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GERMINATION CHANGES OF HELIANTHNS ANNUUS L. UNDER TANNERY EFFLUENT STRESS

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ABSTRACT

Wastewater from leather processing, a major industry that produces upto enormous waste water. The wastewater contains valuable nutrients, but also contaminants, such as salts and heavy metals, that might affect soil processes and crop production. The present investigated, effluent was examined for its chemical constituents and the various concentrations on the seed germination, seedling growth, chlorophyll, carbohydrates and protein content of sunflower (Helianthus annuus L.). The results low concentration (20%) of the tannery waste water promoted the germination, percentage growth, fresh dry weight of sunflower seedlings, whereas the higher concentration (above 20%) reduce the above all the parameters like percentage of germination, chlorophyll, carbohydrate and protein contents of sunflower showed decreasing trend with increasing effluent concentrations. The observation also indicates organ specific differences in the growth of seedlings in presence of different concentrations (20, 40, 60, 80, and 100%) of tannery effluent. However, the tannery effluents due to presence of chemicals are not suitable for inclusion in irrigation system.

INTRODUCTION

Industrialization is an important tool for the development of any nation. Consequently, the industrial activity has expanded so much all over the world. Today, it has become a matter of major concern on the deterioration of the environment (Tiwari *et al.,* 1993). With the rapid growth of industries (sugar, paper, tannery, textile, sago, dye industries) in the country, pollution of natural water by industrial waste water has increased tremendously (Amathussalam *et al.*, 2002).

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 the cyanide and chromium up to 20 times the safe level in 22 critically polluted areas of the country. Tamil Nadu is the 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.

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Vellore district is one of the important districts of Tamil Nadu where more than 1000 tanneries both of big and small scale are concentrated (Lavanya & venkata Krishnan 1997). Today approximately 2500 industries are located in the district. The process of tanning consists in the transformation of animal skin to leather (Alvarez *et al*., 2006). The skin is submitted to different processes to eliminate meet, fat and hair in which different chemicals, such as chromium, sodium hydroxide, sodium hydrochlorite, enzymes, lime, chloride, sulphuric acid, formic acid, ammonium salts, kerosene, chlorobenzen, tenso-active agents are used. The effluents thus generated contains large concentrations, sodium (Na), sulphates, cholorides and Cr (Ine-Dgmrar, 1999). The tannery industry has been in existence in the Vellore District for the past 100 years. This would reveal the level of concentration 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. World society is faced with the challenge of controlling the environmental problems and to enhance crop production under threat of drastic

environmental conditions. There should be a concerted effort to entirely reduce or avoid environmental pollution. This would help solve the ecological crisis and will provide clean environment for unrestricted explosion of human population.

Sunflower (Helianthus annuus L.) is ranked 4th in the world among source of vegetable oils. Sunflower seed oil has a productive of about 18% of the world production edible vegetable oils. For human consumption, sunflower oil is equal to the finest olive oil for its food value, lack of taste, color, keeping qualities. Present study has been envisaged to study the effect of tanneries wastewater effluents on seed germination and growth performance of sunflower as it is an important crop of the region.

MATERIALS AND METHODS

Sample

The tannery effluent used in the present study, the effluent sample was collected in the plastic containers from the outlet of a tannery industry in Vaniyambadi at Vellore District in Tamil Nadu. Its various physico-chemical characteristics were analysed using standard methods (APHA, 1998). The effluents were stored at 4°C during storage period to avoid changes in its characteristics.

The seeds of sunflower were collected from experimental farm, Department of Agronomy, Annamalai University, Tamil Nadu, India.

Germination experiment

Six test solutions (0, 20, 40, 60, 80 & 100% v/v) prepared by diluting tannery effluent with distilled water were used to investigate the effects of wastewater on germination of sunflower. The healthy and uniform sized sunflower seeds were surface sterilized with 0.1% mercury chloride for 2-3 mins, washed in running tap water for 3 mins and in distilled water for 2 mins. They were thoroughly washed with tap water to avoid surface contamination. 10 healthy and undamaged seeds of equal size were evenly placed in each sterilized petridish which contained water soaked filter papers. The petridishes were arranged in completely randomized block design. Measured quantities of test solutions was added in each replicate and exposed for 8 hrs. Seedlings were then grown in distilled water. Random samples were taken from each treatment after 7 days and chlorophyll content was estimated using the flag leaf. The absorbance was taken using UV-Spectrophotometer. The Chlorophyll a and b were determined following the method of Arnon 1949. The trichloroacitic acid (TCA) insoluble protein of shoot and root was measured by the procedure described by lowry *et al* (1951), using bovine serum albumin as standard. Carbohydrate contents of shoot and root were measured according to the method of yemm and willis (1954). Germination potential, seedling length, fresh and oven dry weight were also determined.

