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GERMINATION CHANGES OF VARIETIES OF *VIGNA MUNGO* L. UNDER TANNERY EFFLUENT STRESS

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Abstract

Wastewater from leather processing, a major industry that produces upto enormous wastewater. The wastewater contains valuable nutrients, but also contaminants, such as salts and chromium (Cr), that might affect soil processes and crop production. The present investigated the different concentrations of tannery effluent on seed germination and seedling growth of five variety of blackgram (*Vigna mungo* L.). The results low concentration 10% of tannery waste water promoted the germination, percentage growth, fresh, dry weight of blackgram seedlings, whereas the higher concentration (above 20%) reduced the above all the parameters. The observation also indicates organ specific differences in the growth of seedlings in presence of different concentrations (10, 20, 30, 40, 50 and 100%) of tannery effluent.

Key Words: Wastewater; *Vigna mungo*; Tannery effluent.

Introduction

Water pollution is a large set of adverse effects upon water bodies such as lakes, rivers, oceans and groundwater caused by human activities. Industries discharge a variety of pollutants in their wastewater including heavy metals, resin pellets, organic toxins, oils, nutrient and solids. Discharge can also have thermal effects, especially those from power stations, and these too reduce the available oxygen. Silt bearing runoff from many activities including construction sites, deforestation and agriculture can inhibit the penetration of sunlight through the water column, restricting photosynthesis and causing blanking of the lake or river bed, in turn damaging ecological systems.

Indian industries have registered a quantum jump, which has contributed to high economic growth but simultaneously it has also given rise to severe environmental pollution. It is found that one-third of the total water pollution comes in the form of effluent have increased the level of toxins in like cyanide and chromium up to 20 times the safe level in 22 critically polluted areas of the country. Tamil Nadu is a state having much share in the industrial economy of India. The tannery industry as a major sharecropper of the foreign exchange earner has in the recent past become a highly controversial subject because of the scope with which it is viewed in the midst of environmentalists.

Vellore district is one of the important districts of Tamil Nadu where more than 1000 tanneries both of big and small scale are concentrated (1). Today approximately 2,500 industries are located in the district. The process of tanning consists in the transformation of animal skin to leather (2). The skin is submitted to different processes to eliminate meet, fat and hair in which different chemicals, such as chromium(Cr^{3+}), sodium hydroxide, sodium hypochlorite, enzymes, lime, chloride, sulphuric acid, formic acid, ammonium salts, kerosene, chlorobenzen, tenso-active agents are used, the effluent thus generated contains large concentrations, sodium (Na), sulphates, chlorides and Cr^{3+} (3). The tannery industry has been in existence in the Vellore District for

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the past 100 year. This would reveal the level of contamination in the Palar river belt. Nearly million gallons of effluent has been discharged per day in the Palar river basin. During early days leather processing was done through vegetable tanning. In the recent past of 25 years chemical tanning has been in vogue and this has ultimately damaged the whole environment, as well the ecological balance remaining upset. So, an attempt was made to investigate the response of different concentrations of tannery effluent on germination percentage, growth of five varieties of blackgram.

Materials and Methods

Tannery effluent

The tannery effluent used in the present study the effluent samples were collected in plastic containers from the outlet of a tannery industry in Ranipet at Vellore district, Tamil Nadu. Its various physico-chemical characteristics were analysed using standard methods (4) (Table 1). The effluents were stored at 4°C during storage period to avoid charges in its characteristics.

Table 1. Physico-chemical analysis of tannery effluent with its tolerance limits for agricultural irrigation

S.No.	Parameters	Raw effluent	Tolerance limits for agricultural irrigation prescribed by (TNPCB)
1.	Colour	Gray colour	Colourless
2.	Odour	Disagreeable smell	Odourless
3.	PH	6	5.5-9.0
4.	Electrical conductivity (Micromho's / 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

Seeds

Ten varieties of balckgram namely, ADT-3, ADT-5, TMV 1, VBM 1, K1, the seeds were procured from Tamil Nadu Agricultural University. The healthy and uniform sized blackgram seeds were selected and surface-sterilized with 0.1% $HgCl_2$ for 3 minutes. They were thoroughly washed with tap water to avoid surface contamination.

