efficacy of bacterial species to decolourise reactive azo, anthraquinone and triphenylmethane dyes from wastewater: A review. Environmental Science and Pollution Research. 2018;25(9):8286-8314.
12. Ranga P, Sharma D, Saharan BS. Bioremediation of azo dye and textile effluents using *Pseudomonas putida* MTCC2445. Asian Journal of Microbiology, Biotechnology and Environmental Sciences. 2019;22(2):88-94.
13. Robinson T, McMullan G, Marchant R, Nigam P. Remediation of dyes in textile effluent: A critical review on current treatment technologies with a proposed alternative. Bioresource Technology. 2001;77(3):247-255.
14. Sudarshan S, Harikrishnan S, RathiBhuvaneswari G, Alamelu V, Aanand S, Rajasekar A, Govarthanan M. Impact of textile dyes on human health and bioremediation of textile industry effluent using microorganisms: Current status and future prospects. Journal of Applied Microbiology. 2023;134(2):lxac064.
15. Van der Zee FP, Villaverde S. Combined anaerobic-aerobic treatment of azo dyes: A short review of bioreactor studies. Water Research. 2005;39(8):1425-1440.