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Analysis of Selected Roadside Plants (*Chromolena Odorata*) and (*Pennisetum Purpureum*) For Lead Pollution Monitoring

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***Abstract* - The indication provided by roadside has great significance in ecological terms particularly when environmental pollution is a matter of concern. Soil and plants (*Chromolena odorata* and *pennisetum purpureum* from ten locations along Akure-Owo highway were analyzed for lead (Pb) concentration in (mg/kg) using atomic absorption spectrometry. The locations were further divided into site A and site B for spatial difference of lead concentration. The data were subjected to multivariate analysis to examine the relationship between distance and Pb concentration in plants. A strong correlation was observed for the concentration of Pb in soil and plants. In addition, the highest and lowest values of Pb concentration in both the soil and plants were found at the same location. The results show that Pb concentration in soil decreases with increasing distance from roadside as the Pb concentration in site A sample of one location declined in site B samples of the same location. This indicated that road traffic may be the key source of Pb present in soil and plants of this area. Furthermore; values of Pb concentration in soil and *C.odorata* correlated more than *P. purpureum* and soil. So *chromolena odorata* can be used as a good choice species for biomonitor of Pb in this area.**

Keywords: Chromolena Odorata, Pennisetum purpureum, Pollution, Lead (Pb), Roadside Pollution, Soil Contamination, Biomonitoring, Heavy Metals, Environmental Pollution, Atomic Absorption Spectrometry (AAS), Traffic Emissions.

I. INTRODUCTION

It is indeed now a common knowledge that heavy metals, including lead, cadmium mercury are toxic with no beneficial effects to humans and wildlife (Tyler, 1981, Borgmann, U.1983). Lead is one of the major heavy metals that has been known for ages and has gained considerable importance as a potent pollutant of the terrestrial and aquatic ecosystems. Besides natural weathering processes of geological materials and soils (Shea, 1983), the main sources of lead pollution are exhaust fumes of automobiles, chimneys of factories using lead, effluents from the storage battery industry, mining, and smelting of iron ores, metal plating and finishing operations, fertilizer, pesticides and additives in pigment and gasoline (Eick,*et.al*.,1999, Dean, *et al.*, 1972, Field and Larger, 1975).

In urban areas automobile exhaust contribute substantially to the atmospheric pollution. Lead compound are the major pollutants emitted by automobiles. In effect plants growing on highways are usually exposed to more lead than other localities. Sewage sludge containing large quantities of lead and other metals are regularly discharged on to the field and garden soils due to increasing trends in urbanization (Paivoke, 2002). In Nigeria, it has been predicted that at least 15,000kg of lead is emitted into the environment through burning (Agbo, 1997). Hence automobile exhausts were believed to account for 80% of the air pollution and lead content in Nigeria super grade gasoline is 600-800mg/l (Osibanjo and Ajayi, 1989, Shy, 1990), which is much higher than permissible levels in some pollution conscious countries. Lead is also available to plants from soil and aerosol sources. The importance of this plant as a fodder not only for feeding of cattle but domestic ruminants, further prompts the interest in wanting to know the level of this metal in soil where they grow. Moreover, leaded petrol is still in use in Nigeria and a good number of commercial vehicles that ply the roads are not road worthy with high volume of exhaust released into the environment. Atmospheric deposition of lead has been reported as a major contributor to a lake sediment burden (Outridge, et al., 2002) the presence of lead and other heavy metals has been reported in soils and plants including leafy vegetables in Nigeria (Akinola and Ekiyoyo, 2006, Adeyeye, 2005, Osibanjo and Ajayi, 1980).

The present study was aimed to look into the pollution levels of Pb in soil, *chromolena odorata* and *pennisetum purpureum* on Akure-Owo highway and to assess the effect of distance and the location on metal contents in road soils and plants. This study was also intended to assess whether *C. odorata and P.purpureum* are useful as a bioindicator of soil heavy metal pollution originating from traffic.

