

## INFLUENCE OF CADMIUM TOXICITY ON GERMINATION AND GROWTH OF SOME COMMON TREES

M. ZAFAR IQBAL, M. TARIQ MAHMOOD AND FIRDOUS AHMED

Department of Botany, University of Karachi, Karachi-75270, Pakistan

(Received June 27, 1990; revised May 22, 1991)

Seed germination of *Leucaena leucocephala*, *Samania saman* and *Dalbergia sissoo* showed significant reduction with increase in concentration of cadmium solution. *Dalbergia sissoo* showed most dismal germination as compared to other species. The seedling length of assigned species showed gradual decrease with increase in concentration of cadmium, but the reduction was significant. The dry biomass of the above species also showed significant reduction with increasing concentration of cadmium solution.

**Key words:** Cadmium, Germination, Growth, Trees.

### Introduction

Cadmium is a common heavy metal used in different industries for manufacturing a wide range of goods. Cadmium is usually in the form of  $CdSO_4$  which is readily absorbed by the plants.

Sahu and Warriar [1] have reported the contamination of cadmium and other heavy metals in soil and vegetation due to vehicular emission in India. They found higher concentration of cadmium in leaves. Similarly, Smith and Brennan [2] had demonstrated that Cd had negative impact on stem height, leaf area and dry weight of soybean. Yocup *et al.* [3] had studied the impact of cadmium on *Petunia* plants, e.g. culture of 1.0 ppm effects the fresh weight, whereas organogenesis occurred by more than 10 ppm. Sadiq [4] had reported the accumulation of Cd, Pb and Ni in corn plants growing in a polluted soil. Ismail [5] found direct correlation between cadmium concentration in plants and distance from motorways in Izmir (Turkey). Plants with hairy leaves were badly affected by cadmium pollution.

The main purpose of this study was to investigate the impact of different levels of cadmium on seed germination, seedling length and dry biomass of some common roadside plants.

### Materials and Methods

The seeds of *Leucaena leucocephala* (Lam) de Wit., *Samania saman* Merrill and *Dalbergia sissoo* Roxb. were collected from the University Campus. The seeds of *L. leucocephala* and *S. saman* were rubbed with sand paper because of their hard seed coat. Different concentrations of cadmium ranging from 50 to 125 ppm were prepared from  $CdSO_4$ . Germination was performed in large size petri dishes (14 cm in diameter) in which filter papers were placed. Ten seeds of each species were kept at three different concentration of cadmium solution. This experiment was replicated three times.

Cadmium solution applied to each Petri dish was 2ml, at alternate days for 10 days. The emergence of plumule was considered as germination. The rate of germination was recorded daily, and it was considered completed when there was no chance for further changes.

After the completion of seed germination, length of the germinated seedlings were measured. Thereafter, these seedlings were placed in oven at 80° for 24 hrs and oven dried weight was recorded. The data was statistically analyzed by analysis of variance and Students-Newman Keul's multiple range test.

### Results and Discussion

The seeds of all the species i.e. *L. leucocephala*, *S. saman* and *D. sissoo* showed high rate of germination in control (Table 1) whereas, the seeds of all the species showed comparatively less germination particularly at higher concentrations of cadmium.

The seed germination of *L. leucocephala* showed reduction at 75 and 125 ppm concentrations. The seed germination at 125 ppm concentration was found significantly different with relation to other concentrations ( $p < 0.05$ ). The germination of *S. saman* at 125 ppm concentration was found significantly different with other concentrations and control ( $p < 0.05$ ). The seed germination of *D. sissoo* was also found significantly reduced ( $p < 0.05$ ). The reduction at all the concentrations significantly differ with each other. The seedling length of all the observed species showed reduction with increase in concentration of cadmium, the reduction was significant. The reduction was most prominent in *D. sissoo* and *S. saman* (Table 2). The dry biomass accumulation of all the species showed significant effect with increasing concentration of cadmium. The dry biomass of *L. leucocephala* was found significantly reduced ( $p < 0.05$ ). The dry biomass at 125 ppm concentration showed maximum reduction and was found

TABLE 1. SEED GERMINATION, SEEDLING LENGTH AND DRY BIOMASS OF ASSIGNED SPECIES AT DIFFERENT LEVELS OF CADMIUM SOLUTION.

Parameters	<i>L. leucocephala</i>				<i>S. samen</i>				<i>D. sissoo</i>			
	CON	50	75	125	CON	50	75	125	CON	50	75	125
Percentage germination	100	100	96.6	83.3	100	100	96.6	66.6	96.6	63.3	66.6	43.3
	A	A	A	B	A	A	A	B	A	C	B	D
Seedling length	14.8	13.5	12.5	7.4	8.24	9.01	7.12	7.83	4.18	3.42	2.88	3.43
	A	AB	B	C	B	A	D	C	A	B	C	D
Biomass	0.21	0.21	0.20	0.17	0.41	0.38	0.39	0.18	0.06	0.05	0.02	0.008
	A	A	A	B	A	C	B	D	A	B	C	D

Statistical significance was determined by analysis of variance. Number followed by different letters in each parameters is significantly different ( $p < 0.05$ ) to Students Newman Keul's multiple range test.

