Indian J. Plant Physiol., Vol. 13, No. 3, (N.S.) pp. 297-299 (July-Sept., 2008)

SHORT COMMUNICATION

PHYTOEXTRACTION OF LEAD BY MARIGOLD AND CHRYSANTHEMUM

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Received on 11 July, 2008, Revised on 23 Sept., 2008

Chrysanthemum and marigold were grown in the pots at five levels of lead (0,100,150,200,250 and 500 ppm). At lower levels, the applied Pb promoted growth of the plants but at the highest level suppressed the growth. The concentration of Pb in the tissues followed the order: root>stem>leaf>flower. Chrysanthemum recorded higher concentration of Pb in root (649 $\mu g\ g^{-1}$ dw) at 500 ppm of applied Pb than marigold (587 $\mu g\ g^{-1}$dw) at the same level of Pb. Marigold because of its high biomass recorded higher total Pb uptake than chrysanthemum. Therefore, marigold could have a great prospective as a phyremediator of soils contaminated with moderate to relatively high levels of Pb.

***Key words*: Chrysanthemum, lead, marigold, phytoextraction**

Lead is a major pollutant of the environment and is highly toxic to human beings. The major source of Pb pollution arises from petrol combustion. According to Lagerwerff (1972) this source accounts for about 80% of the total Pb in the atmosphere. The Pb content of agricultural soils lies between 2-200 ppm. The bioaccumulation of toxic heavy metals by various crop plants has already been recorded (Ray 1987, Mishra and Singh 2000). A positive correlation has been found between lead in soil and blood lead concentration (Jin *et al.* 1997). Studies on phytoremediation of heavy metals with non food crops is limited. Susselan *et al.* (2006) used *Mimosa pudica* for extracting Hg, Cd, U and Zn. Lee and Chen (1992) suggested to grow cut flowers to phytoextract Cd from contaminated soil in Taiwan. Wu *et al.* (2004) advocated growing of cotton for cleaning cadmium contaminated soil. In the present experiment, an attempt has been made to explore the feasibility of two floriculture plant species (marigold and chrysanthemum) for phytoextraction of Pb.

The soil was collected from the agriculture field and treated with aqueous solution of Pb $(NO_3)_2$ at different levels so as to get the soil contaminated with Pb at 100,150,200,250 and 500 mg kg^{-1} soil, mixed thoroughly and brought to field capacity. The soil in the pot was subjected to wetting and drying cycles for 15 days. Seeds were sown in 5 kg plastic pots filled with soil and kept in net house under bright sunlight. Five days after emergence, the seedlings were thinned to 4 plants per pot and the plants were grown as per the standard agronomic practices. The experiment was conducted in a completely randomized block design (CRBD) and was replicated five times and the data was analysed statistically **(**Gomez and Gomez 1984) **.** At the time of peak flowering period, the plants were carefully uprooted and separated in to roots, stems, leaves and flowers and dried in an oven at 75^0C till constant weight was obtained. For the determination of Pb in different plant parts, the dried plant samples were ground, digested with 10 ml di acid mixture (9 HNO_3 : 4 $HClO_4$) and the concentration of Pb was determined with Inductively Coupled Plasma Optical Emission Spectrometer(Model Perkin Elmer Optima 2100 DV).

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Both the plant species showed a slight enhancement in growth when exposed to lower levels of Pb and some times higher levels as well. In marigold, the application of Pb increased the dry weight of roots and stem up to a level of 200 mg/kg over control and beyond that it declined. On the other hand, the dry weight of leaf and flower was inhibited (Fig.1). In chrysanthemum, the applied Pb increased the dry weight of roots over control. The dry weight of root and leaf increased up to Pb 200 ppm, flower upto 250 ppm and stem up to Pb 500 ppm (Fig. 2).Although, there is no evidence that Pb is essential for the growth of any plant species, there are many reports on the stimulating effects on plant growth by some Pb salts mainly $Pb(NO_3)_2$ at lower concentrations (Pendias and Pendias 2001). Diehl *et al.* (1983) also found that concentrations of 100 ppm Pb^{2+} in the soil had no effect on growth and yield of spring wheat.