RESULTS

Quality of waste water effluents

The results of chemical analysis of waste water effluent of a tannery are presented in Table 1. The pH value of full strength (100%) effluent water was highly basic. BOD and COD were very high showing that no life sign could be present in the effluent. Effluent was very rich in calcium^{+2}, Mg, Na, Cl and suspended solids. Hardness was also very strong rendering it unfit for domestic use. For irrigation purpose, water is usually classified for its quality on the basis of electrical conductivity and sodium adsorption criteria. According to this classification, full strength wastewater was highly saline and low sodium water.

Table 1
Physico-chemical cherateristics of tannery effluent (mg/l)

Parameters	Tannery constituents
Colour	Brown
Temperature	34°C
pH	8.6
Electrical conductivity	358
Total dissolved solids	406
Total suspended solids	215
Hardness	412
Biochemical oxygen demand (BOD)	1260
Chemical oxygen demand (COD)	2035
Calcium	150
Magnesium	58
sodium	86
Chloride	462
Sulphate	345
Fluride	6.0
Nitrate	46.4
Chromium	9.8
Iron	3.4
Nickel	1.2
Manganese	2.6
Chloride	380
Sulphate	74
Sodium adsorption ratio	4.2

Germination percentage

The germination percentage of sunflower grown under different concentrations of tannery effluents is given in a fig 1. Germination percentage was initially delayed with increasing levels of effluent water but it became relatively faster after 4 days. Maximum plumules emergence occurred in T0, T1 and T2 treatments, 5days after sowing and gradually declined in T3 and T4 treatments. Severe delay in plumules emergence was recorded in T5 starting from day 3 to 7 day. However, after 8 days 100% germination had occurred in all the six treatments (fig.1).

Growth of seedlings

Fresh and dry weight and length of 15 days old seedling of sunflower decreased with increasing effluent concentrations (T4 and T5), (Fig 3, 4). The chlorophyll contents, carbohydrates and proteins were much higher in control followed by other treatments (Fig 5, 6,7). There was not much difference in the early growth of seedling except that seedlings of T1 treatment emerged a day earlier than those from T4 and T5 treatments. But in the case of T4 and T5 treatments, seedling emergence was slightly delayed (Fig 2). The plants from T1 treatment

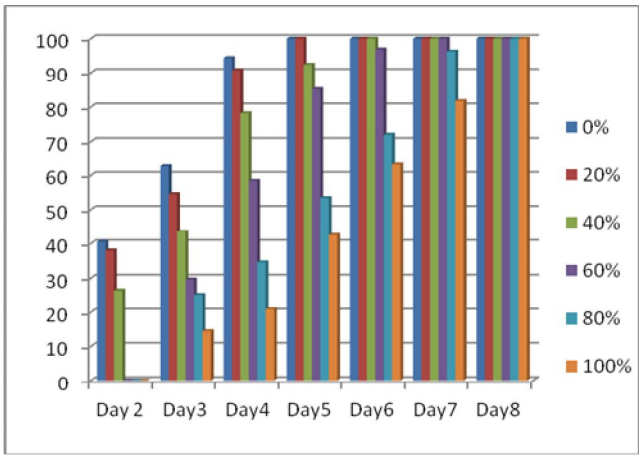

Fig 1.Effect of different concentrations of tannery effluent on the germination potential

