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ELEMENTAL ANALYSIS OF SOME CEREAL PLANTS GROWN IN NORTH EASTERN NIGERIA FOR POSSIBILITIES OF SECONDARY MINERALS PROSPECTING

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ABSTRACT

The elemental contents of the roots and tops of (tissue and leaf) of some plants have been determined by solution experiments with computer calculations of aqueous species. The ratio of roots/tops of Zn in Wheat is 150, Pb13.6, Cd, 30 and Ag, 0.7. The ratio for Zn in sorghum is 80, Pb, 2.1, Cd, 37 and Ag is 2.3. Zinc and Lead, for example are apparently largely immobilised by precipitation in root tissues of some of the cereal plants studied. These plants may then serve as geo-biochemical indicators of secondary minerals in this zone.

Introduction

Each species of plants has its own individual nutritive requirements that differ somewhat from those of every other species. Thus different species of plant all supported by identical solutions will contain widely varying concentration of many of the minor and major elements. Some workers [1 – 2] have proposed that plants require a certain small amount of every element in the periodic table, but perhaps in quantities so small that the need would be extremely difficult to demonstrate in greenhouse experiment. The root systems of plants act as powerful sampling mechanism, collecting aqueous solutions from a large volume of moist ground below the surface. These solutions then serve as a source of inorganic salts that may be deposited in the upper parts of the plant, or may stimulate, inhibit, or otherwise modify the growth habit of the plant. For whatever reasons the elements are needed by plants.

It has been established [2 – 3] that in addition to the common nutritive element (N, K, P, S, Ca and Mg) most plants require small quantities of many minor elements, including principally Cu, Zn, Fe, Mo, Mn and B. If the soil solutions do not contain adequate quantities of these elements, the plant will be unhealthy or may not survive. Cereals are members of the grass family of plant which include wheat, sorghum, millet and rice. The family is rich in carbohydrate, fat, vitamin and mineral elements, but they have low protein content. Cereals have also been reported [4 – 5] to form major source of raw materials in industries.

The aim of this work is to examine cereals group of plant in the Northern part of Nigeria for traces of ore metals as biogeochemical indicators.

Material and Method

Selected samples of wheat, sorghum (yellow), sorghum (white), soya beans, millet, local rice, Acha and maize, were collected from Gubio, a mineralised area of Borno state in North East of Nigeria.

All reagents used were analytical grades. The samples (20g) were digested using a mixture of HCl ($50cm^3$), $HClO_4$ ($50cm^3$) (v/v). This mixture was heated until the acid was evaporated from each sample. The ash were weighed to obtain about 5g of each of the sample.

The residue was heated for 30 minutes then diluted with 70% $HClO_4$ (v/v) according to the method outlined by AOAC [6]. The amounts of zinc, silver, lead and cadmium in these solutions were measured by AAS using a Varian AA – 275 spectrophotometer. The temperature of the reaction mixture was maintained at 25 ± 0.5^0C. The species distribution in the working solution was calculated using the computer programme according to Perrin and Sayce [7] with equilibrum constants taken from Smith and Martell [8] to calculate the total concentration of each species.

Results and Discussion

The concentration of Zn and Ag of the roots and tops of the vegetation are listed in Table 1, while the values in Table 2 are the amounts of Pb and Cd in the roots and tops of cereal from the North East of Nigeria. In all the samples Cd, Ag, Pb and Zn were largely present in the root cells, some of the species reach the upper

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parts of most plants to be readily detected (Tables 1 and 2). The pattern of distribution observed may be a more true reflection of the composition of the soil moisture than the patterns of some of the more readily accepted [9 – 10] nutrient elements.

It has been suggested [11] that plants of arid regions that grow during short rainy reasons tend to be more susceptible to toxicity than those in which rain is concentrated in the season before the growing season. The exclusion may operate at the soil-root interface, with the roots, or the roots, or at higher level in the plant.

Lead, for example is an element that is apparently immobilized by precipitation in the root tissues of some plants [12]. Thus, toxic excesses of Pb may not reach the active centres of growth in the upper parts of the plant. If the quantity of Pb in the soil solution is too much, the precipitated Pb mineral apparently impedes the flow of solution, and the plant does not grow normally. The ratio of root/Top for Zn was as high as 150 in Sorghum (Table 1) and 37 for Cd (Table 2) for the same plant while the ratio of Pb in sesamum (Acha) is low, 0.5. Warren et al [13] has earlier reported that, although, the amounts of Pb and Zn in plants in mineralised areas may vary through a wide range due to variations in local conditions, the ratio will remain fairly constant. This otherwise constant ratio would be modified by the presence of either Pb or Zn ore within the reach of the plant roots. They considered that a Pb/Zn ratio above 0.23 would indicate Pb ore in the bedrock and a ratio below 0.07 would indicate Zn ore.

Conclusion

In secondary mineral prospecting these cereals, in this study with high elemental ratios may serve as geobiochemical indications and important in that they point to areas where hydromorphic anomalies may have developed as a result of precipitation of ore element from shallow groundwater.

Table 1: The Zn and Pb Contents of Roots of cereal compared to Tops of the plants

		Zn		Ag	(ppm)	
Plant Species	*Tops	Roots	Root/Tops	Tops	Roots	Roots/Tops
Wheat	20	3000	150	180	266	1.44
Sorghum (Yellow)	50	4000	80	100	230	2.3
Sorghum (White)	90	1700	18.9	70	180	2.57
Soya beans	54	110	2.04	8	80	10
Millet	70	1600	22.85	11	80	7.27
Local Rice	70	100	1.43	10	90	9
Sesamum (Acha)	50	50	1.0	8	80	10
Maize	3000	2600	0.87	7	70	10

Table 2: The Pb and Cd Contents of Roots of cereal compared to Tops of Vegetation.

		Pb		Cd	(ppm)	
Plant Species	*Tops	Roots	Root/Tops	Tops	Roots	Roots/Tops
Wheat	1.3	18	13.85	30	1000	33.3
Sorghum (Yellow)	3	0.2	2.07	40	1500	37.5
Sorghum (White)	3	5	1.67	30	185	6.17
Soya beans	30	40	1.33	16	140	8.75
Millet	0.2	2	1	90	140	1.56
Local Rice	70	70	1	63	150	2.38
Sesamum (Acha)	40	20	0.5	40	50	1.25
Maize	-	-	-	33	100	3.03

* Tops = the plant tissue and leaves above ground level.

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