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Full Length Research Paper

Cadmium, Copper, Lead and Zinc levels in sorghum and millet grown in the city of Kano and its environs

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The amounts of cadmium, copper, lead and zinc on tissues of sorghum and millet grown in Kano city and the environs were determined by atomic absorption spectrometry. Analyses were performed on sample leaves, grains as well as the soil were the plants grew. Leaves of all the cereals studied showed a higher content of the metals than the grains. The location with higher levels of heavy metals in the soil also showed to have higher metal uptake by the various parts of the crops.

Keywords: Heavy metals, sorghum, millet, Kano.

INTRODUCTION

Plants and their products play important role in human diet, they supply in the cheapest form, some of the essential nutrients in which other food materials are deficient (Devadas *et al,* 1964). Cereals constitute a source of energy for million of people in Asia and Africa. According statistics from food and agriculture organizations of the United Nations, the average annual global production of sorghum in 1979 was 68.7 million tons. Over 52 million hectres were planted each year with numerous varieties of sorghum and millet. The two crops are the most important and most common plants cultivated in the far northern part of Nigeria (the area which is characterized with low rainfall). Kano, a densely populated town with numerous industries and high number of automobiles, is located in this area.

The main staple food of the inhabitants of the town is: “tuwo” (prepared from sorghum grains), “koko” and “kunu” (all prepared from millet grain)

There has been an increasing concern regarding the accumulation of toxic heavy metals in our environments, which pose a threat to both public health and the natural ecosystem. The bioaccumulation of heavy metals presents a problem both from the standpoint of how the metals can be effectively removed from contaminated sites. Unlike many substances, metals are not biodegradable, and thus they accumulate in the environment.

Many studies have indicated that the accumulation of heavy metals in soil has adverse effect on the growth and development of a wide variety of plant species. Although low concentrations of some heavy metals, such as copper and zinc, are necessary for proper functioning of most plant ecosystems, higher concentration of copper and zinc have been found to be responsible for metabolic disturbances and growth inhibition of some plants (Fernandas and Henriques, 1991; Slivinskaya, 1991; and Satry and Chaudhary 1989). Other studies have demonstrated that the uptake of metals such as lead, nickel and cadmium can damage the integrity of cell membranes in certain plants (Vojtechova and Leblova, 1991). For example, excess concentrations of Pb, Cd, Cu and Zn significantly affected the plant water status of sunflowers causing water deficit and subsequent change in plant (Kastori *et al,* 1992). Although the uptake of heavy metal is antagonistic to a number of plant systems,

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Table 1. Heavy Metals Content Of Kano Soils (mg/kg), (Average of three measurements)

Soil Sample	Cadmium	Copper	Lead	Zinc
Plot 1	4.00	11.10	141.3	89.10
Plot 2	5.00	20.70	119.0	74.30
Plot 3	4.00	08.70	146.9	543.6
Plot 4	3.00	07.10	149.7	237.0
Plot 5	10.00	06.30	177.7	389.0

other studies have shown that some plants are able to absorb heavy metals, adapt to them, and thrive. The site that have the highest concentration of heavy metals are located near industrial sources such as smelters and steel refineries (motto *et al,* 1970; Nriagu and Paeyna, 1988; Kansanen and Venetvaara, 1991; and Wortington, 1989). Even in these locations, certain plant species have been able to adapt to heavy metal ions (Narwal et-al, 191). Because Sorghum and millet grown in Kano and its environs, area assumed to be contaminated with heavy metals due to large deposit of waste, automobile emissions and industrial development (Reaves and Berrow, 1984), do reach maturity and harvest very well, it become important to investigate the amount of heavy metals stored in the consumable parts of the crops.

In an effort to investigate the risks or otherwise of taking the consumable parts of sorghum and millet, grown in Kano town for food, we determine the amount of cadmium, copper, lead and zinc content of the crops'grains and leaves (consumed by domestic animals) and the soil on which they were grown. The objective of this study was to determine the amount of metal ions present in each consumable tissue of sorghum and millet, and also to access the level of contamination of the town soils.

