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Toxic Effects of Zinc on Different Tree Seedlings

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A significant reduction in seed germination, seedling growth and dry weight of *Albizia lebbeck, Peltophorum pterocarpum* and *Thespesia populnea* was noted when zinc concentration was increased. A significant reduction ($p<0.05$) in seed germination due to zinc toxicity at 50 $\mu g\ ml^{-1}$ was observed in *A. lebbeck* and *P. pterocarpum*. Higher percentage of decrease in seed germination of *P. pterocarpum* was found with 125 $\mu g\ ml^{-1}$ zinc treatment. The seedling length and seedling dry weight of *A. lebbeck* was significantly ($p<0.05$) reduced with 50 $\mu g\ ml^{-1}$ and 75 $\mu g\ ml^{-1}$ treatment of zinc respectively.

Key words: Germination, Seedling growth, Tolerance, Toxicity, Zinc sulfate.

Introduction

Enviromental pollution is a constant threat to humanity. It is the result of industrialization, urbanization and phenomenal growth in population. In the last decade much information has been obtained on the effects of heavy metal ions on the environment imbalances. The manufacturing of useful products such as dye stuffs, pigments, drugs, agrochemicals, plastics, batteries, zinc recovery operations, electroplating and metal surface cleaning agents and discharge of untreated effluents from these industries are causing a wide range of environmental problems (Raihan *et al* 1995). There has been a world wide increasing concern in recent years over metal pollution and toxicity (Naidu *et al* 1984). Studies on zinc toxicity have been carried out by many workers (Berry and Wallace 1981; Khalil *et al* 1989; Taylor *et al* 1991; Parker *et al* 1991 Xingfu 1996). Aqueous effluents emitting from mining, industries and different factories contain dissolved heavy metals. If these discharged metals are left untreated they may have an adverse impact on the environment (Khalid *et al* 1990). There are about 50 metals that are of special interest with respect to their toxicological importance to human health. There are different types of heavy metals such as zinc, cadmium, cobalt and nickel which are used in the industries for many purposes (Valee and Ulmer 1990). Among the heavy metals, zinc is a major inorganic pollutant, which has shown inhibitory and promotory effects on the growth along with accumulation in plants (Kumar 1989). Seedling growth and enzymes activities have been found inhibited by zinc in *Phaseolus aureus* cv. R-851 (Veer 1989). Mineral nutrient cations such as zinc also exist in several forms in the soil solutions (Soon 1994).

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The ever increasing metals concentration in the environment through human activities is affecting the plant growth. The present study was undertaken to find out the toxic effects of zinc on seed germination and seedling growth of some trees.

Materials and Methods

Random samples of healthy seeds of *Thespesia populnea* (L.) soland.ex Correa, *Albizia lebbeck* (L.) Bth.and *Peltophorum pterocarpum* Baker, were collected from the sandy loam soil on the campus in the month of June,1997 before the commencement of rain. The seeds were rubbed slightly with sand paper for softening the seed coat then seeds were surface sterilized with 0.2% mercuric chloride for one minute to prevent any fungal contamination. The petridishes and filter papers were sterilized in autoclave to reduce the chances of any fungal contamination. Thereafter, the seeds were washed with distilled water and transferred to medium sized petridishes and placed on filter paper at room temperature. There were three replicates and in each replicate, 25 seeds were kept. The surface sterilized seeds were placed at three different concentrations of zinc sulfate, 50, 75 and 125 $\mu g\ ml^{-1}$, respectively. In the control, no treatment was given except distilled water. The germination of seeds was recorded daily and noted the emergence of radicle. After 10 days, seed germination percentage, root and seedling length were noted. Seedling dry weight was determined by drying the plant materials in an oven at 80°C for 24 h.Data obtained were statistically analyzed by ANOVA and Duncan's Multiple Range Test.

