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Soil Lead: Testing, Interpretation, & Recommendations

Soil Lead Contamination

Lead is naturally present in all soils. It generally occurs in the range of 15 to 40 parts lead per million parts of soil (ppm), or 15 to 40 milligrams lead per kilogram of soil (mg/kg). Pollution can increase soil lead levels to several thousand ppm. The major cause of soil lead contamination in populated areas is the weathering, chipping, scraping, sanding, and sand-blasting of structures bearing lead-based paint.

In the past, significant causes of soil contamination by lead included the use of tetraethyl lead as an anti-knock ingredient in gasoline and lead arsenate as an insecticide in fruit orchards. Automotive lead emissions have effectively ceased with the phasing out of leaded fuels. With the development of more effective pesticides and Integrated Pest Management (IPM), lead arsenate is no longer in use. Unfortunately, lead persists in soil for many hundreds of years, and past use of these products continues to present problems in some areas.

Due to the nature of the contamination process, lead in soil may be very unevenly distributed. The lead in paint removed from a structure will generally be concentrated near the source, but levels may vary greatly over small distances (e.g., one foot). Lead arsenate residues in old orchards closely reflect the locations of sprayed trees. Consider these facts carefully when sampling. If the purpose of testing is to establish the extent of play area contamination, combine several small, randomly spaced samples from the top 1- to 2-inches to create one sample for testing. If the concern is for lead uptake by garden vegetables, combine several vertical slices from the top 6- to 8-inches of soil to create a sample.

Soil lead becomes a health risk when directly ingested or inhaled as dust. Garden produce, which has accumulated lead in its tissue or has soil particles adhering to it, can also be a hazard if eaten. Lead poisoning is a particular concern for young children (under the age of six) because their rapidly developing bodies are very sensitive to the effects of lead, and their play habits tend to increase exposure.

Soil Lead Levels, Methods of Measurement, and Results

The method used for lead screening included in the **Routine Soil Analysis** is the same one used for routine measurement of plant nutrients. This lead screening is meant only to identify areas where lead contamination may be a concern. The Modified Morgan extracting solution (dilute glacial acetic acid and ammonium hydroxide) removes the reactive or "plant available" portion of the total soil lead present in New England soils. A safe soil lead threshold level of **22 ppm Modified Morgan extractable** has been determined using data collected at the UMass Soil Lab.

It is recommended that soils with elevated levels of extractable lead (>22 ppm) be tested for Total Sorbed Lead. The UMass Soil Lab offers a Total Sorbed Metals test that measures total lead and other heavy metals using an alternate EPA 3050B and EPA 6010 methods. Results given correspond to threshold levels set by the US EPA. Order forms for the Total Sorbed Metals test and other analyses may be found on our website (http://soiltest.umass.edu/ordering-information).

The **Total Sorbed Metals Test** reports environmentally available levels of lead, nickel, copper, chromium, cadmium, and zinc, and uses strong acids and heat to digest and dissolve almost all elements in the sample. Elements that are bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

The EPA has set a safe soil lead threshold limit of 400 ppm total lead using this method. To reduce your risk of lead poisoning, the following is advised:

Good Gardening Practices to Reduce Lead Exposure

1. Locate gardens away from old painted structures and heavily travelled roads.
2. Give planting preferences to fruiting crops (tomatoes, squash, peas, sunflowers, corn, etc.).
3. Incorporate organic materials such as high quality compost, humus, and peat moss.
4. Lime soil as recommended by soil test (a soil pH of 6.5 to 7.0 will minimize lead availability).
5. Wash hands immediately after gardening and prior to eating
6. Discard outer leaves before eating leafy vegetables. Peel root crops. Wash all produce thoroughly.
7. Protect garden from airborne particulates using a fence or hedge. Fine dust has the highest lead concentration.
8. Keep dust in the garden to a minimum by maintaining a well-mulched, vegetated, and/or moist soil surface.

Recommendations (using results from the Totals Sorbed Metals Test)

Low – Less than 400 ppm

- Follow the good gardening practices listed above.

Medium – 400 to 999 ppm

- Follow the good gardening practices listed above.
- Restrict access of children to these soils by maintaining dense cover.
- Do not grow leafy green vegetables or root crops in this soil; instead, grow them in raised beds built with non-contaminated soil and organic amendments.

High – 1,000 to 2000 ppm

- Follow the good gardening practices listed above.
- Do not grow food crops in this soil and do not allow children access to it.
- Keep soil covered and take steps described above to reduce lead availability.
- Grow food crops in containers filled with growing media or clean topsoil; or create lined, raised beds filled with non-contaminated soil and organic amendments.

Very High – Greater than 2,000 ppm

- Contact your local Health Department, Cooperative Extension, or the Department of Environmental Protection office for advice on lead abatement measures.

Additional Resources

- *Lead in Residential Soils: Sources, Testing, and Reducing Exposure*. 1999. Penn State University Cooperative Extension. http://extension.psu.edu/plants/crops/esi/lead-in-soil
- *Lead Safe Yards: Developing and Implementing a Monitoring, Assessment, and Outreach Program for your Community*. 2001. U.S. EPA Office of Research and Development. EPA/625/R-00/012. https://soiltest.umass.edu/sites/soiltest.umass.edu/files/EPA%20Lead-Safe%20Yards.pdf
- *Lead Contaminated Soil: Minimizing Health Risks*. 2010. Rutgers University Cooperative Extension. FS336. http://www.njaes.rutgers.edu/pubs/download-free.asp?strPubID=FS336
- *Lead in Garden Soils*. University of Connecticut Soil and Nutrient Analysis Lab, Cooperative Extension. http://www.soiltest.uconn.edu/factsheets/LeadGardenSoils.pdf

This factsheet is a revision of a previous UMass Soil and Plant Nutrient Testing Laboratory document. Ref. No. SPTTL_5
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