



Effect of tannery effluent on germination, seedling growth and pigment content of *Triticum aestivum* L. var. PBW-373

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Received: 15.09.2012

Accepted: 8.01.2013

Abstract

The present study has been focussed on the effect of untreated tannery effluent on germination, seedling growth and pigment contents of wheat (*Triticum aestivum* L. var. PBW-373). Germination studies were conducted with wheat seeds having various concentrations of (4.5, 9, 13.5, and 18%) tannery effluent and five treatments (E₀, E_{4.5}, E₉, E_{13.5} and E₁₈). The +ve germination parameters i.e. cumulative percent germination, germination index etc. found to be maximum in E_{4.5}. The -ve germination parameters like delay index, percent inhibition showed minimum values for E_{4.5}. Growth parameters also decreased with increase in effluent concentration. The pigment contents i.e. chlorophyll-a and chlorophyll-b also showed good results at E_{4.5}.

Keywords :Chromium, Pigments, Pollution, Germination, Tannery effluent, *Triticum aestivum*

Introduction

Industries are the valuable assets of a country and are undoubtedly a boon to mankind as they fulfill most of the man's needs by manufacturing a wide variety of products as well as eradicate poverty by generating employment sources but serious environment degradation is also caused by their toxic discharges (Malaviya and Sharma, 2011). The effluents discharged into land and water spoil surface and ground water quality, soil, vegetation and productivity of crop grown which deteriorates human health (Khurana and Pritpal, 2012). Tannery effluents are ranked as one of the highest polluted effluents among all others industrial discharge. In India, tanneries are mostly located in Tamil Nadu, West Bengal, Maharashtra, Punjab, Karnataka, Andhra Pradesh and Kanpur (U.P). The Tannery effluent is characterized by high toxicity due to chromium, higher dissolved solids, and high salinity. To assess pollutants toxicity, plants are the best ecological monitors (Nath *et al.*, 2009).

Although various workers have suggested suitable application rates for tannery effluent under different

conditions (Karunyal *et al.*, 1994; Thangavel and Balagurunathan, 2002), the local studies are essential to determine optimum loading rates in order to avoid the possible reduction in crop yields because of inorganic toxicity. In the present study, an attempt has been made to study the effect of different concentrations of tannery effluent on germination, seedling growth and pigment content of wheat (*Triticum aestivum* L. var. PBW-373).

Material and Methods

The effluent was collected from a tannery industry in CLRI, Leather complex, Kapurthala Road, Jalandhar in plastic containers and kept under refrigeration. The effluent was analyzed for various physico-chemical parameters by standard methods according to Greenberg *et al.* (1995). Certified seeds of wheat variety PBW-373 were procured from the Directorate of Agriculture, Talab Tillo, Jammu (J&K). Wheat seeds were surface sterilized with carbendazim for two minutes and washed with distilled water to remove surface contamination. Twenty seeds were arranged at equal distance in petriplates of diameter 14cm lined with two filter papers. Different concentrations of the tannery

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effluent viz. 4.5%, 9%, 13.5% and 18% were made by adding distilled water and sprinkled into respective petriplates designated as E_{4.5}, E₉, E_{13.5} and E₁₈. The petriplate poured with tap water was used as control E₀. Similarly three replicates of each set were maintained and kept in a BOD incubator at room temperature of 28 ± 2°C. Filter papers were moistened regularly during experiment to prevent dryness of the seeds. The number of seeds germinated on each day was noted until it became constant. The seeds were considered to have germinated when the radical pierced through the seed-coat. On 10th day seedlings were removed and germination parameters viz. cumulative percent germination, germination index, delay index, germination value, peak value, speed of germination, germination period, percent inhibition and vigour index were estimated (Czabator, 1962). Growth parameters like root length, shoot length, root-shoot ratio, total seedling length, fresh weight of root, dry weight of root, fresh weight of shoot, dry weight of plant, biomass (fresh and dry weight of plant), moisture content were also estimated (Greenberg *et al.*, 1995). For estimation of pigment content the leaves were extracted in 80% acetone and the absorbance of pigment extract was measured spectrophotometrically at wavelength 663 and 645 nm for chlorophyll content (Arnon, 1949) and 480 and 510 nm for carotenoid content (Duxbury and Yentsch, 1956).

