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Effect of Rain on Lead Levels in Roadside Vegetation in Hong Kong

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Increasing attention has been drawn to lead contamination in roadside vegetations as a result of vehicular emission upon the combustion of leaded gasoline (PAGE et al. 1971, SMITH 1976). Such contamination takes the form of deposits of lead particles on plant surfaces (KOSLOW et al. 1977, SMITH 1977). As a surface contaminant, its distribution, deposition and accumulation are influenced by meteorological factors such as the direction of prevailing wind (SCHUCK & LOCKE 1970, PAGE et al. 1971) and precipitation (HEICHEL & HANKIN 1976). Due to the relative lack of information, this study was initiated to find the extent to which rain affects the level of lead in roadside plants.

PROCEDURES

Pokfulam Road with a daily mean traffic flow of 25,590 vehicles (TRAFFIC AND TRANSPORT SURVEY DIVISION 1978) was selected for this study. Two species of plants, namely Alocasia odora and Mikania guaco were investigated. Both plants grew within 3 m from the road curb. They were unshaded and hence were exposed to the direct impact of rain and splashing caused by vehicular traffic. Ten regular harvests of the aboveground parts of the plants were made between January 12 and April 5, 1979. All plant materials were taken from the same crop everytime. In the laboratory, the leaves from each sample were oven-dried at 90°C for 48 h before they were powdered by a stainless steel microhammer mill with a 1 mm aperture sieve. Accurately weighed subsamples of about 0.7 g from each sample were taken. Lead was extracted from each subsample by boiling in 15 ml of 4 M nitric acid for 30 min. The solution was then filtered and made to 25 ml with distilled water. The amount of lead in the filtrate was determined by the dithizone method (ALLEN 1974). Fluctuations in the plant lead levels were then correlated with the pattern of rainfall during the study period. Rainfall was monitored at the Pokfulam Reservoir weather station situated 2 km south of the study site.

RESULTS AND DISCUSSION

Figure 1 gives the variation in lead levels (ppm, dry weight basis) in the leaves of A. odora and M. guaco together with the rainfall data throughout the sampling

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period. No rainfall had been recorded for 16 days before the first sampling occasion (Jan 12). From the figure, it is apparent that the level of lead in the leaves of both plants dropped in the occurrence of short, light rain periods. And such a drop could be considerable as was examplified in the period between the 12th and 18th of January, during which a total of only 13 mm of rain was recorded but there was a corresponding drop in the leaf lead level in A. odora from 240 to 80 ppm. The accumulation of leaf lead level in between the rain period, however, was equally fast. For example, in M. guaco, the level of lead rose from 180 to 340 ppm in a short span of 6 days (Jan 18 to Jan 24) when there was no rain.

Despite frequent and sometimes heavy (some 120 mm in the first few days of April) rainfall towards the end of the experimental period the amount of lead in both plants remained in a steady albeit relatively low level (Figure 1). Apparently a portion of lead remained in the leaves and was resistant to washing by rain. This 'non-washable' portion probably corresponds to the portion of lead that could not be removed by washing with distilled water (e.g. MOTTO et al. 1970, SCHUCK & LOCKE 1970, PAGE et al. 1971, LITTLE & WIFFEN 1977) or by simulated rain (CARLSON et al. 1976). This 'non-washable' portion of lead was 19 ppm for A. odora as against 87 ppm for M. guaco. The higher level of the latter was probably due to the hairy surface of the leaves which hence could retain more lead (HEICHEL & HANKIN 1976, LITTLE & WIFFEN 1977). Alocasia odora has smooth and waxy leaves and lead deposits could easily be washed away. Indeed due to the difference in the topography of the leaf surfaces of the two species, M. guaco had consistently higher lead level than those in A. odora throughout the sampling period (figure 1).

Very little emphasis has been put on the effect of rain on lead levels in roadside vegetations. In this work, we have demonstrated that rain could bring about great and rapid fluctuations in the level of lead in these plants. Hence great care should be taken in comparing lead levels between samples. Any such differences might be due to rain effect rather than other more generally accredited factors such as differences in traffic volume between sites. This is especially so if one compares samples that were harvested at different times.

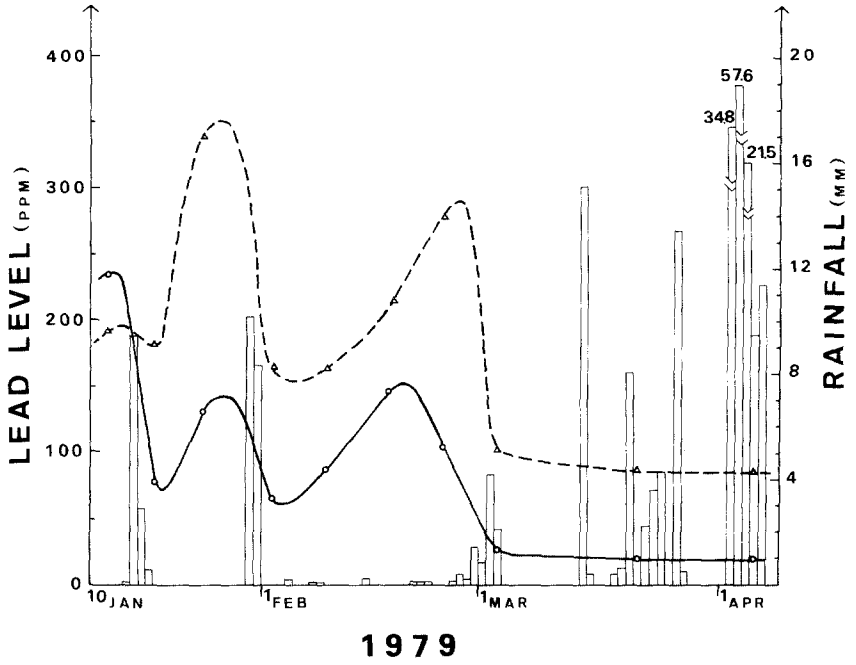

Figure 1 Variation in lead levels in the leaves of Alocasia odora (o——o) and Mikania guaco (Δ----Δ), together with the rainfall data during the sampling period.

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