Understanding Your Test Results: Metals in Garden Soils and Vegetables

Healthy Soils, Healthy Communities

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Please note: The following excerpts are taken from project reports sent to gardeners from gardens sampled through the *Healthy Soils, Healthy Soils Communities* project, and are shared here for general use. Please visit *http://cwmi.css.cornell.edu/healthysoils.htm* for more information or contact Hannah Shayler, Extension Associate at Cornell University, by phone at 607-245-2377 or by email at has34@cornell.edu.

Project Information

Urban community gardens bring many benefits to gardeners and their communities, including nutritious and affordable food. However, urban soils can contain chemicals from years of human activity. In 2009, GreenThumb began a partnership with Cornell University, Cornell University Cooperative Extension-NYC (CUCE-NYC), and the New York State Department of Health (NYSDOH) to test some garden soils and help provide information about chemicals in urban community gardens.

Vegetables from New York City community gardens were also tested in the 2011 and 2012 growing seasons. The vegetables were washed and prepared as they would be for eating, and the soil and vegetable samples were tested for **lead, cadmium** and **barium** by a New-York-State certified laboratory. **Lead, barium** and **cadmium** are metals that can be found at elevated levels in urban soils. Levels of metals in soil can be influenced by many factors such as past land use and traffic patterns, use of lead paint or treated wood, or the presence of construction debris or other materials in soil.

Lead occurs naturally in the environment, but it often occurs at higher levels in soils affected by human activity. Exposure to lead can be associated with health effects (see **Resources** section at the end of this letter for more information). Gardening may increase your contact with lead if you swallow soil particles, track soil into your home, or eat vegetables grown in the soil. Lead in soil can pose a health concern, especially for young children. Lead can harm a young child's growth, behavior, and ability to learn. Lead in soil can pose some risks even if test results are below guidance values.

Finding **barium** and **cadmium** in soil near or above guidance values is not uncommon. High levels of exposure to these metals can be associated with health risks. The higher the level is above the guidance value, the greater the concern. Health risks associated with barium and cadmium in soils at levels slightly or moderately above the guidance value cannot be ruled out, but are likely to be low. If you would like more information about barium and cadmium, see the Agency for Toxic Substances and Disease Registry's Frequently Asked Questions fact sheets ("ToxFAQs") for these metals, available at: http://www.atsdr.cdc.gov/tfacts24.pdf (barium) and http://www.atsdr.cdc.gov/tfacts5.pdf (cadmium).

Did you know…?

- New York State requires health care providers to test all children for lead in their blood when they are one and two years old.
- Parents can also ask their child's doctor or nurse if their child should get a blood lead test, and what the lead test results mean.
- You can find more information about lead and how to prevent lead poisoning by visiting the New York State Department of Health's web site at *http://www.health.ny.gov/environmental/lead/*

Notes on Recommendations for Garden Soils and Vegetables

- When reading the following **Recommendations** pages, keep in mind that there are no health-based standards specifically for chemicals in community garden soils.

Our project compared levels of lead, cadmium, and barium in garden soil to typical "background" levels found in rural soils. We also compared soil results to guidance values based on soil cleanup objectives that New York State uses for contaminated sites. These background levels and guidance values are not fixed limits above which there is a concern. Rather, they help identify levels that may call for additional steps to reduce potential exposures.

- There are also no health-based standards in the U.S. specifically for lead or other metals in vegetables.

Our project compared the levels of metals in garden vegetables to health-based guidance values when possible. Because there are no U.S. standards for metals in vegetables, we considered standards for fruits and vegetables from the European Union (EU). The EU sets these standards to account for risk and ensure protection of health, and we can use them as guidelines to give us a frame of reference to help identify levels that may call for additional steps to reduce potential exposures.

We compared the metals results for vegetables to guidance values based on EU standards for

- **Cadmium** in vegetables and herbs, and
- **Lead** in vegetables.

There are no EU standards for **lead** that apply specifically to herbs (such as mint, sage, tarragon, or chives). There are also no standards for **barium** in vegetables or other foods that we could use as guidance values.

We also compared the vegetable results to estimates of typical levels of metals found in store-bought vegetables. We compared **lead** and **cadmium** results to levels measured in store-bought vegetables from across the U.S. in a U.S. Food and Drug Administration (US FDA) study between 1991 and 2008, and to other similar studies. The US FDA study did not measure levels of barium.

Levels of metals in vegetables and soil are often described in units of "parts per million" or "ppm." A level of 1 ppm means that for every million "parts" of soil by dry weight, there is 1 part of the chemical being measured. For the vegetable samples, a level of 1 ppm means that for every million "parts" of a fresh vegetable by weight, there is 1 part of the chemical being measured.

