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Research Paper

Impact of Lead Toxicity on Morphological and Biochemical Parameters of Red Sanders (Pterocarpus Santalinus L), Tirupati. A.P. India

Environmental Science

KEYWORDS : Morphological, biochemical parameters, chlorophyll, protein, lead.

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ABSTRACT

Morphological studies of Pterocarpus santalinus L were carried out in the pot culture experiments. The experimental plants were treated with increasing concentrations of lead (Pb) (0 (Control), 0.05, 0.10, 0.15 and 0.20 mg/L) and to investigate for 15 days time intervals. Results showed that toxicity of lead reduced the leaf area and root and shoot length and also impact on biochemical parameters viz., total chlorophyll and protein content of Pterocarpus santalinus L, were decreased with increasing concentrations of Pb, in all experimental days when compare to control.

Introduction

Red sandalwood (*Pterocarpus santalinus* L) belonging to the Family *Fabaceae*, is one of the most valuable medicinal plant species. It is used as an external application for curing inflammations of skin diseases (Bhattacharjee, 2004), treating bone fracture, leprosy, spider poisoning, and scorpion sting (Aslam *et.al*., 1998). *Pterocarpus santalinus* L is a highly impressive indigenous herb (Shoba et al., 2007), thus researches during the past two decades have shown a renewed interest (Gupta et al., 1998; Kwon et al., 2006) Anthropogenic pollutants such as heavy metals enter our environment in a variety of ways. Heavy metals are significant environmental concern because they are non-biodegradable pollutants with long lives in soil (Ram, M.S, et al., 2000). The contamination of soil with heavy metals due to the industrial activity has increased considerably nowadays, adverse effects of contamination being reported in several habitats in the world (*E. Henden* et al, 1997, *E.Alvarez et al., 2003)*. Soil constitutes part of vital environmental, ecological and agricultural resources that should be protected from further degradation so as to produce healthy food for the world's increasing population (Rashad, M. and E.A. Shalaby, 2007). Lead (Pb) is one of the prominent examples for anthropogenic environmental metal pollution that originates from various activities including mining and smelting of lead-ores, burning of coal, effluents from storage battery industries, automobile exhausts, metal planting and finishing operations, fertilizers, pesticides and from additives in pigments and gasoline (Sharma and Dubey, 2005).Among the contaminant metals, lead is almost always present in contaminated soils together with copper, zinc and other heavy metals (Mihaela ULMANU et al., 2006). Plants exposed to stressing agents such as drought, salinity, excess of heavy metals, air pollutants, or pathogens have developed strategic defense mechanisms that vary between species and the nature of stressing agent (Sharma & Dubey. 2005). Pb-induced changes in the leaf epidermis structure involved a reduction in the cell size, more abundant wax coating and an increase in the number of stomata and trichomes per unit area with simultaneous reduction in the size of the guard cells (Weryszko- Chmielewska & Chwil, 2005). Stiborova et al., (1987) and Verma & Dubey (2001) reported the increase in sugar and glucose contents under metal stress with reduced carbon metabolism, which results in the disorder of light reactions of photosynthesis leading to growth inhibition. Hence, the present work aimed to investigate lead (Pb) accumulation in *Pterocarpus santalinus* L determine the effect of lead toxicity on growth parameters, chlorophyll and protein content in different culture conditions.

Materials and Methods

Pot culture experiment was conducted with freshly young seedlings of *Pterocarpus santalinus* L. Seedlings were obtained from Biotechnology Centre for Tree Improvement (BIOTRIM), Akkarampall Road, Tirupati, Chittoor District, Andhra Pradesh. Seedlings were planted in earthen pots containing red soil and biomanure by applying various lead concentration viz., 0.05, 0.10, 0.15 and 0.20 mg/L. Seedlings were maintained under natural day light and night temperature of 30^0 C ± 2^0 C. Seedling were removed at regular intervals (15, 30 and 40^{th} day) days after planting for experiments. Seedlings after through washing of the plant tissues like leaf root and shoot washed with double distilled water. Root and short length was measured by meter scale. Chlorophyll content was estimated according to the method of Arnon (1949), total protein content estimated by Lowry *et al*., 1951.

Data were expressed as Mean ± Standard error of mean (SEM). Results were statistically analyzed by student's test (Pillai and Shinha 1968).

Results and Discussion

The present work was undertaken to study the impact of lead toxicity on growth and biochemical response of *Pterocarpus santalinus* L. The results of this study showed that increased concentration leads to decreased in growth and biochemical parameters of the experimental plants. Root length was observed high growth rate (8.20 cm) in control on 45th day and low growth rate (3.66 cm) at 0.20 mg/L Pb treatment. Moreover shoot growth rate (12.06 cm) was high in control on 45 day and low growth rate (5.13 cm) at 0.20 mg/L of Pb treatment. Root and shoot length was affected at 0.10 and 0.15 mg/L concentrations of Pb at all experimental days whereas at 0.20 mg/L of Pb treatment was severely affected length in root and shoot. It may be done due to the increase in concentration of Pb treatment. The result was similarly compared with several reporters (Ana Capelo et al., 2012, Eun, S.O et al., 2000). The levels of chlorophyll a and b and subsequently total chlorophyll were declined with increasing concentrations of Pb at 0.10 mg/L, and 0.15 mg/L as compare to control. The result revealed that the reduction in chlorophyll a, b and total chlorophyll content of *Pterocarpus santalinus* L, it may be done by high amount accumulation of lead content. It was reported by the findings of R. John et al., 2009, Abdul Ghani 2010, Mostafa Lamhamdi et al., 2013. The content of protein was also reduced with the increasing concentration of Pb treatment at 0.10, 0.15 and 0.20 mg/L when compare to control. It was also resulted by the reports of Abrar Hussain et, al 2013 and Jamal, S.N et al., 2006).