Germination studies

The germination studies 15 seeds of five varieties of blackgram seeds were placed in equidistantly in plastic containers filled with sterilized soil. The seeds were irrigated with equal quantity of various concentrations (control 10, 20, 30, 40, 50 and 100%) of effluent and the seed were irrigated with distilled water were treated control. The number of seeds germinated and the length of seedlings were observed and measured on 10 day seedlings. The germination percentage were calculated using the formula.

The root, shoot length were measured in cm/plant and the fresh weight of seedlings were taken by using on electrical Single Pan Balance. The dry weight was taken after drying the seedlings in a hot air over at 80°C for 24 hours.

The percentage of phytoxicity (5) was also calculated.

$$\frac{\text{Redicle length of control} - \text{Radicle length of test}}{\text{Radicle length of control}} \times 100$$

The vigour index of the seedlings was calculated by using the formula proposed by (6).

Vigour index = Germination percentage × Length of seedlings.

The Tolerance Index of the seedling was calculated by (7).

$$\text{Tolerance index} = \frac{\text{Mean length of longest root in treatment}}{\textit{Mean length of longest root in control}}$$

Results

The germination percentage of five varieties of blackgram gown under different concentrations of tannery effluent is given in a Fig. 2.

The maximum seed germination percentage of (ADT 3, 100), (ADT 5, 99), (TMV 1, 99), (VBM 1, 100) and (K 1, 94) were recorded at 10 per cent concentration of tannery effluent. At the same time, the minimum germination percentage (ADT 3, 34), (ADT 5, 31), (TMV 1, 38), (VBM 1, 36) and (K 1, 29) were recorded in 100 per cent concentration of tannery effluent. Root length and shoot length of blackgram the maximum root length (ADT 3, 7.1), (ADT 5, 7.9), (TMV 1, 6.9), (VBM 1, 7.0) and (K 1, 6.6) cm/plant and shoot length (ADT 3, 11.4), (ADT 5, 11.1), (TMV 1, 11.6), (VBM 1, 10.8) and (K 1, 11.0) were observed at 7th DAS in 10 per cent concentration of tannery effluent. The minimum range of root length (ADT 3, 2.0), (ADT 5, 1.3), (TMV 1, 1.2), (VBM 1, 0.9) and (K 1, 0.9) cm/plant and shoot length

(ADT 3, 2.1), (ADT 5, 1.6), (TMV 1, 1.6), (VBM 1, 1.3) and (K 1, 1.0) cm/plant were recorded at 7th DAS in 100 per cent of tannery effluent concentration.

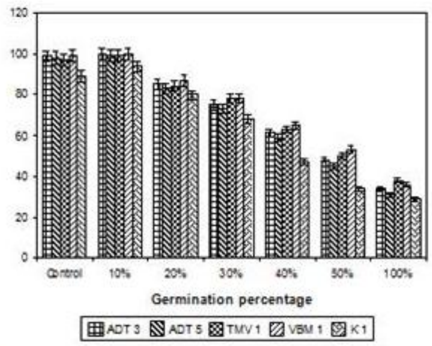

Fig. 1. Effect of tannery effluent on seed germination percentage of *Vigna mungo* on 7th days

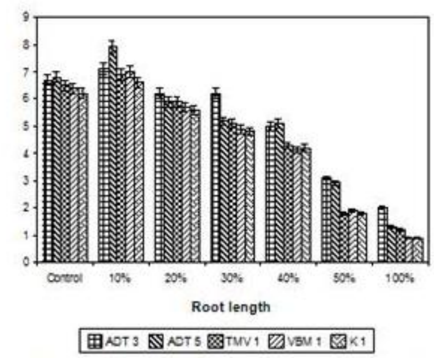

Fig. 2. Effect of tannery effluent on root length (cm) of five varieties of *Vigna mungo* on 7th days

The maximum fresh weight (ADT 3, 3.715), (ADT 5, 3.550), (TMV 1, 3.141), (VBM 1, 3.000) and (K 1, 3.010) g/plant were observed at 7th DAS in 10 per cent concentration of tannery effluent. The minimum range of fresh weight (ADT 3, 0.210), (ADT 5, 0.201), (TMV 1, 0.187), (VBM 1, 0.174) and (K 1, 0.194) g/plant were recorded at 7th DAS in 100 per cent of tannery effluent concentration.

