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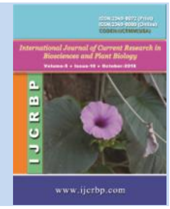

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Effect of Treated Textile Dye Effluent on Germination and Growth of *Sorghum bicolor* (L.) Conrad Moench.

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ABSTRACT

The effect of treated textile dye effluent on morphology and growth pattern of *Sorghum bicolor* (L.) Conrad Moench. in different concentrations (0, 20, 40, 60, 80, 100%) has been studied. For this research work the samples from Kaveri river near Bhavani area were taken and analysed for BOD, COD, EC, pH and concentration of reactive red (R-red) and reactive black (R-black) textile dyes. The BOD at 27°C, for 3 days was observed to be 92 mg/l. The COD level was very high (2325 ppm), and the EC was 13 mS/cm at 25°C R-red dye concentration was 242 ppm and absorbance was 0.791. R-black dye concentration was 301 ppm. pH ranged from 4-7. Chemical analysis was found to be far away from EPA standard of potable water. The high values of the parameters BOD, COD, pH and EC demands pretreatment of the effluent before its discharge into water bodies. Also, the high conductivity observed shows that sufficient ions are present in the effluents, thus suggesting that the treatment may be required. The treated effluent concentration of up to 40% was supporting the germination and growth of sorghum plants with improved biomass to a considerable extent.

Introduction

Rapid growth of industries has not only enhanced the productivity but also resulted in the production and release of toxic substances into the environment, creating health hazards and affected normal operations, flora and fauna. These wastes are potential pollutants when they produce harmful effects on the environment and generally released in the form of solids, liquid effluents and slurries containing a spectrum of organic and inorganic chemicals. The Kaveri River originates in the Brahmagiri hills of the Western Ghats near Coorg (Kodagu). Its total course of 770 km commands a basin area of 8.8 mha (56% in Tamil Nadu, 41% in Karnataka and 3% in Kerala). Industries in

Karnataka and in Tamilnadu contribute a heavy pollution load. These include water intensive textile and sugar units, paper mills, chemical units, engineering units and tanneries. The quantity of waste-water discharged directly into the river is approximately 87,600 cu m/day. The river has a total dissolved solid (TDS) level of 1,450 mg/1 which is three times higher than the permissible limit of 500 mg/1 prescribed by the WHO (1992).
The textile industries use large volumes of water in their operations and therefore discharge large volume of wastewater into the environment, most of which is untreated and there are many options for treating them (Vandevivere et al., 1998). The wastewater contains a variety of chemicals from the various stages of process operations which include desizing, scouring, bleaching and dyeing. The textile industry is distinguished by the raw material used and this determines the volume of the water required for production as well as the wastewater generated. The production covers raw cotton, raw wool and synthetic materials. The industries studied in the present report are raw cotton based. In this type of production, slashing, bleaching, mercerizing and dyeing are the major sources of the waste water generated (Tüfekci et al., 2007).

Salvinia modesta, commonly known as giant salvinia, or as kariba weed after it infested a large portion of the reservoir of the same name, is an aquatic fern native to south-eastern Brazil. It is a free floating plant that does not attach to the soil, but instead remains buoyant on the surface of a body of water. Similar to *Eicchornia crassipes,* the plant is known to be tolerant and has a capacity for the uptake of heavy metals, including cadmium, chromium, cobalt, nickel, lead and mercury, which could make it suitable for the biocleaning of industrial wastewater in addition to heavy metals, other toxins, such as cyanide, which is environmentally beneficial in areas that have endured gold mining operations (Alvarado et al., 2008; Saraswat and Rai, 2010).

The textile industries are very complex in nature as far as varieties of products, process and raw materials are concerned. During production, the cloth has to pass through various processes and chemical operations like sizing, desizing, scouring, mercerising, bleaching, dying, printing, and finishing. In a textile industry, a number of dyes chemicals and auxiliary chemicals are used to impart desired quality in the fabrics. The wastewater of the industry is highly alkaline in nature and contains high concentration or BOD, COD, TDS and alkalinity. It contain toxic load of heavy metals and dyes reactive red and black. It can cause environmental problems like soil pollution and water pollution which makes the water unfit for agriculture and drinking purposes. The objectives of the study were: (1) to collect data on the effluent load being discharged from textile processing units for the various operations requiring water (bleaching and dyeing); (2) to understand the current treatment and disposal practices and the implication of the same on ground and surface water; (3) to analyze heavy metal status and textile dye pollution of Kavery river and to discuss suitable bioremediation methods.

