

## Soil Test Results for the Ithaca Community Garden, June 2018 Sampling

October 2018

In June 2018 Cornell University sampled soils from the Ithaca Community Garden through a collaboration with the City of Ithaca and Project Growing Hope. 38 samples were collected and tested for levels of metals and polycyclic aromatic hydrocarbons (“PAHs”).

To briefly summarize our findings:

- Levels of metals (lead, arsenic, cadmium, and mercury) in garden plots, walkways, and compost samples are all well below health-based guidance values. This is great news!
- As is typical of urban areas, some PAH results exceed guidance values. These results are not unusual for an urban garden and there is no immediate health concern, but there may be some increased risk if you have a lot of exposure to these contaminants over a long time.
- Overall, we recommend that gardeners continue to use healthy gardening practices (see below) and enjoy the many benefits of gardening!

More information follows below and in associated documents, including the resource “What Gardeners Can Do: 10 Best Practices for Healthy Gardening”. Please contact Dr. Jonathan Russell-Anelli ([jmr5@cornell.edu](mailto:jmr5@cornell.edu)) or Hannah Shayler ([has34@cornell.edu](mailto:has34@cornell.edu)) with any questions.

You may also find more information on our *Healthy Soils, Healthy Communities* Project website at <http://blogs.cornell.edu/healthysoils/>.

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### **Project Information**

Cornell has been working with Ithaca Community Garden Board Members and the City of Ithaca to address some questions about the garden soil. The 2018 sampling builds upon a Cornell study from 2008-2009 (see <http://ithacacommunitygardens.org/gardening-resources/soil-testing>) to provide updated information about levels of lead and other metals, while also adding new information about PAHs (short for polycyclic aromatic hydrocarbons – a combustion by-product that is very common in urban soils). Overall, this sampling effort helps us understand more about the soil quality at the Ithaca Community Garden, and how healthy gardening practices can help make the soil even better for gardeners and their families.

We tested 38 soil samples for levels of lead, arsenic, cadmium, and mercury. These metals occur naturally in the environment, but may occur at higher levels in soils affected by human activity. High levels of exposure to some metals can be associated with health effects, and gardening may increase your contact with these metals if you swallow soil particles or eat vegetables grown in the soil. For this study, we wanted to follow-up on previous testing to confirm that levels of metals were below health-based guidance values.

PAHs are chemicals formed by the incomplete burning of organic materials such as wood, oil, gasoline, coal, garbage, etc. In the environment, PAHs are found in road dust, vehicle exhaust, tire wear particles, pavement, asphalt shingles, cinders, ash and smoke. Many of these may be sources of PAHs to soil. Gardening may increase your contact with PAHs if you swallow soil particles or eat vegetables grown in soil containing high levels of these chemicals. However, people are generally most exposed to PAHs by inhaling smoke from tobacco or eating grilled or smoked meats and other foods. High levels of exposure to some PAHs can be associated with adverse health effects.

### **Testing Your Garden**

Researchers and Extension staff from Cornell University (Jonathan Russell-Anelli and Hannah Shayler) visited the garden in June 2018 to collect 36 soil samples and 2 compost samples. Of the 36 soil samples, 27 were from growing areas and 9 were from pathways. We used a soil corer to collect a small amount of soil from randomly selected areas, and were careful to avoid any existing plantings. We then sent the samples to TestAmerica Laboratories to test for metals (lead, arsenic, cadmium, and mercury) and 19 different PAHs.

### **Results from Your Garden**

There are no health-based standards specifically for chemicals found in community garden soils. We compared the test results for your garden to typical “background” levels of metals and PAHs in rural and urban soils, and to guidance values that New York State uses for evaluating contaminated soils (New York State Department of Environmental Conservation Residential Soil Cleanup Objectives – “Residential SCOs”). 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.