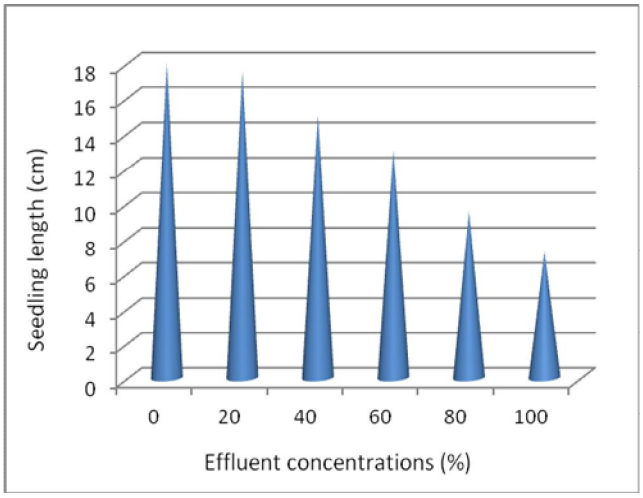

Fig. 2 Effect of different concentrations of tannery effluent on the seedling length

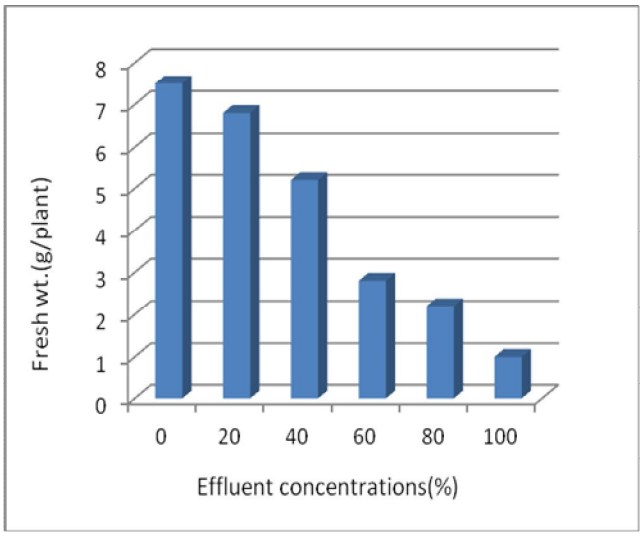

Fig. 3 Effect of different concentrations of tannery effluent on Fresh weight

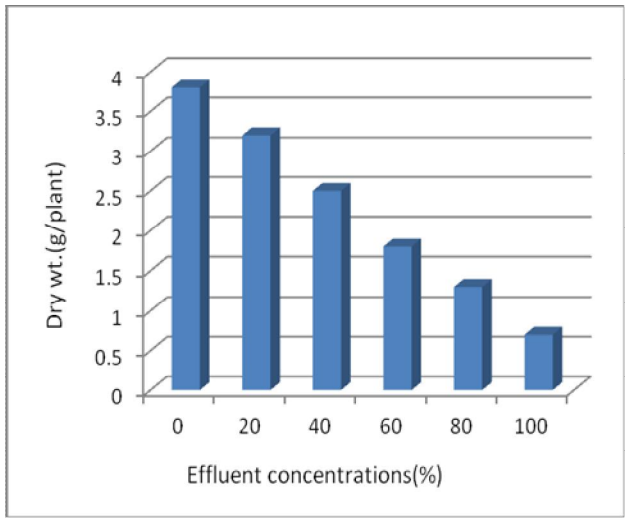

Fig.4. Effect of different concentrations of tannery effluent on dry weight

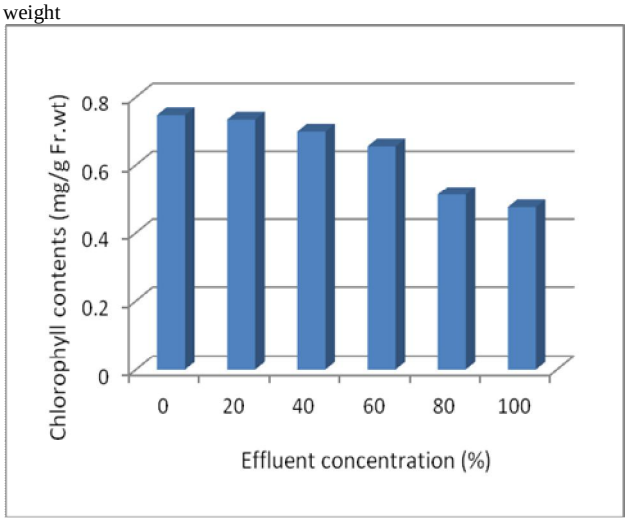

Fig.5. Effect of different concentrations of tannery effluent on chlorophyll contents