Materials and methods

Bhavani is a second grade municipality in Erode district, Tamil Nadu, India. It is situated at the north of erode city and it is about 107 km (66 mi) from Coimbatore city on national highway 47. Bhavani is also known as the carpet city, as the leading business of the town is known for its carpet industry. Bhavani is located at 11.45°N 77.68°E. It has an average elevation of 193 meters (633 feet). Kooduthurai, or Mukkoodal is a holy place situated in Bhavani urban area near the agglomeration of Erode, Tamil Nadu. The physico-chemical and heavy metals considered in the present study were analysed from different effluent water samples of textile industries in the study sites described above using standard procedures (APHA, 2005). Present investigation was carried out to assess the effects of industrial effluents treated with *Salvinia modesta* for three days on the germination and growth of *Sorghum bicolor* (Fig. 1). The concentrations used for the germination and growth studies were 0, 20, 40, 60, 80 and 100% respectively.

Fig. 1: Growth studies on sorghum in treated effluent.

Results and discussion

The pure effluent is analyzed for its chemistry and it indicates typical feature of water pollution. The higher concentration of BOD and COD is notable, and lethal to plants and animals. The pure effluent kills the *Eichhornia* plant which shows the symptoms of death of plant organs. After 10, 20, 30 and 40% dilutions, the effluent favoured the growth. The plant can degrade the azodyes up to 10 ppm for 10, 20 and 30 h of phytoremediation (data not given). The pure effluent is collected, and stored in corked bottles and analysed for BOD, COD, EC, pH and concentration of R-red and R-black textile dyes. The BOD at 27ºC, 3 days was 92 mg/l or ppm. The COD level was very high indicates 2325 ppm, the EC was 13.0 mS/cm at 25ºC. R-red dye concentration was 242 ppm. R-black dye concentration was 301ppm. pH ranged from 4-7.

The chemical analysis was found to be far away from EPA standard of potable water. Physicochemical characteristics of these effluents revealed that both of them contained high amounts of sulphates, nitrates, calcium, various heavy metals, etc., which confirms their highly polluted conditions. Seed germination in 100% treated effluent was 11.66% whereas, in 40% effluent, 75.66% germination of *Sorghum bicolor* was observed. Similarly, plant biomass and growth was found to be retarded from low concentration to high concentration (Table 1; Fig. 2).

Table 1. Germination and biomass of *Sorghum bicolor* (L.) Conrad Moench in treated textile dye effluent (values are mean of five replicates).

Sl. No.	Concentration of treated effluent (%)	Germination (%)	Fresh Weight (g/seedling)	Dry Weight (g/seedling)
1	0	95.3	7.45	3.59
2	20	81.00	7.47	3.17
3	40	75.66	6.04	2.95
4	60	52.66	5.37	2.8
5	80	33.00	5.98	2.55
6	100	11.66	6.12	2.84

Maximum improvement in seedling length was found in 20% of textile effluent. Lower concentrations enhanced the growth. This study indicates pollution that prevent germination certain level and growth pattern after 40%. Phytoremediation, being more cost-effective and fewer side effects than physical and chemical approaches, has gained increasing popularity in both academic and practical circles. More than 400 plant species have been identified to have potential for soil and water remediation. Among them, *Thlaspi*, *Brassica*, *Sedum alfredii* and *Arabidopsis* species have been mostly studied. The textile industry consumes large quantities of water and produces large volumes of wastewater through various steps in dyeing and finishing processes. The textile waste water is a complex and variable mixture of polluting substances like inorganic,

organic, elemental and polymeric products (Brown and Laboureur, 1983). Among complex industrial wastewater with various types of colouring agents, dye wastes are predominant.

Due to low biodegradation of dyes, convectional biological treatment process is not very effective in treating dye wastes. Vasanthy et al. (2011) removed the textile dyes red RB and black B from their aqueous solutions by water hyacinth plant material. The use of industrial waste water for irrigation purposes has emerged an important way to utilize its nutrients and removal of its pollutants load by growing tolerant plant species.