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Fig: 1. Pot culture experimental design of *Pterocarpus santalinus* L at 45th day

Table 1. Change in root length of *Pterocarpus santalinus. L* at different time
Intervals exposed to lead toxicity (cm)

	15th day	30th Day	45th day
Control	3.06 ± 0.17	6.03 ± 0.07	8.20 ± 0.20
0.05	2.23 ± 0.11	5.56 ± 0.11	7.63 ± 0.09
0.10	1.63 ± 0.07	4.73 ± 0.07	6.73 ± 0.09
0.15	1.13 ± 0.11	3.33 ± 0.09	5.66 ± 0.01
0.20	0.63 ± 0.07	1.53 ± 0.07	3.66 ± 0.01

Table 2. Change in shoot length of *Pterocarpus santalinus. L* at different time
Intervals exposed to lead toxicity (cm)

	15th day	30th Day	45th day
Control	4.53 ± 0.07	8.5 ± 0.04	12.06 ± 0.09
0.05	4.06 ± 0.07	7.83 ± 0.07	11.46 ± 0.07
0.10	3.60 ± 0.09	6.73 ± 0.11	10.23 ± 0.11
0.15	3.26 ± 0.01	5.36 ± 0.01	8.1 ± 0.04
0.20	1.56 ± 0.01	3.13 ± 0.07	5.13 ± 0.07

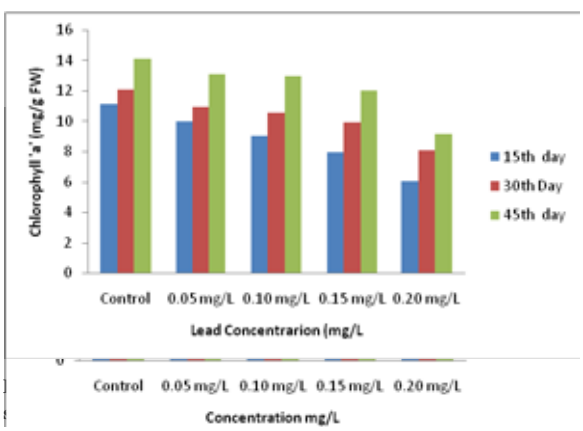

Fig. 3. Chlorophyll 'b' content of *Pterocarpus santalinus* L exposure to lead toxicity

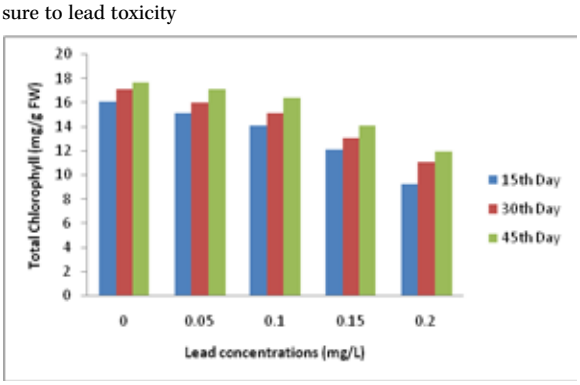

Fig.4. Total Chlorophyll content of *Pterocarpus santalinus* L exposure to lead toxicity

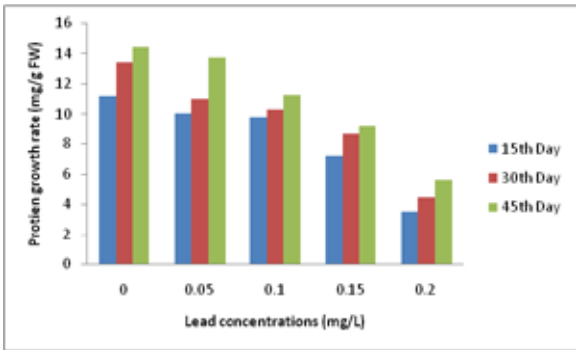

Fig. 5. Total protein content of *Pterocarpus santalinus* L exposure to lead toxicity

CONCLUSION

The present investigation concluded that obviously from our results that lead treatment even at low concentrations induces large disturbances in ion uptake by plants. Which change the metabolic activity and finally in a strong inhibition of plant growth. *Pterocarpus santalinus*. L exhibit different susceptibilities by the influence of lead content with increasing concentrations. It is necessary to eradicate the high amount of lead before discharges into the soil.

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