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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 measurement of plant nutrients. This lead screening is meant only to identify areas where lead levels may be elevated. The Modified Morgan extracting solution is a mild acid which removes the reactive or "plant available" portion of the total soil lead present in soils. Unpublished UMass research indicates that in many New England soils, 22 ppm lead determined with this Modified Morgan method is approximately equivalent to **300 ppm total lead** using the more accurate Total Sorbed Metals test described below. Many variables, including soil pH and organic matter content, affect this correlation, and it is not a reliable predictor of actual lead content.

It is recommended that all soils that may be managed in a way that creates an exposure pathway for humans, and especially children, be tested for Total Sorbed Lead. This includes areas used for food production/gardening and play areas where children may be in direct contact with bare soil. 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 US EPA has set a safe soil lead threshold limit of **400 ppm total lead** using this method. The US EPA also recommends that soils used for gardening fall below **100 ppm total lead**. In Massachusetts, the regulatory safety threshold is **200 ppm total lead**. Requirements and recommendations vary by state, and consumers should seek current and local information as appropriate. 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)

Potential Risk – 100 - 400 ppm

- Follow the good gardening practices listed above. (Additional risk between 100ppm and 400ppm is based on the potential for ingestion of soil in the process of consuming produce grown in the garden.)

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*. Revised 2008. U.S. EPA Office of Research and Development. EPA/625/R-00/012. https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NRMRL&dirEntryId=64153.

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