Case Study: Lead Contamination in Soil and Plants of a Metro Atlanta Home

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INTRODUCTION:

Lead contamination in housing developments of the Metro Atlanta Area has prompted the EPA to establish part of Westside Atlanta as a Superfund site for soil and plant remediation efforts. As a result, affected residents have to review their own health and wellness in a different perspective due to the possibility of having lead contamination. No quantity of lead is considered safe in the human body, especially since it is known to compete with the functionality of calcium in many vital biological processes. Manufacturing and disposal procedures in lead-based industries have contributed to lead contamination of soil and water. This especially occurs along railroads where historic operations involved the transport of industrial products containing heavy metals. These transportation routes are found to have elevated levels of heavy metals due to normal train operations, but in some cases the practice of dumping waste into a railroad's easement has created areas of significant lead contamination. It is possible for these past railroad easements to transition into residential areas, which is the case for one Metro Atlanta home north of the Westside Atlanta Superfund site. Testing of this residence found significant levels of lead contamination, especially where they grew their own produce. Due to the elevated concentration of lead, the EPA has reported to this resident that removal of the soil is recommended.

Lead naturally occurs in soil with an average geologic concentration of 10-30 ppm. If levels exceed the average geologic concentration, caution should be considered because it indicates that lead was added by exogenous sources. The lead soil screening level (SSL) of 400 ppm represents the conservative estimate by the EPA as a level of contamination considered a public health issue. The EPA recommends the removal of the lead contaminated soil if levels exceed the lead SSL.

OBJECTIVES:

The goal of this study is to observe the possible lead propagation from contaminated soil into surrounding plants. This study was conducted in collaboration with the Saikawa Lab of Emory University.

METHODS:

Soil and Plant Sample Collection Parameters:

1. The soil collected has to be within proximity to the root system of the plant and/or collected directly from the plant's roots.
2. Plants were chosen based on the ability to be fit within a one gallon zip lock bag and location.

Soil and Plant Sample Collection Process:

1. Plants were chosen relative to each testing site of the EPA for data comparison as shown in Figure 1. Preference went to testing sites used for gardening, narrowing down to Sites 1-10.
2. The plant was removed from the ground with the soil collected on/around its roots. The soil around the roots was separated into a one quart zip lock bag while the full plant, root to leaf, was placed in a separate one gallon zip lock bag. Each bag was labeled relative to its site and given a letter representing a sample group of plant with its respective soil as shown in Figures 4 and 5A.

Soil and Plant Sample Preparation:

1. Soil and plant samples were prepared for dehydration as follows:
   a. Each soil sample bag was mixed and distributed into three aluminum weigh boats.
   b. Each plant sample was trimmed down in size using shears and distributed into three aluminum weigh boats.
2. The aluminum weigh boats containing sample were weighed and placed onto dehydration trays as shown in Figure 6A and stacked onto the dehydrator apparatus shown in Figure 6B. Samples were dehydrated for 48 hours at 100°F. Each weigh boat was weighed before and after dehydration (Figure 5B, C).
3. After dehydration, soil and plant samples were ground down as shown in Figure 5D, E.
4. Soil and plant samples will be sent to an offsite facility for further analysis.

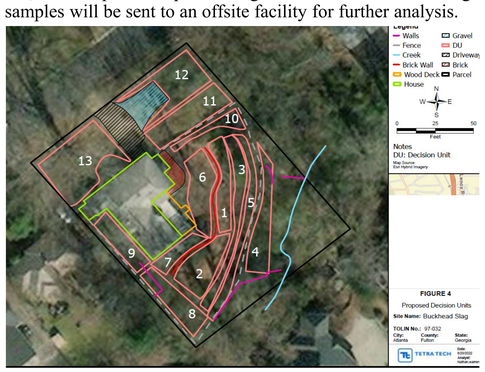

Figure 1: Aerial view of property with borders of testing sites demarcated originally by the EPA in their analysis on 08/29/2022. Test results relative to each site can be seen in Figure 7.