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II. MATERIALS AND METHODS

Akure-Owo road which is the actual area under study is both intra and interstate to Akure the state capital. The main socio-economic activities along this road are farming, food processing and marketing of farm produce. Soil and plant *C-odorata* and *pennisetum purpureum* were collected from ten different sites along the highway. In each location two distances named as A and B points were selected for sampling. The first one site A was at the edge of the road and the second one site B was five meter away from the first point.

Soil pH was determined by using glass electrode pH metal as described by hendershot *et al;* 1983), EC was measured with the EC pocket meter (conductivity- ^{O}C, cyber scan 500 con). The concentration of Pb (mg/kg) in plants and soil were determined after acid digestion. The acids used were: agua regia for soil and HNO_3-HC1O*4*-H_2SO_4 for plants digestion (Eaton, 1995).

Table 1: The mean and standard deviation of Pb(mg/kg) in soil samples

S/N	Location	Samples Sites	Pb concentration (mg/kg)
1	FGC	A	4.9946
		B	2.5542
2	Sasa	A	3.8116
		B	3.5845
3	Airport Junction	A	4.0933
		B	3.5719
4	Ogbese	A	3.2753
		B	3.6028
5	Isuada	A	3.9953
		B	3.6346
6	Emure-Ile	A	4.2793
		B	3.6928
7	Express	A	3.7774
		B	2.2884
8	Ipele	A	4.2983
		B	3.9668
9	Iso	A	3.6904
		B	3.5649
10	Iyere	A	3.9989
		B	3.5763
11	Control sample		0.9434

Table 2: Comparison of permissible soil heavy metal concentration (mg/kg)

Element	WHO permissible	Present study (mean values)	
	Conc. In soil (1996)	Road side soil	control
Pb	3.00	3.72758	0.9434

Table 3: The mean and standard deviation of Pb (mg/kg) in Roadside Plants leaves

S/N	Location	Samples Sites	*C.odorata*	*p. purpureum*
1	FGC	A	4.0957	3.9253
		B	3.9782	2.3378
2	Sasa	A	2.8422	3.4778
		B	1.9681	1.4882
3	Airport Junction	A	3.2456	2.8141
		B	2.1357	1.0518
4	Ogbese	A	2.6356	2.2856
		B	1.842	1.2266
5	Isuada	A	2.8156	2.325
		B	2.2554	1.2828
6	Emure-Ile	A	3.3618	3.0998
		B	2.5896	2.3909
7	Express	A	3.113	2.9071
		B	3.1355	2.5553
8	Ipele	A	3.0705	2.7954
		B	3.0712	2.6765
9	Iso	A	3.2441	2.3529
		B	2.5451	1.7365
10	Iyere	A	3.6843	2.5451
		B	2.9869	2.9593
11	Control sample	B	0.7154	0.8156

III. RESULTS

In the study area soil pH was observed in the range from pH 7.47 to pH 9.30. The normal pH range for productive soil is from 6.5 to 8.4 (WHO, 1996). Among the studied soil, relatively higher pH was recorded in only two soil samples (Location No3, B and location No 7, site A) whereas on all other points pH was within the normal range. The maximum EC i.e., 490µs/cm was recorded in soil sample of location No.4, site B while the minimum EC i.e. 66.4µs/cm was observed in location No. 10, site B, concentration of lead in the soil of study area varies from 2. 28mg/kg (Location No.7, site B) to 4.99 mg/kg (Location No.1, site A). Concentration of Pb in control sample was recorded to be Pb 0.94 mg/kg

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(Table 1). The average soil Pb concentration in the study area is 3.72 mg/kg. Lead concentration in most of the soil samples of study area was higher than the permissible limits of world health organization (3mg/l) (Table 2). Comparatively almost all the samples collected from sites A showed higher soil Pb concentration. The main reason for high lead content in soil of this area may be as a result of emission from road traffic.