**Metals:** All of the test results for areas of the Ithaca Community Garden that we sampled for lead, arsenic, cadmium, and mercury are below guidance values based on protection of health or typical background levels. This is great news! Because the results from areas we sampled in your garden are below guidance values, gardeners don’t need to take any specific precautions to reduce their exposure to metals based on these results. Remember, it is always good to follow healthy gardening practices (see the enclosed sheet entitled “What Gardeners Can Do: 10 Best Practices for Healthy Gardening”).

**PAHs:** Most of the PAHs we tested in your garden are below guidance values based on protection of health or typical background levels - and that is good. But 6 out of 19 PAHs were higher than guidance values in some locations, and about half of the samples collected had at least 1 PAH result higher than guidance values. These results are not unusual for an urban garden and there is no immediate health concern, but there may be some increased risk if you have a lot of exposure to these contaminants over a long time.

Please see the attached table for a summary of results and comparison to guidance values and typical rural soil background levels. Also included is a map showing sampling locations in your garden where PAH samples were higher than Residential SCOs.

### **Your Results Compared to Results from Other Studies**

As described above, levels of lead, arsenic, cadmium, and mercury are all well below Residential SCOs, and most results are within the range for rural background levels.

Levels of soil PAHs measured in cities, and even in rural areas, can be higher than guidance values. Soil PAH levels can be influenced by past land use and how much fuel or other materials were burned nearby. So the levels in your garden are not unexpected. For example, a study of 27 soil samples collected in Manhattan, NYC from ornamental gardens, cemetery lawns, grass-covered vacant lots, and grass-covered courtyards found that the levels of one PAH (benzo[a]pyrene) ranged from 0.07 to 2.0 ppm<sup>1</sup> (“ppm” = “parts per million”; see note in Table 1) with seven samples<sup>2</sup> above a guidance value of 1 ppm. In another study of urban soils collected in Western New York, benzo[a]pyrene levels exceeded the guidance value of 1 ppm in 19 out of 24 samples<sup>3</sup>. For comparison purposes, in the Ithaca Community Garden 8 locations (6 garden beds and 2 pathways) had benzo[a]pyrene levels at or exceeding the guidance value of 1 ppm (with values ranging from 1-3.8 ppm). For all of the PAH results that exceeded Residential SCOs, the maximum measured level was within the range found in a *Healthy Soils, Healthy Communities* Project study of NYC community gardens<sup>4</sup>.

### **Recommendations**

Because PAH test results for some areas of the Ithaca Community Garden exceeded guideline values, we encourage gardeners to follow the recommendations listed below as you continue to garden. We also recommend that gardeners consider following all of the best practices on the enclosed “*What Gardeners Can Do*” sheet (also available at <http://blogs.cornell.edu/healthysoils/>). These healthy gardening practices help reduce exposure to PAHs and other chemicals in soil in both growing areas and non-growing areas of your garden. Remember that there are many health benefits to eating fresh fruits and vegetables from your garden!

- Use **raised beds** filled with clean soil and compost. If some of the soil samples above guidance values are from raised beds (see attached results sheets), consider removing some of the soil and mixing in clean soil and compost. Incorporate new compost or other organic material often.
- **Avoid use of wood treated with creosote, such as telephone poles or railroad ties**, to build your beds because they contain PAHs that get into soil.
- **Cover (or mulch) soil in beds** to reduce dust and soil splash onto vegetables. Different materials can be used such as compost or dried leaves.
- Always **wash your hands** after gardening, and have children who play or work in the garden wash their hands.
- **Avoid bringing soil into your home** after gardening by removing soil particles 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 can be especially important for leafy and root vegetables, which are more likely to have soil particles on their surfaces.

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<sup>1</sup> *Characterization of Soil Background PAH and Metal Concentrations in Manhattan, New York*, prepared by Consolidated Edison Company and submitted to NYSDEC on March 30, 2007.

<sup>2</sup> Inferred from the reported distribution percentiles summarizing the 27 samples.

<sup>3</sup> *Seneca-Babcock Neighborhood Soil Sampling Program*. Results of December 1994 Sampling. Final Technical Report, July 1998. <http://nysl.nysed.gov/Archimages/4431.pdf>

<sup>4</sup> *Concentrations of Polycyclic Aromatic Hydrocarbons in New York City Community Garden Soils: Potential Sources and Influential Factors*, Marquez-Bravo et al. 2015. See more information at <http://blogs.cornell.edu/healthysoils/other-resources/research/>.

