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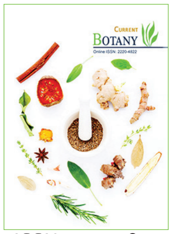
Short Communication



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Impact of tannery effluent on *Sorghum bicolor* (L.) Moench

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ABSTRACT

The present study is aimed to investigate the effect of tannery effluent on different varieties of *Sorghum bicolor*. The disparate concentrations of tannery effluent *viz*., 5, 25, 50, 75 and 100% were tested for its impacts on six varieties of *Sorghum bicolor* (L.) Moench (TNAU CO 5, TNAU CO 30, CO (S) 28, BSR 1, K Tall and Paiyur 1). The experimentation was carried out in a completely randomized design (CRD) with five replications. The impact of tannery effluent on the germination percentage, shoot length (cm), root length (cm), seedling weight (g), vigour index, tolerance index and phytotoxicity were recorded. The outcome revealed that the parameters escalated in 5% effluent concentration and declined after 25% concentration of tannery effluent.

KEYWORDS: Tannery effluent, *Sorghum bicolor*, CRD, phytotoxicity, vigour index

INTRODUCTION

Water contamination is a worldwide crisis and it is a dominant global cause of disease and consequent death. Environmental contagion was caused by the emission of mixture of elements from manufacturing progression which has now become a constant environmental threat. The rapid industrialization and urbanisation, abundance of chemicals including dyes, pigments and aromatic molecular structural compounds and assortment of industrial functions such as tannery, textiles, printing, pharmaceuticals, sugar industry, paper, plastic and cosmetics are leading causes of water pollution (Swathanthra & Rao, 2014; Tadesse & Guya, 2017).Tannery sewage are categorised as the prominent pollutants among all manufacturing dissipates. India is the 3rd largest manufacturer of leather in the globe containing about 3000 tanneries with annual processing capacity of 0.7 million tonnes of animal skins. The tannery industry waste matter is exceedingly noxious to flora and fauna precisely by the occurrence of surplus quantity of dissolved solids, chlorides, sulphides, chromium with an extremely elevated BOD, COD and conductivity in the effluent (Buljan & Kral, 2011). Chromium (trivalent, Cr III and hexavalent, Cr VI) present in effluent is one of the uttermost venomous pollutants (Amir *et al*., 2017).

S. bicolor (L.) Moench is cultivated through the rainy and post-rainy seasons in Tamil Nadu. *Sorghum* are imperative feed for farm animals, especially in the dry months when other feed resources are in short supply. The sorghum grain produced during the post-rainy period (Rabi) is from local and enhanced land races of better quality (bold, white, and with a sweeter taste) and hence chosen for human utilization. In contrast, the sorghum produced in the rainy time (Kharif) is from hybrids, with deprived grain quality, and is not much favoured for human consumption. About 50 percentage of the Kharif produce goes into substitute utilization such as poultry feed, alcohol, and animal feed, while Rabi sorghum is fully used as foodstuff (Rao *et al*., 2010).The objective of present study is to find the effect of tannery industry effluents (diluted and raw) on the seed germination and other parameters of the *Sorghum bicolor*.

MATERIALS AND METHODS

Collection and physico-chemical properties of tannery effluent

The effluent tasters were collected in plastic containers from the exit of a Tannery Industry, Ranipet, Vellore District, Tamil Nadu, India. The collected raw tannery effluents were investigated for their physico-chemical properties as per the method of American Public Health Association (APHA, 1998).