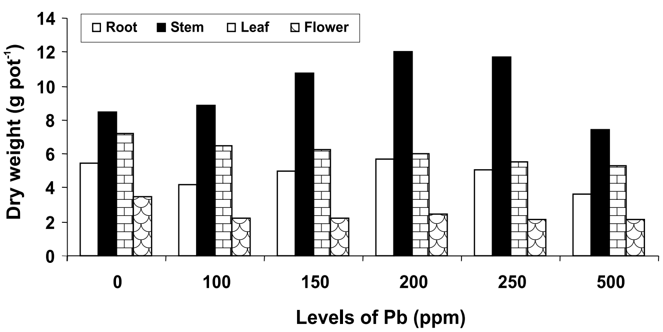

Fig. 1. Effect of different levels of Pb on dry weight of marigold

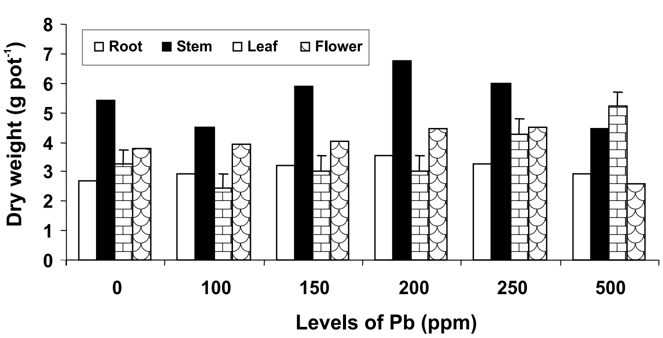

Fig. 2. Effect of different levels of Pb on dry weight of chrysanthemum

There was a gradual increase in the concentration of Pb in root upto 250 mg $kg^{-1}$and at the highest level, i.e. 500 mg kg^{-1}, there was a sudden and dramatic rise. Chrysanthemum recorded higher concentration of Pb in root (649 µg g^{-1}dw) than by marigold (587 µg g^{-1}dw) (Fig. 3 & 4) at 500 mg kg^{-1}. Beyond Pb 250, the concentration of Pb in roots of chrysanthemum, increased by 330 %(> 4 times). Similarly, in marigold also, from Pb 250 to 500, the concentration of Pb in root increased by 163 % (Fig. 3). The roots of both the plant species had invariably higher Pb than the shoots. The root to shoot ratios were 10 and 8 for chrysanthemum and marigold respectively. Research with other species has also revealed similar large differences (Hardiman *et al.* 1984, Malkowski *et al.* 2002). The precise cause of the these large differences in Pb concentration between roots and shoots has not been established, but several workers have suggested that the accumulation of Pb in the roots occurs because the endodermis functions as a barrier to the radial transport of Pb in the root, thereby restricting its movement to the shoots (Hardiman *et al.* 1984).

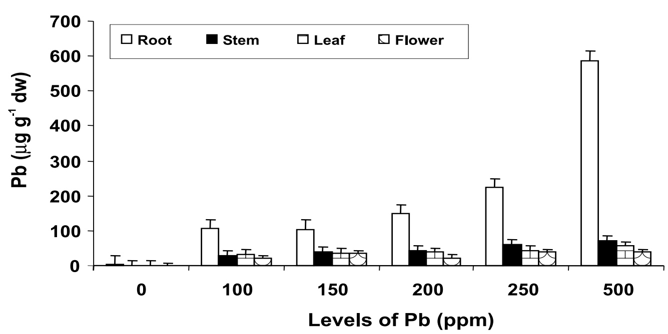

Fig. 3. Concentration of Pb in different plant parts of marigold

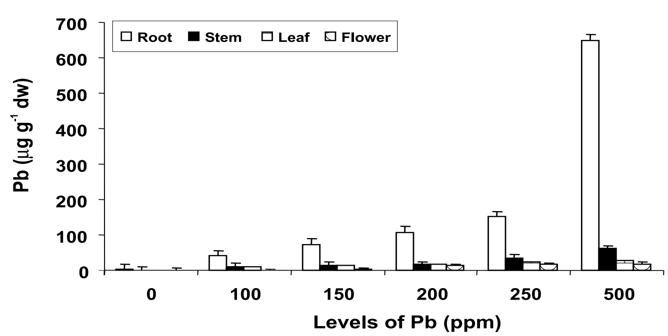

Fig. 4. Concentration of Pb in different plant parts of chrysanthemum

Though, chrysanthemum recorded higher concentration of Pb, the total uptake at different levels

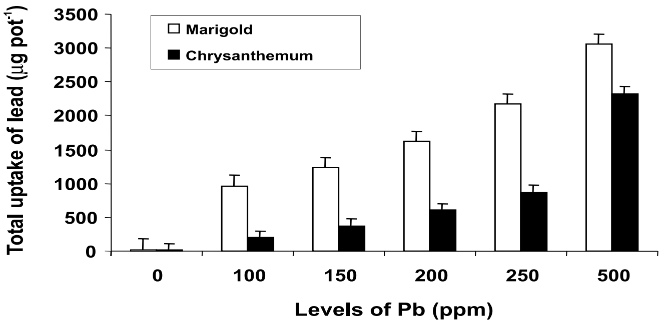

Fig. 5. Total uptake of Pb by marigold and chrysanthemum

was higher in marigold (966 to 3058 µg pot^{-1}) than chrysanthemum (196 to 2324 µg pot^{-1}) (Fig. 5). This is because of higher dry matter production by marigold. It is interesting to note that, a large proportion of Pb (94-97 %) taken up by the plants remained in the vegetative portion and only a little portion (3-6%) was partitioned to flower. Further, among the vegetative parts, root portion accumulated about 42 to 70 per cent. The uptake of metal into the aboveground plant components (shoots) is the essential measure for effectiveness of phytoextraction. Therefore, concerted efforts are needed to increase the translocation of the metal to above ground portion for efficient phytoextraction of Pb from contaminated soil.

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