

## STUDY ON ACCUMULATION OF LEAD IN SUNFLOWER (*HELIANTHUS ANNUUS*)

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### ABSTRACT

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The aim of this study was to determine the effects of heavy metal (Pb) on plant growth and examine their uptake by sunflower in soil. A greenhouse experiment was conducted to determine the phytotoxic effect of heavy metal on plant growth were in a complete randomized design, with seven treatments and three replications, totaling 21 experimental units. Lead was applied at the rate of 0; 10; 20; 30, 40, 50 and 60 ppm in soil. Plant tops were harvested from 120 days after sowing. Lead reduced the plant height of sunflower plant at higher concentration but had no significant effect on 40 Days of plant height. The higher concentrations of Pb showed a significant decrease in leaf number. The heavy metal has shown significant effect on plant dry matter, seed germination and shows a significant effect on the accumulation of these elements in the plant parts, shoot, leaves and seeds. This study concludes that the higher concentration of heavy metal is harmful for the plant growth.

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### INTRODUCTION

Phytoremediation consists of mitigating pollutant concentrations in contaminated soils, water, or air, with plants able to contain, degrade, or eliminate metals, pesticides, solvents, explosives, crude oil and its derivatives, and various other contaminants from the media that contain them.

Phytoremediation technology is more favorable due to its potential for cleaning up environment and the overall aesthetic perfection of the contaminated sites (Chen & Cutright, 2002; Fayaiga *et al.*, 2004). However, the tribulations of contaminated soils and water can be resolved by the application of

phytoremediation. The improvement of contaminated soil through this technology, based on the use of plants, has the objective to extract or stabilize the metals in soil (Silveira *et al.*, 2003; Wahla & Kirkham, 2008). Although phytoextraction, the plant accumulation to above ground tissue of pollutants from soil, is a simple, inexpensive remediation technology (Baker *et al.*, 1994; Chaney *et al.*, 1997).

Sunflower (*Helianthus annuus*) is an annual plant native to the Americas. It possesses a large inflorescence (flowering head). The sunflower is named after its huge, fiery blooms, whose shape and image are often used to depict the sun. The plant has a rough, hairy stem, broad, coarsely toothed, rough leaves and

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circular heads of flowers. The heads consist of many individual flowers which mature into seeds, often in the hundreds, on a receptacle base. What is usually called the "flower" on a mature sunflower is actually a "flower head" (also known as a "composite flower") of numerous florets (small flowers) crowded together. The outer petal-bearing florets are the sterile florets and can be yellow, red, orange, or other colors. The florets inside the circular head are called disc florets, which mature into seeds. Sunflower has abundant health benefits that ensure you a healthy living in the long run. The health benefits of sunflower in two different ways; one from sunflower seeds and the other from sunflower oil. Sunflower seeds improve digestion, brain power and cardiovascular system.

Lead (Pb) is a major anthropogenic pollutant that has been released to the environment since the industrial revolution and accumulated in different terrestrial and aquatic ecosystems (Verma & Dubey, 2003). It is an extremely toxic metal whose effects on human health have been widely described (Juberg *et al.*, 1997). For example it occur through multiple pathways, through inhalation of air, water, soil or dust, as it is emitted in excessive lead (Pb) exposure can cause mental retardation and behavioural disorder and its exposure can the environment from vehicles and automobiles. It can also enter the food chain via plants (Wierzbicka and Antosiewicz, 1993). In plants, its accumulation has been reported in stem, leaves, roots and seeds that increase with increase in exogenous lead levels (Singh *et al.*, 1998). It detrimentally influences plant growth particularly by hampering enzymatic activities (Javed & Saher, 1987).

The experiment was conducted using a completely randomized factorial design containing one plant and seven soil treatments. About two or three seed of sunflower (*Helianthus annuus* (cv.hybride, hysun) were sown in separate pots for respective treatments. Different level of solutions of lead nitrate were applied as irrigation water whereas composted manure was mixed thoroughly with soil before sowing. Soil moisture was maintained at 60% of water holding capacity based on soil moisture.

## MATERIAL AND METHOD

The present study entitled "Study on Accumulation of Lead(Pb) in sunflower(*Helianthus annuus*)" comprise of a pot experiment which was laid out at the Nursery of School of forestry & environment , Sam Higginbottom Institute of Agriculture & Technology

Sciences –Deemed to be- University, Allahabad during Rabi season 2012-2013. The detail of the experiment site, experiment details, plan of lay out, details of treatment, chemical analysis, planting material, measurement of plants, laboratory studies and statistical analysis are given here.