Results and Discussion

The results are presented in Figs 1-3 and Tables 1-2. Seed germination and seedling length of *A. lebbeck* were significantly (P<0.05) reduced at 50 μg ml^{-1} zinc treatment as compared with control. The toxicity of zinc at 75 μg ml^{-1} concentration also significantly (p<0.05) reduced the seedling dry weight of *A. lebbeck* (Fig 1). A highly significant (p<0.01) reduction in seed germination of *P. pterocarpum* was observed at 50 μg ml^{-1} zinc treatment (Fig 2). A non-significant effect on seedling length and dry weight was observed in *P. pterocarpum* (Fig 2). Similar non-significant effect in seed germination, seedling length and seedling dry weight was observed of *T. populnea* (Fig 3). However, *T. populnea* showed a significant (p<0.05) reduction in root length at 50 μg ml^{-1} zinc treatment.

The decrease in seed germination, seedling length, root length and seedling dry weight for all the species due to different concentration of zinc was found (Table 1). A high percentage decrease in seed germination (27.9%) and seedling length (38.4%) with 125 μg ml^{-1} zinc treatment was recorded in *P. pterocarpum* as compared with control (Table 1). High percentage decrease in root growth (41%) was found in *T. populnea* with 125 μg ml^{-1} zinc treatment, wherease, 34% reduction in root length of *A. lebbeck* was recorded at the same concentration of zinc.

Germination of *A. lebbeck* and *P. Pterocarpum* was highly affected with zinc treatment, whereas, *T. populnea* was com-

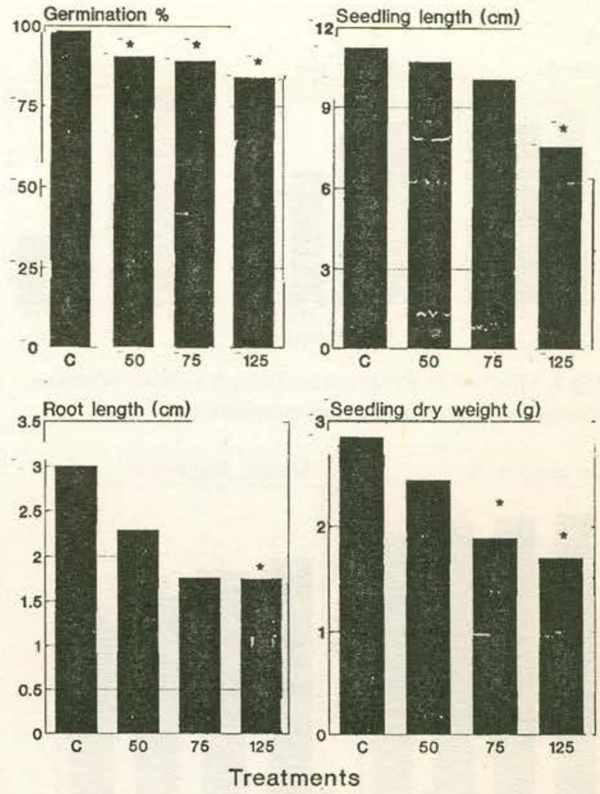

Fig 1. Effects of Zn treatment on *Albizia lebbeck*.
*Significantly different (p<0.05) as compared with control.

Table 1

Percentage reduction in seed germination, seedling length, root length and dry weight at different concentrations of zinc as compared with control

	Concentration μg ml^{-1}								
	A. lebbeck			*P. pterocarpum*			*T. populnea*		
	50	75	125	50	75	125	50	75	125
Seed germination	08.9	10.5	17.3	15.6	27.0	27.9	05.0	16.0	19.7
Seedling length	04.6	10.3	32.6	06.8	16.9	38.4	02.8	04.3	07.9
Root length	18.0	29.0	34.0	ND	ND	ND	23.0	40.0	41.0
Dry weight	15.7	16.7	37.5	04.6	05.0	07.6	01.8	01.7	08.7

ND, Not determined.

Table 2

Significance level L.S.D. (0.05)

L.S.D. Variables	*A. lebbeck*	*P. pterocarpum*	*T. populnea*
Seed germination (%)	8.90	9.47	9.78
Seedling lenght (mm)	2.40	2.30	0.95
Seedling dry weight (g)	0.58	0.95	0.80
Root length (mm)	0.75	ND	0.92

ND, Not determined; LSD0.05, Values determined by Duncan's multiple range test.