METHODOLOGY

Soil sampling for this work was carried out by dividing the town and the environs into five (5) locations. In each of the locations, the plot where the crops were grown, was subdivided into twenty (20) sampling areas. Samples were collected from each of the areas and combined to form bulk sample of the plot moist soil, from which a representative sample was obtained. The above procedure was conducted between August and September 2001. The representative sample was air dried on polythene sheets in aluminium trays and sieved trough a 2mm mesh. Stone and other objects larger than 2mm were discarded. The plant sample was obtained through random sampling, cleaned with deionized water and air – dried. The leaves and the grains of the dried plant were separated, ground to powder and oven dried, together with the sieved soil sample, at 105^0C for 12 hours. The analysis was made by digesting the soil sample with $HNO_3 – HClO_4 – HF – HCl$ acids mixture and plant sample with HNO_3 – HclO4 –HCl acids mixture followed by atomic absorption spectrometry (AAS) measure-ments. Buck Model – 210 V GP was the AAS machine used.

Triplicate measurements were performed for each sample.

RESULTS AND DISCUSSION

The metal contents of the experimental plots were described in Table I. The soils in plot 1, 3 and 4 contain comparable amount of lead, copper and cadmiun. Plot 2, with the least amount of Zinc and lead, has the highest level of copper. A relatively very high amount of zinc was recorded in plot 3. The last plot (plot 5) has the highest levels of lead and cadmium while plot 4 has the least level of cadmium. Generally the level of zinc in the soils of the studied area was higher than the other heavy metals.

According to kabata-pendias (1995), the studied area is said to be contaminated with Pb and cadmium, because their levels have passed the maximum allowable limits. The level of copper in the soils was within the normal content interval (Kloke, 1980). In fact non of the elements determined in this work approach "dangerous concentrations" (Ewers, 199)

The results of the analysis in Table 2 and 3 point out generally that zinc accumulated more than any other metal in both tissues (leaves and grains) of the two crops. The level of lead in the crops' grains was almost eight times lower that that of the leaf. Other metals also showed lower levels in the grains compared to that of the leaf, but not as low as that of lead. Low uptake and low translocation of lead in shoot of the cereals was attributed to lack of specific carriers which in case of other metals may in significant way influence the percentage of the elements accumulation in their grains (Weber and Hrynczuk, 2000). Kabata – Pendias (1975) has also pointed out serious limitation in the accumulation of heavy metals in cereal grain with their low (non-toxic) concentrations in the soil solutions.

Table 2. Heavy Metals Levels Of the Cereals' Leaves (mg/kg)

		Cadmium	Copper	Lead	Zinc
Plot 1	s	0.77	0.29	0.99	1.04
	m	0.81	0.31	0.96	1.00
Plot 2	s	0.91	0.99	0.92	0.73
	m	0.84	0.91	0.14	0.66
Plot 3	s	0.49	0.32	0.93	2.99
	m	0.44	0.41	0.94	2.47
Plot 4	s	0.54	0.36	0.90	2.87
	m	0.66	0.29	0.94	2.92
Plot 5	s	0.61	0.28	0.97	3.01
	m	0.62	0.28	0.88	2.88

Table 3. Heavy Metals Levels Of the Cereals grains (mg/kg)

		Cadmium	Copper	Lead	Zinc
Plot 1	s	0.28	0.17	0.18	1.47
	m	0.22	0.13	0.12	0.40
Plot 2	s	0.36	0.41	0.11	0.32
	m	0.11	0.41	0.19	0.24
Plot 3	s	0.14	0.14	0.13	0.92
	m	0.20	0.13	0.13	0.89
Plot 4	s	0.20	0.13	0.17	0.97
	m	0.16	0.14	0.19	0.99
Plot 5	s	0.23	0.07	0.11	1.08
	m	0.17	0.12	0.12	1.04

S – Sorghum; M – millet

The percentage of the elements in the plants tissues, as in reflection to the total contents in soils where they were grown, was very low to pose any threat.

CONCLUSIONS

With reference to Dutch standard (1988) quoted by Ewers 1991, the studied soils were only contaminated with Pb and Cd and there is no case of pollution.

Very little amount of the metals were translocated to the shoot, and the metals accumulation was more in the leaf than in the grain of the two cereals.

The cereals consumable parts of the crops grown on the studied soils are therefore safe for consumption.

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