JOURNAL OF CURRENT RESEARCH IN SCIENCE (ISSN 2322-5009)
CODEN (USA): JCRSDJ
2013, Vol. 1, No. 4, pp:242-246
Available at www.jcrs010.com

ORIGINAL ARTICLE

TRACE METAL PROFILE OF *MORINGA OLEIFERA* (LINN.) SEEDLINGS SOWN IN SPENT LUBRICATING OIL CONTAMINATED SOILS

Agbogidi OM[1] and Ohwo AO[2]
1- Department of Botany, Faculty of Science, Delta State University, Abraka, Delta State, Nigeria.
2- Department of Forestry and Wildlife, Faculty of Agriculture, Delta State University, Asaba Campus, Nigeria.

ABSTRACT: Trace metal profile of *Moringa oleifera* seedlings grown in spent lubricating oil contaminated soil was evaluated in Asaba, Delta State, Nigeria during the 2012 growing season. Oil concentrations used were 0.00, 1.37, 2.77, 4.15 and 6.92% (w/w). The results showed that spent lubricating oil in soil significantly (P≤0.05) increased trace metals in soil and *Maringa oleifera* plant tissues relative to the control. Trace metal identified included Pb, Fe, Zn and Cu and their values were significantly (P≤0.05) higher when compared with values obtained from the uncontaminated soils. The results also showed that the amount of trace metals accumulated is dose-dependant as the values obtained in higher concentrations of oil application were significantly (P ≤0.05) higher than values recorded in the control subplots. This study has demonstrated that spent lubricating oil leads to gradual accumulation of trace metals in soils and plant tissues which could have health risk in the Nigeria rural environment especially in the Niger Delta where oil activities are predominant.

KEYWORDS: *Moringa Oleifera,* Spent Lubricating Oil, Soil Contamination, Trace Metals, Health Risk.

INTRODUCTION

Spent engine oil otherwise called used engine oil or spent lubricating oil consists of hydraulic fluids and gear oils, used in cars, bikes, lawn movers is brown to black liquid produced when new mineral base oil is subjected to high temperature with high mechanical strain. It is a common and toxic environmental pollutant not naturally found in the environment but large amounts are disposed in the environment when motor oil is changed and disposed indiscriminately into gutters, water drains, open vacant plots of farmland which is mainly implemented by motor and generator mechanics (Agbogidi and Ilondu, 2012a; Agbogidi *et al.,* 2013). It contains heavy metals and polycyclic aromatic hydrocarbon and chemical additives including phenols, benzenes, Cd, Co, Ni, Fe, As, Hg, Va, Zn, Pb, Ba, Mn, Mo, P and S which may be dangerous to biota depending on the concentration. When released into the soil, they constitutes havoc to life farms by reducing their growth, development, agricultural productivity and yield well as affecting the natural ecological functions (Abdulhadi and Kawo, 2006; Ehiagbonara *et al.,* 2011; Agbogidi, 2013) leading to environmental degradation, health hazards and destruction of crop plants (Grystsyuk *et al.,* 2006; Itumoh *et al.,* 2012). Heavy metals are metals having densities greater than 5g/cm^3. Other sources of heavy metals include mining, smelting and tannery industries. Heavy metals also influence the quality of the atmosphere and water bodies; threaten the health and life of animals and man. It has been reported that heavy metal pollution affects both the shoot and root growth and development of *Medicago sativa*. Spent oil also lowers soil pH, causes poor aeration, affects the biological, physical, chemical and microbiological components of soil (Wyszkowski and Kucharski, 2000; Odejimi and Ogbahe, 2006; Nwaogu *et al.,* 2008; Njoku *et al.,* 2009). Reports by Adams and Duncan (2002); Whyszkowski and Ziokowska (2008) and Agbogidi and Enujeke (2012) also showed that oil in soil affects the organic carbon, mineral components and other properties of the soil. Spent engine oil could also be released into the environment from exhaust system during engine use and by engine leak. Spent oil contaminated soils are now of environmental concern because they are unsuitable for agricultural and recreational use and are potential sources for surface and ground water contamination (Dauda and Obi, 2000; Ross, 2004, Agbogidi and Eruotor, 2012; Agbogidi and Ilondu, 2012b). *Moringa oleifera* belongs to the family Moringacere. It is a native southern foothill of Himalayas and possibly Africa and Middle East. It is however, widely cultivated in many places today including southern America, Mexico and Malaysia