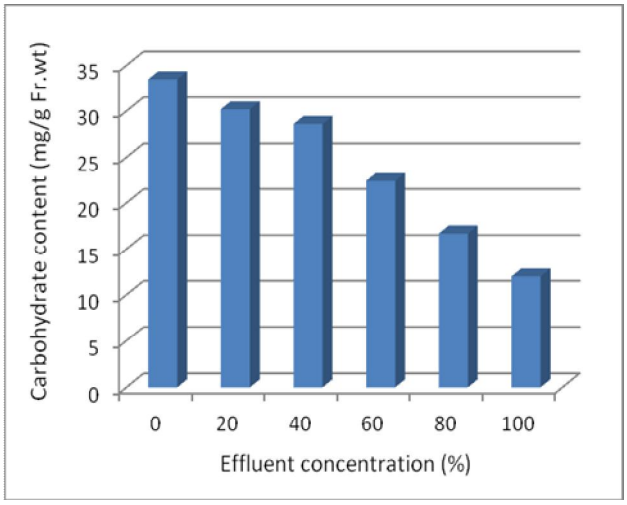

Fig.6 Effect of different concentrations of tannery effluent on Carbohydrate contents

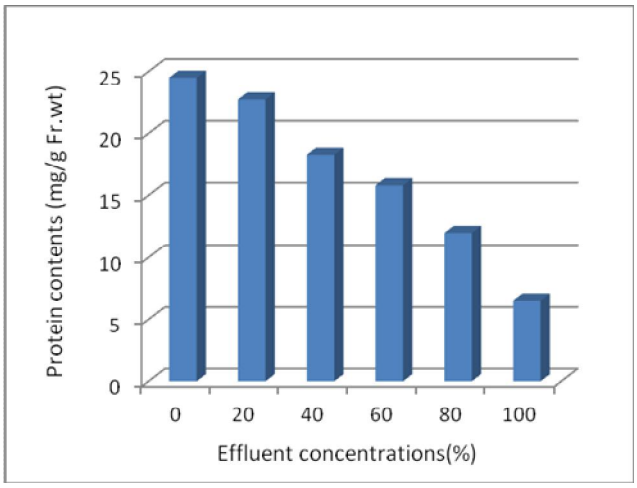

Fig.7 Effect of different concentrations of tannery effluent on protein contents

were lush green and healthier than the plants in T2, T3, T4 and T5 treatments.

DISCUSSION

The physic-chemical properties of tannery effluent are shown in Table 1. The effluent was brown in color, unpleasant odour may be due to decomposition of skin and hides of the animal, the pH of the effluents was highly basic 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 Cr, Fe, Mn. The results of effluent analysis at the source are in conformity with the studies of several workers (Algur *et al*., 1995; Chatterjee and Chatterjee, 2000; Sillen and Martell, 1989; Wahid *et al*., 1999, 2000).

Nearly, all irrigation waters have been used successively for considerable times having electrical conductivity less than 2250 µmhos/cm (Rhoades and Bernstein, 1971). It has been reported that higher chemical concentration has strong inhibitory effects on seed germination (Bishoni, 1993; Jamal *et al*., 2006a, b, c, d; Yasir, 2003). In the present study, germination was reduced in higher effluent treatments but in lower treatments germination was although affected, but not completely suppressed. It may be due to the effect of higher amount of total solids and heavy metals stress on the seed germination process during effluent treatment. Similar observations have been made by Mahmood *et al* (2005) for seed germination in Corn, Jamal *et al* (2006a, b, c, d) for seed germination in Wheat, Vigna spp and Prosopis juliflora and Safiq *et al* (2008) for seed germination of P. Juliflora).

All the concentrations of tannery effluent showed an adverse effect on chlorophyll, protein and carbohydrate contents. A gradual decline in the protein and carbohydrate contents with time of exposure to effluents and with concentration of effluent seems to be correlated with the loss of chlorophyll (Gibert and Dubey, 2003). The adverse effects may be due to the higher concentrations of suspended solids together with 18 different types of dissolved chemicals as reported by Nesmann *et al* (1980). The results of the study clearly demonstrate that germination was reduced in higher effluent treatment. Effluents application showed adverse effect on chlorophyll, protein, carbohydrate contents.

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