Figure 2: Sampling sight taken in 2020, obtained from the owner of the property. (A, C) Sites 1-3, (B,E) sites 1, 3, and 5; and (D) sites 2 and 8.

Figure 3: Photos of research site on day that samples were obtained with (A) sites 2 and 5 and (B) sites 3-5.

Figure 4: Soil and plant samples.

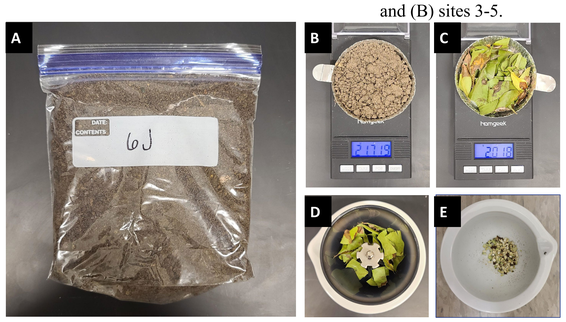

Figure 5. Materials used in the processing of soil and plant samples: (A) ziploc bags for soil and plant samples, labeled alphanumerically for site location and sample ID, aluminum weigh boat containing (B) soil or (C) plant material on a gram scale, (D) Ceramic grinder, and (E) mortar and pestle.

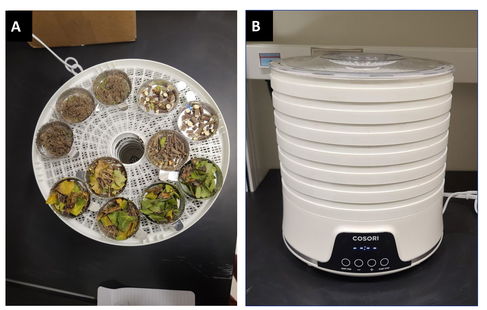

Figure 6. The dehydration process used to dry both soil and plant samples with the dehydrator trays (A) and dehydrator unit with trays stacked on top (B).

RESULTS:

Table 1.EPA Results: Average soil lead contamination for all sites.

Sample Statistic	Value
Mean	412 ppm
Standard Deviation	210 ppm
Relative Standard Deviation (RSD)	51%
95% UCL	766 ppm

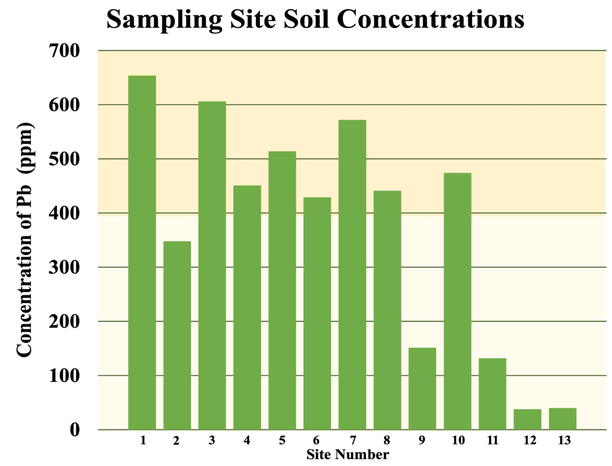

Figure 7. EPA Results: Soil lead contamination analysis relative to the site locations shown in Figure 1.

DISCUSSION

The results obtained in this study will be utilized to understand lead propagation into plants from lead contaminated soil. Sample processing is still under way. Soil analysis will be compared to preliminary lead contamination testing performed by the EPA (Table 1, Figure 7). The soil lead levels for sites 1-10, the areas where the resident planted produce, ranged from 348 to 654 ppm.

CONCLUSIONS:

1. Food scarcity relative to the COVID-19 pandemic and the following inflation on produce has led many to start home or community gardens. Increasing awareness on the risks of planting in areas without heavy metal evaluation is paramount for the future of those wishing to grow produce safely in their own backyard.
2. Analysis of samples collected by the EPA show a concentration of lead that is above the acceptable range of safety. This is significant due to propensity for hyperaccumulator plants to absorb heavy metals from the soil.
3. We are currently analyzing plant and soil samples from this collection site to quantify the propagation of lead.

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References