Levels in vegetables are measured as "fresh weight," meaning that the concentration is for fresh, rather than dried, vegetables, as they are sometimes reported.

Recommendations: Garden Vegetables

We recommend that **all gardeners follow healthy gardening practices** that can help reduce your exposure to chemicals from garden soils, even if the vegetable results from your garden are below guidance values for metals. In particular, remember to **wash your garden vegetables thoroughly** before eating them. This is especially important for root crops (like carrots or beets), which grow directly in the soil, and for leafy greens and herbs, which are especially likely to be contaminated by soil and dust. Thorough washing can also help to remove bacteria and other contaminants from garden vegetables. You may also consider **peeling vegetables** like carrots and beets or **throwing away the outer leaves** of crops like head lettuce and cabbage.

We recommend these practices to all gardeners because our results showed that levels of metals in vegetables cannot necessarily be predicted from levels of those chemicals in soil. It is also important to note that levels of chemicals in vegetables can change significantly with time, much more quickly than levels in soil. Chemical levels in plants are affected by many factors, including weather, growth rate, and plant maturity. This means that levels of chemicals measured in a vegetable at one point in time may not represent the levels that would be in the same vegetable at another time during the growing season.

EU standards (in washed, fresh crops)

Cadmium: 0.2 ppm for leafy vegetables and fresh herbs, 0.1 ppm for stem and root vegetables, and 0.05 for all other vegetables.

Lead: 0.3 parts ppm for leafy vegetables, mushrooms and brassicas (e.g., kale, broccoli, cauliflower, cabbage, collards, Brussels sprouts, etc.); 0.1 ppm for other vegetables (excluding herbs).

Recommendations: Garden Soils

1. If your soil results were below guidance values for lead (400 ppm), cadmium (2.5 ppm), and barium (350 ppm)[1]:

The soil testing results from your garden do not call for any specific steps to reduce your exposure to these chemicals in your soil. **This is good news!**

However, it is important to remember that we tested only for certain chemicals, and only in a small number of locations. So, **it is always a good idea to follow healthy gardening practices**, like the ones described in the enclosed sheet ("*What Gardeners Can Do: General Best Practices for Healthy Gardening*").

2. If some or all of the soil results from your garden bed exceeded guidance values for metals:

It is not unusual for metals levels in soil from an urban garden to be higher than guidance values. In most cases there is no immediate health concern, but there may be some increased risk if you have a lot of exposure to certain contaminants over a long time. It is particularly important to minimize exposure to **lead** in soil, especially for young children.

We recommend following the specific healthy gardening practices in the box below in your garden bed. These steps are good practices that reduce contact with metals and other chemicals in soil in your garden beds.

- **Use raised beds** filled with clean soil and compost. Incorporate additional compost or other organic material often.
- **Avoid use of railroad ties, telephone poles, pressure-treated wood and previously painted wood** to build your beds because they contain chemicals that can migrate into soil.
- Maintain a **good soil nutrient balance** and a **pH near neutral.**
- **Cover (or mulch) soil in beds** using materials such as compost, straw or bark mulch to reduce dust and soil splash onto vegetables.
- **Thoroughly wash and/or peel garden produce**. This is especially important for leafy and root vegetables, which are more likely to have soil particles on their surfaces.
- **Watch children** while they are in the garden, and remind them often to avoid touching their mouths after digging in the soil.
- Always **wash your hands** after gardening, and have children who play or work in the garden wash their hands. Also, consider wearing gloves while gardening, and remove the gloves when leaving the garden.
- **Avoid bringing garden soil into your home** by removing soil from your garden tools and harvested vegetables while at the garden and changing your shoes before going indoors.

[1] "Residential SCOs" from New York State Department of Environmental Conservation (NYSDEC) Residential Soil Cleanup Objectives

And remember, it is always good to follow healthy gardening practices! See the enclosed sheet titled "*What Gardeners Can Do: General Best Practices for Healthy Gardening*" for more information.

We recommend these steps because they are generally good practices that reduce exposure to chemicals in soil in both growing areas and non-growing areas of your garden. Some of the resources listed below have more information about chemicals in soil and about other actions you can take that may help reduce your exposure to them.

In addition to thoroughly washing and/or peeling vegetables, another way to help limit your exposure to chemicals from garden soil is to **select vegetable crops** that are less likely to have contaminants on or in their edible parts. If **metals** are a concern in your garden soil, you could consider growing only fruits or vegetable fruits, such as tomatoes, peppers, eggplants, squash, green beans, and peas. Some studies have shown that fruits and vegetable fruits are less likely than other vegetables to have metals on or in their edible parts.