**Table 1. Summary of Metals and PAH Levels in Ithaca Community Garden Beds, Pathways, and Compost Samples Compared with Guidance Values**

<b>Chemical Name</b>	<b>Guidance Value <sup>(a, b)</sup> (ppm)</b>	<b>Midpoint <sup>(f)</sup> and Range of Levels in 38 Garden Samples (ppm)</b>	<b>Rural Soil Background Levels <sup>(h)</sup> (ppm)</b>	<b># of Samples with a Level Higher than Guidance Value</b>
Arsenic	16 <sup>(c)</sup>	5.4 (3.2-8.6)	<0.2-69	0
Cadmium	2.5 <sup>(c)</sup>	0.35 (0.25-0.55)	<0.05-4.2	0
Lead	400	76.3 (16.7-137)	3-110	0
Mercury	0.81	0.12 (0.048-0.24)	.01-0.34	0
Acenaphthene	100 <sup>(d)</sup>	ND <sup>(g)</sup>	<0.008-0.11	0
Acenaphthylene	100 <sup>(d)</sup>	0.22 (0.11-0.79)	<0.01-0.59	0
Anthracene	100 <sup>(d)</sup>	0.205 (0.097-0.31)	<0.008-0.15	0
<b>Benzo(a)anthracene</b>	1 <sup>(c)</sup>	0.69 (0.052-2.9)	<0.005-2.6	<b>6</b>
<b>Benzo(a)pyrene</b>	1 <sup>(c)</sup>	0.78 (0.073-3.8)	<0.006-3.4	<b>8</b>
<b>Benzo(b)fluoranthene</b>	1 <sup>(c)</sup>	1.05 (0.083-5.9)	<0.02-4.6	<b>17</b>
Benzo(g,h,i)perylene	100 <sup>(d)</sup>	0.67 (0.079-3.8)	<0.02-1.5	0
<b>Benzo(k)fluoranthene</b>	1	0.50 (0.069-1.9)	<0.01-1.7	<b>1</b>
<b>Chrysene</b>	1 <sup>(c)</sup>	0.79 (0.067-2.8)	<0.01-2.4	<b>4</b>
Dibenz(a,h)anthracene	0.33 <sup>(e)</sup>	ND <sup>(g)</sup>	<0.01-0.23	0
Fluoranthene	100 <sup>(d)</sup>	1 (0.093-4)	<0.005-1.8	0
Fluorene	100 <sup>(d)</sup>	0.14 (.047-0.23)	<0.01-0.13	0
<b>Indeno(1,2,3-cd)pyrene</b>	0.5 <sup>(c)</sup>	0.65 (0.063-3.2)	<0.008-1.4	<b>17</b>
Naphthalene	100 <sup>(d)</sup>	ND <sup>(g)</sup>	<0.0003-0.03	0
Phenanthrene	100 <sup>(d)</sup>	0.51 (0.031-1.4)	<0.008-1.1	0
Pyrene	100 <sup>(d)</sup>	0.99 (0.099-4.1)	<0.006-2.9	0

Notes:

- (a) There are a number of different sets of guidance values for soil developed by various agencies for various purposes. We are using New York State Department of Environmental Conservation (NYSDEC) Residential Soil Cleanup Objectives (SCOs) as guidance values - or a point of reference - to interpret your soil results. SCOs were developed as part of a regulation by the NYSDEC and New York State Department of Health (NYSDOH) for specific State programs to clean up contaminated sites. While not developed specifically for community gardens, “Residential SCOs” can be used outside of these programs as guidance levels to help interpret levels of chemicals in soil when considering human health and the environment. Residential SCOs are more relevant to garden soils than SCOs for other land uses, because they were developed to consider residential exposures including gardening. However, the guidance values we used

here assume that you live on the property with the soil that was tested-and that you are exposed in some ways every day and over a lifetime. Exposure to PAHs in soils for a community gardener may be less than this.

