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Evaluation Potential of *L.triscula L.* in the absorption of Zn and its effects on tissues

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Abstract

The aim of our work was to illustrate absorption of Zn ion and anatomical changes induced by the metal ion in *Lemnatriscula L.*Plants were cultured in Hoagland medium supplemented with various zinc concentrations (1,3,5,7 and 9 mg/ml) and harvested after 3 days and the metal ion accumulation within the plants was determined. Anatomical changes in the metal treated plants were observed to access the toxic effect of the metal. Treated plants of *L. Triscula L.* when examined by light microscopy, exhibited alteration in leaf diameter, disintegration of epidermis and layer of cortex (aerenchyma cells) and variation in vasculature resulting from Zn ion toxicity.

Keywords:*Zn ion, L. triscula L., Hoagland medium, anatomical changes, toxicity.*

Introduction

Zinc at appropriate concentrations is required for structural and catalytic components of proteins and enzymes as cofactors, essential for normal growth and development of plants, and a vast number of protein sequences containing Zn-binding structural domains (Steffens 1990, Clarke and Berg 1998). However, excessive accumulations of the micronutrient in plants operate as stress factors causing physiological constraints leading to decreased seed vigor and plant growth (Assche and Clijsters 1986, 1990, Ali *et al.* 2000).

Several mechanism by which Zn toxicity is avoided in plants have been reported by many worker (Frey *et al.*, 2000; Aravind and Prasad 2005; Benavides *et al.*, 2005). After uptake, Zn can be transported in the xylem where it is chelated by different small molecules (Haydon and Cobbett 2007), including organic acids such as malate and citrate (Broadley *et al.* 2007) and nicotianamine (Callahan *et al.* 2006) and is most likely stored in vacuoles.

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Therefore, the study was conducted to determine zinc ion accumulation in *L. triscula L* and tocharacterize the interfering effects on zinc ion on *L. triscula L.* anatomical structures caused by zinc toxicity.