Results and Discussion

The tannery effluent used for the present study was dark bluish green in colour with an unpleasant odour. The physicochemical characteristics of the 100% effluent exhibited low pH (3.61), EC (67.5 mS/cm) and turbidity (023 NTU). The average values of total suspended solids (1580 mg/l), sodium (4210 mg/l), chloride (4570 mg/l) and COD (1840 mg/l) were also estimated. The effect of tannery effluent on various germination parameters of *Triticum aestivum* L. var. PBW-373 are shown in Table 1. It was observed that the average values for +ve germination indices were highest [cumulative percent germination (78.33), germination index (120.116), germination value (1539.583), peak value (19.583), speed of germination (7.833), and vigour index (2214.266)] in E_{4.5} (4.5% effluent concentration) and lowest in effluent treatment E₁₈

(18% effluent concentration). The average value for –ve germination parameters like delay index was negative in E_{4.5} and zero in other treatments. The value of percent inhibition was lowest (-1.666) in E_{4.5} and increased with increasing effluent concentration. The value of germination period (days) was found to be two days in all the effluent treatments. From the study it is evident that at 4.5% effluent concentration, the values of all the +ve germination parameters were maximum. It may be due to the reason that up to 4.5% concentration, the seedlings are getting some nutrients which promote seed germination and beyond that it becomes toxic. More or less similar results have been observed by Sharma *et al.* (2002) while studying the effect of distillery effluent on sugar beet. Sahai and Srivastava (1986) also observed that lower concentration distillery wastewater (2.5%) promoted seed germination of *Cajanus cajan*. High osmotic pressure caused due to high salt concentration in the effluent might be responsible for reduced seed germination.

Table 2 reveals the effect of tannery effluent on growth parameters of *Triticum aestivum* PBW-373 seedlings. The average values of root–shoot ratio (in terms of length) of seedlings showed an increase at E_{4.5}, followed by E₀ and the values were minimum in E₁₈ treated seedlings. The reduction in root length, shoot length and root–shoot ratio might be due to high salinity of tannery effluent (Rao and Kumar, 1983). The root system is adversely affected by the higher concentration of effluent which results in reduction of root–shoot ratio (Vijayarengan, 2003). Also heavy metals accumulation in roots causes decrease in root growth. The biomass also showed an increase at E_{4.5} tannery effluent concentration. The values of % moisture of E₀ and E_{4.5} also showed similar pattern and increase in effluent concentration caused decrease in % moisture. Table 3 reveals the effect of different concentrations of tannery effluents on pigment content of *Triticum aestivum* seedlings. The chlorophyll a, chlorophyll b and total chlorophyll have been increased up to E_{4.5} effluent concentration, followed by control and then gradually decreased with an increase in effluent concentration. It may be due to chromium compounds present in the effluent which caused



Table 1: Effect of different concentrations of tannery effluent on germination parameters¹ of *Triticum aestivum* L.var. PBW-373 on 10th day of germination

Treatments	Cumulative Percent germination (%)	Germination Index	Delay Index	Germination value	Peak value	Speed of germination (days)	Germination period (days)	Percent Inhibition (%)	Vigour Index
Control (E ₀) ²	76.66	-	0	1475	19.166	7.666	2	-	2004.933
E _{4.5}	78.33	120.116	-11	1539.583	19.583	7.833	2	-1.666	2214.266
E ₉	73.33	91.15	0	1345.833	18.333	7.333	2	3.333	1848.283
E _{13.5}	71.66	69.933	0	1289.583	17.916	7.166	2	5.000	1540.416
E ₁₈	70.00	66.396	0	1229.166	17.500	7.000	2	6.666	1468.500

¹Mean of three replicates, ²E₀: tap water, E_{4.5}, E₉, E_{13.5}, E₁₈: 4.5, 9, 13.5 and 18% of tannery effluent, respectively.