Germination and growth studies on *Sorghum bicolor*

The tannery effluent was prepared into 5, 25, 50, 75 and 100% concentrations using tap water and used for all experiments. Six varieties of *Sorghum bicolor* (TNAU CO 5, TNAU CO 30, CO

(S) 28, BSR 1, K Tall and Paiyur 1) were acquired from Tamil Nadu Agricultural University (TNAU), Coimbatore, Tamil Nadu, India. The number of seeds germinated in the whole lot behaviour was calculated on each and every day up to 7 days. The total germination fraction was calculated by using the following formula: Germination % = Total No. of germinated seeds/Total number of seed sown×100

The seedlings were randomly selected on the 7th day from each treatment for studying the plantlet expansion. The augmentation of the six varieties of *Sorghum* seedlings was deliberated by using a centimeter scale and the values were tabulated. The sprouts were taken, air-dried and their fresh weight was taken. The same plantlets were kept in a hot air oven at 80ºC for 24 h. Then, the tasters were kept in desiccators and their dry weight was taken using electrical single pan balance. Vigour index of the sprouts were assessed by using the precepts initiated by Abdul-Baki and Anderson (1973). Tolerance index of the plantlet were totaled by exerting the prescription posited by Turner and Marshal (1972).

Phytotoxicity

The rate of phytotoxicity of tannery seepage was assessed by maneuvering the rules recommended by Chou *et al.* (1978). Phytotoxicity % = Radicle length of control- Radicle length of test/Radicle length of control ×100.

RESULTS DISCUSSION

Physico-chemical Assets of Tannery Effluent

The physico-chemical features of tannery effluent with its tolerance limit standards for agricultural irrigation is given in Table 1. The tannery effluent was gray in colour with acidic (pH 6) in nature contained elevated amount of total dissolved solids (11218 mg/L). The electrical conductivity of the effluent was 14380 mMhos/cm with lofty biological oxygen demand (960 mg/L) and chemical oxygen demand (4800 mg/L). In the aggregate, a substantial amount of calcium (671 mg/L), magnesium (381 mg/L), sodium (1981 mg/L), sulphate (2888 mg/L) and chromium (14.34 mg/L) were also present in tannery sewage. The tolerance confines of the wastewater for farming irrigation as prescribed by Tamil Nadu Pollution Control Board (TNPCB) were also specified in the same table for similarity. Most of the factors are found to be exceeding the tolerance limits. The acidic pH, excessive hardness, total suspended solids, BOD, COD and towering amount of this indicates that the effluent is inappropriate for the continuation of aquatic organisms owing to the decline of dissolved oxygen content (Zereen*et al.*, 2013).

Table 1: Physico-chemical investigation of tannery effluent with its tolerance limits for farming irrigation

S. No.	Parameters	Raw effluent	Tolerance limits for farming irrigation approved by TNPCB
1.	Colour	Gray colour	Colourless
2.	Odour	Disagreeable smell	Odourless
3.	pH	6	5.5-9.0
4.	Electrical conductivity (mMhos/cm)	14380	–
5.	Temperature (°C)	32	40
6.	Chloride	2718	20
7.	Total hardness	2850	–
8.	Total dissolved solids	11218	200
9.	Biological oxygen demand	960	30
10.	Chemical oxygen demand	4800	250
11.	Calcium as $CaCO_3$	671	–
12.	Magnesium as Mg	381	–
13.	Sodium	1981	–
14.	Sulphate	2888	20
15.	Total chromium	14.34	–

All parameters except colour, odour, pH, EC and temperature are expressed in mg/L.; TNPCB- Tamil Nadu Pollution Control Board

Germination and Growth Studies on *Sorghum Bicolor*

The consequence of various concentrations of tannery waste matter on seed germination proportion of six varieties of *Sorghumbicolor* is tabulated in Table 2. The elevated seed germination fraction (99, 100, 99, 98, 99 and 99%) for the six varieties (TNAU CO 5, TNAU CO 30, CO (S) 28, BSR 1, K Tall and Paiyur1) were documented at 5% application of tannery sewage. The lowest seed germination % values (19, 23, 20, 21, 20 and 18%) were enlisted for the six variation of *Sorghum bicolor* at untreated tannery effluent. The enhancement in germination percentage at lesser concentrations indicates the stimulation of physiologically motionless seeds of the lot by the behavior as suggested by Kumari *et al.*, 2014. It may be due to the diminution in level of toxic metabolites by dilution and enhancedexploitation of nutrients present in the effluent. Similar trends were also noted in case of shoot length, root length, fresh and dry of weight of the seedlings, vigor and tolerance index (Table 2) The root which constantly remains in direct contact with effluent with elevated concentrations of the effluent could influence cell multiplication or the growth (Hussain *et al.*,2010). The being of most favourable level of nutrients in the 5 % diluted tannery effluent might have increased the growth and weights of seedlings (Mythili & Fathima, 2018).

