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Lead Toxicity in (Cymbopogon flexuosus. Steud) Lemon grass

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Abstract

Lead concentration (0.5mM, 1.0mM & 2.0mM) was investigated in Lemon grass (Cymbopogon flexuosus. Steud) plants. Increasing concentration of Lead (1.0mM & 2.0mM) shows reduction in growth, Chlorophyll content, Total Sugar and Total Protein in Lemon grass leaves. At increasing concentration of lead (1.0mM & 2.0mM), Catalase and Peroxidase activity was found to be enhanced.

Keywords: Lemon grass, Chlorophyll, Sugar, Protein, Catalase & Peroxidase.

1. Introduction

Lead is most toxic heavy metal pollutants that cause environmental and human health hazards due to high affinity for soil. Lead is a ductile, very soft malleable bluish metal with poor electrical conductivity.

Its atomic number is 82 & atomic weight 207.2. It is placed in the VI group in periodic table. Since, last 7000 years lead has been used by humans. All chemists thought that lead was the oldest metal & associated with the planet Saturn. Past hundreds of years, lead has been used in both industrial and domestic application (Abbassi et al., 1998). Patterson (1980), reported lead pollution in the urban environment since the beginning of modem technology. Lead concentration in the earth crust has been found at 12.5 ppm and in order of abundance; lead has 36th rank (Abbassi et al., 1998).

Recent findings suggest that traces of Pb (~ 29 mg/g diet) is important for enzyme activities and cellular systems, especially during cell development, hematopoiesis & reproduction. (Assi et.al., 2016)

Pb from the soil solution is absorbed (unevenly) through roots and is bound with uronic acid/polysauccharides of rhizoderm in many plant species such as *Brassica juncea*. (Meyers et.al., 2008), *Festuca rubra* (Ginn et.al.,2008), *Funaria hygrometrica* (krzeslowska et.al., 2009, 2010), *Lactuca sativa*, (Uzu et.al., 2010) and *Vigna unguiculata*, (Kopittke et.al., 2007).

Lead causes loss of turgor & changes in membrane permeability reduces CO_2 fixation, calcium & phosphate uptake. (Bazzaz et. al.,1974). Tomar et al., (2000) found that plant height, root shoot ratio, dry matter, protein content and nitrate redutase activity decreased with increasing level of lead concentration, while the stomatal index of leaves increased.

With these aspects in view, the present investigation was made to study the effect of different concentration of lead on the growth and metabolism of Lemon grass.

2. Materials & Methods

The present study was undertaken to analyze the lead toxicity of widely distributed & fast growing Lemon grass (*Cymbopogon flexuosus.* Steud) plants. The experiment was carried out in earthen pots using soil as growing medium under controlled glass house conditions.

The nutrient solution had the following composition: As M eq/L-- Ca $(NO_3)_2$-8; KNO_3-4; $MgSO_4$-4; NaH_2PO_4-4. As ppm → Fe - 5.6; Mn - 0.55; Cu - 0.046; Zn - 0.065; B - 0.37; Mo - 0.05; Co & Ni - 0.006 each.

Lead acetate was used to produce lead concentration of 0.5, 1.0 & 2.0mM. Growth in terms of plant height was measured at regular intervals. Chlorophyll, sugar & protein concentration were estimated respectively by the method of Petering et al., (1940), Dubais et al., (1956) & Lowry et al., (1951). Catalase & peroxidase activities were assayed respectively by the method of Euler and Josephson (1927) & Luck (1963).

3. Results & Discussion

The results showed that plant height was significantly increased at O.5mM Pb concentration. At 1.0mM & 2.0mM Pb concentration, plant height was significantly decreased. The chlorophyll concentration, total sugar & protein content was significantly decreased at increasing concentration of lead. Activities of enzymes, catalase & peroxidase were found to be significantly increased on increasing the concentration of lead as compared to control. (Table 1).

Reduced growth of plants might be due to abnormal transport of essential nutrients including zinc. Lack of growth might be due to deficiency of zinc, which helps in the synthesis of Auxin. Chaudhry & Ain (2003), observed inhibition in growth of *Phaseolus vulgaris* plants when lead nitrate was supplied. Boura et al., (1986) and Prasad & Prasad (1987), also reported inhibitory effect on growth of the plant. Mehra and Farago (1994) reported that lead ions disturb the electrolytic equilibrium, cell division inhibition and adversely influence plant germination and development.

Excess concentration of lead may cause adverse effect on iron metabolism of lemon grass, which might have resulted into reduced concentration of total sugar. and chlorophyll. Bisht et al., (1976) reported heavy metal induced iron deficiency. They were of the view that heavy metal toxicity causes adverse effect on enzymes, individual amino acids and cellular metabolism.

The number of stress factors including excess heavy metals is responsible for inhibition of photosynthetic pigments (Corradi et al., 1993). According to Tandon & Gupta (2002), chlorophyll content was also found to be decreased at 0.25, 0.5 & 2.0mM doses of Pb in gram plants.

Hemalatha et al., (1997) were of the view that sugar is an important constituents manufactured during photosynthesis and breakdown during respiration by plants. Heavy metals cause water stress like condition (Pandey & Sharma, 2002) and decrease relative water content (Bhattacharya & Chaudhuri, 1995).

Bisht et al., (1976) observed decreased protein nitrogen content as a result of heavy metal toxicity. The increase in catalase activity might be due to the increasing toxic effects of H_2O_2 & ROS (Reactive Oxygen Species) produced as a result of membrane damage (Dixit et al., 2001 and Tandon & Gupta 2002). Increased activity of peroxidase might be due to the growth reduction caused by excess amount of lead. This might have cause enhancement in peroxidase generation in plants. According to Van Assche & Clijsters, (1990) peroxidase induction is caused by uptake of toxic amount of metals such as zinc, copper, cadmium, nickel & lead in roots and leaves of various species.

Lead – induced oxidative stress is caused due to lead poisoning as it disrupts the pro-oxidant / Antioxidant cell defense system. Antioxidant nutrients such as vitamins E, C, B_6 and β – carotene and also Zn and Se are believed to combat Pb induced oxidative stress. (Hsu & Guo, 2002).

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Table 1: Effect of different concentration of Lead on growth, activity of catalase & peroxidase enzymes, concentration of chlorophyll, sugar and protein in Lemon grass (*Cymbopogon flexuosus.* Steud) plants.

Parameters	Lead Concentration			
	Control	0.5mM	1.0mM	2.0mM
Plant Height (cm)	63.000±0.400	68.100±0.500*	59.850±0.250*	55.200±0.600*
Catalase activity (µ moles H_2O_2 decomposed/min/ mg protein)	107.6990±2.500	128.010±0550*	139.905±1.115*	181.475±1.245*
Peroxidase activity (Units/mg protein)	21.135±0.445	23.945±0.285*	24.230±0.640*	29.725±0.305*
Chlorophyll concentration (mg/g fresh weight)	1.570±0.005	1.494±0.006	1.440±00.001*	1.311±0.008*
Total Sugar (mg/g fresh weight)	1.223±0.003	0.905±0.005*	0.850±0.000*	0.655±0.005*
Total protein (% fresh weight)	4.870±0.120	4.160±0.040*	4.800±0.080	3.205±00.195*

Values given in the table indicate mean ±S.E.

** Sign indicate that difference between control & respective treatment are significant at p=0.05.*

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