### Experimental Sites

The pot experiment was conducted during Rabi season on green house of school of forestry and environment SHIATS, Allahabad.

### Soil preparation for pots

Soil were taken from the field of forest nursery in December 2012. During the collection events the top two inches of surface soil was removed along with all types of plant growth. Surface soil were gathered at depths ranging from 0 - 15 cm. Equipments used for collecting the soil were cleaned. Soil were separated, and contained in plastic bags. In order to preserve the soil moisture level, the plastic bags were sealed immediately after sampling. These soils were put in experimental pots. These pots were arranged in green house.

### Plan of lay out

Experiment was laid out in complete Randomized design with seven levels of lead nitrate solutions. The treatments were replicated three times and allocated randomly in each replication. The replication were R1, R2, R3 and treatment were T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub>, T<sub>4</sub>, T<sub>5</sub>, T<sub>6</sub> and T<sub>7</sub>. T<sub>1</sub> was a control.

### Details of the treatments

Water with different concentration of the Pb(NO<sub>3</sub>)<sub>2</sub> were used as treatment. Different concentration were made from stock solutions. They are as follows:

T<sub>1</sub> = 0 ppm T<sub>2</sub> = 10 ppm T<sub>3</sub> = 20 ppm T<sub>4</sub> = 30 ppm  
T<sub>5</sub> = 40 ppm T<sub>6</sub> = 50 ppm  
T<sub>7</sub> = 60 ppm

### Planting material

Sunflower (*Helianthus Annuus*) was raised in pots.

### Measurements of plants

*i. Height of plant (cm):* Three healthy plants were selected from each pot and tagged. The height of these tagged plants were measured at 40, 80 DAS and at the time of harvesting.