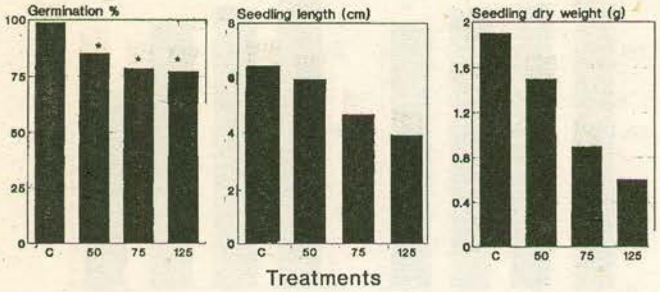

Fig 2. Effect of Zn treatment on *Peltophorum pterocarpum*. *Significantly different (p<0.05) as compared with control.

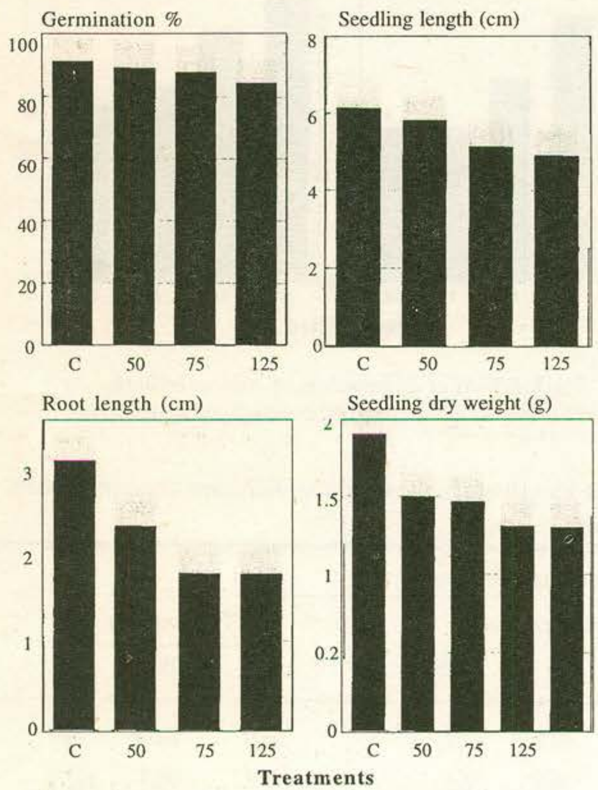

Fig 3. Effect of Zn treatment on *Thespesia populnea*. *Significantly different (p<0.05)as compared with control.

paratively less affected. Reduction in the seedling growth of *A. lebbeck* agrees with the findings of Veer (1989), who also found inhibition in seedling growth and enzymes activities in *Phaseolus aureus* CV R-851 with zinc treatment. Reduction in root growth of *T. populnea* might be due to absorption of zinc from the substrate by root cells. Excessive amount of toxic element usually caused reduction in plant growth (Ganeson and Manoharan 1983). Cereal grains and vegetables usually contain zinc less than 50 $\mu g\ ml^{-1}$ in tissue (Berry and Wallace 1981). The phytotoxicity of a wide variety of metals has been well established in the current literature (Taylor *et al* 1991). A metal is toxic if an increase in the dose of metal results in the decrease of yield (Ganeson and Manoharan 1983), since, plants response to metals is dose dependent. The reduction in seed germination might be due to absorption of zinc through seed coat and breakdown of the stored food material present in the seed. The treatment of zinc also affected the root and seedling length in A. lebbeck. Reduction in seedling dry weight in *A. lebbeck* was evidently due to poor growth of shoot and root due to zinc. Inhibition of mulberry plant growth due to accumulation of zinc from the polluted soil was observed (Xingfu 1996). The toxicity of zinc in seed germination was found high in *A. lebbeck* and low in *P. pterocarpum* followed by *T. populnea.*

It may be concluded from the present study that *T. populnea* is more tolerant to zinc sulfate followed by *P. petrocarpum* and *A. lebbeck*. It is also suggested that *T. populnea* should be planted around zinc manufacturing industrial units to over come the reduction in environmental pollution problem.

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