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Original Research Article

Effect of Textile Dye Effluent on Soybean Crop

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ABSTRACT

Textile dye effluent collected from three different stages like Raw, primary treated and secondary [Outlet] treated effluent in Trippur area and analysed physiochemical parameters using standard methods. These various stages effluent treated to soybean crop to analysed seed germination, shoot length, root length, number leafs, root nodules, number of lateral roots and total chlorophyll content. Raw effluent directly inhibits all the parameters evenly and primary treated effluent also significantly inhibits the soybean crop. Outlet effluent didn't inhibit the all parameters to compare control. Outlet treated effluent showed the significant result to compare the raw and primary treated effluent.

Keywords: Textile; dye; effluent; soybean; physiochemical

INTRODUCTION

The growing competition for water and declining freshwater resources, the utilization of marginal quality water for agriculture has posed a new challenge for environmental management. In water scarce areas there are competing demands from different sectors for the limited available water resources. The disposal of industrial effluents water resources unsuitable for other uses [1-4]. Industrial effluents often contain various toxic metals, harmful gases, and several organic and inorganic compounds [5]. The industrial waste containing hazardous pollutants and they are discharging in rivers, streams and on the land. The major important industries polluting the water bodies are identified as tanneries, chemical, refineries, sugars mills, textile dye and paper pulp industries [6]. The waste water from textile dye industry is a complex mixture of many polluting substances ranging from organochloride based waste to heavy metals associated with dyes and dying process [7]. The industry is using more than 8000 chemicals in various processes of textile manufacture including dyeing and printing [**8**]. The daily water consumption of an average sized textile mill having a production of about 8000 kg of fabric per day is about 1.6 million liters. 16% of this is consumed in dyeing and 8% in printing. Specific water consumption for dyeing varies from 30 - 50 liters per kg of cloth depending on the type of dye used [9-10]. This water used for irrigational purposes in agriculture land to cause various damages to the plants and soil flora through directly and indirectly also reduce the soil fertility due to toxic substances.

The scouring effluents are strongly alkaline. Dyes are carbon based organic compounds while pigments are normally inorganic compounds often involving heavy toxic metals [i.e. chromium, copper zinc, lead or nickel]. Most of the dyeing factories discharge their effluent into the environment either, after partial treatment or no treatment at all.

The industrial effluents hold various organic and inorganic chemical compounds. The presence of these chemicals compounds will show harmful effects germination and growth of plants. Previous studies suggested that effluents from industries inhibit seed germination and seedling growth. The utility of municipal and industrial waste water for irrigation to crops is well documented [11-12]. In this present study, an attempt has been made to identify the effect of textile dye industry mill effluent on seed germination and growth of soybean crop.

MATERIAL AND METHODS

Textile dye effluent collected from Tiruppur district of Tamilnadu, India. The effluent collection made at three stages i.e. raw effluent [before treatment], Primary treated effluent and secondary treated effluent [final release]. The effluents were stored at 4 ºC to avoid changes of their physiochemical properties.

The physio-chemical parameters were analyzed, like pH, temperature, salinity, dissolved oxygen [DO], electrical conductivity [EC] were determined by portable water analysis kit Eutech [model 1160]. Biochemical oxygen demand [BOD], Chemical oxygen demand [COD] total dissolved solids [TDS], total suspended solids [TSS], alkalinity, dissolved phosphate [PO4], nitrate, chloride measured by methods APHA, 1998 [13].

Germination study

Soybean seeds are seeds collected from the TNAU seed centre and segregate the quality seeds through the morphological observation based on the size and weight.

For germination test, 35 seeds of each vegetable were placed in sterilized glass Petri dish of uniform size lined with one filter paper disc. This filter paper disc was moistened with 4 ml of distilled water for control and with the same quantity of untreated and treated textile effluent. The Petri dishes were incubated at 20°C in the growth room. Germination was recorded daily at a fixed hour and the emergence of radical was taken as a criterion of germination.