The maximum dry weight (ADT 3, 0.670), (ADT 5, 0.674), (TMV 1, 0.665), (VBM 1, 0.660) and (K 1, 0.664) g/plant were observed at 7th DAS in 10 per cent concentration of tannery effluent. The minimum range of dry weight (ADT 3, 0.034), (ADT 5, 0.030), (TMV 1, 0.031), (VBM 1, 0.030) and (K 1, 0.031) g/plant were recorded at 7th DAS in 100 per cent of tannery effluent concentration.

The maximum vigour index (ADT 3, 1971), (ADT 5, 1980), (TMV 1, 1960), (VBM 1, 1911) and (K 1, 1924) were observed at 7th DAS in 10 per cent concentration of tannery effluent. The minimum range of vigour index (ADT 3, 100), (ADT 5, 98), (TMV 1, 98), (VBM 1, 99) and (K 1, 97) were recorded at 7th DAS in 100 per cent of tannery effluent concentration.

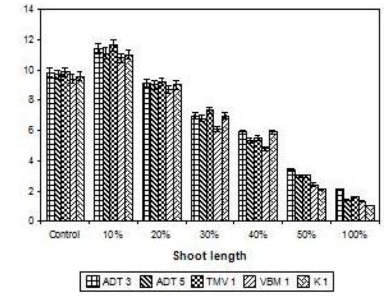

Fig. 3. Effect of tannery effluent on shoot length (cm) of five varieties of *Vigna mungo* on 7th days

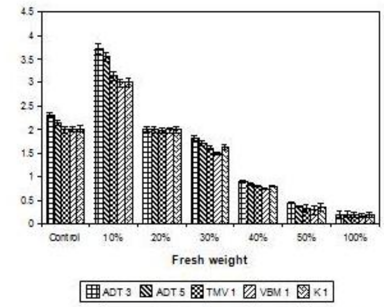

Fig. 4. Effect of tannery effluent on seedling fresh weight (g/plant) of five varieties of *Vigna mungo* on 7th days

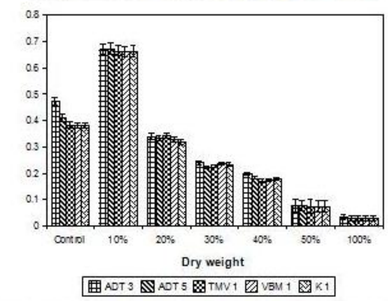

Fig. 5. Effect of tannery effluent on seedling dry weight (g/plant) of five varieties of *Vigna mungo* on 7th day

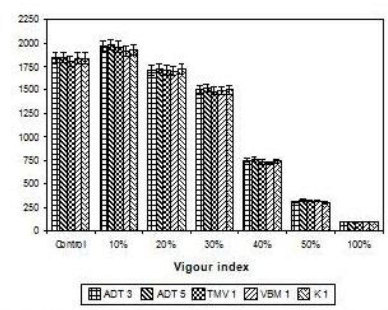

Fig. 6. Effect of tannery effluent on vigour index of five varieties of *Vigna mungo* on 7th day

The maximum tolerance index (ADT 3, 1.189), (ADT 5, 1.138), (TMV 1, 1.148), (VBM 1, 1.124) and (K 1, 1.23) were observed at 7th DAS in 10 per cent concentration of tannery effluent. The minimum range of tolerance index (ADT 3, 0.317), (ADT 5, 0.308), (TMV 1, 0.293), (VBM 1, 0.248) and (K 1, 0.264) were recorded at 7th DAS in 100 per cent of tannery effluent concentration.