TABLE 2. PERCENTAGE DECREASE IN SEED GERMINATION, SEEDLING LENGTH AND DRY BIOMASS AT DIFFERENT LEVELS OF CADMIUM AS COMPARED TO CONTROL.

Species	<i>L. leucocephala</i>			<i>S. samen</i>			<i>D. sissoo</i>		
	50	75	125	50	75	125	50	75	125
Conc.(ppm)	50	75	125	50	75	125	50	75	125
Percentage germination	0.0	3.4	16.6	0.0	3.4	33.4	34.4	31.0	55.1
Seedling length (cm)	8.7	15.4	50.0	9.3	13.6	4.9	18.1	31.1	17.9
Dry biomass (gm)	0.0	4.7	19.6	7.3	4.88	56.0	16.6	66.6	85.8

significantly different with other concentrations. The dry biomass accumulation of *S. samen* also showed reduction with increasing concentration. *D. sissoo* showed maximum reduction in dry biomass accumulation. The dry biomass of *D. sissoo* was significantly reduced with increasing concentration of cadmium.

Cadmium is usually absorbed by plants and fruits of trees are specially very sensitive to this metal. Cadmium is also present in vehicular emission and previous reports indicated that cadmium level increases with traffic intensity. The plants, specially with hairy leaves were found most affected [5].

The rate of germination of assigned species showed significant effect with increase dose of cadmium. This result clearly indicated that increasing dose of cadmium significantly inhibit the seed germination. Similarly, the seedling growth of assigned species also showed gradual decrease in seedling length with increase in cadmium concentration, however, this reduction was not significant. Both of these prominent observations clearly proved that cadmium has toxic effects on growth and germination of plants and increase in concentration of cadmium also increases its toxicity. Ostrolucka and Mankovska [6] reported that *Q. robur* showed accumulation of lead and cadmium and this accumulation was

found dependent mainly on air pollution. The concentration of Pb and Cd was found correlated with the concentration in soil. Similarly, Ostrolucka and Holub [7] studied the effect of Pb and Cd on pollen tube germination and growth of *Q. cerris*, *P. nigra* and *P. abies*. They reported that low concentration produces a slight stimulation, while reduction was observed at higher concentration of Pb and Cd. Barcelo *et al.* [8] also reported the significant effects of different concentrations of cadmium on the growth of Beans. Similarly, Yoeup *et al.* [3] had also reported the poor growth response of *Petunia* against several pollutants including cadmium *in vitro*.

The dry biomass accumulation of *L. leucocephala* and *D. sissoo* was found significantly reduced with increasing concentration of cadmium solution. Similarly, *S. samen* also showed reduction, when compared with control. These observations indicated that the toxic effects of cadmium resulted in decrease of biomass accumulation in different species. McGarth *et al.* [9] had reported the lethal impact of cadmium on *Holcus lanatus*. According to these workers cadmium caused not only retardation in growth, but also reduced the dry weight significantly. These findings match with our observations.

On the basis of this study it could be concluded that seed germination, seedling length and dry biomass of all the observed species were found badly affected by different concentrations of cadmium. *D. sissoo* showed most dismal growth and was found most susceptible, whereas *L. leucocephala* was found to be the most tolerant of the three. This experiment suggested that this heavy metal cadmium is delirious for the growth of common cultivated trees found around Karachi.

#### References

1. K.C. Sahu and R. Warriar, Indian J. Earth Sci., 12, 50 (1985).
2. G.C. Smith and E.G. Brennan, Environ. Exp. Bot., 25, 99 (1985).

3. P.K. Yoeup, S.L. Choi, L.W. Lee and J.K. Lee, Korean J. Bot., **27**, 139 (1985).
4. M. Sadiq, Water, Air and Soil Poll., **26**, 185 (1985).
5. T. Ismail, Doga. Biol. Serisi., **10**, 116 (1986).
6. M.G. Ostrolucka and B. Mankovska Biologia, **40**, 883 (1985).
7. M.G. Ostrolucka and Z. Holub, Biologia, **38**, 393 (1983).
8. J. Barcelo, C. Poshenrieder and C. Cabot, Zpfln. Bod., **148**, 278 (1985).
9. S.P. McGarth, A. J. Baker, M.N. Morgan, A.J. Soloman and M. Williams, UK, Environ. Pollut. Ser. A. Ecol. Biol., **23**, 267 (1980).