Corresponding Author: Agbogidi OM, Department of Botany, Faculty of Science, Delta State University, Abraka, Delta State, Nigeria. **E-mail:** omagbogidi@yahoo.com

(Agbogidi and Ilondu, 2012b). The plant has a great bio-energy potential and is an exceptionally nutritious vegetable tree with multipurpose uses. The potentials of *M. oleifera* as a food security and rural medicinal item have been extensively exrayed by Agbogidi and Ilondu (2012b). This study has been undertaken to evaluate the trace metal concentration of *M. oleifera* seedlings frown in spent lubricating oil contaminated soil.

MATERIALS AND METHODS

2.1. Study Area

The experiment was conducted at the Research Farm of the Department of Forestry and Wildlife, Delta state University, Asaba Campus, Abraka. Nigeria during the 2012 cropping season. Asaba lies within the tropical rain forest zone at latitude 6 ^{0}14'N and longitude 6^{0}49'E of the equator and it is characterized by annual rainfall ranging from 1596mm to 1955mm. The temperature is 28+6^{o}C. The mean monthly soil temperature at 100cm depth is 29.7$^{0\ C}$ and monthly sunshine of 4.7bars. Asaba raining season is between March and October (Asaba Meteorological Station, 2011).

2.2. Source of Seedlings

M. oleifera dry were collected from a selected tree at Delta State University Asaba Campus. Seed husks were removed from the fruit pods by land and the extracted seeds were Sun-dried for a day and were planted a nursery site of the Research Farm of the department of Forestry and Wildlife, Delta State University, Asaba Campus. After germination, 60 seedlings were used for the experiment.

2.3. Source of Soil Samples

Soil used was collected from the Teak (*Tectona grandis*) plantation at the Research Farm of the Department of Forestry and Wildlife, Delta State University, Asaba Campus. The soil sample used for the experiment was mixture of top soil and river sand at ratio 2:1 which was air dried and passed through a 2mm sieve to remove stones, rot and other debris that may be harmful to seedlings. In order to determine the minimum level of contamination that will cause damage, five levels of spent oil contamination 0, 20, 60, and 100ml were measured using measuring cylinder, thus applied at 1.4kg of soil.

2.4. Source of Spent Lubrications Oil

Spent lubricating oil for the experiment was obtained from 10 mechanic workshops in Asaba, Delta State as a pool sample.

2.5. Experimental Design

Complete Randomized Block Design (CRBD) with three replications was used in the experiment.

2.6. Procedure

Seedlings of *Moringa oleifera* (7 weeks of age) were transplanted into soil that has been thoroughly mixed with the appropriate level of spent oil contamination. The poly pots were filled up with 1.4kg of the contaminated soil and the various level of spent lubrication oil used were 0, 20, 40, 60, and 100ml and by calculating the equivalent concentration of spent lubrication oil in the soil was 0.00, 1.37, 2.77, 4.15 and 6.92% in perforated poly pots which were watered immediately and subsequently, once daily to, field capacity. The set up was monitored for 9 weeks after transplanting (WAT) after which, the plants were harvested, separated into roots, stems and leaves. These were oven dried at 85$^{o}_{c}$ for 20hours following the procedure of Agbogidi and Eshegbeyi (2010). The plant tissues were ground to powdered state and packaged separately according to treatment and were weighed into a conical flask for wet-ashing before subjecting them to analysis for trace metals by Atomic Absorption Spectrophotometer in the Soil Science Laboratory of the Faculty of Agriculture, Delta State University, Asaba Campus using the standard addition method (AOAC, 1985).

2.7. Soil and Heavy Metal Analyses

The concentration of heavy metals including Lead, Iron, Zinc, and Copper was determined in both plant tissues and soils used in the experiment. Composite soil samples were collected from 0-15cm depth prior to treatment application and after harvest and the samples were used to determine soil trace metal elements.

2.8. Data Analysis

Data collected was subjected to analysis of variance (ANOVA) at 0.05 probability levels, while the significant means were separated with Fisher's Least Significant Difference (LSD) (SAS, 2005).