*ii. No. of leaves per plant:* No. of leaves were counted

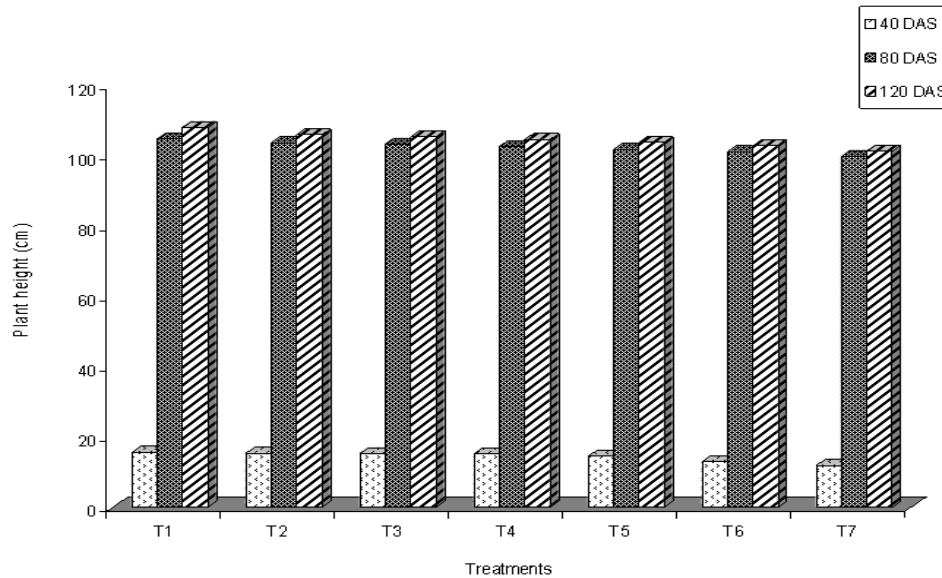


Fig. 1 Effect of different Concentration of Lead on Plant height (cm)/plant

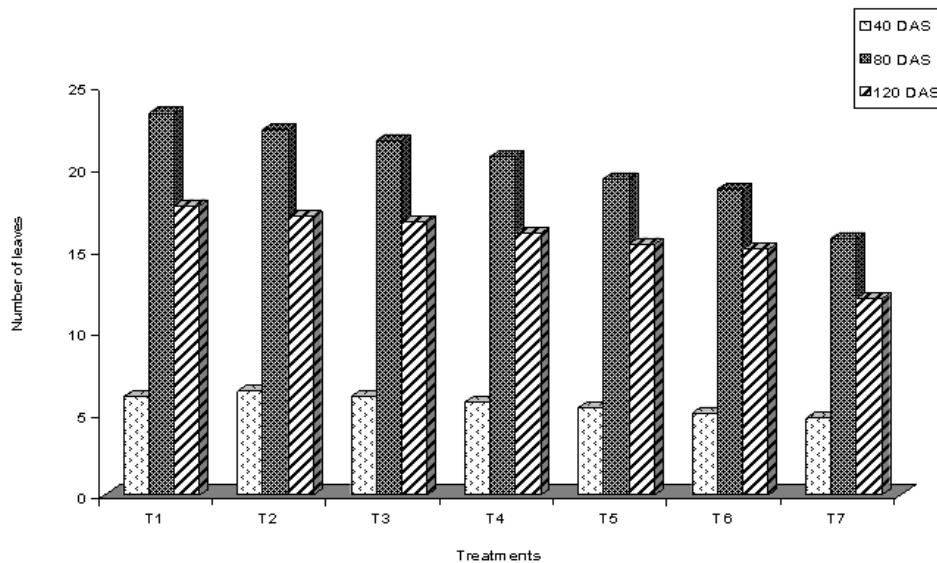


Fig. 2 Effect of Different Concentration of Pb On Number of Leaves of Sunflower plant

at 40, 80 Days and at the time of harvesting. Number of leaves per plant was recorded in the tagged plants only.

*iii. Root dry weight:* This was weighted after harvesting per plant.

*iv. Shoot dry weight:* This was weighted after harvesting per plant.

#### Chemical analysis of the plant samples

Plant sample was taken from different pots after harvesting and Lead accumulation was estimated from root, shoot, leaves and seeds. A known weight of the processed plant sample (0.5g) was digested in an acid mixture of  $\text{HNO}_3$ ,  $\text{HClO}_4$  (3:1) as per the procedure stated by Jackson (1967).

