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# EFFECT OF TANNERY EFFLUENT ON SEED GERMINATION AND SEEDLING GROWTH IN *CROTALARIA JUNCEA* LINN

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**ABSTRACT**

Tannery effluents are one of the major causes of land and water pollution. In the recent times efforts have been taken to reduce the release of these effluents or to adopt eco-friendly tanning methods. However, the damage already caused to soils of Tamilnadu in regions having tanning industry has to be reversed and there have been several attempts to achieve this end. In the present investigation, the effect of tannery effluents on the seed germination and seedling growth of *Crotalaria juncea* has been studied. The effluent showed marked growth promoting effect in seedling growth at lower concentration while inhibitory effects at higher concentration. Increase in effluent concentration showed decrease in shoot and root length. It can be concluded from this study that if tannery effluent is properly treated and diluted, it can be used for crop growth. The tannery effluent can be effectively used at diluted concentration, as it improves the growth of *Crotalaria juncea* which is legume, commonly used as a green manure crop that can further enhance the fertility of the soil.



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## INTRODUCTION

The major cause of water pollution is release of industrial wastes though agricultural and municipal wastes also play a major role. Industrial water pollution is caused by the discharge of harmful chemicals and compounds into water, which makes it unsuitable for drinking and other purposes. These effluents contain toxic organic and inorganic suspended or dissolved solids, which have adverse effects on environment and human health (Begum, 2010). Many Industries that release wastes which are not properly treated and the tanning industry is also one of them. Tannery industrial waste is generated through different processes and the toxicity of the waste remains relatively high. This effluent if not properly treated poses a significant threat to the environment as it contains high concentration of salts and chromium (Baby shakila, 2009).

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Due to the addition of such pollutants to the soil, plants come under stress and it may affect the general physiology of plants and even seed germination (Kumar, 2013). It is reported that growth and yield of plants grown in soil using raw effluents for irrigation has been considerably decreased (Mythili, 2011). Raw tannery effluent without treatment reported high Chemical oxygen demand (COD), Biological oxygen demand (BOD) and variety of salts which are highly alkaline (Bajza, 2001). Industrial effluents with heavy metals adversely affect the growth and development when used for irrigation (Nagajyoti, 2008). The presence of different ions such as Chlorides, Sulphates, Phosphates, Calcium, Magnesium and Potassium which are essential for plant growth, when accumulated in higher concentrations, induce morphological and physiological disorders in plants. It was reported that an increased absorption of dissolved solids by the seed also could have affected the germination (Singh, 2007). Seeds germinated in undiluted effluents did not survive for longer period. The objective of the present study is to determine the effects of the tannery effluent in different concentrations on the seed germination and seedling growth of *Crotalaria juncea* Linn. a common green manure crop.

## MATERIALS AND METHODS

### Effluent Collection

The effluent was collected in plastic containers, from the outlet of a tannery industry near Pammal, Chennai, and prepared in different concentrations by diluting with distilled water. The different concentrations of tannery effluents used in the present study are given in Table 1.

**Table 1. Showing the different concentrations of tannery effluents used**

| Treatment Group | | |
|---|---|---|
| Control | Water | |
| Tannery effluent (100 %) | Raw Tannery effluent | |
| Tannery effluent (50 %) | 50% Tannery effluent + 50% | Distilled water |
| Tannery effluent (25 %) | 25% Tannery effluent + 75% | Distilled water |

### Seed germination

*Crotalaria juncea* seeds were collected from farmers in Thiruvallur District. Healthy seeds were washed with distilled water. The seeds were placed on Whatman paper No. 1 on top of a cotton bed in sterilized petridishes of 10cm diameter and 10 mL of tannery effluent in the prescribed concentration (100%, 50%, and 25%) was poured into the different petridishes. Ten seeds were taken in each petridish. There were 3 replicates for each treatment (Figure 1). The rate of germination and seedling growth were observed daily. The growth parameters like percentage of germination and seedling growth were measured. Total number of germinated seeds was counted at 24-hour intervals, starting from the first day until all the seeds had germinated and the germination percentage was calculated using the formula (Aklilu Asfaw, 2012).

$$\text{Germination \%} = \frac{\text{Number of seeds germinated}}{\text{Total number of seeds}} \times 100$$

### Seedling growth:

The seedling growth was recorded every 24 hours for five days. The shoot and root length were measured by using a scale and the values were recorded for all three replicates in each treatment.