Remember that there are many health benefits to eating fresh fruits and vegetables from your garden!

Resources

- Agency for Toxic Substances and Disease Registry ToxFAQs™ - Information about contaminants: *http://www.atsdr.cdc.gov/phs/phs.asp?id=120&tid=25*
- Cornell Waste Management Institute fact sheets and other *Resources for Healthy Soils*: *http://cwmi.css.cornell.edu/soilquality.htm*
- NYSDOH brochure on Healthy Gardening: *http://www.health.ny.gov/publications/1301/index.htm*
- NYSDOH Environmental Laboratory Approval Program (ELAP) list of certified laboratories: *http://www.wadsworth.org/labcert/elap/elap.html*
- NYSDOH Lead Poisoning Prevention website*:* *http://www.health.ny.gov/environmental/lead*
- U. S. Environmental Protection Agency information about Brownfields and Urban Agriculture: *http://www.epa.gov/brownfields/urbanag/*
- Agro-One Services - Testing for soil pH and fertility: *http://www.dairyone.com/AgroOne/Form_H_Lawn_Garden_Landscape*

What Gardeners Can Do: Best Practices for Healthy Gardening

Healthy Soils, Healthy Communities

General Best Practices for Healthy Gardening

- **Add clean soil and compost**. Consider having these materials tested by a NYS-certified laboratory. **Use raised beds if appropriate for your garden.** Incorporate new compost or other organic material often.
- **Avoid use of railroad ties, telephone poles, pressure-treated wood and previously painted wood** to build your beds because they contain chemicals that can migrate into soil.
- Maintain a **good soil nutrient balance** and a **pH near neutral.**
- **Cover (or mulch) soil in beds and in non-growing areas** such as pathways to reduce children's exposure to soil, and to reduce soil splash, dust and tracking of soil home. Different materials can be used such as stones or wood chips for paths, and compost or dried leaves for beds.
- **Create a barrier to separate underlying soil from children's play area surfaces**. Consider laying down landscape fabric (or other durable material) and put clean play materials such as sand or wood chips on top. **Check the barrier** over time to be sure underlying soil isn't mixing with play materials.
- Always **wash your hands** after gardening, and have children who play or work in the garden wash their hands. Consider also wearing gloves while gardening.
- **Avoid bringing soil into your home** after gardening by removing soil from your garden tools and harvested vegetables while at the garden and changing your shoes before going indoors.
- **Thoroughly wash** and/or **peel garden produce**. This is especially important for leafy and root vegetables, which are more likely to have soil particles on their surfaces.

Consejos generales para practicar la jardinería de manera saludable. Lo que los jardineros podemos hacer…

- **Agregar suelo y composta limpios**. Si es posible, haga analizar estos materiales por un laboratorio certificado por el estado de Nueva York. Si cultiva verduras en su jardín, trate de hacerlo en camas (arriates/canteros) y agrégueles frecuentemente composta o materia orgánica.
- **No usar durmientes de tren, postes de teléfono, madera tratada o madera que haya sido pintada** para construir las camas porque la madera puede contener sustancias químicas que pueden pasar al suelo.
- Mantener los **nutrientes del suelo bien balanceados** y un **pH cercano al neutro**.
- **Cubrir con astillas de madera "mulch"**, tanto las camas como los andadores y otras áreas donde no se cultivan verduras para disminuir el contacto de los niños con el suelo, reducir las salpicaduras y la cantidad de polvo que se lleva a la casa. También puede usar materiales como grava y piedrecillas para cubrir los andadores y composta u hojas secas para las camas.
- **Colocar una barrera para separar el suelo por debajo de las áreas de juego de los niños.** Puede cubrir el suelo con tela de las que se usan en jardinería (u otro material durable) y colocar encima arena o pedacería de madera limpios. **Revise de vez en cuando la barrera** para asegurarse de que el suelo por debajo no se ha mezclado con los materiales de juego.
- **Lavarse las manos siempre después de trabajar en el jardín** y procurar que los niños que juegan o trabajan en el jardín hagan lo mismo. Considere usar guantes mientras trabaja en el jardín.
- **Evite llevar suelo del jardín a su casa** sacudiendo las herramientas y raíces cosechadas mientras está en el jardín y cambiándose los zapatos antes de entrar a la casa.
- **Lavar muy bien y/o pelar las verduras del jardín**. Esto es especialmente importante en el caso de vegetales con hojas anchas o aquellos que crecen enterrados, de los cuales es más difícil eliminar las partículas de tierra.