Phytotoxicity

The effect of various concentrations of tannery effluent on phytotoxicity values of six varieties of *Sorghum*seedlings are presented in Table 2. The highest phytotoxicity values (7.5, 5.6, 6.2, 6.6, 6.9 and 8.2) for the varieties (TNAU CO 5, TNAU CO 30, CO (S) 28, BSR 1, K Tall and Paiyur1) were recorded at 100% concentration of tannery effluent. *Sorghum* seedling growth and maturity are essential processes of life and propagation of plant species. They constantly dependent on the external situation, showing of an assortment ofcontaminant in lower concentration (5%) diluted tannery effluent at enhanced the growth and maturity (Sangeetha *et al.*, 2012).

Table 2: Effects of different concentrations of tannery effluent on *Sorghum bicolor* (L.) Moench. varieties

Tannery Effluent Treatments	Name of the varieties					
	TNAU CO 5	TNAU CO 30	CO (S) 28	BSR 1	K Tall	Paiyur 1
Germination Percentage						
Control	91± 4.55	90± 4.50	90± 4.50	91± 4.55	90± 4.50	88± 4.4
5	99± 4.95	100± 5.0	99± 4.95	98± 4.9	99± 4.95	99± 4.95
25	80± 4.00	82± 4.1	81± 4.05	84± 4.2	83± 4.15	82± 4.1
50	71± 3.55	69± 3.45	70± 3.5	71± 3.55	69± 3.45	70± 3.5
75	48± 2.4	49± 2.45	45± 2.25	44± 2.2	41± 2.05	40± 2.0
100	19± 0.95	23± 1.15	20± 1.0	21± 1.05	20± 1.0	18± 0.9
Shoot length (cm/plant)						
Control	4.2± 0.21	5.7± 0.28	4.0± 0.2	4.3± 0.21	4.1±0.20	3.8±0.19
5	6.8± 0.34	7.9± 0.39	5.5± 0.27	5.7± 0.28	5.3±0.26	4.3±0.21
25	3.8± 0.19	4.5± 0.22	3.2± 0.16	3.0± 0.15	3.1±0.15	3.4±0.17
50	2.7± 0.13	3.3± 0.16	2.5± 0.12	2.1± 0.10	2.0±0.1	2.0±0.1
75	1.9± 0.09	1.6± 0.08	1.3± 0.06	1.2± 0.06	1.2±0.06	1.2±0.06
100	0.8± 0.04	1.4± 0.07	0.9± 0.04	0.8± 0.04	0.6±0.03	0.6±0.03
Root length (cm/plant)						
Control	2.5±0.12	3.0±0.15	1.9±0.09	1.8±0.09	2.0±0.1	1.7±0.08
5	3.2±0.16	3.7±0.18	2.0±0.1	2.1±0.10	2.7±0.13	2.4±0.12
25	1.9±0.09	2.7±0.13	1.6±0.08	1.5±0.07	1.4±0.07	1.2±0.06
50	1.2±0.06	1.6±0.08	1.3±0.06	1.1±0.05	1.0±0.05	1.0±0.05
75	1.0±0.05	1.2±0.06	1.0±0.05	0.8±0.04	1.0±0.05	1.0±0.05
100	0.9±0.04	1.2±0.06	0.8±0.04	0.6±0.03	0.4±0.02	0.3±0.01
Fresh weight (g/seedling)						
Control	5.4±0.27	7.1±0.35	5.6±0.28	6.8±0.34	5.7±0.28	5.0±0.25
5	6.9±0.34	9.4±0.47	7.1±0.35	7.4±0.37	7.1±0.35	6.5±0.32