RESULTS AND DISCUSSION

As observed in Table 1, there was a build up of trace metals (Pb, Fe, Zn and Cu) in soils contaminated with spent lubricating oil when compared with values recorded in soils of no oil impact. In the same vein, plant tissues (leaves, stems and roots) analysis of *M. oleifera* seedlings exposed to spent lubricating oil treatment differed significantly (P≤0.05) from their counterparts grown in soils without oil treatments (Tables 2,3 and 4.) respectively. A positive relationship was observed between the concentration of oil applied to soil and the amount or accumulation of the trace metals. It was also observed that metal accumulation in roots was significantly (P≤0.05) higher when compared with the amount accumulated in the leaves and stems.

The observed build up of trace metals in soils contaminated with hydrocarbons and other petroleum products is well reported phenomenon. Adams and Duncan (2002); Agbogidi and Ejemete (2005); Agbogidi *et al.,* (2007); Agbogidi and Ilondu (2012a); Agbogidi and Eruotor (2012) had separately reported that petroleum and its products exert a significant effect on the soil including an accumulation of heavy metals. This observation is in harmony with prior reports (Edet *et al.,* 2008; Omosun *et al.,* 2008; Omosun *et al.,* 2009). The results of plant tissue analysis where there was appreciable build up of trace metals in soils of oil impact also agree with earlier findings of Vwioko *et al.,* (2006); Agbogidi, (2009) on heavy metal absorption from soil through roots and subsequent translocation to other parts of plant although their values are more at the source than the sink. Although the observed values fall within tolerable levels prescribed by the World Health Organisation (WHO), there is the need for continues monitoring as these metals are stable, and persistent in the environment and their health risks and hazards cannot be underestimated.

Table 1: Heavy metal contents (ppm) of soil under different levels of spent oil contamination

Oil level (%) w/w	Heavy metals Pb	Fe	Zn	Cu	Means
0.0	0.011	0.005	0.016	0.108	0.035e
1.37	0.040	0.089	0.110	0.703	0.230d
2.77	0.068	0.089	0.193	0.746	0.273c
4.15	0.078	0.121	0.236	0.760	0.299b
6.92	0.083	0.135	0.275	0.767	0.315a
Means	0.056	0.083	0.166	0.617	

Means with different letters are significantly different from each other at (P≤0.05) level of Significance using Fisher's least significant difference.

Table 2: Heavy metal contents (ppm) of *M. oleifera* root under different levels of spent oil contamination

Oil level (%) w/w	Heavy metals Pb	Fe	Zn	Cu	Means
0.0	0.019	0.007	0.014	0.108	0.037e
1.37	0.028	0.051	0.079	0.701	0.215d
2.77	0.040	0.054	0.143	0.741	0.245c
4.15	0.086	0.98	0.160	0.752	0.274b
6.92	0.099	0.117	0.192	0.752	0.274b
Means	0.054	0.065	0.118	0.614	

Means with different letters are significantly different from each other at (P≤0.05) level of significance using Fisher's least significant difference (LSD).

Table 3: Heavy metal contents (ppm) of M. Oleifera stem under different levels of spent oil contamination

Oil level (%) w/w	Heavy metals Pb	Fe	Zn	Cu	Means
0.00	0.005	0.076	0.010	0.105	0.049e
1.37	0.025	0.098	0.153	0.738	0.254d
2.77	0.040	0.107	0.174	0.742	0.266c
4.15	0.045	0.146	0.177	0.744	0.278b
6.92	0.078	0.155	0.182	0.748	0.291a
Means	0.039	0.116	0.139	0.615	

Means with different letters are significantly different from each other at (P≤0.05) level of significance using Fisher's least significant difference (LSD).

Table 4: Heavy metal content (ppm) *of M. Oleifera* leaves under different levels of spent oil contamination

Oil level (%) w/w	Heavy metals				
	Pb	Fe	Zn	Cu	Means
0.0	0.003	0.009	0.001	0.104	0.0029e
1.37	0.027	0.072	0.076	0.672	0.212d
2.77	0.032	0.088	0.109	0.680	0.227c
4.15	0.057	0.105	0.114	0.727	0.25b
6.92	0.069	0.116	0.214	0.734	0.283a
Means	0.038	0.078	0.103	0.583	

Means with different letters are significantly different from each other at (P≤≤0.05) level of significance using Fisher's least significant difference (LSD).

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