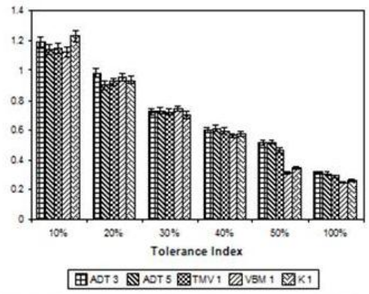

Fig. 7. Effect of tannery effluent on tolerance index of five varieties of *Vigna mungo* on 7th day

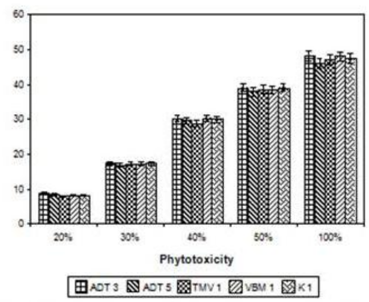

Fig. 8. Effect of tannery effluent on percentage of phytotoxicity of five varieties of *Vigna mungo* on 7th day

The maximum phytotoxicity (ADT 3, -10.87), (ADT 5, -10.11), (TMV 1, -10.68), (VBM 1, -10.33) and (K 1, -10.32) were observed at 7th DAS in 10 per cent concentration of tannery effluent. The minimum range of phytotoxicity (ADT 3, 48.03), (ADT 5, 46.08), (TMV 1, 47.14), (VBM 1, 48.00) and (K 1, 47.44) were recorded at 7th DAS in 100 per cent of tannery effluent concentration.

Discussion

The physico-chemical properties of tannery effluent are shown in Table 1. The effluent was grey in color, unpleasant odour may be due to decomposition of skin and hides of the animal, the pH of the effluent was highly acidic in nature, deficit in dissolved oxygen rich in total solids, total alkalinity. The higher amount of BOD and COD. In addition a considerable amount of salts, such as calcium, magnesium, sodium, chloride, sulphate and chromium (8, 9, 10). The pollution load of the effluent depends upon the nature of raw materials. The chemicals used the processes of tanning consists in the transformation of animal skin to leather and also the methods of treatments given to the effluent discharge in the factory.

The germination percentage, growth and seedlings weight of blackgram seedlings increased at 10 per cent concentrations of tannery effluent when compared to other treatments shown in Fig. 2. The increase in germination percentage over control at lower concentrations indicates the stimulation of physiologically in active seeds of the effluent treatment (11). It may be also due to the lower concentrations of effluent which create the favourable environmental condition for the germination and utilization of nutrients present in the effluent (12). The diluted effluent might have played a role in promoting plant growth in lower concentrations (13). At the same time the higher concentrations of tannery effluent inhibited the germination of blackgram it may be due to the effect of higher amount of total solids ad heavy metals stress on the seed germination process during effluent treatment.

The seedling fresh weight and dry weight increased in the lower concentration and decreased in higher concentration of tannery effluent shown in Figs. 4-5. These observations are in conformity with previous reports of various industrial effluent treatment on various crops (14, 15). The presence of optimum level of nutrients in the lower concentrations of tannery effluent might have increased the growth as well as fresh weight and dry weight of seedlings. The growth promoting effect of the lower concentration of various chemicals present in the effluent (16, 17). The higher concentrations of tannery effluent decreased the fresh weight and dry weight of seedlings. The reduction in seedlings weight may be due to the poor growth of seedlings under effluent stress.

The salt content outside the seed is known to act as liming factor and causes less absorption of water by osmosis and inhibit the germination of seeds. (18, 19 and 20).

In the lower concentrations of tannery effluent at (10%) increased the growth and development (Figs. 2-3). This observations are in conformity with (21) in *Vigna radiata, Cajanus cajan, Sorghum bicolor.* It may be due to presence of the excess amount of trace elements in the effluent. The germination of seeds under higher concentrations of effluent treatment would get low amount of oxygen which might have restricted the energy supply and retarded the growth and development of seedlings (22). Inhibition of root and shoot length at higher concentrations of the effluent may be due to the high level of total dissolved and suspended solids present in the effluent which interfered and inhibited the uptake of other elements (23). The root which continuously remains in direct with the effluent hence the higher concentrations of the effluent could affect cell multiplication or the growth (24).

The tolerance index value decreased with increase in the effluent concentrations (Figs. 6-8). The 10 per cent concentrations of tannery effluent increased the vigour index values. Decreased with the increase of effluent concentrations (25, 26). The percentage of phytotoxicity values showed a reverse trend. The toxicity of the effluent increased gradually with the increase of percentage of phytotoxicity values. The vigour index was considerably decreased by 50 and 100% effluent concentration. For pure effluent, the maize seedlings had a high effluent tolerance index than groundnut seedlings (27).

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