Pot experiment

Four hundred viable seeds of soybean bean were randomly selected from the stock. Twenty seeds were sown in each of four Polybags [12 cm diameter and 15 cm height] and filled with required ordinary garden soil and washed well by tap water and then pour distilled water as to flush through all the salts that were present in the soil. The pots were irrigated with ground water as the control treatment and three different stages of dying effluent. 200 ml of each stage of effluent were applied respective Polybags regularly. The observation of growth, seedlings were picked from each of the poly bags in regular interval of 20, 40, 60, 80 days. Shoot length, root length, leaf area, number of leafs; lateral roots, root nodules and chlorophyll content were recorded at the regular interval of the experiment. All the experiment maintained in triplicate and results were analysed. Shoot length, root length, lateral roots and root nodules are measured manually using measuring scale.

Chlorophyll content

Mg/g FW [fresh weight]: The chlorophyll content was estimated by extracting fresh leaves with 80% acetone and after centrifugation at 8000 rpm for 20min, measuring the colour intensity of the extract at 645 and 663 nm wave lengths by spectrophotometer [14]. Spectrophotometer Electronics India [Model: UV 2373] was used to calculate the chlorophyll A and chlorophyll B contents.

Chlorophyll A and B were calculated using the following formulae:

Chl. a [mg g^{-1} f. wt] = 12.7 [A_{663}] - 2.69 [A_{645}] $\times \frac{V}{1000 \times W}$

Chl. b [mg g^{-1} f. wt] = 22.9 [A_{645}] - 4.68 [A_{663}] $\times \frac{V}{1000 \times W}$

Chl. b [mg g^{-1} f. wt] = 20.2 [A_{645}] + 8.02 [A_{663}] $\times \frac{V}{1000 \times W}$

V = final volume of chlorophyll extract in 80% acetone

w = fresh weight of tissue extracted.

The experimental data was subjected to analysis of variance [ANOVA]. Significant differences between the values were determined by using Duncan's Multiple Range test [P<0 .05] following ANOVA. Statistical analyses were performed using SPSS 14.0.0.

RESULT AND DISCUSSION

The physico-chemical characteristics of raw and primary and secondary treated forms of the effluent are shown in Table 1. Untreated raw effluent was dark in colour, deficit in dissolved oxygen & total alkalinity, rich in total solids, BOD & COD with significant amounts of total nitrogen, chlorides, phosphate, sulphates, sodium and calcium. The potassium content was negligible.

The control was shown 96% of seed germination, but in raw, primary and secondary treated textile dye effluents shows respectively 12, 56 and 71 percentage of seed germination. The higher pH, BOD, COD and other indicating higher organic loads, that causes the adverse effect on germination [15-17]. Diluted various industry effluent enhance the germination percentage [18, 19]. Ramana et al. [20] reported that crop species such as tomato, chilli, bottle gourd, cucumber, and onion showed a decrease in germination percentage with increase in concentration of effluent salinity.

After 20th 40th 60th and 80th day of regular irrigation of different range of effluents the morphological characters was been absorbed. During initial period 20th day there is no much different was absorbed in shoot length, root length, lateral roots and number of leafs. This could also be related to the fact that some of the nutrients present in the effluents are essentials. But in higher [raw] concentration, they become hazardous and toxic to the soybean crop. The greatest effect on shoot and root lengths was observed in untreated effluent concentrations of 40th, 60th and 80th days compare to the control.

The root length of soybean crop during initial treatment period's similar results was only obtained. Final stages of treatment [after 60 days] showed significant different between raw, primary treated effluent to compare the control. The secondary treated effluent much effects on the soybean crop. Similar result obtained in distillery effluent treated plants [17, 21and 22].