## RESULTS

Table 2 shows the percentage of germination in *Crotalaria juncea* L. at various concentrations of tannery effluent. *Crotalaria juncea* seeds exhibited differential responses to different concentrations.

**Table 2. Showing the Germination (%) of Crotalaria juncea L. seeds in different concentration of Tannery effluent**

| | Germination (%) | | | |
|---|---|---|---|---|
| Time (hrs) | Control (Water) | Tannery effluent 100% | Tannery effluent 50% | Tannery effluent 25% |
| 0 | 0 | 0 | 0 | 0 |
| 24 | 30 | 0 | 60 | 53 |
| 48 | 97 | 83 | 100 | 100 |
| 72 | 100 | 100 | -- | -- |

Values are percentage of three replicates

The maximum seed germination was recorded at 48 hrs in 25% and 50% tannery effluent and minimum in 100% tannery effluent when compared to control.

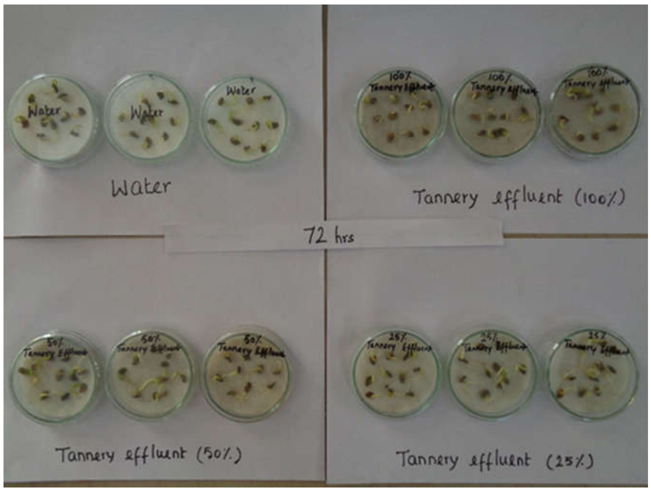


**Fig.1 Germination of *Crotalaria juncea* L. seeds at 72 hours**

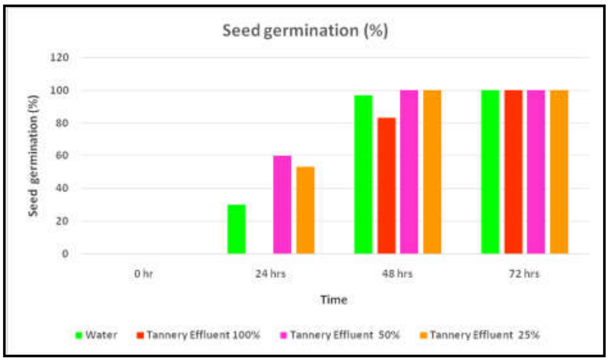


**Fig. 2 Comparison of the rate of seed germination in Crotalaria juncea L. treated with different concentration of tannery effluents at different time intervals**

