ISSN: 2278-3369
International Journal of Advances in Management and Economics
Available online at: **www.managementjournal.info**

RESEARCH ARTICLE

Phytoextraction Potential of *Sesbania grandiflora L.* (Katurai) in Lead Contaminated Soil: Biological Method to Decontaminate Soil from Polluted Rivers

Maria Jenina A Tongol

Bulacan State University, City of Malolos, Bulacan, Philippines.

*Corresponding Author: Email: ***jenina_tongol@yahoo.com***

Abstract

The study determines the phytoextraction of Sesbania grandiflora L. or commonly known as Katurai in lead contaminated soil. The lead contaminated soil was collected from barangays Tabing-Ilog and Patubig in Marilao, Bulacan last October 2010. The soil from both sites was air-dried initially and treated with ethylenediamine tetraacetic acid (EDTA) at a concentration of 3mmol/kg. After the treatment, the katurai seedlings were placed on the pots filled with EDTA treated soil. The soil samples were analysed for lead content after one month and two months of phytoextarction. The results of the lead content analysis of the soil samples show that the soil from Tabing-Ilog initially had a lead content of 165 mg/kg of soil and this was reduced to 120 mg/kg after a month and further reduced to 77.6 mg/kg after 2 months of phytoextraction. The sample from Patubig initially had a lead content of 33.7 mg/kg and was reduced to 25.03 mg/kg after a month and reduced further to 17.77 mg/kg after 2 months of phytoextraction. The lead content of the katurai samples were also determined. The seedlings from Tabing Ilog accumulated an average lead concentration of 83 mg/kg while those from Patubig had an average concentration of 11.4 mg/kg. The study showed that katurai, scientifically known as Sesbania grandiflora L. has phytoextraction potential that decreases the amount of lead from contaminated soils.

Keywords: Phytoextraction, Katurai, Lead content, Soil, EDTA.

Introduction

Phytoextraction is the use of vegetation and its associated microorganisms, enzymes, and water consumption to contain, extract or degrade contaminants from soil and groundwater. Both organic and inorganic contaminants can be successfully contained or degraded using phytoremediation in a variety of media (i.e. soil, sediment, sludge, wastewater, groundwater, leacheate and air) [1]. The Marilao-Meycauyan-Obando river system also known as MRS has been the subject of many environmental programs. Blacksmith Institute, a nonprofit environmental facility has undertaken several studies that deem the water from MRS to be undrinkable and the freshwater fish to be contaminated with heavy metals. Fish species from the river are contaminated with copper and zinc and that these are above the acceptable limit [2]. These were the bases for considering the sampling site for this study. The prevalence of many heavy metals in the river water is an indication that the metals have accumulated in the soil nearest to the river.

Objectives

The study focuses on the phytoextraction of *Sesbania grandiflora L.* or commonly known as *Katurai* in lead contaminated soil. Lead contaminated soil was collected and used to determine the potential of the plant for hyperaccumulation.

Materials and Methods

Collection and Preparation of Soil Samples

The lead contaminated soil was collected from barangays Tabing-Ilog and Patubig in Marilao, Bulacan. These areas are in close proximity to the river that is considered as one of the dirtiest in the world.

The soil samples were collected from Tabing-Ilog and Patubig on October 2010. The soil from both sites was air-dried initially to facilitate the lead content analysis of the samples prior to phytoextraction using katurai. After the initial analysis, the samples from both sites were placed in identical plastic pots. From each sampling site, soil samples in pots were labelled and treated with ethylenediamine tetraacetic acid (EDTA) at a concentration of 3mmol/kg. According to Barlow [3] addition of a chelating agent like EDTA increases the potential of accumulating lead in the plant. After the treatment, the katurai seedlings were placed on the pots filled with EDTA treated soil. The soil samples were analysed for lead content after one month of being phytoextracted with katurai. Another set of analyses were conducted after two months. After two months, the katurai seedlings were also subjected to lead content analysis to determine if phytoextraction took place.

Preparation of Katurai Seedlings

Stem cuttings from one katurai tree were propagated in garden soil for a period of two weeks. Upon growth of roots and shoots, the seedlings were washed and separated with deionized water prior to replanting. According to Gaspar [4] accumulation of heavy metals can be objectively measured under such controlled conditions.