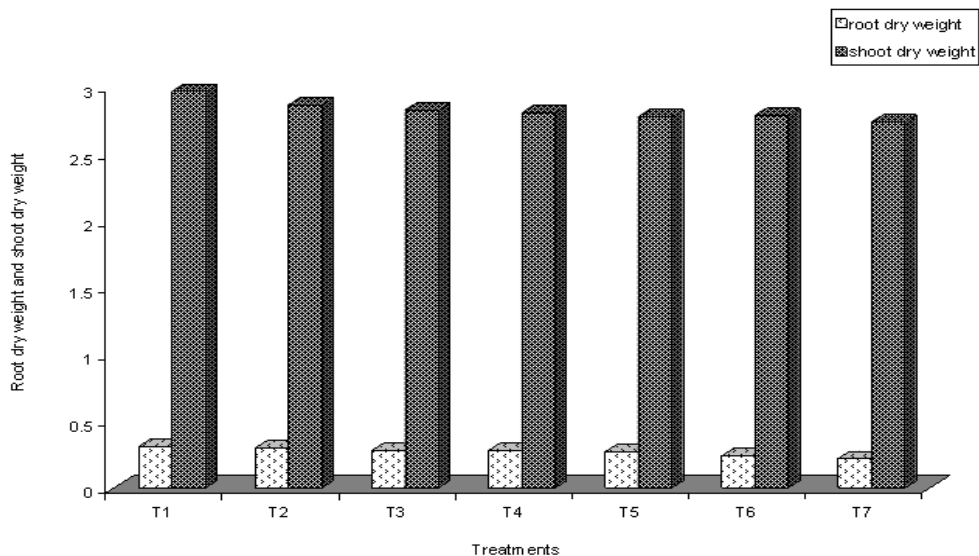


Fig. 3 Effect of different concentrated of Lead on Shoot and Root Dry Weight

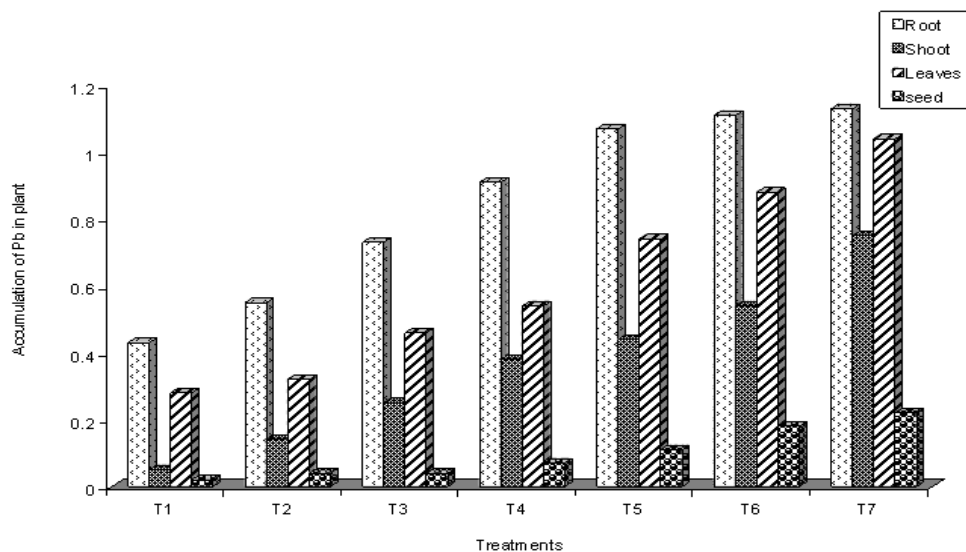


Fig. 4 Accumulation of lead in plant after harvesting

**Statistical Analysis**

Complete randomized design was used for statistical analysis. The significant and non-significant treatment effects were judged with the help of 'F' table. The significant differences between the means were tested against the critical difference at 5% probability level.

**RESULTS AND DISCUSSION**

The result on the above mention the parameters are

presented in Fig. and discussion are made in light of scientific reason with their supporting reviews. During the course of study the results obtained from present investigation, "Study on accumulation of Lead (Pb) in Sunflower (*Helianthus annus*)" have been described and discussed under the following headings:

**Effect of Lead on Plant height (cm)/plant**

The plant height was recorded at 40, 80 Days and at



the time of harvesting. The data depicted in Fig.1, clearly shows that the plant height increased with the age of plants, and it was maximum height at the time of harvesting. The plant height was showed a significant effect on plant height of sunflower. The higher concentration of heavy metal has been reported to retard the cell division and differentiation, reduce their elongation and effect plant growth and development (Soares *et al.*, 2001).

#### Effect of Lead on Number of leaves

In Fig. 2 the number of leaves was gradually decreases as increases the concentration of lead (Pb). In 40, 80, and 120 Days was shown a significant effect in No. of leaves. This fig showed that excess amount of heavy metal was toxic for No. of leaves. According to the Jothinayagi *et al.*, 2009, less amount of heavy metal was not affected the leaf area but excess amount is harmful for leaves.

#### Effect of lead on root and shoot dry weight

The Fig. 3 shows that the mean value of root dry weight of sunflower were maximum in control ( $T_1$ ) 0.305g and minimum was recorded in treatment ( $T_7$ ) 0.217 is due to higher concentration of Lead present in stock solution. Lead was not significant effect on root dry weight. Weight of dry root was slowly decreases, compare to the control with in higher concentration of heavy metal. The mean value of shoot dry weight of sunflower were maximum in control ( $T_1$ ) 2.967g and minimum was recorded in treatment ( $T_7$ ) 2.742g. The Shoot dry weight gradually decreases. But showed a significant effect on root and shoot dry weight. According to Jadia and Fulekar (2008) suggested that increases the concentration of heavy metal with decreases the shoot and root dry weight.

#### Accumulation of lead (ppm) in plant at post harvesting

Sunflower was grown in soil. Heavy metal (Pb) was applied in soil in different concentration. The higher concentration of heavy metal was harmful for plant. Heavy metal was observed through the roots of the plant. Accumulation of heavy metal in higher at roots than leaves, shoot and seeds (root>leaves>stem>seed). Accumulation of lead in plant was showed a significant effect on plant growth. According to Arsenijevic *et al.*, 2001 root of the sunflower is the major organ of heavy metal accumulation.

## CONCLUSION

Thus the present investigation showed that Pb at higher concentrations exerted toxic effects on sunflower growth and on the accumulation of these elements in the plant parts, shoot, leaves, roots and seeds. The heavy metals have significant effect on plant dry matter.

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