BIOLOGICAL MONITORING OF ATMOSPHERIC TRACE METAL DEPOSITION IN NORTH-EASTERN NIGERIA

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Abstract. The epiphytic moss *Polytrichum juniperinum* and the tree bark of *Azadirachta indica* were used to determine the atmospheric Cd, Cu, Pb, Mn, Fe, Ni and Zn levels in the North-East region of Nigeria. A good correlation exists between levels in the moss and the tree barks. The Pb, Zn and Fe levels in both sample types were higher than other metals in most sites. There was no significant difference in the levels of Cd, Cu, Ni and Mn recorded for inhabited and forest sites. The area derives its atmospheric metal contamination from vehicular, urban, industrial and agricultural sources.

1. Introduction

The use of plants in the study of atmospheric metal monitoring has been well documented (Ruhling and Tyler, 1968a). This is possible due to the characteristic accumulation methods: for instance, mosses are known to accumulate trace metals by ion-exchange and chelation (Thomas, 1979; Martin and Caughtrey, 1982; Gyselen et al., 1983; Ruhling and Tyler, 1984b) and because of their undeveloped root system they obtain their nutrients from rain and atmospheric particles. Similarly, tree barks have been well utilized in atmospheric heavy metal studies because they can effectively collect airborne particles due to their porous structure (Laaksovirta et al., 1976; Osibanjo and Ajayi, 1980). Many trace elements, such as Cd, Pb, Ni, Zn, etc. are mobilized in association with airborne particles derived from high temperature combustion sources like fossil fueled power plants, blast furnaces, metallurgical smelters, municipal incineration and vehicles (Lee and Dunffield, 1979).

The development of industry and urbanization in Nigeria in the last few years has resulted in the contamination of the environment by heavy metals. Most of the atmospheric trace metal pollution studies in Nigeria have been carried out in the southern rain forest zone (Oluwande, 1977; Osibanjo and Ajayi, 1980; Onianwa et al., 1986). In this study the epiphytic moss *Polytrichum juniperinum* and the tree bark of *Azadirachta indica* (Dogoyaro) were used in assessing the heavy metal burden in the North-Eastern region of Nigeria, which is a savannah land, in order to establish the atmospheric heavy metal status in the region.

2. Materials and Methods

2.1. SAMPLE COLLECTION AND PRESERVATION

Duplicates of samples were collected from fifty-six sites between July 1988 and October 1989 from the North-East region of Nigeria (Figure 1). The moss samples were removed from their supporting substrates with clean hands, whilst the tree bark samples were removed with a stainless steel knife. All samples were collected into polythene bags which had been previously cleaned with nitric acid (1 : 3). The samples were oven dried at 60°C for 24 h, after which they were ground in a porcelain mortar and stored in polythene bags ready for analysis.

2.2. ANALYTICAL PROCEDURES

A portion of each sample (5.0 g) was digested with 20 mL of freshly prepared 1 : 1 (v/v) nitric acid-hydrogen peroxide mixture (Kakulu et al., 1987). The digests were quantitatively transferred into 100 mL volumetric flasks and diluted to the mark with distilled water. Blanks were similarly prepared to determine the effect of the reagents’ purity on the metal levels, and these were found to have no significant effect on the metal levels. Standard stock solutions of metal (1000 μg/L) were prepared from either the metal or a soluble salt of the metal (Analytical-reagent grade) manufactured by BDH, England, and the working standards were prepared