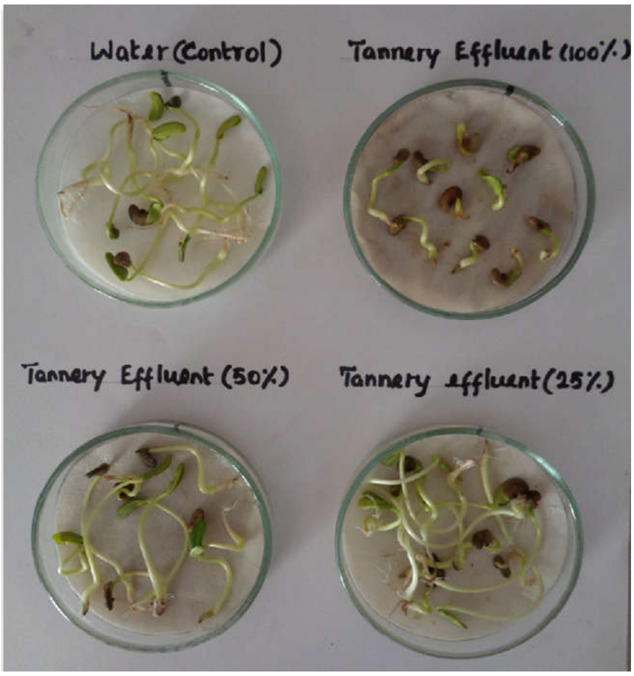


**Fig. 3 Seedling growth of *Crotalaria juncea* L. at 120 hours**

In the seeds treated with 50% Tannery effluent and 25% Tannery effluent, 100% germination was achieved within 48 hrs.

**Table 3. Showing shoot and root length of *Crotalaria juncea*L. exposed to tannery effluent at different time intervals**

| Time (hrs) | Shoot length (cm) | | | | Root length (cm) | | | |
|---|---|---|---|---|---|---|---|---|
| | Control (Water) | Tannery effluent 100% | 50% | 25% | Control (Water) | Tannery effluent 100% | 50% | 25% |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 24 | 0.6 ±(0.21) | 0 ±(0.00) | 0.1 ±(0.00) | 0.1 ±(0.02) | 0.1 ±(0.02) | 0 ±(0.00) | 0.1 ±(0.01) | 0.1 ±(0.05) |
| 48 | 1.7 ±(0.15) | 0.4 ±(0.01) | 2.4 ±(0.07) | 2.7 ±(0.04) | 0.3 ±(0.03) | 0.1 ±(0.02) | 0.9 ±(0.11) | 0.8 ±(0.10) |
| 72 | 2.4 ±(0.09) | 0.9 ±(0.04) | 3.2 ±(0.04) | 3.6 ±(0.08) | 0.9 ±(0.06) | 0.3 ±(0.06) | 1.5 ±(0.06) | 1.3 ±(0.03) |
| 96 | 4.3 ±(0.11) | 1.3 ±(0.06) | 5.0 ±(0.11) | 5.2 ±(0.08) | 1.2 ±(0.07) | 0.6 ±(0.07) | 2.0 ±(0.09) | 2.0 ±(0.10) |
| 120 | 5.8 ±(0.08) | 1.7 ±(0.02) | 6.1 ±(0.05) | 6.6 ±(0.18) | 1.6 ±(0.08) | 0.8 ±(0.09) | 2.3 ±(0.04) | 2.3 ±(0.16) |

Values are arithmetic mean ± SD of three replicates

Though there was 100% seed germination in Tannery effluent (100%) at 72 hrs, the percentage of germination was 0 at 24 hrs compared to a germination percentage of 30, 60 and 53 in Control, 50% Tannery effluent, and 25% Tannery effluent respectively (Figure 2). In this study, though all the seeds have germinated the germinated seeds in 100% tannery effluent appear shrunken which reveals that there was significant sensitivity of *Crotalaria juncea* seeds to 100% tannery effluent, and at the same time the seeds are well grown in 50% and 25% tannery effluent. The results obtained indicate that effluents at suitable concentration increase germination of seeds. The root and shoot length was reduced with increased concentration of tannery effluent(Table 3).At 120 hours, the maximum shoot length (6.6 cm) and root length (2.3 cm) was recorded in 25% tannery effluent, when compared to control (5.8 cm and 1.6 cm of shoot and root length respectively). The significant decrease in the seedling length under the high concentration of tannery effluent was observed in this study.

In control and 50% tannery effluent treated seeds, well developed root system with lateral roots were observed (Figure 3 and 4).