- (b) Levels of metals and PAHs in 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.
- (c) If the SCO calculated based on health risks was lower than rural soil background concentrations for a particular metal or PAH, the rural soil background concentration was used as the SCO for that chemical.
- (d) The SCOs were capped at a maximum value of 100 ppm.
- (e) For PAHs where the calculated SCO was lower than the Contract Required Quantitation Limit (CRQL), the CRQL is used as the SCO value.
- (f) The midpoint (or “median”) of samples is the middle value of the samples ranked by concentration. For an even number of samples, the middle two values are averaged to obtain the midpoint.
- (g) Below laboratory detection limit.
- (h) These values are from the New York State Department of Health/NYS DEC’s Rural Soil Background Survey that measured the range of levels for a number of chemicals in “source-distant” rural soils in NYS. Source-distant samples were obtained from areas that were reasonable points of human contact with soil, such as yards and trails, but at least five meters distant from potential pollution sources such as trash, roads, driveways or structures. (See [http://www.dec.ny.gov/docs/remediation\\_hudson\\_pdf/appendixde.pdf](http://www.dec.ny.gov/docs/remediation_hudson_pdf/appendixde.pdf)).
- (i) 3 PAHs (2-Fluorobiphenyl, Nitrobenzene-d5 [Surr], and p-Terphenyl-d14 [Surr]) are not shown because results were all below laboratory detection limits and no NYSDEC Residential SCOs are available.

# What Gardeners Can Do: 10 Best Practices for Healthy Gardening

## **1. Use clean soil and compost.**

If you are concerned about contamination in your garden soil, consider having it tested by a New York State-certified laboratory.

## **2. Use raised beds.**

Build beds deep enough for the roots of your crops, and maintain them by adding compost often.

## **3. Avoid treated wood.**

Railroad ties, telephone poles, pressure-treated wood and some painted wood contain chemicals that can get into soil.

## **4. Maintain soil nutrients and pH.**

Healthy garden soils have a good nutrient balance and a pH near neutral (6.5 – 7).

## **5. Cover (or mulch) soil.**

Use compost, straw or bark mulch in garden beds, and stones or wood chips in paths and non-growing areas. This helps reduce soil splash, dust and tracking of soil home.

## **6. Keep an eye on children.**

Make sure children do not eat soil or put dirty toys or other objects in their mouths. Young children can be more sensitive to certain chemicals in soil, such as lead.

## **7. Leave the soil in the garden.**

Avoid bringing garden soil into your home. Remove soil from garden tools and harvested vegetables while at the garden, and change your shoes before going indoors.

## **8. Wash your hands.**

Wash up after gardening, and have children who play or work in the garden do the same. Consider wearing gloves, and remember to remove them when leaving the garden.

## **9. Wash and/or peel produce.**

Wash vegetables thoroughly – especially leafy and root crops, which are more likely to have soil on them. Consider peeling if appropriate.

## **10. Put a barrier under play areas.**

Separate children's play areas from underlying soil with landscape fabric or other durable material. 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.



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See reverse for more about the **Healthy Soils, Healthy Communities** project, or visit us at <http://cwmi.css.cornell.edu/healthysoils.htm>

**Healthy Soils, Healthy Communities** is a research and education partnership with urban gardeners. For more information on healthy gardening, check out our resources online or contact one of our project partners!

Healthy Soils, Healthy Communities Project:

<http://cwmi.css.cornell.edu/healthysoils.htm>

NYS Department of Health *Healthy Gardening* Page:

<http://www.health.ny.gov/publications/1301/>

More Resources for Healthy Soils:

- ✓ Sources and Impacts of Contaminants in Soils
- ✓ Guide to Soil Testing and Interpreting Results
- ✓ Best Practices for Healthy Gardens
- ✓ Metals in Urban Garden Soils
- ✓ What Gardeners Can Do: Tips for Urban Chicken Keepers (English and Spanish)

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