Concentration of Pb in *C.odorata* in the study area varies from 1.8mg/kg (location No.4, site B) to 4.09mg/kg (location No.1, site A) concentration of Pb in control sample was recorded to be 0.71mg/kg (Table 3). The average Pb concentration in *C. odorata* in the study area is 3.6935 mg/kg. Lead concentration in most of the plant samples of study area was higher than the valves mentioned in other literature. The mean Pb concentration in *C. odorata* also exceeded the normal level of Pb in plants (3ppm as given by Allen (1989) comparatively almost all the samples collected from site A which was directly at the border of the road showed higher Pb concentration than site B. concentration of Pb in *P.purpureum* leaves in the study area varies from 1.05mg/kg (Location No.3, site B) to 3.92 mglkg (location No.1, site A). concentration of Pb in control sample was recorded to be 0.8156 mg/kg (Table 3). The average Pb concentration in *P. purpureum* leaves in the study area was 2.41mg/kg. According to Singh et al; (2002) the lead concentration in *P.purpureum* ranges between 2.1-12.3Nglg. Most of the plant samples collected from site A showed higher Pb concentration in their tissues than site B. The comparison between Pb concentration for soil and both the plant species shows that *C. odorata* had the higher mean Pb concentration than *P_.purpureum* and indicating that it had the ability to accumulate lead.

IV. DISCUSSION

From toxicological perspective, the bioavailability of metal pollutant in soil is important and at the same time the nutrient availability is crucial for the growth of vegetation in the area. Soil pH is a one simples and direct measure of the overall chemical condition of soils. It is commonly recognized that at pH 6.5 nutrient availability to plants is at highest and toxicity lowest (Harris t al; 1996). In the present study pH in soil of the study area is ranging from 7.47 to 9.30. The normal pH range for productive soil is from 6.5 to 8.4 (WHO, 1996) high pH of soil generally can affect plant growth and nutrient availability (Williams, 2003). The heavy traffic on road emits smoke containing heavy metals like Pb that are ultimately deposited into the soil. Therefore higher concentration of heavy metals in soil increases its pH, and with the increase in soil pH, the fertility of soil is affected. In general Pb is a major pollutant of the roadside environment. There is a general agreement that combustion of gasoline containing lead is major sourc of Pb pollution.

The amount of lead in the roadside soils is strongly but inversely corrected with increase in distance from the road. (Akbar et al; 2003) calculated a sharp decrease in lead concentration from border zone to verge zone in the sahiwal district punjab, Pakistan. In the present study also a distinct gradient with a pronounced decease in the lead content from the border zone i.e. site A, to the verge zone i.e. site B, has been observed. The mean soil Pb concentration of the study area was 5.72 mg/kg which is higher than the WHO permissible limits of Pb in soil (3mgl). The roadside soils have been reported to have usually higher lead content because of vehicular exhaust.

The average Pb concentration in *C. odorata* in the study area was 3.69mg/kg. lead concentration in most of the plant samples of study area is higher than the values mentioned in other literature. According to shams and Berg (2000), the maximum Pb accumulated by roadside plants was noted to be 3.12ppm. The mean lead concentration in *C. odorata* also exceeded the normal level of Pb in plants (3ppm) as given by Allen (1989).

The average Pb concentration in *P. purpureum* leaves in the study area was 2.411mg/kg and all the samples collected from site A which was directly at the border of road showed higher Pb content than site B samples which was five meters away from site A. Various studies have showed heavy contamination of roadside soils and vegetation with lead concentration declining steeply with distance from the road (Little, 1995) as was seen in the present study. The rate of Pb deposition to the ground is very much dependent upon the presence and nature of vegetation. The rate of lead deposition on grass is about four times greater than on bare soil (little and Wiffer, 1978). The distribution of lead in the soil is very characteristic, with a steep decline in lead concentration with increasing distance from the road.

As long as lead remains in petrol, levels of lead in soils will continue to increase and zone of heavy metal contamination will gradually widen away from the roads. Ward et al; (1977) calculated a sharp increase in lead concentration in the roadside soils with heavy metals. In the roadside soils with heavy metals in the present study the lead concentration recorded was quite higher than national environmental quality standard range i.e. 0.5Nglg. High lead concentration in soil will affect the soil fertility.

The plant samples collected from FGC have high lead content as compared to other locations. The soil samples collected from FGC also have higher Pb concentration .This study indicates that the plant samples under study can be used

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as bioindicators in future studies. Especially the Pb concentration in *C. odorata* was recorded higher than *P.Purpureum* which indicates that *C.odorata* can be used as an indicator species.

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