Determination of Lead Concentrations

The lead concentrations were determined using the standard method published by the American Society for Testing and Materials (ASTM) [5]. The Industrial Technology and Development Institute (ITDI) of the Department of Science and Technology (DOST) conducted the analyses using ASTM 4698-92.

This is the Standard Practice for Total Digestion of Sediment Samples for Chemical Analysis of Various Metals. To determine if the decrease in lead content was due to the accumulation in the katurai seedlings, the lead content of the katurai samples were also determined this time by using the AOAC (Association of Analytical Chemists) Official Method [6]. The analyses were also conducted by the ITDI of DOST.

Results and Discussions

After two months of growing the katurai in the soil samples and monthly analyses for lead concentrations the results obtained are as follows.

Lead Concentration of Soil

The results of the lead content analysis of the soil samples are shown in the table below. The table shows the mean values of the initial lead concentrations and concentrations after one month and two months.

Table 1: Lead Concentration of soil samples

Lead concentration, mg/kg			
Sample	**Initial**	**After 1 month**	**After 2 months**
Tabing-Ilog	165.6	120	77.6
Patubig	33.7	25.03	17.77

The results show a marked decrease in the amounts of lead from the samples from Tabing-Ilog and Patubig. There is a decrease by 27.5% in the lead content after a month of phytoextraction with samples from Tabing-Ilog and a decrease by 25.7% with the samples from Patubig. A further decrease by 35.9% was seen after two months of phytoextraction with the samples from Tabing-Ilog and a 29.3% decrease with the samples from Patubig. All in all, the samples from Tabing-Ilog had a 53.1% decrease in lead content after 2 months of phytoextraction with katurai and a 47.5% decrease with the samples from Patubig.

Lead Concentration of Katurai Seedlings

The katurai seedlings were tested for lead concentration to determine if accumulation has taken place. Table 2 shows the mean values from the lead concentration analysis of katurai.

Table 2: Lead concentration of katurai samples

Lead Concentration, mg/kg	
Sample	
Tabing-Ilog	83
Patubig	11.4

Using the results in Table 1 as reference, out of the 165.6 mg/kg lead from samples in Tabing-Ilog, 88 mg/kg were removed from the soil. The lead content found in the katurai samples was 83 mg/kg. For the samples from Patubig, lead concentrations from soil samples decreased by 15.3 mg/kg. This was based from the initial concentration of 33.7 mg/kg to a concentration of 17.7 mg/kg.

Conclusions

The study showed that katurai, scientifically known as *Sesbania grandiflora L.* has phytoextraction potential that decreases the amount of lead from contaminated soils. Hoffnagle [7] notes that accumulation of lead in plants has been most successful over the years. This is the basis for a future study that is being proposed by the author wherein katurai will be planted in the river banks of Bulakan, Bulacan to control the accumulation of lead and other heavy metals in the soil and groundwater.

Acknowledgement

The author acknowledges the support extended by the ITDI-DOST, the Biology Department of Bulacan State University and the research assistants who contributed their time and skills for the study, Rosalyn C. Carangan and Teresa Eliezel J. Borja.

References

1. Susarla S (2000) Phytotransformation of per chlorate contaminated waters. Environ. Sci. Tech. 21:1066-1065.
2. Cruz G (2009) Bioaccumaltion of Heavy Metals in Selected Fishes and Shellfishes along the Marilao-Meycauayan-Obando (MMO) River System, Province of Bulacan. Bulacan State University Research Journal. Vol.2.
3. Barlow R (2000) Lead Hyperaccumulation in Sesbania drummondii. Accessed on September 10, 2010 at http://www.engg.ksu.edu/HSRC/00Proceed/barlow.pdf.
4. Gaspar G (2005) Phytoremediation Studies:Factors Influencing Heavy Metal Uptake of Plants. Accessed on December 4, 2010 at http://www.sci.u-szegad.hu/ABS
5. American Society for Testing and Materials. ASTM 4698-92: Standard Practice for Total Digestion of Sediment Samples for Chemical Analysis of Various Metals. Accessed on September 10, 2010 at http://www.astm.org.
6. Association of Analytical Chemists. Standard Method for Ash Determination. Accessed on September 10, 2010 at http://www.aoac.org
7. Hoffnagle A (2001) Phytoremediation Field Studies Database for Chlorinated Solvents, Pesticides, Explosives and Metals. Accessed on December 4, 2010 at http://www.clu-in.org/download/studentpapers/hoffnagle-phytoremediation.pdf