

Behaviour of Lead in the Unsaturated Zone in tropical Climate (Urban and Agricultural Area in the State of São Paulo, Brazil)

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Abstract

This study was carried out in the region of Louveira (State of São Paulo) in terrains constituted of weathered schists. At the site where fruits are cultivated, the lead was analyzed by Atomic Absorption Method, in the solutions of pesticides and fertilizers; in the rainwaters; in the litter; in the soil and in waters of the unsaturated and saturated zone. At two sites wells were drilled and porous cups installed at various depths. At one site tensiometers and a rainwater collector were also installed. The results of monitorings during a year showed low concentrations of lead in the pesticides and fertilizers, i.e. cca 0.00015 mg/m²/a; in the litter 5.036 - 31.34 ppm and in the rainwater 16.324 mg/m² a. The concentration of lead in the soil was 25.406 - 131.55 ppm, increasing with depth and could be related with ferrous constituents of the soil, decreasing in the saturated zone. In waters of the unsaturated zone the concentrations were 0.001 - 0.209 mg/l and of the aquifer 0.01 - 0.059 mg/l.

Introduction

The study was carried out in Louveira (State of São Paulo), situated at a distance of 2,300 m from a highway of intense traffic, where fruits, such as grapes, are cultivated since decades. The grapevines are pulverized with solutions containing pesticides.

The lithology of the region is constituted of metamorphic rocks rich in quartz (BATISTA et al, 1986).

The climate of the region, in accordance with classification of Koeppen, is mesothermic, tropical of altitude (MONTEIRO, 1973). Rainfall is more intense from September till March, being 1,263 mm/a in the year of the study.

The aims of this study were to contribute to the understanding of the behaviour of lead in the unsaturated and saturated zone under influence of agricultural and urban activities.

Methodology

At two sites of different characteristics, one at a higher topography "G" in the culture of grapevines where pesticides are directly applied, and at an other lower, "S" where the culture of grapevines were substituted since a year by other plants, wells were drilled for sampling of waters of the aquifer. Porous cups were installed at 0.5 m intervals till the groundwater level for sampling of waters from the unsaturated zone.

At site "S" a rainwater collector and tensiometers at 0.1; 0.5; 1.0; 1.5 and 2.0 m were also installed.

At levels with different textural characteristics soil samples were collected for analyses of lead, clay, organic matter and iron. The litter spread at the "G" site was analyzed from May 1992 till January 1993.

During the period of February 1992 till January 1993 the pesticide solutions, rainwater and waters of the unsaturated and saturated zone were analyzed by the Atomic Absorption Method.

Results and Discussion

In the litter at "S" site the lead was found with concentrations between 5.036 - 31.310 ppm (*Table 1*).

The contents of clay decrease with depth at "G" and increase at "S" sites. At both profiles the organic

matter in the soil decreases with depth (Tables 2 and 3).

At both profiles the concentration of lead increases with depth, having the highest value at the superior part of the aquifer (groundwater levels 5.40 m at "G" and 2.35 m at "S"). The profile "G" shows a much higher content of lead than profile "S".

There was not observed existence of relations between values of lead and organic matter in the soil at both profiles.

The lead showed low values at superficial levels where the organic matter is the highest.

The values of clay are clearly related with lead only at profile "S", however, it is observed a strong relationship between lead and iron at both profiles.

Rainwater and water of the unsaturated and saturated zone

The quantities of lead in the applied pesticide solutions is insignificant, i.e. 0.00015 mg/m²/a. The contribution of lead is 16.324 mg/m²/a by the rain.

The contents of lead in waters of the unsaturated zone of the "S" profile decrease with depth (*Table 4*) indicating retention on the solid material. In the season of intense rainfall the concentration of lead in the waters of the unsaturated zone are higher.

At profile "G" waters of the unsaturated zone show a tendency of increase in the values of lead with depth (*Table 5*).

The concentration of lead in the groundwater shows relatively high values (*Table 6*), a little more than the limits permitted by EPA, i.e. 0.05 mg/l. These values were observed at the beginning of the period of more intense rains.

Conclusions

The concentration of lead in pesticides represent small contribution of this metal for the soil and for waters at both profiles.

The lead transported by the rainwater could be admitted as having its origin by diverse aerial emissions, considering the localization of the studied area.

The organic matter (lifter) spread on profile "G" does not interfere with the transference of lead to the soil, because there was a very little variation during the studied period.

As the iron is the component which has the best relationship with lead values, it could be considered as the principal responsible for the retention of lead in the solid phase (soil).

The circulation of infiltrated rainwater and water in the unsaturated zone can be accounted for the mobility of lead reaching the aquifer with a little higher concentrations than permitted by EPA.

References

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Curriculum Vitae

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