25	4.9±0.24	6.8±0.34	5.0±0.25	5.3±0.26	5.1±0.25	4.5±0.22
50	3.5±0.17	5.7±0.28	3.9±0.19	4.1±0.20	3.7±0.18	3.7±0.18
75	3.1±0.15	4.6±0.23	3.2±0.16	3.5±0.17	2.9±0.14	2.6±0.13
100	2.0±0.1	2.8±0.14	2.1±0.10	2.2±0.11	2.0±0.1	1.7±0.08
Dry weight (g/seedling)						
Control	2.8±0.14	3.5±0.17	2.7±0.13	3.0±0.15	2.9±0.14	2.6±0.13
5	3.2±0.11	4.0±0.2	3.4±0.17	3.5±0.15	3.5±0.17	3.1±0.15
25	2.1±0.10	2.9±0.14	2.2±0.11	2.6±0.13	2.0±0.1	1.8±0.09
50	1.0±0.05	1.4±0.07	1.1±0.05	1.1±0.05	0.9±0.04	0.9±0.04
75	0.7±0.03	1.0±0.05	0.8±0.04	0.7±0.03	0.6±0.03	0.6±0.03
100	0.3±0.01	0.8±0.04	0.4±0.02	0.6±0.03	0.5±0.02	0.4±0.02
Vigour index						
Control	1540±77	1710±85.5	1342±67.1	1408±70.4	1512±75.6	1180±59
5	1861±93.0	1979±98.5	1504±75.2	1720±86	1698±84.9	1499±74.9
25	1310±65.5	1570±78.5	1190±59.5	1280±64	1321±66.0	1001±50.0
50	901±45.0	1100±55	980±49	875±43.7	912±45.6	780±39
75	523±26.1	690±34.5	570±28.5	482±24.1	376±18.8	355±17.7
100	220±11	310±15.5	289±14.4	198±9.9	186±9.3	173±8.6
Tolerance index						
Control	-	-	-	-	-	-
5	3.5±0.17	4.9±0.24	3.8±0.19	3.5±0.17	4.0±0.2	3.3±0.16
25	2.1±0.10	3.7±0.18	2.9±0.14	2.5±0.02	2.9±0.14	2.2±0.11
50	0.8±0.04	1.9±0.09	1.2±0.06	1.0±0.05	1.0±0.05	1.0±0.05
75	0.3±0.01	1.0±0.05	0.8±0.04	0.5±0.02	0.7±0.03	0.5±0.02
100	0.1±0.005	0.9±0.04	0.7±0.03	0.6±0.03	0.5±0.02	0.5±0.02
Phytotoxicity						
Control	-	-	-	-	-	-
5	0.6±0.03	0.4±0.02	0.5±0.02	0.6±0.03	0.6±0.03	0.5±0.02
25	2.8±0.14	1.8±0.09	2.1±0.10	2.2±0.11	2.5±1.25	2.0±0.1
50	4.9±0.24	3.8±0.19	4.0±0.2	4.1±0.20	4.4±0.22	4.3±0.21
75	6.3±0.31	4.2±0.21	5.3±0.26	5.8±0.29	5.8±2.9	6.9±0.34
100	7.5±0.37	5.6±0.28	6.2±0.31	6.6±0.33	6.9±0.34	8.2±0.41

± Standard deviation

CONCLUSION

The outcomes of this experiment clearly demonstrate that germination was drastically shortened in elevated concentration of tannery effluent (above 5%). The adverse effects may be in this process of soaring amount of BOD, COD, suspended solids and heavy metals jointly with assorted kind of dissolved chemicals. Irrigation of the soil with raw tannery effluents or tannery effluent polluted water resources destructively affect the plant germination and growth and also expand acidity of the soil.

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