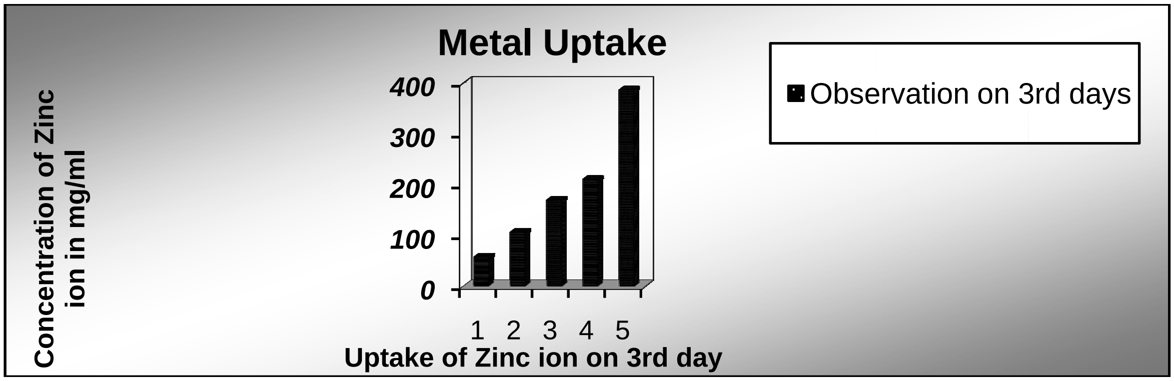
Material and Methods

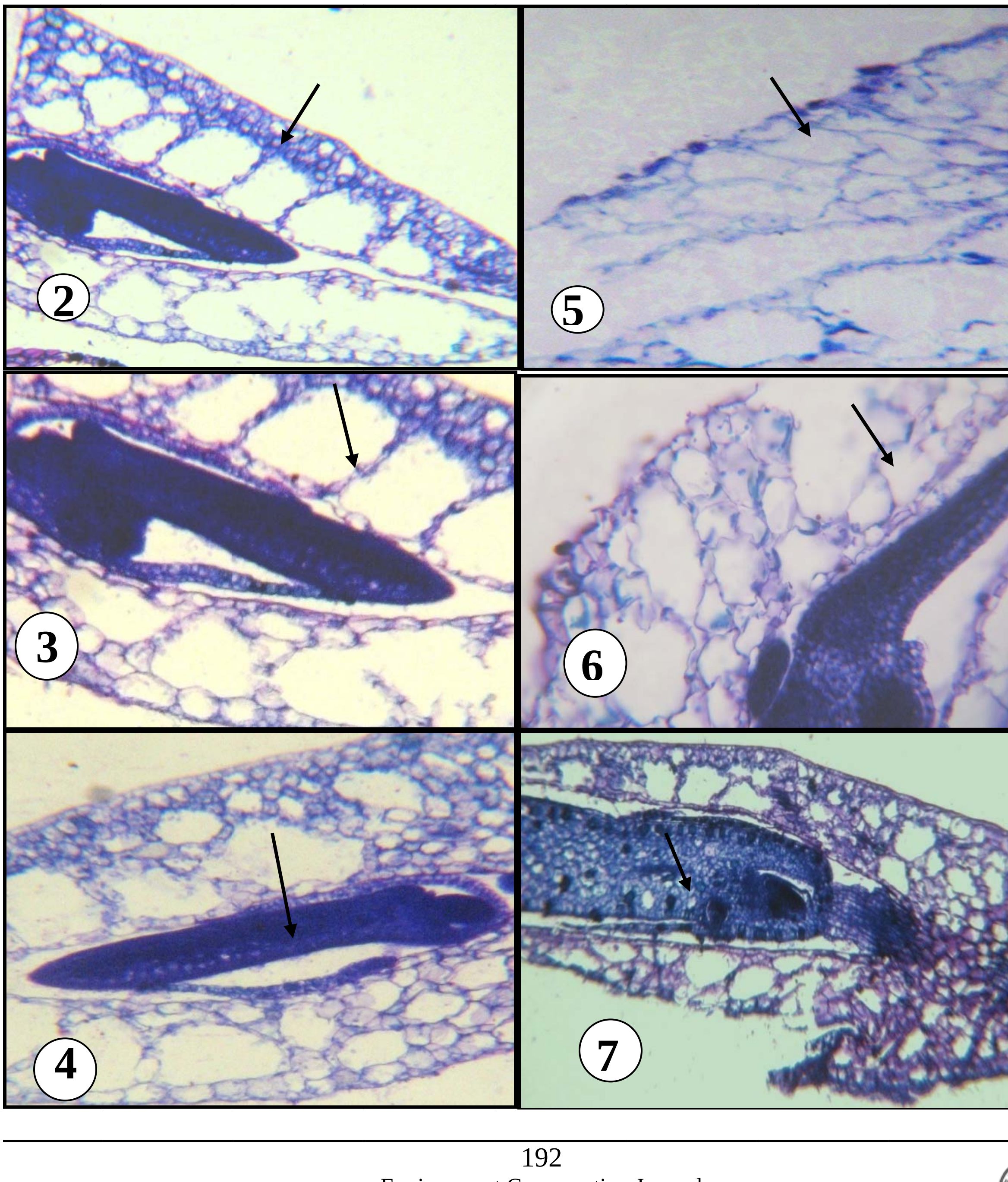
The culture of test plant (Hoagland *et al.* 1938), the determination of LC 50 value, metal accumulation by the plants followed the method of Munshi and Munshi, 1995. The method described by Johnsen (1940) was used to observe the anatomical changes in Zn exposed plants following microtechnique.

Observations were made on organization of epidermal cells, arenchyma cells and vasculature region in the control and treated cells of *Lemna triscula L.*

Results and Discussion

Bioaccumulation of Zn ion in 3 days treated plants at different concentration is shown in figure 1. The Zinc treated plants showed gradual changes in the structure with an increase in metal concentration compared to the control group. On examination, of control plants of *Lemna triscula*L revealed that


Metal Uptake
Observation on 3rd days
Concentration of Zinc ion in mg/ml
400
300
200
100
0
1 2 3 4 5
Uptake of Zinc ion on 3rd day


2
5
3
6
4
7

uniformly distributed radially narrow epidermal cells (Fig. 2), well organized cells of cortical layer with compactly arranged parenchyma cell interrupted by arenchyma cells (Fig.3). At the center of the central cylinder was a vasculature (Fig. 4).

Lemna triscula L growing in excess of Zinc ion exhibits anatomically number of differences compared to the control leaf. Zinc treated leaf showed disruption in arrangement of epidermal cells (Fig. 5) and Cortical cells (aerenchyma) being disintegrated forming dark zone (cavity), Fig.6. Most significant feature was the change in structure of vascular system which revealed expansion in the xylem and phloem tissues (Fig.7).The addition of Zn at low concentration had a favorable effect on the growth of plants, which may be attributed to the fact that the plants utilize Zn as a micronutrient for their growth (Lu *et al*., 2004). But its enhanced concentration caused toxic effect on the plants. It was earlier reported that in long term experiment (24 days), *Eichhorniacrassipes*exposed to 9 mg/L of Zn resulted in 30% reduction in weight (Delgado *et al.*. 1993). Stress caused by the presence of high zinc ion levels in the medium contributed to the disruption of the growth and development of the*Lemna triscula L.* Our study shows that Zn treatment at different concentration increase linearly in metal accumulation in *Lemnatriscula L*. Such results were also reported by Stratford et al.,1984 and Lu *et al*., 2004 in water hyacinth. In the previous study significant changes in root, stem and leaves of water hyacinth were observed (Warrier *et al*, 2008). The changes in anatomical features at 9 mg/ml (9 days) Zn treated *L. triscula L.*were also observed in the current research. These alterations include disorganization in epidermis, breakage in aerenchyma of the cortex and expansion of xylem. Chmielewska, 2001 and Sridhar, 2007 have earlier reported disorganized epidermis in Glycine max exposed to lead and Hordeumvulgare exposed to Zinc and Cadmium metal.The relative volume of the cortex became reduced in treated plant as compare to control due to disorganization of the parenchyma tissues (Panou-Filotheou *et al*, 2006 and Shridhar B.M., *et al.*, 2007). One of the significant observations was that that zinc stress in *Lemna triscula L*. resulted in an increase of volume of xylem. The higher number of vessel may facilitate the movement of water (Paunou-Filotheou and Bosabalidis, 2004) may be due to some physiological activities caused by the metal stress (Martens, *et al*., 2002 and Tahseen *et al*., 2004).

The information available in this work is an important step towards obtaining a better understanding of the structural changes caused by Zn and its effects on metabolic processes. The study envisaged the toxic effect of excessive Zn leading to development of stress symptoms. These symptoms comprise characteristic structural alterations apparently reflecting divergence from at least some normal metabolic patterns.

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