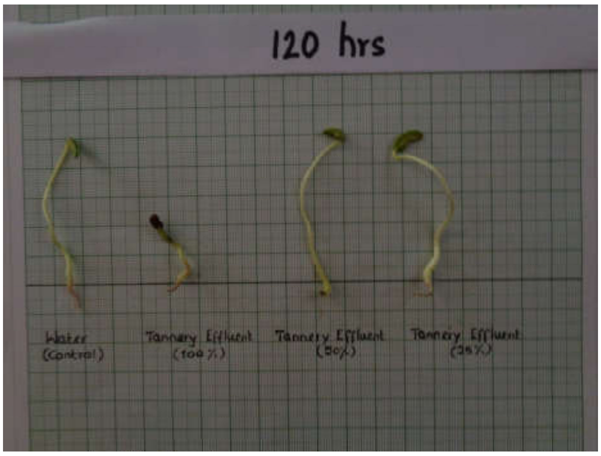


**Fig. 4 Difference in Seedling length of *Crotalaria juncea* L. at 120 hours in different concentration of Tannery effluent**

## DISCUSSION

The salt content outside the seed is known to act as limiting factor and reduces absorption of water by osmosis and inhibits the germination of seeds (Gomathi, 1992). Tannery effluent has been reported to affect the mitotic process and reduces seed germination in extensively cultivated pulse crops (Altaf, 2008).

The percentage of germination and seedling growth was maximum in diluted effluent than the control, while undiluted effluent elicited an inhibitory effect, due to excess amount of solid present in the effluent (Sundaramoorthy, 2001). At a lower concentration of the tannery effluent the seed germination was higher in *Parkinsonia aculeata* and *Caesalipinia coriaria* (Mariappan, 2002). 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 (Rao, 1983). The low amount of oxygen in dissolved form due to the presence of higher concentration of solid in the effluent, reduced the energy supply through anaerobic respiration resulting in restriction of the growth and development of the seedling (Saxena, 1986). Similar findings have been reported in *Zea mays* (Mishra, 1996). Rani and Akilan (2007) also reported that the shoot and root length decreased with increasing concentration of treated distillery effluent on two cultivars of *Oryza sativa*. Growth promoting effect of dairy effluent on paddy seed germination, seedling growth and dry matter production was studied (Dhanam, 2009). Tannery effluent(100%)showed a significant inhibition of seed germination and seedling growth, due to the increase in osmotic pressure caused by high concentration of nutrients, and thus absorption of water by the seed is affected (Dhanam, 2009).

The optimum level of nutrients present in the effluent may serve as a liquid fertilizer for the favourable development of seedlings at lower concentrations (Reddy, 2001). When diluted tannery effluent gets converted to utilizable nutrients, it enhances plant growth (Bhabindra Niroula, 2003). The alternative use of diluted effluent for irrigation not only solves its disposal problems, but also will serve as natural fertilizer for several crops if used at proper concentration (Rajendra, 2010). In the present investigation, the seed germination and seedling growth were reduced with increasing concentration of effluent. It is evident from the present study that seed germination in *Crotolaria juncea* is highly sensitive to the concentration of the tannery effluent. From the above results it could be concluded that the development of seedlings is seriously affected by raw tannery effluent and the effect of the effluent gets mitigated with dilution. Though the percentage of germination is not influenced very much by the high concentration of tannery effluent, the growth of seedling is affected. Thus, it is required that tannery effluents be properly treated to bring down their adverse effects within tolerable limits. The study therefore corroborates the earlier reports.

## Conclusion

It can be concluded from the present study that tannery effluent when diluted can be used as a growth enhancing factor for plant growth as it has a positive influence on seed germination and seedling growth in *Crotolaria juncea*. Since this plant is a legume that is commonly used as a green manure crop, the results obtained in the present study indicate that reclamation of effluent affected soils can be brought about by thorough irrigation to dilute and leach out the effluents. The root stocks left in the soil will contribute to the further replenishment of nitrogen in the soil making it suitable for cultivation.

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