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Impact of tannery effluent on germination of various varieties of wheat (*Triticum aestivum* L.)

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Abstract: The present study has been focused on the impact of tannery effluent on germination pattern of ten varieties of wheat (*Triticum aestivum*).The physico-chemical analysis of the tannery effluents showed that it had high salinity (45.97 ppt) and an acidic pH (3.61). For screening test, a setup with various concentrations of tannery effluent (4.5%, 9%, 13.5%and 18%) was prepared in petri plates to check the impact of tannery effluent on various varieties of wheat. Among ten varieties, PBW-343 and HS-365 showed better performance at 4.5% tannery effluent and considered to be more tolerant, whereas HS -295 was the most sensitive to tannery effluent treatment.

Keywords: Chromium, Germination, Screening, Tannery effluent, Toxicity

INTRODUCTION

In India, tannery industry seeks major attention than several other industries as it earns foreign exchange through leather export and also pollutes agricultural land by toxic effluent discharge. The prime stages in leather process include curing, soaking, liming, detaining, bating, pickling, degreasing and tanning (Sundaramoorthy and Lakshmi, 2000). From all the stages, wastewater is released which contains high concentrations of salts and chromium (Babyshakila and Usha, 2009). The chemicals used in tanning operation include chromium sulphate, formic acid, sulphuric acid, sodium chloride, sodium bicarbonate, calcium hydroxide, magnesium sulphate, dyes, fat liquor's etc. Chromium released has different impacts on plants, animals, human health and also causes environmental problems (Andaleeb *et al.*, 2008). Hence,the disposal of high volume of industrial effluent is a major problem faced by industries with limited space for treatment and disposal (Kumar and Chopra, 2012). Now a days use of wastewater in agriculture is gaining importance. Crops irrigated with wastewater have given higher yields and reduce the need for chemical fertilizers as they serve as nutrient (Kumar and Chopra, 2012). Various workers have carried out many investigations to find the effect of different effluents on germination of crops (Gautam *et al.*, 1992, Sundaramoorthy and Lakshmi, 2000 and Augusthy and Mani, 2001). Although tannery effluents contain many constituents which are phytotoxic at higher concentrations many of these constituents may prove to be beneficial. Effect of tannery wastewater on germination pattern of some crops have already been studied (Karunyal *et al.*, 1994, Sundaramoorthy and Lakshmi, 2000), still many crops can be screened for their effluent tolerance capacities. Keeping in view the above points, ten varieties of wheat were selected for presentwork to study their germination responses on exposure to tannery wastewater.

MATERIALS AND METHODS

The certified seeds of different varieties of wheat were procured from the Directorate of Agriculture, TalabTillo, Jammu (J&K). The untreated effluent used for the study was collected from a tannery unit in CLRI, Leather complex, Kapurthala Road, Jalandhar in plastic containers and kept under refrigeration.The physico-chemical analysis of the effluent for various parameters was done according to Greenberg *et al.* (1995) and their average values were calculated. The ten varieties of wheat used for screening were HS-240, HS-365, HS-295, PBW-373, PBW-343, PBW-154, Raj-3077, Raj-3765, WH-542 and HD-2687. The wheat seeds were surface sterilized with antifungal carbendazim for two minutes and then washed with distilled water. The twenty seeds of each variety were arranged at equal distance in petriplates of diameter 14 cm lined with two sterilized filters paper and a cotton layer. Different concentrations of tannery effluent viz. 4.5%, 9%, 13.5% and 18% were made by adding distilled water and then poured into petriplates which were designated as $E_{4.5}$, E_9, $E_{13.5}$ and E_{18}, respectively. The seeds treated with tap water were used as control (E_o). Three replicates of each variety were maintained and kept in BOD incubator at temperature 28±2^{0}C. To prevent dryness of seeds during experiment, filter papers were moistened regularly. The number of seeds germinated on each day was noted until it becomes constant and no

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seed germinated after that. When the radical pierced through the seed coat, the seeds were considered to be germinated. The germination was observed up to 10th day. The percentage of seed germination of each variety was recorded separately according to Czabator (1962). The percent germination was calculated by the following formula;

$$\text{Percent germination} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds sown}} \times 100$$

RESULTS AND DISCUSSION

The physico-chemical characteristics of tannery effluent are given in Table 1. The effluent used for the present study was dark bluish green in colour with an unpleasant odour. The physico- chemical analysis of raw effluent showed pH (3.61), EC (67.5 mScm^{1}), salinity (45.97 ppt), total suspended solids (1580 mgl^{-1}), chloride (4570 mgl^{-1}), sodium (4210 mgl^{-1}), COD (1840 mgl^{-1}). Table 2 showed a marked difference in percent germination of ten varieties of wheat on exposure to tannery effluent. At $E_{4.5,}$ there was maximum percent germination in all the varieties followed by control except PBW-154 and Raj-3765 in which percent germination was higher in control than at $E_{4.5}$. The percent germination gradually decreased with an increase in effluent concentration, i.e., above $E_{4.5}$ concentrations percent germination value decreased.

