INTERPRETING THE RESULTS OF TOTAL SORBED METALS TESTING

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Agricultural soils normally contain low background levels of heavy metals. Contamination from industrial activities or byproducts can increase the natural levels of heavy metals in soil, creating a health hazard to people, livestock and plants. Fertilizers and other soil amendments also add small amounts of heavy metals to the soil, which can build up over time with repeated applications.

The actual toxicity of a heavy metal will be affected by soil texture, organic matter, and pH. The health effects of exposure to heavy metals depend on the amount and duration of exposure, i.e. the volume of contaminated soil or food consumed over time.

It is not clear exactly what levels of heavy metals in soil are safe or unsafe, so the following information is provided only to help you understand your test results and the relative level of risk they represent. In soils with elevated heavy metal levels, which may pose higher levels of risk, you should consider whether remedial actions are appropriate, or whether crops should be grown at all.

The US Environmental Protection Agency (EPA) and NY Department of Environmental Conservation (NYS DEC) have guidelines for determining the safety of various land uses based on total soil metal concentrations. Table 1 shows these limits, which are used to guide clean-up efforts. EPA levels are used to guide clean-up efforts of contaminated sites; NYS DEC levels are based on removing human health risks (unrestricted use includes agriculture): Maine Remedial Action Guidelines (RAGs) for Soil Exposure Pathway are used to determine whether a site poses risk to public health and therefore whether remedial action is needed.

Table 1. Levels of heavy metals in soil used to guide cleanup and land use decisions (mg/kg).

Element	US EPA	NYS DEC Soil Clean-Up Objectives		Maine RAGS	Maine RAGS
	Soil level requiring clean-up	Unrestricted Use	Residential Use	Residential Use	Undeveloped background levels
Arsenic	60	13	16	9.3	16
Copper	--	50	270	4300	23
Cadmium	70	2.5	2.5	98	0.26
Chromium*	230	1/30	22/36	4.2/10000	--
Nickel	1600	30	140	2100	39
Lead	400	63	400	140	32
Zinc	23600	109	2200	32000	100

* hexavalent/ trivalent

Table 2. Additional data regarding naturally occurring metal levels in Maine Soils		
Metal	**Maine Natural Background Soil Levels**	**Natural Background Maximum**
Arsenic	7.40	73
Cadmium	0.37	1
Copper	23.3	237
Chromium (total)	30.0	140
Lead	17.0	75
Mercury	0.003	0.40
Nickel	18	72
Zinc	68.5	153

From: Maine DEP-Guidance for Municipalities – Regulation of Septage and Sludge -Land Application by Municipalities. 9/12/02

Lead is a Special Case

There has been a lot of attention paid to lead levels in soil because it is well-known to cause adverse health effects, and is relatively widespread as a result of its historical use in many commercial products, from gasoline to paint. Table 3 shows the guidelines for garden soil use based on total lead content that have been developed by the states of New Jersey, Pennsylvania and Maine.

Table 3. Soil Lead contamination levels and recommended actions.				
Contamination Level	**Total Lead in soil , mg/kg**			**Recommended Action**
	PA	**NJ**	**ME**	
None/Low	< 150	< 100	< 50	None Needed
Low/Elevated	150-400	100-300	50-300	Conduct best management practices (BMPs) to minimize lead exposure from vegetable gardens: apply phosphate fertilizer, maintain high pH for fruiting vegetables, keep soil mulched to minimize dust and lead inhalation.
Moderate/Significant	300-1000	300-400	300-500	Conduct BMPs; do not grow leafy vegetables.
High/Cleanup	>1000	> 400	> 500	Do not grow vegetable garden.

Best Management Practices for Soils with Elevated Levels of Heavy

Although heavy metals remain in soil for a very long time, there are some steps that can be taken to reduce the level of risk they pose. In some cases, heavy metal concentrations can be 'diluted' with deep tillage; for example, to distribute contaminated surface sediment that was deposited by flooding. In garden plots, dilution can be achieved by the addition of uncontaminated soil. Adding organic matter to the soil can help 'tie up' heavy metals chemically, reducing their availability for potential plant uptake. Similarly, liming to a neutral pH and maintaining optimal soil phosphorus levels can reduce heavy metal availability to plants. For some heavy metals, such as lead, there is little evidence that it is accumulated within crops; the main health hazard is through soil ingestion and inhalation. Soils high in heavy metals pose a greater health risk to children than to adults because children are still growing, and they are more likely to ingest soil directly.

To reduce health risks in soils with elevated heavy metal content, food crops should be thoroughly washed to remove as much soil as possible. Outer leaves of leafy greens should be removed and root crops should be peeled to further reduce risk.

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