Table.1 Essential parameters analysed in textile and dye industry waste

S.No	Parameters	Untreated	Primary	Secondary (Outlet)
1.	Colour	Green/Red/ yellow/Blue	Clear	Clear
2.	pH	9.6	7.52	7.52
3.	EC	8.93	7.34	7.28
4.	Specific Gravity	1.01	0.98	0.98
5	Suspended Solids (ppm)	232	125	119
6	Total Solids [TS] (ppm)	7343	6756	6586
7	Total Alkalinity	966	772	761
8	DO	Nil	Nil	Nil
9	BOD (mg/l)	1236	486	422
10	COD (ppm)	2170	983	962
11	Total Nitrogen (ppm)	236	228	216
12	Sodium (ppm)	196	132	123
13	Potassium (ppm)	8	7	7
14	Calcium (ppm)	328	257	249
15	Chloride (ppm)	840	672	664
16	Sulphate (ppm)	351	306	301
17	Fluoride	Nil	Nil	Nil
18	Phosphate (ppm)	19	15	13

After 60th day number of leaves was significantly decrease in raw [7.00±1.00] effluent treated crop to compare the control. Primary and secondary treated crop was not much significant differed to compare the control [13.00±1.00]. It similar results in the number of produced leaves differed among salinity levels and exposure times initially 4.0-5.0, reached maximum values in the control and low salinities [7.0-8.0 leaves per seedling] than in the higher salinity levels after 32 days [5.6 -7.6 leaves per seedling [23].

The adverse effects were more pronounced at 75% and 100% [i.e., primary treated effluent and raw effluent] due to high effluent concentrations. The initial periods not much variation of shoot length but after 60th day of treatment some variation occurs. Significant effects of seedling root growth was at the end of the experiment [49 days], seedlings at the control salinity shown root length of 1.4± 0.2 cm, significantly higher than at elevated salinities [0.5-0.8 cm at 39-51], while root lengths at lowest salinities were similar to the control [0.6-1.6 cm].

The shoot length of after 60th day raw [19.466±0.5] and primary [28.93±0.11] and secondary [34.06±0.55] treated soybean was significantly low to compare control [43.10±1.95] soybean crop. Also root length of soybean, raw and primary effluent treated crop shows shunted growth and outlet treated plant was not significantly vary to compare control. The Shoot length of *Pioneer jowar* in untreated effluent was only 1.3±0.31 cm in 100% concentration which is 9.2 times lower than control [11.9±0.49 cm] and the shoot length of Desi *jowar* in 75% untreated effluent concentration was 1.2±0.25 cm which is 7.4 times lower than control [27] using paper pulp effluent treated plants obtained similar results by Gomathi and Oblisami, 1992. In low concentration of chemical load in effluent did not affect the root and shoot length only higher concentration of chemical load significantly affect the plants root and shoot length [24-26].

Lateral root of Soybean plants shown not much difference between untreated, treated effluent compare to the control at initial stages of irrigation but, after 60th day later roots significantly differs in raw [17.33±2.51] and primary [21.66±2.88] effluent compare to the control [34.00±1.00]. Textile outlet treated crops shown not much different from the control. Untreated [4.66±0.57], primary [5.66±0.57] and outlet [7.66±1.15] treated effluents are significantly suppressed the form of root nodules in soybean plant when compared to the control [18.00±1.00].

Total chlorophyll content in 20, 40, and 60th days are not much different between the control, raw and treated effluent. After 60th day chlorophyll content was in raw [0.03±0.001] and primary [0.038±0.001] treated effluent and secondary treated effluent [0.049±0.001] slightly varied to control [0.21±0.01] and Chlorophyll content was high in control, secondary, primary treated effluent and then raw effluent. The effluent treated plants showed a decrease in total chlorophyll content in the leaves of *Vallisneria* when compared to control plants. The decrease in pigments contents will seriously affect the photosynthesis and consequently the productivity of the plants [27-29].

CONCLUSION

Textile dye industrial untreated effluent significantly influence growth parameters of soybean crop due to the overload of chemicals but subsequently treated effluent did not affect the growth parameters due to the less toxic chemical content in the treated effluent. The final outlet showed only trace amount of chemical compound released this did not cause any major problems to the growth of the soybean crop.

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