At $E_{4.5}$ (4.5% effluent), the maximum value of percent germination was observed in PBW-343 (86.66), followed by HS-365 (83.33). PBW-373 and Raj-3077 showed the same values (78.33), followed by HD-2687 (76.66), followed by Raj-3765 and WH-542 which showed the same percent germination (75), followed by PBW-154(73.33), HS-240 (66.66) and HS-295 (65). At E_o (control) the maximum percent germination was observed by PBW-343 (83.33), followed by HS-365 (80). PBW-373 and Raj-3765 showed the similar percent germination (76.66), followed by PBW-154 (75). Raj-3077, WH-542, and HD-2687 had same values (73.33), followed by HS-240 (65) and HS-295 (58.33). At E_9 (9% effluent treatment), the decreasing trend for ten varieties were PBW-343(80), HS-365 (76.66), PBW-373 (73.33), Raj-3077 (71.66), Raj-3765 (71.66), WH-542 (71.66), PBW-154 (70), HD-2687 (70), HS-240 (63.33) and HS-295 (53.33).At $E_{13.5}$ (13.5% effluent treatment), the decreasing values of percent germination were PBW-343 (76.66), HS-365(75), PBW-373 (71.66), PBW-154 (68.33), Raj-3765 (68.33), Raj-3077 (66.66), WH-542 (66.66), HD-2687 (66.66), HS-240 (56.66) and HS-295 (51.66). The decreasing pattern of percent germination of ten varieties of wheat at E_{18} (18% of effluent treatment) included PBW-343 (75), HS-365 (73.33), PBW-373 (70), PBW-154 (66.66), Raj-3765 (66.66), Raj-3077 (65), HD-2687 (65), HS-240(55) and HS-295 (50).

Table 1. Physico-chemical characteristics of tannery effluent.

S. No.	Parameters	Values
1	Colour	Dark bluish green
2	Odour	Unpleasant
3	pH	3.61
4	Electrical conductivity (mScm^{-1})	67.5
5	Salinity (ppt)	45.97
6	Total suspended solids (mgl^{-1})	1580
7	Chloride (mgl^{-1})	4570
8	Sodium (mgl$^{-1)}$	4210
9	COD (mgl^{-1})	1840

All values are the mean of three replicates

The percent germination of various varieties of *T.aestivum* with different concentration of tannery effluent and tap water was observed in order of 4.5% >Eo> 9% > 13.5% > 18%. Malaviya and Sharma (2011) have already been reported that there exists a specific correlation between effluent concentration used and germination parameters. Similar type of varietal screening experiments were conducted by Sundaramoorthy and Lakshmi (2000) using tannery effluent on ten varieties of groundnut in which they found that maximum germination response was shown at lower concentration (10%) of tannery effluent. In present study, among all the varieties, the variety PBW-343 showed the highest percent germination, followed by HS-365. The wheat variety HS-295 showed the lowest percent germination on exposure to tannery effluent treatment. If a seed is able to germinate in chromium contaminated medium then it indicates its tolerance level for chromium, because first physiological process affected by chromium is the seed germination (Peralta *et al.*, 2001).

The difference observed in the tolerance capacity of ten varieties of wheat might be due to the difference in their ability to accumulate the element which might be a genetic aspect. At lower concentration (4.5%), the percent germination was increased and with the increase in effluent concentration, percent germination was decreased. The reduction in percent germination can be attributed to the presence of higher amount of organic matter, calcium, magnesium, sulphates, residual chlorine and chlorides (Srivastava and Sahai, 1987). Inhibition of seed germination at higher concentrations of the effluent may be due to high levels of dissolved solids which enhance the salinity and conductivity of absorbed solute by the seeds (Sundaramoorthy and Kunjithapatham, 2000). Studies of different industrial wastewaters with several plants have been carried by various workers suggested that lower concentrations of effluent used to cause positive impact on germination (Ramesh and Ramanujam, 1991, Reddy and Borse, 2001, Vijayarengan, 2003 and Malaviya *et al.*, 2012).

Table 2. Effect of tannery effluent on percent germination of various varieties of wheat (*Triticum aestivum* L).

Treatments	Wheat varieties									
	HS-240	HS-365	HS-295	PBW-373	PBW-343	PBW-154	Raj-3077	Raj-3765	WH-542	HD-2687
Control (E_o)	65.00±5.0	80.00±5.0	58.33±2.8	76.66±5.7	83.33±2.8	75.00±5.0	73.33±2.8	76.66±2.8	73.33±2.8	73.33±2.8
$E_{4.5}$	66.66±2.8	83.33±2.8	65.00±5.0	78.33±5.7	86.66±2.8	73.33±2.8	78.33±5.7	75.00±5.0	75.00±5.0	76.66±2.8
E_9	63.33±2.8	76.66±7.6	53.33±2.8	73.33±2.8	80.00±5.0	70.00±5.0	71.66±2.8	71.66±2.8	71.66±2.8	70.00±5.0
$E_{13.5}$	56.66±5.7	75.00±5.0	51.66±7.6	71.66±5.7	76.66±5.7	68.33±2.8	66.66±5.7	68.33±2.8	66.66±5.7	66.66±5.7
E_{18}	55.00±8.6	73.33±2.8	50.00±5.0	70.00±5.0	75.00±5.0	66.66±2.8	65.00±5.0	66.66±5.7	55.00±8.6	65.00±5.0

All values are the mean ± S.D of three replicates; E_o: tap water, $E_{4.5}$, E_9, $E_{13.5}$, E_{18}: 4.5, 9, 13.5 and 18% of tannery effluent, respectively

Conclusion

The present study concluded that the wheat varieties PBW-343 and HS-365 exhibited more tolerance than other varieties at lower concentration of tannery effluent ($E_{4.5}$) while HS -295 was most sensitive to tannery effluent exposure. Thus wheat varieties PBW-343 and HS-365 can be used for field-level study to assess their potential to grow in tannery effluent contaminated soils.

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