Table 2: Effect of different concentrations of tannery effluent on growth parameters¹ of *Triticum aestivum* L.var. PBW-373 seedlings on 10th day of germination

Treatment	Root length (cm)	Shoot Length (cm)	Root Shoot Ratio	Total seedling length (cm)	Biomass (Fresh weight) (g)	Biomass (Dry weight) (g)	% Moisture
Control (E ₀) ²	10.66±0.362	15.523±0.501	0.68±0.001	26.18±0.86	0.1288±0.0009	0.0276±0.0027	78.509±2.269
E _{4.5}	12.51±0.297	15.75 ±0.808	0.79±0.01	28.27 ±0.37	0.1313±0.0003	0.0288±0.0002	78.02±0.1316
E ₉	10.14± 1.43	15.043 ±0.461	0.67±0.11	25.18 ±1.01	0.1227±0.0052	0.0271±0.0003	77.836±0.8323
E _{13.5}	7.94±1.329	13.42±1.145	0.58 ±0.06	21.37± 2.35	0.1014±0.0046	0.0225±0.0007	77.802±0.3799
E ₁₈	7.75 ± 2.5	13.27±0.204	0.58±0.187	21.03±2.569	0.0911±0.0004	0.0206±0.0001	77.322±0.1374

¹Mean ± S.D of three replicates, ²E₀ : tap water, E_{4.5}, E₉, E_{13.5}, E₁₈: 4.5, 9, 13.5 and 18% of tannery effluent, respectively.

Table 3: Effect of different concentrations of tannery effluent on pigment content¹ (mgg⁻¹ fresh weight) of *Triticum aestivum* L.var. PBW-373 seedlings on 10th day of germination

Treatments	Chlorophyll a	Chlorophyll b	Chlorophyll a/b ratio	Total chlorophyll	Carotenoid
Control (E ₀) ²	0.0751±0.0001	0.0506±0.0001	1.4822±0.0025	0.1257±0.0002	0.4656±0.0001
E _{4.5}	0.104±0.0002	0.095±0	1.0947±0.0021	0.199 ±0.0002	0.7991±0.0002
E ₉	0.1003±0.0005	0.0824±0.0004	1.2171±0.0043	0.1827±0.0009	1.1842±0.0004
E _{13.5}	0.0711±0.0012	0.0472±0.0006	1.506 ±0.0455	0.1184±0.0007	1.1996±0.0002
E ₁₈	0.0627±0.0006	0.041 ±0.0011	1.526 ±0.0302	0.1039±0.0016	1.197±0.002

¹Mean ± S.D of three replicates, ²E₀ Tap water, E_{4.5}, E₉, E_{13.5}, E₁₈: 4.5, 9, 13.5 and 18% of tannery effluent, respectively.



reduced chlorophyll content (Rao and Kumar, 1981; 1983). Lakshmi and Sundramoorthy (2001) while working on paddy treated by tannery effluent observed that upto 10% concentration of effluent, the chlorophyll-a, chlorophyll-b and carotenoid content were higher which may be due to the reduced toxicity of effluent to an optimum level by dilution which favoured high pigment content. The carotenoid showed an increase up to $E_{13.5}$ of effluent treatment and decreased slightly in E_{18} . It may be attributed to enhancing influence of increased nitrogen on carotenoid biosynthesis (Cottenie, 1973).

Conclusion

The present study shows that the tannery effluent has an evident toxic effect on the germination, seedling growth and pigment content of *Triticum aestivum* when applied at higher concentrations. The observations shows that at lower concentration (4.5 percent) the effluent has better effect than other concentrations in overall growth of the seedlings. Guruprasada and Kumar (1983) also observed that 5% concentration is beneficial for plants while studying the impact of tannery effluent on seed germinability and chlorophyll content in *Cicer arietinum* L. which is in conformity with the present study. Thus, tannery effluent needs very high dilution before its disposal in agricultural fields.

Acknowledgements

The authors are thankful to Head, Department of Environmental Sciences, University of Jammu, Jammu (J&K) for giving essential facilities and tannery industry (Jalandhar) for providing the effluent samples for conducting the present study.

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