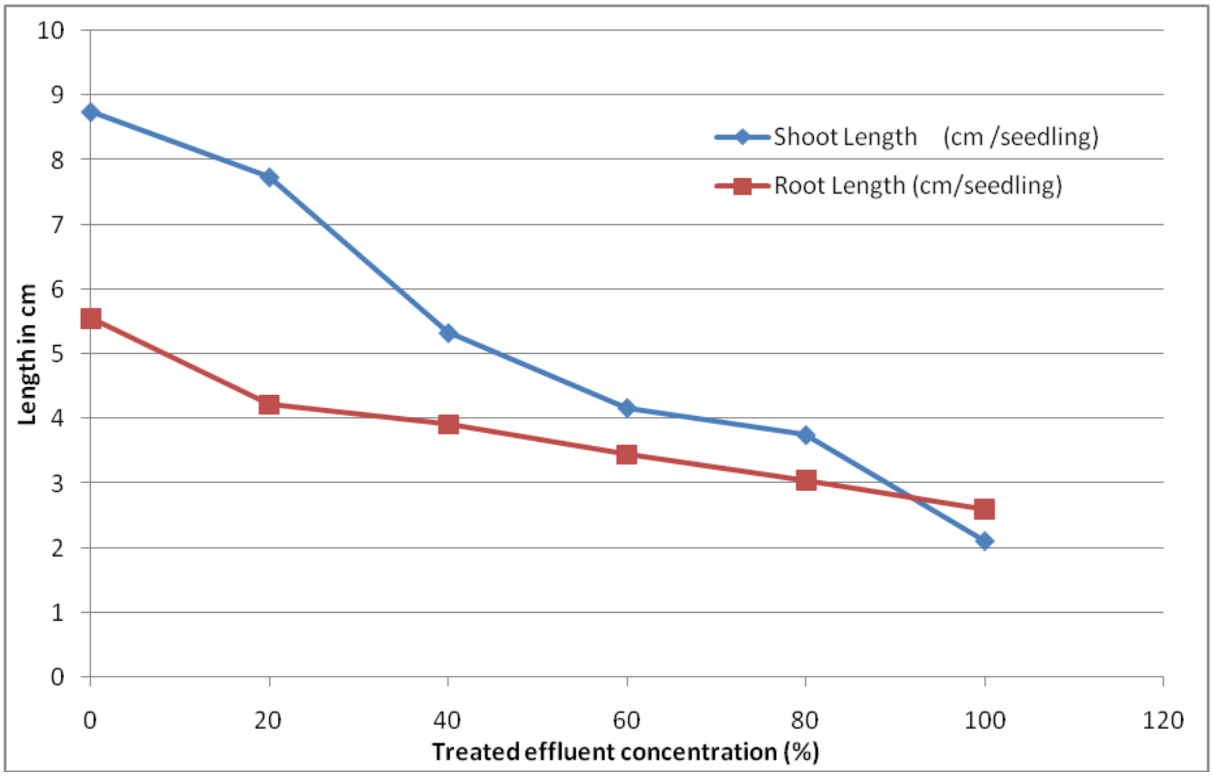

Fig. 2: Shoot and root length of *Sorghum bicolor* in treated textile dye effluent.

Conclusion

From the analysis, the textile effluent was found to have high pH indicating alkalinity of the sample and large amounts of total suspended (TSS) and total dissolved solids (TDS), minerals and metals like sodium, potassium, chromium, zinc, copper etc. The results of biometric observations showed that the sorghum plants grown under 20 and 40% concentration of treated effluent were taller than the plants grown in 60% and more. The seeds did not germinate when the undiluted effluent was used as such for irrigating the plants. Potassium, copper, chromium, cadmium, nickel and zinc were found to be more accumulated in the leaves of the plants treated with 25% dilution effluent. This indicates the accumulation potential of leaves and roots when they are grown using effluent with high dilution. Heavy metal contamination of vegetables cannot be underestimated as these food stuffs are important components of human diet. Vegetables are rich sources of vitamins, minerals, and fibers, and also have beneficial antioxidative effects. However, intake of heavy meta-contaminated vegetables may pose a risk to the human health. Heavy metal contamination of food is one of the most important aspects of food quality assurance.

Conflict of interest statement

Authors declare that they have no conflict of interest.

References

Alvarado, S., Guédez, M., Lué-Merú, M.P., Nelson, G., Alvaro, A., Jesús, A.C., Záray, G., 2008. Arsenic removal from waters by bioremediation with the aquatic plants water hyacinth (*Eichhornia crassipes*) and lesser duckweed (*Lemna minor*). Bioresour. Technol. 99(17), 8436–8440.

American Public Health Association (APHA), 2005. Standard Methods for the Examination of Water and Wastewater, American Public Health Association, American Water Works Association, Water Environmental Federation 21st Edn.

Brown, D., Laboureur, P., 1983. The aerobic biodegrability of primary aromatic amines. Chemosphere 12, 405-414.

Saraswat, S., Rai, J.P.N., 2010. Heavy metal adsorption from aqueous solution using *Eichhornia crassipes* dead biomass. Int. J. Mineral Process. 94(3–4), 203–206.

Tüfekci, N., Sivri, N., Toroz, I., 2007. Pollutants of textile industry wastewater and assessment of its discharge limits by water quality standards. Turk. J. Fish. Aquatic Sci. 7, 97-103.

Vandevivere, P.C., Bianchi, R., Verstraete, W., 1998. Review: Treatment and reuse of wastewater from the textile wet-processing industry: Review of emerging technologies. J. Chem. Technol. Biotechnol. 72, 289–302.

Vasanthy, M., Santhiya, M., Swabna, V., Geetha, A., 2011. Phytodegradation of textile dyes by water hyacinth (*Eichhornia crassipes*) from aqueous dye solutions Int. J. Environ. Sci. 1(7), 1702–1717.

World Health Organization (WHO), 1992. International Standards for Drinking Water, Geneva, Switzerland, 4, 46.

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